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BR 2170(1)

SHIP NBCD MANUAL

VOLUME 1

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CINCFLEET/PFSA
Fleet Staff Authors Group
Pepys Building
HMS COLLINGWOOD
FAREHAM
Hants
PO14 1AS

Copied to the **Lead Authority:**

CINC FLEET/SO1 N7 NBCD
PP 300 West Battery
Whale Island
Portsmouth
PO2 8DX

PREFACE

NBCD: NAVAL NUCLEAR, BIOLOGICAL AND CHEMICAL DEFENCE, DAMAGE CONTROL AND FIREFIGHTING

NBCD concerns every Department and impinges on nearly every aspect of ship life. It directly affects the fighting efficiency of the Fleet and is the responsibility of every member of the ship's company.

The Ship NBCD Manual, BR 2170, comprises six volumes:

Volume 1 Deals with general aspects of NBCD and specific aspects of Damage Control and Firefighting (DC&FF).

Volume 2 Deals with all aspects of NBC Defence.

Volume 3 NBCD Stores Catalogue for HM Surface Ships and RFAs.

Volume 4 NBCD for HM Submarines, including Stores.

Volume 5 NBCD Advancement and Training Requirements.

Volume 6 NBCD Incidents.

Notes:

1. These volumes use the System International (S.I.) units of measurement, except where imperial measurements are necessary.

2. For convenience, the terms 'he', 'his' and 'him' are used when referring to ship's staff, although the billets could be filled by persons of either gender.

Users wishing to comment on the contents of this publication should use the special form overleaf, copies of which are to be forwarded through the usual administrative channels to the addresses shown on page ii.

PROPOSALS FOR CHANGES

Classification...

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DETAILS OF COMMENTS

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		Continue on a separate sheet if required

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RECORD OF CHANGES

***Note**: The incorporation of temporary amendments such as RNTMs, DCIs, signals and AILs etc should be recorded on page vi overleaf.*

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Note. *The incorporation of RNTM, DCI, signals and AILs etc should be recorded below.*

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CHAPTER 1

NBCD - BASIC PRINCIPLES

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CHAPTER 1

NBCD - BASIC PRINCIPLES

Orders to be observed by the Commanders of the Fleet and Land Companies under the charge and conduct of Sir Walter Raleigh, Knight, bound for the South parts of America or elsewhere. An officer or two shall be appointed to take care that no loose powder be carried between the decks, or near flint stock or match in hand. You shall saw divers hogsheads in two parts and filling them with water set them aloft the decks. You shall divide your carpenters, some in hold if any shot come between wind and water, and the rest between decks, with plates of lead, plugs and all things necessary by them. You shall also lay by your tubs of water certain wet blankets to cast upon and choke any fire.

Plymouth, May 1617.

NBCD DIRECTLY AFFECTS THE FIGHTING EFFICIENCY OF THE FLEET AND IS THE RESPONSIBILITY OF EVERY MEMBER OF THE SHIPS COMPANY

0101. Definition

Within all three Services and across NATO, NBCD is the abbreviation for Nuclear, Biological and Chemical Defence. Although Damage Control and Firefighting is no longer part of the RN's formal definition of NBCD, it is accepted that in common usage within RN ships and submarines and the RFA Flotilla the term NBCD may be still be used to encompass both NBC Defence and Damage Control and Firefighting (DC&FF). Personnel corresponding with the other Services or with NATO should be careful to use the abbreviations correctly. Therefore, NBCD means the doctrine, procedures and arrangements for:

a. Protection and defence against the effects of nuclear weapons, biological and chemical agents. (Common meaning)

and (within ships and submarines of the RN and RFA only)

b. Firefighting and the control of damage.

0102. Within BR 2170 NBCD will be used to mean both a. and b. above. NBC Defence will be used when only measures to counter the NBC threat are being discussed.

0103. Fleet NBCD policy matters are coordinated by a series of committees and working groups/parties, which are briefly described in Annex 1A. Feedback and proposals are to be forwarded through normal administrative authorities for discussion at the appropriate meeting.

0104. Aims

a. The aim of NBC Defence is to protect personnel from the effects of chemical and biological agents and from the radiological hazards resulting from the operational use of nuclear weapons such that they can continue to operate in an NBC environment.

b. The aim of DC&FF is to limit, control and repair (within the ship's resources) material damage, however caused, in peace and war and to protect personnel from the effects of fire and damage generally.

0105. Personal Knowledge

All members of the Ship's Company are potential links in the NBCD organisation, and the action taken by them, whether as routine or as an emergency response, may prove decisive to the safety of the ship. Thus every person on board must have a thorough understanding of:

a. What to do in the case of a fire or flood, the first aid equipment available and how to use it.

b. The need for watertight and gastight integrity; the meanings of risk and control markings; the use of location markings.

c. The care and use of personal protection equipment.

d. Elementary first aid.

e. The layout of the ship and the whereabouts of equipment for firefighting and emergency repair.

f. The NBCD organisation and the function of NBCD control positions.

g. The effects of damage.

h. Radiation and contamination, and how they can be minimised.

i. The need for careful stowage of stores in storerooms and offices, and of personal belongings, to reduce the risk of fire, to avoid hampering repair operations or the pumping of compartments and to minimise the potential for personal injury. Personnel must also understand the even more stringent requirements of securing for action which will be ordered when damage through enemy action is possible.

j. How to pass quick and accurate reports.

The specific NBCD responsibilities of key personnel are outlined in Chapter 2.

0106. Principles of Organisation

The NBCD organisation is founded on Damage Control and Firefighting (DC&FF) with NBC defensive measures superimposed on the organisation when needed. Such flexibility is both necessary and practical since fire and damage are ever-present risks, whilst nuclear, biological and chemical attack are primarily a war risk.

0107. Success in NBCD depends mainly on:

a. Being materially prepared.

b. Having well trained and knowledgeable personnel.

c. Intelligent prior planning of responses to the most demanding of potential NBCD scenarios.

These principles can only offer the chance of success if each is regularly and frequently checked. They will need further review if it is anticipated that the ship will face a specific threat or particularly challenging circumstances, eg operations in an NBC environment in very hot climatic conditions.

0108. NBCD Priorities

The relative priority given to safeguarding personnel and minimising damage to materiel depends on the operational circumstances at the time and requires consideration of the following factors:

a. The operational threat to the vessel and the Force.

b. The availability of external assistance.

c. That the fabric of the vessel provides the means of life support for her company.

d. That the safety of an individual may be subordinate to the safety of all or part of the Ship's Company.

0109. The continuous spectrum of operational intensity between peace and full scale war precludes a simple consideration of one or the other. Commanding officers are responsible for determining the balance between saving life, protecting their vessel and projecting military capability but the following principles are to be observed:

a. **Alongside in Peacetime.** With evacuation of the vessel possible and no complicating circumstances, the primary aim is to protect life unless there are factors present which mean that the optimum means of protecting life will be to direct the NBCD effort towards protecting the fabric of the vessel in the first instance. Such factors include the presence of ammunition, or that non-intervention will contravene elements of the nuclear safety case or needlessly endanger other lives and property.

b. **At Sea in Peacetime.** Maintaining a safe, life-sustaining vessel for the Ship's Company is to be the primary aim of NBCD effort.

c. **Wartime.** Maintaining effective military capability is the overriding aim.

| **0110. Battle Damage Repair**

Battle Damage Repair (BDR) is a standard NATO term for essential repair, which may be improvised, carried out rapidly in a battle environment in order to return damaged or disabled equipment to temporary service. The term is used regularly during Operational Sea Training (OST), where a war environment is simulated, but it is not widely used in this book, as the DC & FF procedures also apply to peace-time incidents. BDR is, therefore, a sub-set of DC&FF and is not an alternative term.

| **0111. NBCD Organisation**

The NBCD organisation varies with the size and type of ship and, to an extent, with the size of the ship's complement, although the basic principles are the same. The organisation must be able to exercise the required degree of control under all the differing circumstances in peace and war, and transition smoothly from one set of conditions to another. The NBCD Command and Control organisation is detailed in Chapter 8.

| **0112. NBCD Control Positions**

The requirement for the allocation of NBCD control positions depends on the size of the ship:

a. **Single NBCD Section Ships.** In ships of DD/FF size or smaller, NBCD Headquarters (HQ1) controls a number of Fire and Repair Parties (FRP), based at Fire and Repair Party Posts (FRPP). An Alternative NBCD Headquarters (AHQ) is nominated for emergency use in the event of HQ1 becoming untenable.

b. **Multi NBCD Section Ships.** Larger ships, such as CVS, also have an HQ1, but are divided into a number of NBCD Sections numbered from forward to aft, each controlled by an NBCD Section Base. Each NBCD Section has a number of FRPPs. In lieu of an AHQ, these ships have a permanently rigged Secondary NBCD Headquarters (HQ2). In some ships HQ2 may be combined with one of the Section Bases. In a CVS the hangar and flight deck are classed as separate sections that are controlled from the Hangar Control Room (HCR) and Aircraft Control Room (ACR) respectively.

| **0113.** Responsibility for immediate countermeasures following action damage lies with the FRPP or the quarters or self-contained position, with coordination by HQ1/SCC (small ship) or Section Base (large ship). As a general rule, damage in machinery spaces, hangars, flight decks, tank decks and in quarters positions, is dealt with by the personnel stationed there, leaving the NBCD Team to deal with damage between decks. The extent to which quarters, machinery or Air Department crews can contribute to the total ship, post-damage, organisation will depend on whether they are actively engaged in their primary duties. It may be necessary to augment NBCD teams from these sources in case of serious damage. Conversely, NBCD teams may be needed to assist them, especially in the event of a large fire, heavy NBC contamination, or if extensive repairs are required. Rigid rules cannot be applied; the NBCD organisation must be flexible enough to deal with any form of emergency, all officers and ratings being trained accordingly. NBC protection and countermeasures are controlled directly from HQ1/SCC, in consultation with the Command in the Operations Room. Monitoring and decontamination parties are drawn from NBCD teams, self-contained positions or any other source, as circumstances allow.

| **0114. NBCD Manning**

Only in large ships (CVS/LPD) are personnel included in the complement primarily for

NBCD duties. In the majority of ships (Destroyers, Frigates, RFAs and MM/PPs) ratings required for NBCD duties are provided by all departments. The Executive Officer is responsible for nominating their duties on the NBCD Watch and Station Bill (see Chapter 2). The manning requirements for each NBCD state are detailed in Chapter 4.

0115. The NBCD Team

The NBCD team is made up of the following:

a. **Control.** Manning the control positions of HQ1/SCC, and HQ2 in large ships, electrical control positions and the Weapons Section Bases (and Section Bases in large ships).

b. **Fire and Repair.** Manning the Fire and Repair Party Posts.

c. **Special Parties.** These comprise those personnel who man counterflood positions/ manual spray/flood positions (larger ships) and Mobile Repair Parties.

d. **NBC Parties.** For cleansing station duties, monitoring and decontamination parties.

e. **Self-contained Sections.** Machinery spaces, hangars in CVS or other larger ships with embarked squadrons and tank decks in LPDs etc.

f. **Weapon Repair Teams.** For repair of weapon equipment.

0116. Control Team

In NBCD State 1, HQ1, SCC will normally be manned as follows:

a. **Destroyers and Frigates**

(1) The Action NBCD Officer (normally the Marine Engineer Officer).

(2) The Damage Control Officer (normally the Supply Officer).

(3) A Weapons Engineering Department senior rating as the NBC Protection Officer's Assistant.

(4) An ME(L) senior rating as Damage Control Officer (Electrical).

(5) A CCMEA as the Propulsion Manager.

(6) An Incident Board Operator.

(7) One or more Communication Numbers.

b. **Large Ships**

(1) The action NBCD Officer (normally the MEO).

(2) The Damage Control Officer (normally the ships NBCD Officer).

(3) The NBC Protection Officer (normally the DWEO).

(4) An ME Officer and/or ME(L) senior rating as Damage Control Officer (Electrical).

(5) An ME Officer or CCMEA as Propulsion Manager.

(6) The Hull Section Officer.

(7) One Incident Board Operator for each NBCD section.

(8) Communication Numbers.

(9) NBCD Information Boards Operators.

(10) NBCPO's Assistant.

(11) An Information Number whose duty is to pass to HQ2 and the Operations Room all the information recorded on the various boards in HQ1.

(12) A senior stores rating to assist the NBCD Officer in all matters pertaining to the arrangement and contents of store rooms, provision of emergency stores and the organisation for keys to locked compartments.

| **0117.** In large ships the control team also includes those officers and ratings who man the following:

a. **HQ2.** HQ2 will be manned by sufficient officers and ratings to mark up the information boards duplicating those in HQ1 and ME personnel for machinery and electrical power supply and distribution purposes. In those ships in which HQ2 is combined with a Section Base, it will be manned by the minimum numbers additional to the Section Base personnel to allow a smooth takeover from HQ1/SCC if needed.

b. **Section Bases.** Manned in NBCD State 1 by:

(1) Section Base Officer.

(2) Communication Number.

(3) Incident Board Operator.

(4) An operator to maintain other NBCD information boards.

(5) A stores rating.

(6) A ME(L) senior rating.

(7) A Communication Number to operate the telephone link to HQ1.

0118. NBC Parties

Cleansing stations are manned by the Supply Department and as such those ratings selected should be noted on the Watch and Station Bill. Likewise, monitoring and decontamination teams, (which is a whole ship commitment) should also be noted on the Watch and Station Bill.

0119. Quarters

The action crew at a quarter must be ready to take immediate NBCD counter-measures at or in the vicinity of their quarters. Their organisation must allow for:

a. Emergency firefighting and general damage countermeasures when closed up at Action Stations.

b. Monitoring and decontamination during a lull in or after an NBC attack.

0120. Personnel detailed for these duties should be selected from the quarters crews and specially trained in their NBCD duties, so that when called upon they form a trained team, adapted and equipped to perform any of the above duties. The following general principles apply:

a. The primary function of the quarter takes first priority.

b. NBCD parties at quarters should, where possible, consist of personnel who can most easily be spared from their primary function, so that the quarter can continue to operate, though possibly at reduced efficiency.

0121. Quarters NBCD parties must be mobile in the sense that they can be detailed to assist elsewhere in the ship if the situation requires it. The number of personnel available for NBCD duties in a small ship is severely limited. It is therefore of the greatest importance that quarters personnel should be fully trained in all NBCD measures so that they can make an effective contribution to the ship's NBCD organisation in an emergency.

0122. Main Machinery Spaces

Where the number of personnel within the ME Department permits, machinery spaces should be manned by 2 ratings to enhance incident reporting, speed of response to damage and dispersal of ME personnel. Where possible one should be a Senior Rate. In some modern very lean manned ships it may not be possible to comply with this guidance. Such ships will normally be equipped with comprehensive machinery and fire/flood surveillance equipment as well as fixed firefighting systems. In these ships, to make the most effective use of available manpower, the machinery spaces may be left unoccupied and the personnel allocated to either the Mobile Repair Party or an adjacent FRPP.

| **0123. Hangars and Flight Deck**

All NBCD measures in hangars and on the flight deck of a CVS or other large ship with an embarked squadron(s), are the responsibility of the Air Department, assistance being given by the NBCD sections and parties whenever needed. These NBCD measures are controlled from the Hangar Control Position (HCP) and Aircraft Control Room (ACR) respectively. These positions are Section Bases, in communication with the ship's NBCD HQ, and have broadcast systems for their respective areas. Both positions have the facility for emergency stopping of aircraft re-fuelling systems and the HCP has control of the fire curtains, spray systems and the hangar ventilation. Personnel manning these positions consist of the aircraft handlers and maintenance teams, the engineering department personnel who operate and maintain flight deck machinery and lifts, and the personnel attached to the embarked squadron(s). The aircraft handlers are divided between the flight deck and hangar handling parties and include hangar NBCD parties, consisting usually of one Petty Officer plus seven junior rates for each hangar. All hands of the flight deck party should be detailed for fire duties in the vicinity of their flying stations. Monitoring and decontamination requirements must also be met and the parties detailed should be trained not only to deal with contaminated structure or personnel, but also the with contaminated aircraft (see BR 2170 Volume 2). In a small ship operating aircraft, the few air branch ratings borne must be backed up by ratings detailed from the Ship's Company and trained in aircraft firefighting.

ANNEX A TO CHAPTER 1

WORKING GROUPS AND COMMITTEES

1. NBCD Policy Making Organisation

There is an integrated organisation in ships for the management of NBC Defence together with Damage Control and Firefighting (DC&FF), (see Chapter 8). However, to align with tri Service practices, the structure for the policy management of these two disciplines is separated (see Fig 1A-1).

2. Royal Navy NBC Defence Committee

This committee is chaired by DNO. It is attended by representatives from all TLBs and the RN representatives from the tri-Service panels. This is the highest level forum for discussion of RN (including RFA) NBC Defence policy.

3. Royal Navy NBC Materiel Group

This Working Group is chaired by the Fleet NBCDO and is attended by representatives from CINCFLEET, 2SL/CNH, HQRM, DDOR (Eng & NBC), DJW, DSTL Porton Down, DCT IPT, DPA/NBC IPT, FOST, FSAG, INM, WSA Integrated Project Teams, and the NBCD Training Group - Phoenix. It is a forum for discussion of NBC equipment and facilities in the Royal Navy.

4. Royal Navy NBC Liaison Group

This Group is chaired by Commander NBCD at the Phoenix NBCD School and is attended by representatives from CINCFLEET, 2SL/CNH, FOST, MCTA, RALEIGH, FSAG, DSTL Porton Down, DJW, DNBCC, WSA Integrated Project Teams, DPA/NBC IPT and the NBCD Training Group - Phoenix. It is a forum for the discussion of NBC training, documentation, procedures and policy.

5. Royal Navy DC&FF Committee

This Committee is chaired by Fleet ACOS(W). It is attended by representatives from all TLBs. This is the highest level forum for the discussion of RN (including RFA) DC&FF policy.

6. Royal Navy DC&FF Liaison Group

This Group is chaired by Commander NBCD at the NBCD Training Group - Phoenix and is attended by representatives from CINCFLEET, FOST, MCTA, RALEIGH, WSA/MFFM5, FSAG, DC IPT and the NBCD Training Group - Phoenix. It is a forum for the discussion of DC&FF training documentation, procedures and policy.

7. Surface Ship DC&FF Working Group

This Group is chaired by WSA/MFFM5 and is attended by representatives from CINCFLEET, FOST, MCTA, FSAG, and WSA Integrated Project Teams. It is a forum for the discussion of DC&FF arrangements in RN and RFA surface vessels.

8. Submarine DC&FF Working Group

This Group is chaired by WSA/MFFM5 and is attended by representatives from CINCFLEET, FOST(SM), FSAG, STG, and WSA Integrated Project Teams. It is a forum for the discussion of DC&FF arrangements in submarines.

9. NBCD Training Policy Advisory Group (NBCD TPAG)

| This is chaired by the MWS Cdr TPOL. It is attended by representatives from CINCFLEET, | FOTR, DNM, CND, FOST, training establishments and INM. It is a forum for the coordination of all Royal Navy NBCD training.

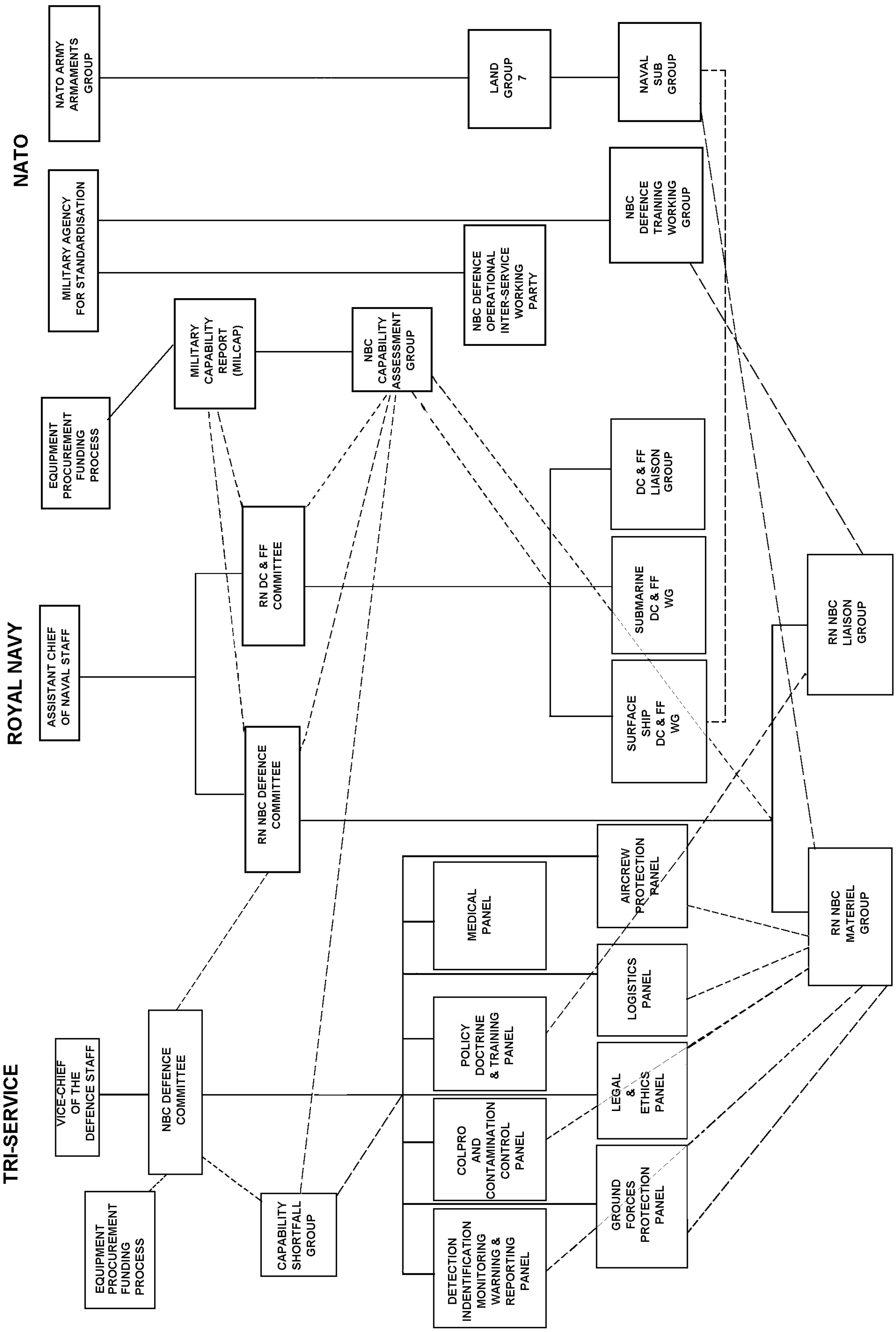

Fig 1A-1. NBC Defence and DC & FF Working Groups and Committees

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CHAPTER 2

NBCD RESPONSIBILITIES

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CHAPTER 2

NBCD RESPONSIBILITIES

0201. As with every aspect of a ship's operation, the ultimate responsibility for NBCD is with the Commanding Officer. Responsibility for preparation and training in NBCD rests with all departments, and the application of countermeasures, although mainly the responsibility of the NBCD team, is shared by those departments controlling the spaces in which countermeasures may be needed (eg machinery spaces, armament quarters, hangars, galleys and storerooms). It is the duty of everyone, by good ship husbandry, knowledge of the ship and the proper appreciation of the NBCD problem, to minimize the risks to a ship at sea and in harbour, in peace and in war. Implicit in this is a responsibility to enhance individual and collective lifesaving by a thorough knowledge of the survival and NBC protection equipment onboard. NBCD and survival at sea training are indisputably linked and ship's organisations are to reflect this. The NBCD Command and Control organisation is covered in Chapter 8.

0202. Executive Officer
The Executive Officer is responsible to the Commanding Officer for:

a. Being able to assume the NBCD responsibilities of the Commanding Officer.

b. Directing the NBCDO when one is appointed.

c. Assuming the duties of the ship's NBCDO where no officer is appointed specifically for NBCD duties, ie:

(1) Arranging training and control of HQ1 watchkeepers and ensuring the effectiveness of the watertight integrity, safety, rounds and keys organisation, except when MEO is closed up in HQ1 as a result of an emergency or as Action NBCDO.

(2) Monitoring changes in the watertight condition.

(3) Monitoring changes in the state of readiness.

(4) Coordinating the whole ship NBCD training organisation.

(5) Being chairman of the NBCD Planning and Training Committee.

(6) Arranging the maintenance of the NBCD Watch and Station Bill.

(7) Coordinating the production of NBCD Standing Orders.

(8) Arranging the maintenance of the NBCD Training and Material Assessment Log.

(9) Ensuring NBCD publications are amended.

(10) Directing the Whole-Ship NBCDQ and coordinating the work of all NBCDQs.

d. Carrying out the NBCD duties of a Head of Department for the Warfare Department.

e. At action, being stationed as directed by the Command or to rove, visiting scenes of NBCD incidents:

(1) Monitoring NBCD preparations for action.

(2) Assessing damage and incident response and keeping ANBCDO and WEO/Command informed of the overall situation.

(3) Coordinating actions at incidents (except stability counter-measures).

(4) Directing the CBM who will also be roving.

f. Training the whole Ship's Company in survival and lifesaving.

g. Ensuring that a minimum of 10% of the Ship's Company are first aid trained.

h. Being the Officer with Medical Charge when a Medical Officer is not borne.

0203. Where an officer is appointed specifically for NBCD duties, some of the above Executive Officer's NBCD duties may be delegated to him.

0204. Heads of Departments (HODs) - General
Heads of Departments are responsible to the Command for:

a. Carrying out the NBCD duties of an officer and supervising all other officers in the department in their NBCD duties.

b. Giving technical advice to the Command on their own departmental aspects of NBCD.

c. Administering departmental NBCD, ie:

(1) Producing their departmental section of ship's NBCD Orders.

(2) Producing NBCD orders for any self-contained NBCD sections that may be allied to the departmental function. (eg main machinery spaces, flight decks, hangars, vehicle decks and docks in certain ships)

(3) Providing suitably qualified persons to the whole-ship NBCD training organisation.

(4) Providing personnel to the NBCD organisation as required by the Watch and Station Bill.

d. Directing the departmental NBCDQ.

e. Managing departmental NBCD training.

f. Managing aspects of whole-ship NBCD training for which the department is responsible.

g. Being a member of the ship's NBCD Planning and Training Committee and assisting in the production and execution of the whole-ship NBCD training programme.

h. Provisioning of specialist advice and maintenance for NBCD equipment which is the responsibility of his department, but situated in a space owned by another department.

i. Bringing to the attention of the responsible department details of any defects found with NBCD equipment, situated in his departmental spaces, which is not the responsibility of his department.

0205. Marine Engineer Officer (MEO)

The MEO is responsible to the Command for:

a. Carrying out the NBCD duties of a Head of Department for the Marine Engineering Department.

b. Being the Action NBCDO (ANBCDO).

c. Taking overall control of damage control and firefighting measures when closed up in HQ1, as a result of an emergency, at NBCD State 2 or 3.

d. The custody and maintenance of all damage control and firefighting equipment except that on the charge of the Air Department, including the following (Day to day checks and servicing may be delegated to the Part of Ship Officer responsible for the compartment in which the equipment is stowed):

(1) Portable firefighting equipment.

(2) Portable pumping equipment.

(3) Breathing and life support apparatus.

e. The maintenance, integrity and operation of all material arrangements for the collective protection from fire damage and NBC hazards, including the following:

(1) Watertight and gastight structure, fixtures and fittings.

(2) Ventilation, filtration, air conditioning and smoke clearance systems.

(3) All fixed firefighting systems except those which are the responsibility of the WEO or AEO.

(4) Fixed pumping and salvage systems.

f. The organisation and training of fire, repair and damage control parties.

g. Training all ship's personnel in firefighting methods.

h. Ensuring that HQ1, HQ2 or AHQ, Section Bases and FRPPs are provided with all necessary drawings, lists, check-off, route and isolation cards, aides-memoire and other support equipment required to assist in the proper management of NBCD at action and in peace-time emergencies both at sea and in harbour.

| **0206. Logistics and Supply Officer (LSO)**
| The LSO is responsible to the Command for:

a. Carrying out the NBCD duties of a Head of Department for the Supply Department.

b. Being the Damage Control Officer (DCO) except where an officer is appointed specifically for NBCD duties.

c. As DCO, assisting MEO in HQ1, when closed up in an emergency at States 2 and 3.

d. The special provision of food when the situation precludes normal feeding arrangements.

e. The custody, provision and resupply of naval and victualling stores at all states of readiness, including arrangements for emergency supply, together with the:

(1) Protection of stores from damage or contamination.

(2) Dispersal of stores.

(3) Stowage of stores in order to allow access to bulkheads or ship's sides and to minimise fire and flooding risks.

(4) Custody and stowage of IPE and NBC stores except those in the charge of WE or medical staffs.

(5) Issue of IPE and, when required, clean clothing at cleansing stations.

f. Training of Action First Aid Party personnel in support of medical staff.

g. Training of cleansing station crews.

h. The whole-ship training programme in respect of individual NBC personal protection measures and procedures.

0207. Weapon Engineer Officer

The Weapon Engineer Officer (WEO) is responsible to the Command for:

a. Carrying out the NBCD duties of a Head of Department for the Weapon Engineering Department.

b. Acting as the Command Adviser in the Action State and during NBCD State 2 and State 3 emergencies.

c. The custody and maintenance of all NBC fitted and portable monitoring and decontamination equipment.

d. The management of the NBC organisation.

e. The whole-ship training of personnel with monitoring and decontamination responsibilities, including operational decontamination.

f. The training of Weapon Repair Teams.

g. The maintenance, integrity and operation of magazine fixed firefighting systems.

h. The custody and maintenance of aircraft firefighting arrangements, when the Ship's Flight are not embarked.

0208. CTG NBC Adviser

WEOs of capital ships are to complete the 2-day NBC Staff Officers' Briefing at DNBCC Winterbourne Gunner to prepare them to undertake the role of CTG NBC Adviser, should that be required. The deployable UK Maritime Battle Staffs (COMUKMARFOR and COMUKAMPHIBFOR) have bespoke NBC Advisers integral within their staff. COMATG may be allocated an NBC Adviser for specific operations but it is anticipated that he will also have a bespoke NBC Adviser in due course.

0209. Head of the Air Department

The Head of the Air Department is responsible to the Command for:

a. Preservation of watertight and/or gastight integrity in the Air Department spaces to accord with the ship's ordered NBCD condition.

b. The distribution of portable firefighting equipment (taking guidance from the NBCD Class Book) and damage repair equipment in Air Department spaces.

c. The maintenance of specialized aircraft firefighting equipment.

d. The continuation training of Air Department personnel in specialized aircraft firefighting techniques, and those NBC monitoring and decontamination procedures which are peculiar to aircraft.

e. In conjunction with the Action NBCD Officer, the firefighting and damage repair in all major Air Department spaces, augmenting the ship's NBCD organisation when required and as directed by HQ1 (or HQ2).

0210. If a ship operating aircraft has no separate Air Department, NBCD matters remain the responsibility of the Executive Officer and the respective HODs.

0211. Medical Officer

The particular aspects of NBCD for which the Medical Officer (or the Executive Officer where no Medical Officer is borne) is responsible are:

a. The medical treatment of casualties.

b. The organisation for immunization of personnel against BW agents and other prophylactic or post-attack medical countermeasures against BW or CW agents.

c. Assistance to the WEO in evaluating for the Command (with regard to future operations) the effects of biological and chemical agents and nuclear radiation experienced by the Ship's Company.

d. The pathological effects of biological and chemical agents and nuclear radiation.

e. First aid training.

f. Investigating and dealing with the contamination of food and fresh water.

g. The organisation, equipment and manning of first aid posts and emergency operating stations, and the distribution and periodical turnover of first aid equipment at quarters.

h. Interpreting and holding the permanent clinical records of radiation received by the Ship's Company, and records of personnel contaminated by B or C agents.

i. The custody of NBC medical stores, eg WTK (B&C), BATS, Combopens and NAPS.

0212. The Medical Officer (or senior medical rating where no MO is borne) is responsible to the Executive Officer for the execution and coordination of first aid training, with the specific support of the Supply Officer in respect of the coordination of Action First Aid Party initial and continuation training.

0213. Hull Section Officer

In ships so complemented, the Hull Section Officer is the structural specialist and is responsible to the MEO (see BR 3000 - Marine Engineering Manual). In circumstance of high NBCD risk, his place of duty is normally HQ1. Should he consider that he is needed at the scene of an incident elsewhere, he may proceed there, subject to the approval of the MEO. His duties include:

a. The training of all DC personnel in the care and maintenance of watertight openings, leak stopping and shoring.

b. The distribution and maintenance of all materials for structural repair.

c. The maintenance of hull structure, fittings and systems.

0214. Deputy Marine Engineer Officer

The DMEO is to be the MEO's immediate deputy in all NBCD related matters. The DMEO is to assume the MEO's Action role if the MEO is unable to undertake or continue his duties. In frigates and destroyers where only two Marine Engineering Officers are borne, DMEO is to be based at the FRPP most distant from HQ1, normally forward. The overriding aim of this stationing is to ensure the DMEO's physical displacement from the MEO prior to major damage being sustained and thus reduce the risk of both officers being injured in an attack. In ships where only one Engineer Officer is borne, supported by a Warrant Officer or CCMEA as deputy, another suitably trained officer with good ship knowledge should be stationed in charge of this FRPP. The WO/SR deputy to MEO is to remain responsible for machinery control as the Action MEOOW.

0215. Deputy Weapon Engineer Officer/Section Officer

The DWEO/Section officer is the WEO's deputy in all NBCD related matters and is to assume the WEO's Action role if WEO is unable to undertake or continue his duties. Otherwise, at Action Stations he is based at the Weapon Section Base (WSB) controlling the activities of the Weapon Repair Party (WRP).

0216. The DWEO/Section Officer will be the NBC Protection Officer (NBCPO), based in the WSB, receiving information from the NBCPO Assistant in HQ1, coordinating responses and briefing the WEO as Command Adviser.

0217. When the NBC threat level increases to Medium, DWEO is to delegate technical matters to the CCWEAs in the WSB, and act as NBCPO in HQ1. If a Section Officer is borne, he is to transfer from the Alternative WSB to the WSB to supervise technical matters.

0218. Officer of the Day (OOD)

All Officers in the OOD roster must be capable of undertaking the following duties:

a. Being responsible for the safety and security of the ship and the Ship's Company in harbour.

b. Being aware of all hazardous activities being undertaken in the ship.

c. Controlling the following routine tasks of the Duty Watch/Harbour Fire and Emergency Party (HFEP):

(1) Briefing and allocating tasks to the HFEP at the start of the duty period.

(2) Directing the work of HQ1 and gangway watchkeepers.

(3) Monitoring alarms and emergency telephones.

(4) Rounds.

(5) RADHAZ.

(6) Watertight and gastight integrity.

(7) Fuel and ammunition danger pipes.

(8) Welding and burning.

(9) Keys.

(10) Responding to emergencies, including the following actions:

(a) Make pipes directing actions by the HFEP, the remainder of the Ship's Company and any visitors.

(b) Crash stop ventilation.

(c) Start HPSW system pumps.

(d) Inform outside authorities in accordance with local orders.

d. Taking personal charge of the HFEP during emergencies, normally from HQ1 by:

(1) Assessing the situation and establishing control.

(2) Directing the activities of all emergency parties and specialist personnel.

(3) Clearing ship of all other personnel if necessary and directing them to supplement the HFEP as required.

(4) Liaising with all outside authorities and integrating any offered support with the activities of the HFEP, eg Local Authority Fire Brigade.

(5) Responding to external incidents in accordance with local orders, eg PORTSAFE.

(6) Making follow-up reports following incidents, consulting or recalling other ship's officers as required.

(7) Ensuring that a narrative of events is kept.

f. Conducting Duty Watch safety training in accordance with the Harbour Watch Training Log.

0219. Other Officers
All other Officers must be capable of:

a. Carrying out the NBCD duties of an AB, LH and SR.

b. Carrying out the NBCD duties of a Divisional Officer.

(1) Checking ratings' personal NBCD equipment.

(2) Monitoring and conducting advancement and ship knowledge training.

(3) Updating divisional NBCD documentation.

(4) Forwarding information for updating the ship's NBCD Training and Material Assessment Log.

(5) Monitoring and counselling of stress casualties.

c. Carrying out the duties of a Part of Ship Officer:

(1) The care of NBCD markings in the part of ship.

(2) Maintaining the structure, fittings and NBCD equipment in the part of ship which is not the clear responsibility of another department or officer.

(3) Passing to the responsible department details of defects of NBCD equipment in departmental spaces which is not the responsibility of the owner department.

(4) Ensuring a high standard of NBCD and equipment knowledge of personnel who live or work in the part of ship.

d. Carrying out the duties of an Officer in Charge of a quarter, post, section or living space:

(1) Taking charge of immediate measures to deal with NBCD incidents occurring in their spaces.

(2) Training of quarters crews and users of a space to take immediate NBCD measures in that space.

(3) Keeping HQ1 and dedicated NBCD parties informed of immediate NBCD actions carried out by quarters crews and users of spaces.

0220. Departmental NBCD Qualified Senior Ratings (NBCDQs)

In ships of DD/FF size and above, all departments are to have at least one NBCD qualified senior rating. Numbers will depend on the ship's Scheme of Complement, but in a typical DD/FF there are normally six NBCDQs.

0221. It will seldom be possible to provide such senior ratings for NBCD duties on a full time basis, since personnel suitable for the task will, by dint of experience and position, have time-consuming specialist commitments to fulfil. The senior ratings nominated for coordination of NBCD departmental tasks must be capable of directing the NBCD work of ratings within their own department. They are additionally to play a full part in the planning, coordination and execution of the whole-ship NBCD and survival training programme.

0222. In general terms, NBCDQs undertake the duties listed below:

a. **General**

(1) In conjunction with other NBCDQs, to check that the recommended NBCD practices (tidy living, correct stowage of gear, maintenance of markings and fittings, etc) are followed at all times.

(2) In conjunction with other NBCDQs, to train ratings in their general NBCD responsibilities and for advancement to higher rate (see BR 2170(5)).

(3) Where no suitably qualified senior rating is borne in a particular department, to assist with general and advancement training in that department.

b. **In Support of their Head of Department**

(1) To undertake specific instruction in particular aspects of NBCD as directed by the NBCD Officer or their HOD.

(2) To assist in the writing and amending of NBCD Orders.

(3) To provide inputs to the NBCD Training and Material Assessment Log and to bring attention to any amendments which should be made to the NBCD Class Book (CB 4538 series).

(4) To bring to the notice of the appropriate HOD shortcomings in the NBCD organisation, the NBCD Watch and Station Bill, and in NBCD material standards.

(5) To be conversant with the catalogue of NBCD stores (BR 2170, Volume 3 for surface vessels, Volume 4 for submarines), and to ensure the outfit of NBCD stores for which the department is responsible is under constant review, so that the correct stocks are held and replacements demanded as necessary.

(6) To arrange instruction and exercises for those ratings detailed as plotters and communication numbers in the NBCD organisation, in conjunction with other NBCDQs as appropriate.

(7) To coordinate and, where appropriate, conduct training in delegated departmental NBCD and survival topics including those for which the department has a whole-ship training responsibility.

c. **In Liaison with Other Departments**

(1) To liaise closely with other departmental NBCDQs and departmental coordinators and, in particular, to keep the Warfare Branch NBCDQ, in his capacity as overall Survival and NBCD Training Coordinator, informed of training intentions.

(2) To assist as necessary with coordination of whole-ship NBCD training commitments and exercises.

0223. Certain specific responsibilities are allocated to departmental senior ratings as follows:

a. **Warfare Department**

(1) In the training coordination role, the XO is to be supported by a Warfare Branch NBCDQ. This post is to be filled by a senior rating qualified in both survival at sea and NBCD, and it will be his function to coordinate and keep a record of the training activities of all other departmental NBCDQs. He is to have particular responsibility for survival and lifesaving training.

(2) In the majority of ships, the Chief Bosun's Mate (CBM) will be free to rove in the Action State. To ensure that he is able to contribute effectively to the NBCD effort in this role, the CBM must be NBCD qualified. This requirement, coupled with the NILE training already given as part of Seaman Specialist training, makes the CBM the most suitable man for the NBCD coordination role described above.

(3) The XO is to be further assisted in the execution of his duties by other suitably qualified Warfare Branch ratings. These are to include a senior rating, other than the CBM, who will assist with the general NBCD training specifically of Warfare Branch ratings, with the conduct of NBCD communications and whole-ship exercises and with the Warfare Branch related NBCD duties. Additional support is to be given by a rating qualified to maintain NILE equipment and assist in NILE/lifesaving/survival instructions.

b. **Marine Engineering Department**

(1) Under the direction of the MEO, the ME Department NBCDQ is to coordinate the organisation and training of fire and repair and damage control personnel and the instruction of the whole Ship's Company in firefighting measures. The ME Department NBCDQ is normally to be the CMEM(M)/(L).

(2) The ME Department NBCDQ is to be assisted in the execution of his duties by other NBCD qualified ME senior ratings.

c. **Weapon Engineering Department.** In addition to the duties outlined in Para 0222, the WE department NBC senior rating is to be the NBC Protection Officer's Assistant (see Para 0231).

d. **Supply Department**

(1) The Supply Officer is to be supported by the Supply Department Coordinator who, himself, need not be NBCD or NBC trained. The Supply Department Coordinator is to assist in coordination of Action First Aid Parties' training, and is to direct the involvement of NBC qualified Supply Department senior ratings in NBC and NBCD related tasks.

(2) A NBC qualified Supply Department senior rating is to be responsible for training Cleansing Station Crews and for the overall training of the Ship's Company in NBC individual protective equipment (IPE) dressing and undressing procedures as required.

(3) A NBC qualified Supply Department senior rating is to lead in the training of the Ship's Company in NBC personal protective measures.

(4) A Supply Department senior rating is to have custody of all NBC protective clothing and NBC stores except those in the specific charge of the CWEM or medical staff.

0224. Action NBCDO

The Action NBCDO is responsible to the Commanding Officer for:

a. Taking overall charge of the SCC, at State 1 and during emergencies in States 2 and 3.

b. Reacting to the Command Aim.

c. Informing the Command of all matters which effect the availability of the ship as a weapons platform, advising on the implications of incidents and defects, and recommending priorities for repairs. Areas covered include:

(1) Propulsion systems.

(2) Ship services.

(3) Services to weapons, aircraft and sensors.(Except where a WE or Air department responsibility)

(4) Hull structure.

(5) Watertight and gastight integrity.

(6) Stability.

(7) Damage control and firefighting.

(8) NBC collective protection.

(9) Casualties.

d. Coordinating the activities of, and giving priorities and direction to the SCC team, ie:

(1) The DCO.

(2) The Propulsion Manager.

(3) The DCO(L).

e. Giving priorities and direction to officers in charge of self-contained NBCD Sections and coordinating their activities with that of the SCC team.

f. Liaising with the WEO on the interface between DC and ME activities, and warfare teams, quarters crews, monitoring and decontamination teams, cleansing personnel and the Weapon Repair Party.

g. Monitoring reports from the XO, when roving, recommending incidents to visit.

h. Authorizing the use of non-automatic fixed firefighting and flooding systems and coordinating stability counter-measures.

j. Recommending to the Command, changes in the NBCD State of Readiness to deal with peacetime emergencies if the incident is beyond the capability of watchkeepers or the SSEP.

0225. NBCD Officer - Large Ships

In large ships where an officer is appointed specifically for NBCD duties he is to be known as the NBCD Officer. He assists the Executive Officer and provides professional advice on firefighting, damage control and NBC matters to other HODs in the discharge of their NBCD responsibilities. His principal duties are:

a. To be the DCO.

b. To produce NBCD Standing Orders, including those for the various states of readiness and to check that Departmental Regulators maintain accurate departmental Watch Bills.

c. To arrange and supervise all NBCD training programmes and exercises, in support of HODs.

d. The overall organisation of NBCD personnel and equipment throughout the ship.

e. To direct the organisation for maintaining watertight and gastight integrity in the different NBCD conditions, and the arrangements for closing down the ship.

f. The organisation and training of HQ1 NBCD watchkeepers, the maintenance of the ordered watertight and gastight conditions, and the control of keys (except keys to magazines in the ‘security’ condition).

g. Monitoring the maintenance of all NBCD markings.

h. Monitoring the correct stowage and readiness of NBCD equipment, except that for which the NBC Protection Officer or Medical Officer is responsible.

0226. Damage Control Officer (DCO)

In ships such as DD/FF, where no officer is appointed specifically for NBCD duties, another officer, normally the Logistics and Supply Officer, will be the DCO. He is to be fully conversant with the ship's NBCD organisation and ship layout and will direct the employment of damage control and FAP personnel, referring to the Action NBCDO for priorities and guidance. The duties of the DCO are:

a. To be in HQ1 at State 1 and during emergencies at States 2 and 3.

b. To direct NBCD preparations by:

(1) Monitoring changes in Watertight and Gastight Condition.

(2) Monitoring changes in the State of Readiness.

c. Giving priorities to NBCD incidents and monitoring reactions of NBCD Section Bases (FRPPs in single Section ships)

d. Coordinating reaction to NBCD incidents which cut across Section or FRPP area boundaries.

e. Re-deploying resources between Sections or FRPs when required.

f. Ensuring that immediate reactions to incidents by quarters crews etc. are coordinated with the work of the dedicated FRP and First Aid Parties.

g. Directing the deployment of personnel taken from outside the damage control organisation to reinforce DC parties, including Warfare personnel allocated by the Command at action and 'spare hands' during emergencies.

h. Redeploying the monitoring and decontamination teams elsewhere within the DC organisation, when approved by the Command, at low NBC risks.

j. Managing use of the HPSW system and coordinating its re-configuration following damage.

k. Acting as the interface between HQ1 and the rest of the SCC by:

(1) Reacting to priorities and directives from the ANBCDO.

(2) Keeping the ANBCDO informed of NBCD incidents and the DC organisation's reaction to them.

(3) Requesting priority changes or assistance for DC parties from outside of the DC organisation, from the Command, through the ANBCDO.

(4) Keeping ANBCDO informed of incidents which require coordination between the DC organisation and any self-contained NBCD Section.

(5) Liaising with the Propulsion Manager.

(6) Liaising with the DCO(L).

(7) Liaising with the NBCPO's Assistant.

l. Directing the work of the HQ1 Incident Board Operator, HQ1 panel operators and any HQ1 communication numbers or messengers.

(1) Ensuring all information coming into HQ1 is properly recorded, rerouted or acted upon.

(2) Ensuring any directives or priorities from the Command and the ANBCDO, and any information generated within HQ1, is passed to all outstations within the DC organisation. (This includes HQ1 alarms).

(3) Ensuring that a narrative of events is kept in all NBCD State 3 incidents.

m. Make broadcast 'sitreps' to the Ship's Company.

0227. Command Adviser

The responsibilities of the Command Adviser in the Action State are:

a. To determine the Command's equipment repair priorities and ensure that the appropriate outstations are aware of them and work to them. In consultation with the PWO, he is to recommend changes to these priorities, depending on the tactical situation and the extent and nature of any damage suffered.

b. To monitor the performance of weapons sensors, communications, data handling systems and all the supporting services taking into account operator, tactical and material factors. He is to assess the effects of damage, defects and degradation on the ship's ability to fight, establishing estimated time back on line (ETBOL) and alternative modes of operation where possible. He is to keep the Command fully informed of all significant changes that may affect the operational ability of the ship.

c. By consultation with the MEO and the XO, he is to monitor the extent of damage to the hull, propulsion and ancillary systems and the effect on the ship's ability to meet the Command Aim. He is to keep the Command informed of all significant changes that may affect the operational capability of the ship.

d. To integrate the requirements of the Warfare and Engineering Departments for the testing, maintenance and repair of systems and equipment within the existing tactical scenario. He is to particularly assess the extent of damage following an attack (mini-SOCs and blanket search).

e. To monitor the identity, number and location of casualties and to monitor the requirement to move personnel within the ship to deal with damage control, firefighting and weapon repair. He is to ensure that the Command Aim is being complied with and that the Command is fully informed of all significant personnel matters.

f. To liaise with the XO on:

(1) Domestic matters such as Action snacks, Action messing, the opening of heads, etc.

(2) Explosive hazards.

(3) Material changes which affect the ship's signature.

g. Carry out the duties of Command NBC Adviser as the NBC threat dictates.

0228. Damage Control Officer (Electrical) (DCO(L))

The DCO(L) is an officer or senior rating, nominated by the MEO, He is stationed in HQ1/SCC when the ship is in NBCD State 1, and his responsibilities are:

a. Control of the main electrical distribution system and converted supplies, keeping the Action NBCDO informed of the current state, limitations and implications of damage repair actions.

b. Compilation of the damage 'picture' of electrical losses gathered from feedback from 'L' DC teams and WSB reports.

c. Advising the Propulsion Manager of any electrical problems affecting machinery.

d. Advising the DCO of any electrical problems affecting the DC&FF efforts under his control (eg HPSW pumps, lighting losses etc).

e. Close liaison with the WSB with regards to power supply problems affecting weapons and sensors, together with any mechanical problems highlighted by the PM, eg chilled water, LP air or hydraulics.

f. Interrogation of the main incident board for incidents that may affect integrity of power supplies or restoration of power supplies.

g. Investigation of electrical defects and instigation of emergency cable runs and electrical repairs in accordance with the Command Aim.

0229. The Propulsion Manager

The Propulsion Manager (PM) is an officer or senior rating nominated by the MEO. He is stationed in the SCC when NBCD State 1 is ordered. His responsibilities are:

a. Supervision of the SCC watch and machinery space crews to ensure that every effort is made to maximise the power available to Command.

b. Directing the actions of the Mobile Repair Party, primarily in support of the machinery space crews.

c. Coordinating the reaction to damage to the propulsion plant in accordance with the priorities set by the ANBCDO.

d. Maintaining a close liaison with the DCO and DCO(L) to ensure that the implications of fires, damage and electrical losses on the propulsion plant are fully appreciated, and that incidents in the machinery spaces are recorded on the main incident board.

e. Managing the reconfiguration and repair to key mechanical systems (chilled water, hydraulics, HP and LP air) throughout the ship.

f. Informing the ANBCDO of damage and limitations affecting the propulsion plant and key mechanical systems, and providing an ETBOL (see Para 0843) for all losses.

0230. NBC Protection Officer

The NBC Protection Officer (NBCPO) is normally the DWEO, although in large ships another WE officer may be nominated by the Command. The duties of the NBCPO are:

a. Advising the Command, through the WEO, on all NBC Defence matters, ie:

(1) Assisting the PWO on the interpretation of NBC related intelligence.

(2) Assisting the Navigating Officer/PWO with the preparation and interpretation of NBC (ATP 45/BRACIS) reports.

(3) Advising the Command, through the WEO, on appropriate NBC protection measures.

(4) Advising the Command, through the WEO, on monitoring and decontamination procedures.

(5) Advising the Command, through the WEO, on the NBC risk-taking philosophy.

b. Advising the WEO of all NBC incidents, and recommending responses and reactions to them.

c. Directing the activities of the NBC Monitoring and Decontamination Teams, ie:

(1) Supervising the NBCPO's Assistant (NBCPOA).

(2) Passing the Command Aim onto the NBCPOA.

(3) Training and exercising the NBC Monitoring and Decontamination Teams.

d. Carrying out the duties of the ship's Radiation Safety Officer (RSO).

e. The production and amending of the NBC Protection sections of the ship's NBCD Orders.

0231. NBC Protection Officer's Assistant

The NBCPO's Assistant (NBCPOA) is normally a WE senior rating who has attended the appropriate NBC course. His duties and responsibilities are:

a. Supporting the NBCPO in:

(1) Reporting NBC incidents including alarms, detection, monitoring and decontamination results.

(2) Providing advice on all NBC matters.

(3) Keeping NBC records.

(4) Assisting in training the NBC Monitoring and Decontamination Teams.

b. Controlling the NBC specialist teams, ie:

(1) The NBC Monitoring Teams.

(2) The NBC Decontamination Teams.

(3) The Cleansing Station Crews.

(5) The Airlock Sentries.

c. Advising the Action NBCDO and DCO on NBC matters.

d. Controlling the custody and maintenance of NBC detection and monitoring equipment for which he is responsible.

0232. NBC Defence Watch Coordinator

During prolonged periods of operation under NBC threat, particularly after the ship has been contaminated by fall-out or chemical agents, there is a need to establish a liaison link between the PWO and the cleansing station team. This is best achieved by employment in HQ1 of the NBCPOA and/or another suitably briefed senior rating at all times when personnel on the upper deck are being watch-changed and need to be check monitored and/or processed through the cleansing station(s) before re-entry into the citadel. It is most important that effective control of incoming RAS parties and off-going upper deck crews is achieved, to ensure a smooth throughput at the cleansing station(s), or check monitor air lock. A waste of man-hours and loss of morale can result from lengthy processing at the end of an evolution or a standard watch change. Following contamination on the upper deck, careful thought must be given to the rate at which personnel are relieved of their upper deck duties. A knowledge of NBC monitoring and cleansing techniques will enhance the performance of the personnel fulfilling this defence watch NBC coordination commitment.

0233. Meteorological Officer

The Meteorological Officer (or the officer performing these duties) is responsible for advising the Command on meteorological factors affecting NBC protection, and on the suitability of weather conditions for the use by the enemy of biological and chemical weapons. After a nuclear, biological or chemical weapon release the Meteorological Officer, in conjunction with the Navigating Officer and the NBCPO, is to assist in estimating the areas of sea and air contamination.

0234. NBCD Responsibilities in Minewarfare and Patrol Vessels (MM/PPs)

Due to the manning levels in MM/PPs, the standard responsibilities of the Executive Officer and the Marine Engineer Officer cannot be fully applied. The following guidance is to be followed:

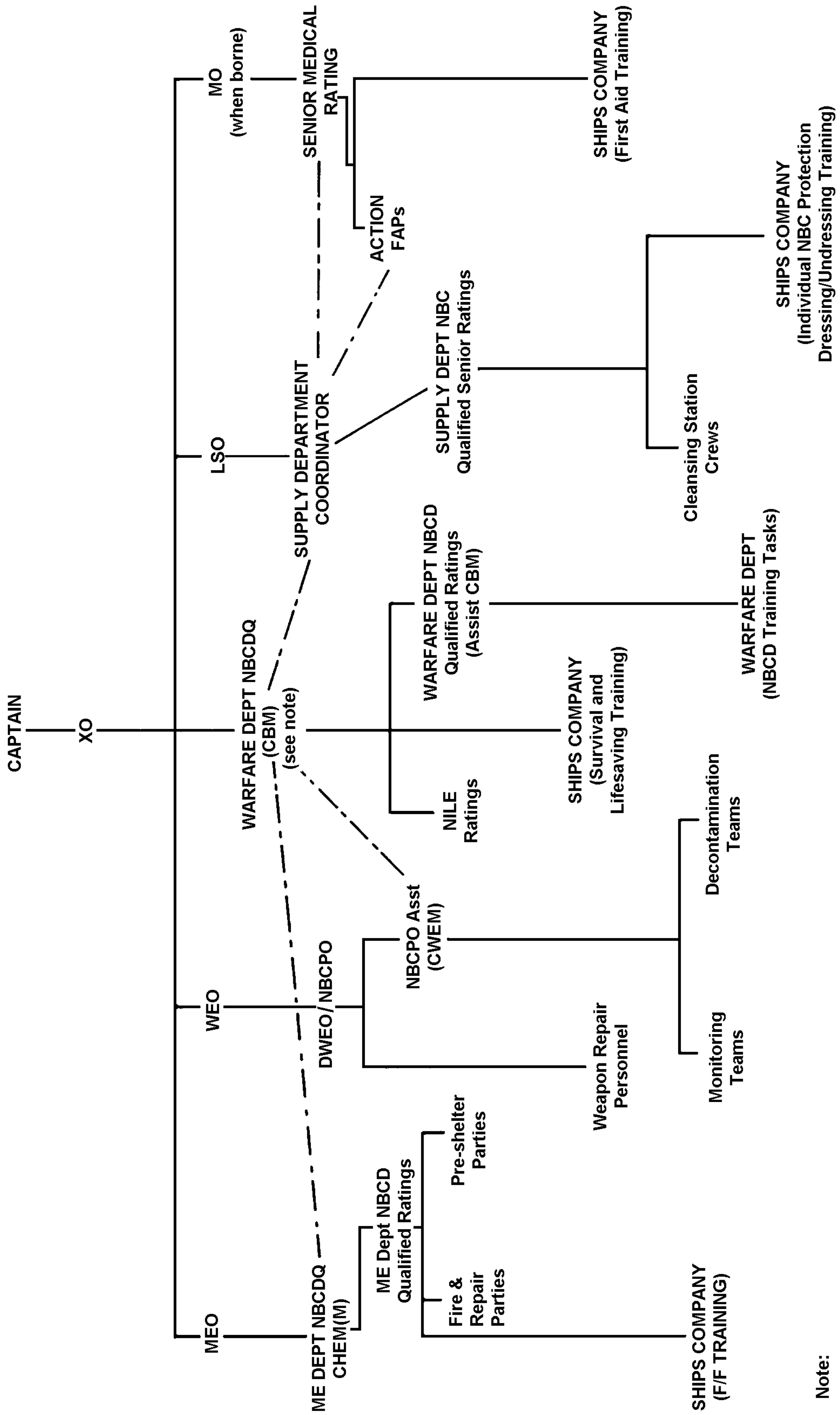
a. In MM/PPs where the MEO is a Senior Rating, the XO is to assume full responsibility for NBCD and is to act as the Action NBCDO. He is to be assisted by the MEO as the senior technical adviser, and is to close up in HQ1 whenever the ship goes to Action or Emergency Stations.

b. The NBCD qualified rating (NBCDQ) in a MM/PP is responsible for all NBCD stores and the implementation of firefighting and damage control training policy. He is accountable to the MEO for the material state of firefighting and damage control equipment, and to the WEO for the material state of NBC equipment.

c. The NBC Protection Officer (NBCPO) in a MM/PP is the Senior WE Rating onboard (WEO). The NBC protection organisation is to be directed by WEO from HQ1. He does not have an NBCPO's Assistant.

0235. NBCD Training Organisation

The organisation for NBCD training in a ship is illustrated at Fig 2-1.



Note:
In those few ships where a specialist NBCD Officer is borne, the CBM is excluded from the NBCD Training Coordination role.

Fig 2-1. NBCD Training Responsibilities

CHAPTER 3

LOCATION AND IDENTIFICATION MARKINGS

CONTENTS

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CHAPTER 3

LOCATION AND IDENTIFICATION MARKINGS

0301. Location Markings

The Royal Navy and Royal Fleet Auxiliary location marking system consists of a series of numbers and letters displayed on bulkheads, doors, hatches and other fittings to indicate positions in a ship.

0302. Basis of the System

Decks divide the ship horizontally and main transverse bulkheads divide the ship into main sections. Minor transverse bulkheads further divide these main sections. Longitudinal (fore and aft) bulkheads also divide the main sections. For convenience, a main transverse bulkhead (and hence a main section) is assumed to continue upwards to the top of the structure even though it may actually finish at a lower deck. Similarly, deck levels are in most cases assumed to be continuous throughout the ship.

0303. Compartments and Openings

The basic unit of the location marking system is the COMPARTMENT. Doors, hatches, manholes etc. are then identified by the location of the compartment in which they are located, or to which they give access. The position, and hence the marking of a compartment, is defined by a combination of figures and letters:

a. **Vertical Component.** A large FIGURE (number) for the deck on which the compartment is located.

b. **Horizontal Components:**

(1) A large capital LETTER indicating the main transverse subdivision.

(2) If needed, a suffix LETTER (small capitals) indicating its position, forward or aft, within the main transverse subdivision.

(3) If needed, a small FIGURE indicating the athwartships position in relation to the centre line.

0304. Decks

Decks are numbered consecutively downward to the outer bottom, starting with the forecastle deck as 1 Deck. In aircraft carriers (eg CVS or LPH), 1 Deck is the flight deck. Decks above 1 deck are numbered 01, 02 and so on consecutively upwards (see Fig 3-1).

0305. Subdivision Fore and Aft

The main sections formed by the main transverse watertight bulkheads are lettered, A, B, C and so on, from forward to aft. The letters I and O are omitted to avoid confusion with deck numbers.

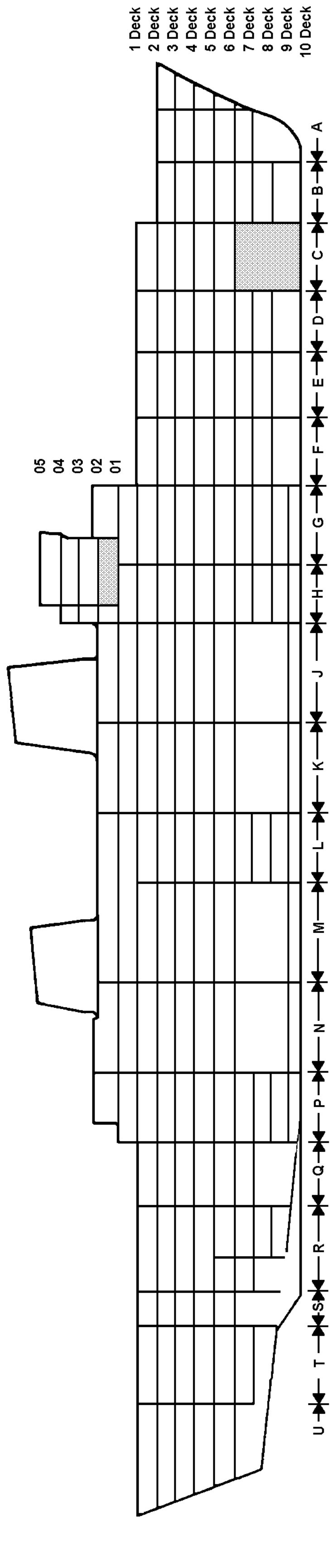


Fig 3-1. Decks and Main Sections in a CVS

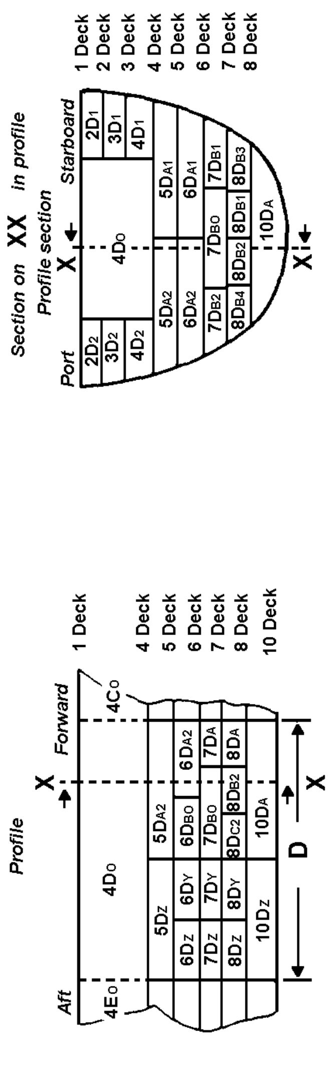


Fig 3-2. Compartments

0306. Watertight compartments formed by transverse bulkheads within the main sections are given suffixes A, B or C, starting from forward, or Z, Y or X starting from aft, as well as the marking of the main section. In the case of an odd number of watertight compartments within a main section, precedence in the suffix letter is given to the top end of the alphabet eg:

ABC YZ; AB Z; ABCD XYZ.

Note. *These suffix letters are capitals, but smaller than the main section letters and deck figures (see Fig 3-2).*

0307. Subdivision Athwartships

Where fore and aft bulkheads divide a main section, forming a number of watertight compartments abreast, small figures are used after the deck number and section letter or letters: 1, 3, 5, 7 and so on to indicate compartments to starboard of the centre line and 2, 4, 6, 8 for those to port of the centre line, in each case numbering outwards from the centre line. Compartments on the centre line are numbered 0 (see Fig 3-2).

0308. Watertight Compartments within Another

When one watertight compartment is contained within another, its marking is that of the larger one, with the addition of -00. If more compartments than one are contained, they are marked -100 and -300 outwards from the centre line if they are on the starboard side of the ship or -200 and -400 if on the port side, eg 8DA-100 and 8DA-200 (see Fig 3-3).

0309. Compartments Extending Beyond a Main Section

Where compartments extend beyond one main section, they bear the letter of the section in which they are mainly situated; this may occur anywhere but is most common on decks above the main watertight subdivision, eg in Fig 3-1, the space on 01 deck running above G and most of H sections will be marked 01H. In aircraft carriers, this system is generally applied to compartments on the upper hangar and gallery decks; the section boundaries are considered as being extended up to 1 deck.

0310. Compartments More than One Deck High

A compartment more than one deck high is marked according to the deck on which it stands (eg: in Fig 3-1, the lowest compartment in C section would be 10C).

0311. Nomenclature of Compartments

Since every watertight compartment is given a marking by this system, (and some non-watertight spaces), it is convenient and desirable to refer to many compartments by the deck number and section letter rather than by any arbitrary number eg:

5C	Plant and Pump Space	4M	Aft Auxiliary Machinery Space
4K	General Service Pump	2N2	Dining Hall

Fuel tanks can also be identified in this way but with the addition, if required, of a number denoting the position of the tank within the section, from forward to aft, odd to starboard and even to port, eg: 6M2 Dieso tank, 7H1 Avcat tank. In multi-unit ships such as CVS, it is often more convenient to identify the tanks by a marking which indicates the unit, eg: A3 Dieso tank, but the tank would also bear its location marking which might be 11LA2.

0312. Doors

In general, a door bears the marking of the compartment to which it gives access. Where two or more doors give access to one compartment they are distinguished by the words PORT (or STARBOARD) and/or FORWARD (or AFT) in abbreviated form after the marking. In rare cases of doubt as to which of two adjacent compartments should govern the door marking, the marking of the compartment in which the door is hinged should be used (see Fig 3-4). Doors that pierce main athwartship bulkheads, separating lettered sections of the ship, are designated by the deck number followed by the letters of the two section in alphabetical order, eg 3D/E.

0313. Hatches

A hatch bears the number of the deck in which it is cut followed by the horizontal co-ordinates of the compartment to which it gives access, eg hatch 5DY giving access to compartment 6DY (see Fig 3-4). Where two or more hatches, cut in the same deck, give access to the same compartment they are distinguished by the words PORT (or STARBOARD) and/or FORWARD (or AFT), in abbreviated form, after the marking.

Note. *Escape manholes or scuttles do not bear location markings.*

0314. Manholes

A manhole with a bolted or otherwise fixed cover bears the marking of the compartment to which it give access, since this may be from the deck above or through a bulkhead. A manhole in a hatch is not marked but is referred to as 'Manhole in hatch', followed by the marking of the hatch in which it is cut.

0315. Trunks

A trunk is marked with the deck number of the top hatch or door and the deck number and compartment letter(s) of the lowest compartment to which the trunk leads. This applies to the whole trunk and is shown in each separate watertight part (eg trunk 5/8DA in Fig 3-3). Each hatch in the trunk, and any intermediate access door, is marked with its own deck number and with the deck number and compartment letter(s) of the bottom of the trunk (eg hatch 5/8DA in Figs 3-3 and 3-4). In addition, the word TRUNK is marked on the top hatch (or door) and each intermediate one.

0316. Drawings

On drawings only, the markings of doors, hatches and manholes are prefixed by code letters D, H and M, respectively, but these letters are not included in the actual markings onboard.

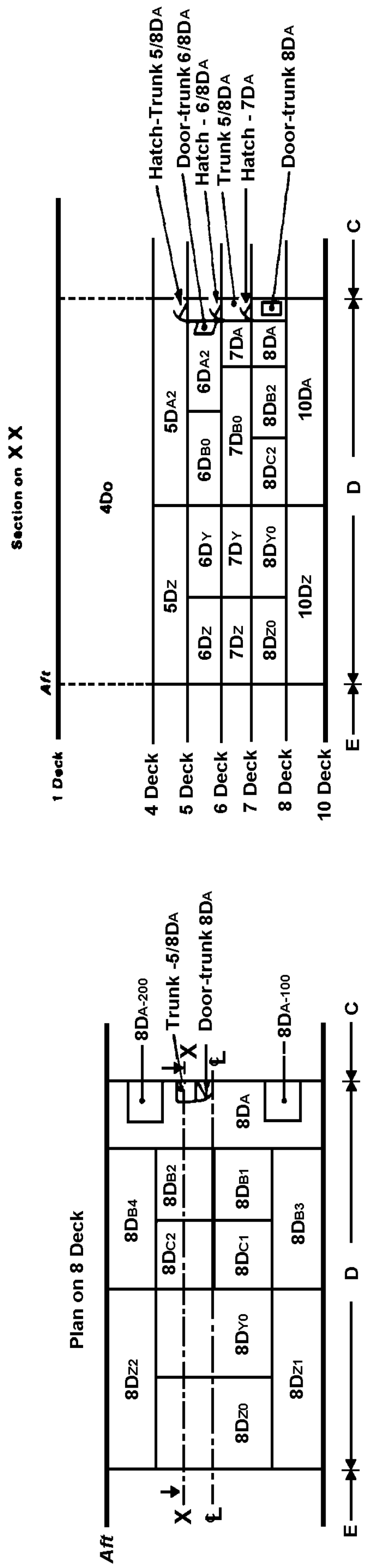


Fig 3-3. Compartments - Plan and Section - Showing Trunk

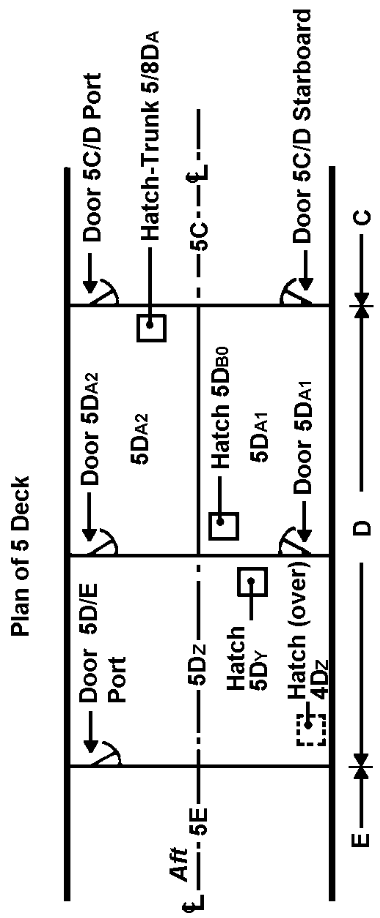


Fig 3-4. Doors and Hatches

0317. Ventilation Systems

a. Each ventilation system is marked by a number, a large capital letter and a two-figure number. The first number is the number of the deck on which the fan is located, the large capital letter donates the main watertight section containing the fan, and the two-figure number indicates the position of the fan in that main watertight section, eg 11 is the first fan on the starboard side, 13 the second on the starboard side, 12 the first on the port side, 14 the second on the port side and so on. The two-figure number is used to prevent confusion with deck numbering. The explanation of ventilation system 3C11 is that it is supplied by a fan situated at the starboard forward end of C section on 3 deck. The whole system (terminals, closures, flaps, valves and trunking) carries the fan marking, with tallies fitted as follows:

(1) At each system component, eg terminal flaps, fan, fan starter, valves, heaters, fire flaps, grease filters, etc.

(2) On trunking serving a compartment, including recirculation trunking.

(3) On trunking passing through an unlined compartment.

(4) At intervals along a trunk within a specific compartment where passing services or complexity of vent systems results in the identification of the system being difficult, eg main machinery spaces supply, air-conditioning supply to messdecks.

(5) In lined compartments, on portable access panels to vent heaters, valves, etc, in lieu of a tally on the component.

(6) Tallies are not required on trunking in cabins, nor on trunking in a compartment where a component is identified (subject to (4) above).

(7) Ventilation flaps to Main Machinery Spaces have an additional sign:

CLOSE IN THE EVENT OF FIRE IN .... (name of compartments)

painted or tallied on both sides of the flaps to enable personnel to quickly identify which flaps need closing in the event of a fire.

b. The above markings are in addition to any NBCD risk and control markings on the system and fittings. In group ventilation systems, a subsidiary run from the main system is marked as a separate system if it contains a booster fan. Lengths of trunking and bulkhead flaps provided to promote recirculation but not related to specific ATUs are also to be treated as separate systems and marked accordingly. A natural system in which no fan is fitted, is treated as if there were a fan in the compartment served and is marked accordingly.

c. The location and system identification (in abbreviated form) of all main machinery space fan starters, closures and flaps are to be clearly marked in white figures and letters on a red background at their control position and outside the compartment in which they are located, eg 01H14 GTR SUP. Ventilation controls are not to be located in compartments which are normally required to be locked.

d. The location and system identification of all other fan starters are also to be clearly marked at their control position. The system identification is to be in abbreviated form and where grouped compartments are involved, should be restricted to the principle function, eg 2E13 MAG SUP or 2J16 No 4 ATU. Tallies for galley and machinery space fan starters are to be clearly marked in white figures and letters on a red background. Other fan starter tallies are to be marked in black figures and letters as for standard location markings (see Para 0320).

e. All other ventilation outlets, including free breathing ventilation systems, eg diesel crankcase breathers, are to be marked with the system of origin in abbreviated form. Where grouped compartments are involved the marking is to be restricted to the principle function of the ventilation system.

0318 Fan Starters

If the starter is remote from the fan, the position of the starter is indicated at the fan.

a. If the starter is in the same watertight section as the fan, the sign is marked on the fan casing in the following form:

$$\xrightarrow[\text{3 METRES}]{\text{STARTER}}$$

b. If the starter is not in the same watertight section, the exact location of the starter is indicated on the fan casing, eg:

STARTER AT 3C, 52½(S)

0319. Sea-cocks

Sea-cocks and their controlling mechanisms are marked by the deck number and main section letter of the compartment in which the sea-cock is fitted, followed by PORT (or STARBOARD) and/or FORWARD (or AFT), if there are two on the same deck and within the same section. The only sea-cocks marked are those that admit water into the hull, either directly or through additional valves, eg floods to magazines. Those that admit water into a closed system, eg pump suctions, are not marked.

0320. Method of Marking

Markings are generally in the form of embossed aluminium tallies, applied with an impact adhesive. Letters and figures on the embossed tallies are painted black with the background the same colour as the surface on which they are located, except for galley and main machinery space ventilation system tallies as referred in para 0317 c and d. The size of tallies is as follows:

a. **In compartments.** 75mm figures and capital letters for the deck number and section letter, and 50mm capital letters and figures for the remainder. The tallies are placed so that they are visible from all entrances to the compartment, more than one tally being used if necessary.

b. **Doors, Hatches, Manholes and Sea-cocks.** 25mm figures and capital letters for the deck number and section letter, and 20mm capital letters and figures for the remainder. The words PORT, AFT and so on, when needed, are in 25mm capital letters. Doors and hatches are marked on both sides, doors near the upper corner of the hinged edge.

c. **Ventilation Fans, Systems and Fittings.** 25mm figures and capital letters for the deck number and section letter, 20mm capital letters for the remainder. Fan starters are also to be marked SUPPLY or EXHAUST in 20mm capitals.

0321. Station Numbers

A station number is a means of locating a position in a ship in relation to the nearest transverse frame, eg when reporting the position of an incident of damage to authorities holding drawings of the ship, or for other technical purposes. Frame stations are numbered consecutively from forward to aft, Station 0 being the forward perpendicular. (This numbering system is reversed in ships built to merchant ship standards, where the numbers run from aft to forward.) A main transverse bulkhead is marked, in a conspicuous position on the bulkhead at each deck level, with the number of the frame at which it is fitted (see Table 3-1).

0322. Other Side Markings

These are applied to certain bulkheads to indicate the type of compartment on the other side and hence its contents:

a. **In DD/FF and Smaller Ships.** On bulkheads forming the perimeters of dangerous compartments, namely; magazines, machinery spaces, paint and flammable stores.

b. **In Larger Ships.** On all main transverse and longitudinal watertight bulkheads below the lowest communication deck, on bulkheads of dangerous compartments as for smaller ship.

c. The markings consist of the name of the compartment followed by the underlined letters <u>OS</u> (see Table 3-1).

Note. *A communication deck is one on which fore and aft movement through the ship is freely possible.*

0323. Compartments Below Markings

These indicate the names of compartments to which a hatchway gives access and are generally painted on a nearby bulkhead above the hatch, eg:

Compts below

SRE compartment
TV studio
A/C machinery compt.
Sewage plant

0324. Contents Circles

These indicate, within the Red Risk Zone (see Chapter 5), the number and types of all openings within a watertight compartment or group of compartments to which a watertight door or hatch gives access, for the guidance of personnel responsible for shutting them. Self-evident letters are used, eg:

2H	2 hatches
1V	1 ventilation valve or closure
1D	1 door
2M	2 miscellaneous openings

Only valves or closures which affect flooding boundaries (eg scuppers) are indicated, not system operating valves. An (O) after a V or M indicates that the operating mechanism (eg handwheel) is outside the compartment. An arrow on the contents circle indicates that it refers to the compartment to which the arrow points. These markings are available as transfer waterslides and are listed in BR 2170(3).

0325. Suction Strainers

The position of a suction strainer is indicated by the letter S enclosed in a square, high up on the bulkhead, with an arrow pointing towards the strainer. This is to enable repair parties, in a flooded compartment being pumped, to locate a strainer that has become choked.

0326. Deck Tubes

a. Deck tubes for the passage of emergency cables from one deck to another are indicated by a green cross on the white-painted cap of the deck tube.

b. Foam tubes for machinery space firefighting are painted red. Adjacent signs, with white lettering on a red background, are to indicate the use of foam tubes.

0327. Traffic Routes

Where necessary or desirable, black arrows are used to indicate routes in passageways or through doors or hatches.

0328. First Aid Posts and Secondary Medical Positions

First Aid Posts and Secondary Medical Positions are indicated by a white cross on a green background, an arrow being added where necessary to indicate direction. The designation of the F.A.P., eg its number or section letter, or forward/aft, may be added if required.

0329. Cleansing Posts

Cleansing posts are indicated by the words CLEANSING POST in orange, an arrow being added where necessary to indicate direction. The cleansing post locker is to be painted white with an orange, upright, cross.

0330. Pipe Systems

Pipe systems, together with ventilation systems and rod gearing, are to be identified with self-adhesive tapes or paints, as specified in BR 2170(3). Where an identifying system colour is not specified they are to be painted in the colour of the background surface.

0331. Escape Markings

In all cases, escape routes are to be clearly marked, using the signs listed in BR 2170(3). These markings are not to be obscured by any doors in the open position.

a. **Escape Routes.** These are to be marked by:

(1) Photoluminescent arrows applied at prominent positions high on bulkheads adjacent to all hatches (except where only a single route is possible), to indicate the direction of escape. Arrows are also to be applied at intermediate positions on bulkheads in lobbies and passageways leading to the point of escape, particularly when changes of direction occur. These arrows are to be positioned at a nominal height of 1.5 metres above the deck in order to remain visible in the event of flooding.

(2) Deck mounted arrow dot markers are to be positioned in the centre of passageways adjacent to high level bulkhead mounted markings.

(3) In large ships, in large compartments with multiple doors, the escape route door is to be painted emerald green.

b. **Escape Recess Markings.** These markings are to be applied to ships where this type of escape is provided in way of aircraft or ammunition lifts. Escape recesses are to be indicated by the application of a photoluminescent ESCAPE marking at prominent positions, on bulkheads, within the recess.

c. **Escape Hatches and Scuttles**

(1) Normally emergency escape hatches and scuttles are painted green on both sides. However, the escape side of hatches sighted on ship's weather decks are to be painted in the appropriate deck covering material and the escape side of scuttles on ship's screens are to be painted in accordance with the ship's overall paint scheme.

(2) In all cases the presence of escape hatches and scuttles must be clearly indicated on adjacent structure in the compartment from which escape is intended to be made, by the application of a photoluminescent ESCAPE marking (on a green

background). A photoluminescent arrow marking (on a green background) is to be added adjacent to the ESCAPE marking to indicate the direction of escape. The word ESCAPE may also be painted directly on the emergency escape hatch or scuttle in 40mm white letters, in addition to the photoluminescent markings on adjacent structure, where this is considered more practical to indicate its position.

(3) With the exception of those which open onto the upper deck, escape hatches which can be open from the non-escape side by means of a T handle are to have these T handles painted in a combination of photoluminescent paint on the centre bar and emerald green on all other parts. Details of the paint are in BR 2170(3).

0332. Important Valves and Fittings

Thixotropic photoluminescent paint is used to highlight the position of the following important valves and fittings:

a. High pressure sea water system main isolating valves.

b. High and low pressure air machinery space bulkhead isolating valves.

c. BA Charging panel isolating valves.

d. Hydraulic system main isolating valves.

e. Remote diesel engine stops. |

f. Remote fuel stops to auxiliary boilers. |

g. The fully CLOSED position on Leith Cardle WT door handles. |

h. Operating levers/handwheels on the underside of escape scuttles. |

0333. HPSW System Valve Marking

Valves and hydrants in the high pressure sea water (HPSW) system are marked numerically to assist rapid identification for damage control and firefighting. The marking system is applied to surface warships and RFAs as follows:

a. The marking of valves and hydrants involves the complete HPSW main but excludes all other parts of the system ie sprays, cooling and domestic lines etc.

b. Numbering of the main isolating valves begins on the isolating valve closest to the end of the ring main on the forward most spur with the isolating valves numbered consecutively from forward to aft along the ship. Where a spur meets a ring main, the conventional NBCD numbering of even numbers to the port side and odd numbers to starboard is used, counting from the last number on the spur. When the spur is in the middle of a port or starboard leg, the numbering of the ring main recommences from the last number on the spur. This means that two adjacent isolating valves may not have consecutive numbers.

c. Numbers are only repeated when the main system exists on more than one deck, an example being a CVS. In this instance isolating valves on the higher and lower rings will have either a suffix H or L. Whether at the end of, or in the middle of a port or starboard leg the numbering of the valves is to be from forward to aft.

d. All hydrants are numbered with the numbers of the isolating valves either side of the hydrant take-off; the lower number is first and the higher number is separated with a dash. When the hydrant is supplied from a lower or higher ring main the two numbers are followed by the relevant suffix eg 18-20L. Where more than one hydrant is supplied from the main between the same two isolating valves, they are to have exactly the same number. This defines exactly which hydrants are unavailable when the isolating valves are closed. Fig 3-5 shows a typical arrangement, identifying each valve.

e. The actual marking of the isolating valves is included on the Main Systems Board in HQ1 and AHQ (HQ2) and FRPPs as appropriate. Black indelible markings are used.

f. Marking numbers are applied as follows, using luminous red self adhesive tape:

(1) *Isolating Valves.* 25mm black numbers on a 75mm square red background on, or close to, the valve.

(2) *Hydrants.* 12mm black numbers on a 50mm square red background, on the boss of the instantaneous coupling.

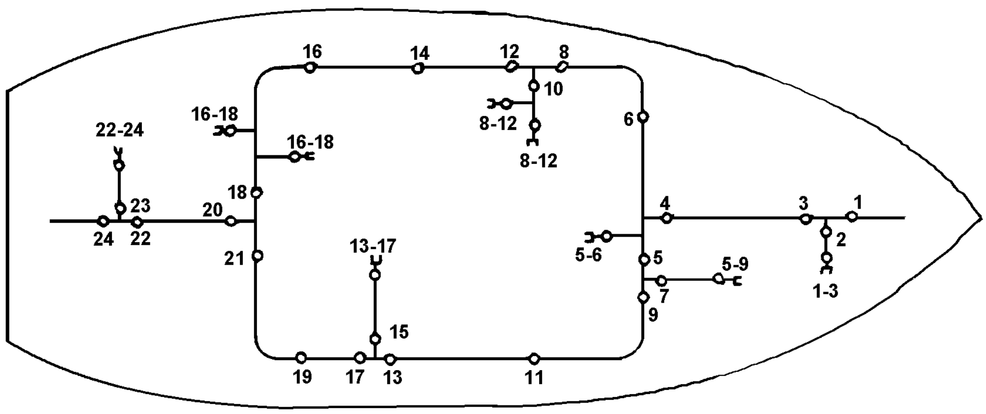


Fig 3-5. HPSW System - Valve Marking

0334. Electrical System Markings

Electrical system markings are detailed in BR 2000(52) - Electrical Power Distribution and Utilization.

0335. NBCD Zone Marking

NBCD zones are numbered from forward to aft. They are marked, numerically, on NBCD drawings, but the bulkheads which separate zones are only marked by the words ZONE BOUNDARY.

0336. Upper Deck Markings for MMS Boundary Cooling

Markings, as shown in Table 3-1, are applied to the inboard edge of the upper deck or adjacent superstructure to aid MMS boundary cooling operations. The marking (in black) consists of a line indicating the position of the transverse bulkhead, with an arrow pointing forward/aft from the bulkhead line in the direction of the MMS compartment. Below this arrow is the space name in 50 mm italic letters. The line indicating the MMS limit is 150 mm long and 15 mm wide and the arrow line is 70 mm long. Where the marking is on superstructure, it should start 100 mm above the deck. Where a transverse bulkhead separates two machinery spaces, the marking should indicate both spaces.

Table 3-1. Summary of Markings

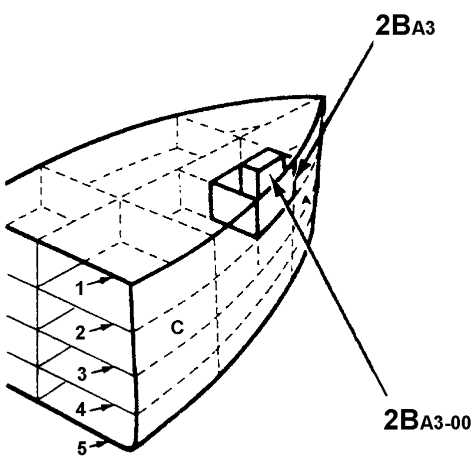
EXAMPLE	APPLICATION
COMPARTMENTS **2BA3** indicates a compartment on 2 deck that is situated at the fore end of B section and is the second compartment to starboard of the centreline  **2BA3-00** indicates a watertight compartment within compartment 2BA3	IN A POSITION THAT CAN BE SEEN FROM ALL ENTRANCES FIRST (FIGURE) DECK. Numbered 1, 2, 3, etc. downwards from fo'c'sle or flight deck, and 01, 02, etc, upwards. SECOND (LETTER) SECTION. ie Main compartment between main transverse bulkheads, lettered A, B, C, etc (not I or O) from forward to aft. THIRD (LETTER) Fore and aft position of compartment within section. Lettered A, B, etc, from forward; Z, Y, etc, from aft. FOURTH (FIGURE) Athwartships position of compartment from centreline, 1, 3, etc, to starboard, 2, 4 to port. Centreline compartment, 0. SUFFIX (FIGURES) Watertight compartment contained in another. Suffix -00. (-100 or -200, etc, where two or more contained compartments, odd to starboard, even to port.)

Table 3-1. Summary of Markings (continued)

EXAMPLE	APPLICATION
DOORS **2PB** door giving access to compartment 2PB **2D/E** door connecting D and E sections on 2 deck	BOTH SIDES, UPPER CORNER OR HINGED EDGE Doors bears marking of compartment to which it gives access. If two doors give access to same compartment, marking is qualified by PORT/STBD or FWD/AFT. Doors in main transverse bulkheads separating lettered section have deck number and letters of both sections in alphabetical order.
HATCHES **2DA1** hatch on 2 deck giving access to compartment on 3 deck that has horizontal co-ordinates DA1	NEAR CORNER ON HINGED SIDE. FIRST FIGURE - DECK IN WHICH HATCH IS CUT Remaining letters and figures give fore and aft and athwartships position of compartment to which hatch gives access. Where two hatches give access to same compartment, markings qualified by PORT/STBD or FWD/AFT.
MANHOLES (fixed) **6GZ4** manhole gives access to 6GZ4	Marking of compartment to which manhole gives access. A manhole in a hatch is not marked by referred to as 'manhole in hatch' ...
TRUNKS **1/5DA** Trunk running from 1 deck down to compartment 5DA	MARKED ON EACH SEPARATE SECTION OF TRUNK Trunk carries deck number of top hatch or door, plus marking of compartment at bottom of trunk. Each hatch in trunk, and any intermediate door, has its own deck number plus marking of compartment at bottom of trunk. Word TRUNK on all hatches and doors giving access to trunk.
STATION NUMBER **17** indicates a main transverse bulkhead at the seventeenth frame station from the foremost frame	Frame stations at main transverse bulkheads, as needed in conspicuous position on bulkheads.
OTHER SIDE MARKING **MAGAZINE <u>OS</u>**	On bulkheads forming perimeter of dangerous compartments, eg magazines, machinery spaces, flammable stores. Also, in multiple section ships, on main bulkheads below lowest communication deck.
COMPARTMENTS BELOW	As needed above a hatchway to indicate compartments gained thereby. Instead of the heading 'Compts. below', an arrow can be used if desired.

Table 3-1. Summary of Markings (continued)

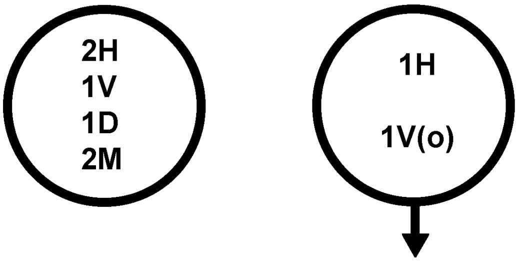
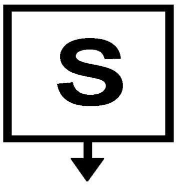
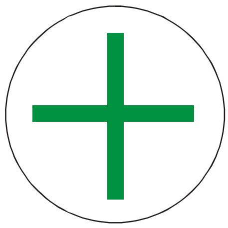
EXAMPLE	APPLICATION
VENTILATION SYSTEMS **3C11** system with fan at starboard forward end of C section on 3 deck	On vent trunking, at regular intervals.
Temperature Monitoring Signs	High risk (fire) compartments external boundaries (see Annex 21B for illustration)
CONTENTS CIRCLES  	WITHOUT ARROW - indicates number and types of openings in that compartment. WITH ARROW indicates number and types of openings in compartment to which arrow points. H = hatch; D = Door; V = ventilation valve; M = miscellaneous openings. (o) after V or M indicates that opening mechanism is outside the compartment.
STRAINERS  	Placed high on bulkhead with arrow pointing to position of strainer.
DECK TUBES 	On caps of deck tubes for flexible emergency electrical cables.
TRAFFIC ROUTES 	Where needed in passages or through doors or hatches.
FIRST AID POSTS  	To mark FAP or SMP. A white arrow on a green background may be used to indicate direction.

Table 3-1. Summary of Markings (continued)

EXAMPLE	APPLICATION
CLEANSING POSTS CLEANSING POST	To mark cleansing post, with orange arrow where needed.
ESCAPE ROUTES 	On escape routes, recesses, hatches and scuttles.
HPSW SYSTEM 	On HPSW isolating valves and hydrants.
NBCD ZONES **ZONE BOUNDARY**	On bulkheads which separate NBCD zones.
SHELTER ROUTE SHELTER	Alongside doors/hatches on shelter routes
MMS BOUNDARY COOLING 	On deck edge or superstructure to indicate forward/aft limits of machinery spaces.

CHAPTER 4

NBCD STATES OF READINESS

CONTENTS

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CHAPTER 4

NBCD STATES OF READINESS

0401. At all times ships must be prepared to limit the extent of damage and to minimise the effects when it occurs. This preparedness before damage is provided by the NBCD states of readiness, and by watertight and gastight conditions (see Chapter 5).

0402. Need for NBCD State of Readiness

At all times there must be some means of ensuring the highest state of ship preparedness compatible with fighting efficiency, habitability, routine and maintenance of structure, machinery and services. It is also necessary that manpower and materials to carry out effective countermeasures are readily available in sufficient numbers and quantity to meet the calculated risk of damage. NBCD states of readiness are designed to ensure that NBCD manning requirements are met and material arrangements provided in varying degrees appropriate to the threat of attack or risk of damage. Since there is always some element of risk, there is always a need for some state of readiness to be in force. Obviously, maintaining the highest state is the best way to limit and control damage. However, the measures which this state imposes take personnel from their normal tasks and adversely affect habitability, routine and maintenance of the ship, its machinery and services. The highest state, therefore, cannot be maintained indefinitely and ships have to adopt a state of readiness which will afford reasonable habitability and as much opportunity as possible for normal routine and maintenance, at the same time permitting the highest state to be assumed before the risk of damage becomes imminent. The state adopted must thus depend on:

a. The calculated risk of damage.

b. The expected warning of attack.

c. The speed with which the highest state can be assumed.

0403. Aspects Governed by NBCD States

NBCD states of readiness govern NBCD manning requirements, machinery and material preparations, and arrangements to limit and control damage, except:

a. Preservation of watertight and gastight integrity, the Conditions for which are described in Chapter 5.

b. The special needs in manning, machinery and material to meet solely the NBC threat. This threat exists only in certain situations where the enemy has an NBC capability and conditions are suitable for its use. These requirements are therefore governed by the gastight condition and not by a state of readiness.

0404. Typical Arrangements

Typical arrangements governed by NBCD states of readiness include:

a. Control and operation of machinery.

b. Operation of HP sea water systems and other services.

c. The spraying (and flooding, if applicable) of certain high risk areas.

d. Operation, distribution and isolation of electrical power and services.

e. Availability and stowage of NBCD stores and equipment.

f. Security of and access to locked compartments (locks and keys).

g. Operation of galleys.

h. Organisation of the Secondary Medical Position, Sickbay and first Aid Posts.

i. Securing of stores and gear in other places (including personal gear) to minimize the risk of damage, pump suction chokage and fire.

j. Measures to protect the individual against the effects of damage, eg clothing, anti-flash gear, life-jackets.

k. NBCD manning requirements.

0405. Definition of NBCD States

There are three states of readiness, designed to meet all possible situations. These states provide a uniform framework throughout the Surface Flotilla into which each ship must build its own organisation, being guided by the principles outlined in this chapter and by the typical arrangements given in Table 4-1. Classes of ships and even ships within a Class, differ considerably and it is not possible to define manning, material and machinery arrangements to meet the needs of all ships. Therefore, the arrangements given in Table 4-1 are for guidance only. The NBCD states of readiness are defined as follows:

STATE 1	Attack or damage imminent.	Highest state of NBCD preparedness compatible with fighting efficiency. Disregards habitability and wear and tear of machinery. All NBCD positions fully manned, with NBCD personnel relaxed for meals, etc, as ordered by the Command.
STATE 2	Attack or damage possible.	Normal war cruising and harbour state. Skeleton watch system with personnel drawn from all departments.
STATE 3	Attack or damage unlikely without adequate warning.	Normal peacetime cruising and harbour state. Large ships provide skeleton watch system as for State 2. Small ships, no NBCD manning except for the SCC watchkeeper (if applicable) and patrols. In harbour, maximum possible habitability, routine and maintenance.

Notes:

1. NBCD states of readiness do not necessarily coincide with armament degrees of readiness. Although NBCD State 1 is always assumed when the armament goes to the first degree of readiness (Action Stations), the converse is not necessarily true, eg when operating in a mine threat area.

2. *States and conditions can be altered independently of each other, but when changing one or the other it is advisable to mention both. For instance, when changing from State 2, Condition Yankee to State 3, Condition Yankee, the order should be 'ASSUME NBCD STATE 3, CONDITION YANKEE'.*

3. *The three States defined above refer only to surface ships. Submarines have four NBCD States (see BR 2170(4)).*

0406. Preparation of States of Readiness

Deciding the material conditions of the ship and the organisation of the personnel needed to achieve the different states of readiness is the responsibility of the Executive Officer/NBCDO, who must work in accord with the Heads of Departments concerned. He should consider first the highest state when all safeguards have been applied, since these will affect all departments of the ship to a greater or lesser degree. The relaxations from this state that can be permitted in the lower states should then be considered. When the organisation for all states has then been decided for the ship as a whole, Heads of Departments must formulate the organisation for each state in their departments; for example, the Marine Engineer Officer will draw up orders for the working of machinery.

0407. Responsibility for Setting the State

When ships are in company, the Officer in Tactical Command (OTC) is responsible for ordering the NBCD state of readiness that is to be set. However, in a high threat situation in wartime, the Command should not wait for such an order if to do so would prejudice the achievement of a higher state in time to meet the threat and the Rules of Engagement permit. At all other times the responsibility rests with the Commanding Officer of the ship.

0408. Choice of State

The following points must be considered before deciding the state of readiness to be set:

a. In war, NBCD State 2 is normal at sea and in harbour except for the relatively short periods when State 1 will be necessary.

b. In peace, the assumption of State 2 or State 1 will rarely be needed, except when ordered for exercise purposes.

c. At any time, the NBCD state of readiness assumed should be no higher than that needed to accomplish the task and safeguard the ship in the particular circumstances.

0409. Peacetime Navigational Hazards

Most peacetime navigational hazards (eg fog, gale, narrow waters, RAS, entering and leaving harbour) are usually of relatively short duration and the full assumption of State 2, with all that it entails, could not be justified, but there should be no question of assuming a degraded State 2 (ie not carrying out all the measures implicit in assuming the State). It is tempting to do so in order, perhaps, to muster enough manpower to maintain watch on watertight integrity, but if this is done there will be a State 2 in peace different from State 2 in war, when all the measures must be properly carried out. Thus the organisation will fall into disrepute, and if an emergency requires the ship to be put on a war footing, much that has been practised in peace must be relearned. A way must be found to overcome the temporary manpower difficulty or the state must be properly assumed without debasement.

0410. Special Sea Dutymen

The best way of dealing with this problem is to remain in State 3 but to add to this 'Special Sea Dutymen', including in it any other special provision that seems prudent for the particular hazard. Thus for entering harbour in very poor visibility, order NBCD State 3, Condition Yankee and pipe 'Special Sea Dutymen' which should include in this instance an HQ1 watchkeeper, NBCD patrols and any material measures ordered by the MEO (eg extra pumps, isolation of systems). Ships' orders should give details of the NBCD provisions for the particular hazard, (over and above State 3), required when Special Sea Dutymen are piped. Tackling the problem in the right way needs careful thought and firm but flexible organisation, but the alternative of degrading State 2 is a trap that must be avoided. If, in peacetime, it seems probable that the hazard encountered or expected will be of long duration (perhaps many hours or some days), the full assumption of State 2 is then a practicable step which the Command is free to take with complete justification.

0411. Assuming State 2

It follows from the previous paragraphs that State 2 would generally be assumed only for long periods. Common prudence dictates that when the ship must be placed on a war footing, State 1 should be assumed for a thorough check of manpower and material, and that only after this should State 2 be ordered. In peace, if a navigational hazard is likely to be long-lasting, and the Command decides that State 2 is to be assumed, the same routine should generally be followed.

0412. Assuming the Gastight Condition

Assuming the gastight Condition Alfa (see Chapter 5) poses another problem. The superimposing of gastight Condition Alfa on watertight Condition Zulu or Yankee will, in most instances, require the assumption of State 1 in order to have the manpower necessary to get all the openings and flaps set and the citadel pressure proved. When this has been achieved State 2 Condition YA can be assumed. State 2, condition YA preserves the integrity of the citadel whilst allowing internal Z doors to be open for greater freedom of movement through the ship and a better air flow in the air conditioning system. The relaxations to Condition Alfa which the NBCD Officer can allow are dealt with in Chapter 5.

0413. Exercises

During exercises of long duration in peace, ships should exercise assuming State 2 via State 1, but on no account should this be attempted during a short exercise, lest State 1 itself becomes degraded.

0414. Manning for NBCD State 1

The Watch and Station Bill must nominate sufficient personnel to ensure prompt and effective response to all forms of damage and fire. To achieve this it must:

a. Man essential control positions.

b. Provide Fire and Repair Parties, which include teams for pumping and flooding and electrical repair.

c. Provide a Mobile Repair Party, stationed adjacent to HQ1, with specialist tools eg Thermal lance, Ramset Tool and Cutting & Spreading Equipment.

d. Man magazine flood and spray positions (mainly in large ships).

e. In Condition Alfa, man the cleansing station(s) as required and provide monitoring and decontamination parties after contamination.

0415. Manning for NBCD State 2

In NBCD State 2, personnel are required to partially man certain positions to ensure the maintenance of the ordered NBCD condition of watertight/gastight integrity and to enable a smooth transition to NBCD State 1 when ordered. The State 2 NBCD Command and Control organisation is covered in more detail in Chapter 8. The following requirements are to be covered in State 2:

a. **Control**

(1) *Multi-section Ships.* An officer or senior rating and two junior ratings as assistants in HQ1. One communication number in each Section Base.

(2) *Single-section Ships.* Ships with SCCs to be manned continuously by permanent watchkeepers. In other ships the OOD/OOW should maintain the Watertight Integrity Log.

b. **Patrols.** Two-man patrols to maintain a continuous check on the NBCD state and condition ordered. Consideration should be given to making the patrol personnel permanent watchkeepers, rotated at approximately three-month intervals. In addition to carrying out NBCD patrols, their duty is to assist the rating in charge in HQ1/SCC.

c. **Relaxation to Condition Alfa.** One sentry to man each Alfa opening that has been opened, whilst it remains open.

0416. Manning for NBCD State 3

In State 3, NBCD requirements are to be covered as follows:

a. **Control**

(1) *Multi-section Ships.* HQ1 only manned.

(2) *Single-section Ships.* Ships with SCCs to be manned continuously by permanent watchkeepers. In other ships the OOD/OOW should maintain the Watertight Integrity Log.

b. **Patrols.** As for State 2, except that in single-section ships patrol duties are covered by duty personnel and ratings on watch. In ships with a permanently manned SCC, some of the NBCD functions normally carried out by rounds are covered by automatic alarms and warnings displayed in the SCC and are monitored by the watchkeeper. Notwithstanding this, there remains a requirement for NBCD rounds to be carried out.

0417. Material Condition of a Ship

The material condition of a ship is of vital importance to its NBCD preparedness. Planned maintenance schedules take care of most of the requirements but constant vigilance is needed for such as the following:

a. Ensuring the continued watertightness and gastightness of structure and fittings by regular air testing, citadel tests, making certain that holes made when equipment (especially electric cable) is moved are efficiently blanked.

b. Frequent and systematic examination of all clips, rubbers, gas flaps, rod gearing, etc, to ensure that no distortion or other deterioration has taken place.

c. The maintenance of location, control and risk markings.

d. The systematic checking, testing and replacement as necessary of NBCD stores equipment and fittings.

The amount of paint on a ship's side and superstructure should be kept to the minimum required to protect from corrosion, as unnecessary coats of paint can make a significant difference to a ship's stability and too much paint also increases the smoke hazard in case of fire. It is worthy of note that fresh paint absorbs liquid chemical agent more easily than does paint that is a few weeks old. Redundant fittings and stores of all types should always be landed.

0418. Pump Suctions

The suction strainers of fixed and portable pumps can quickly be choked by loose material left lying on decks or thrown there by shock or blast. Particularly, this applies to soft materials, rags and paper, and to such things as paint chippings and rust scale. If a compartment is in darkness and only partly flooded, the difficulty of clearing suction strainers needs no emphasis. Even large gratings such as those fitted to hangar scuppers can be made useless by loose rags and other gear washed against them.

0419. Stores and Equipment

Storerooms and provision rooms normally have fitted stowages for their contents and keep-battens or wire mesh grills to secure them. The stores should always be properly stowed with all keep-battens in place and secured. Wrapping papers and bags, cardboard cartons and sacks should not be left lying about in the storerooms or anywhere else. In workshops, hangars, messdecks, etc, cleaning cloths should be kept in metal containers when not in use, or removed from the space and properly secured. Throughout the ship, loose clothing or other materials should never be left about and locker doors should not be left unsecured.

0420. Access to Compartments

a. On assuming NBCD State 1, personnel are to ensure that non-watertight doors are secured in the open position. Exceptions are non-watertight doors classed as fire doors and those giving access to compartments containing highly classified equipment/materials or attractive store items.

b. Compartments containing highly classified equipments/materials and those containing attractive stores items (NAAFI store) may be excluded if the door securing mechanisms are left unlocked. If the compartment is required to remain physically secure during NBCD State 1 this may be achieved by the fitting of a hasp and securing the compartment with a soft padlock.

c. Compartments containing highly classified material accessed by non-watertight doors secured by combination key pads are to have their locks latched in the open position. If required, a hasp may be fitted and the compartment secured during State 1 with a soft padlock.

0421. Accessibility of Ship's Side and Bulkheads

Unless there is ready access to the ship's side and to bulkheads, the efforts of repair parties, especially in leakstopping and shoring, may be seriously hampered . This is particularly important in storerooms and is dealt with in Chapter 12. Throughout the ship, heavy materials or equipment that are stowed near the ship's side or bulkheads may prove a serious hindrance when damage and/or flooding are being dealt with. Likewise, such items, if not properly secured, can shift as a result of explosion or heeling of the ship and become wedged against the ship's side or bulkheads.

0422. Security of Magazines

The conditions of magazines and ammunition lockers depend upon the perceived threat and whether it is peace or wartime, and is decided by the Command.

a. **Peacetime.** Normally all compartments (including hoists and trunks giving access) and lockers in which ammunition is stowed are kept locked, and this is known as the 'security condition'.

b. **Wartime.** When speedy access to these compartments is likely to be necessary in order to bring the armament into action quickly or to take urgent NBCD action, the doors/hatches to magazines are to be clipped but unlocked, and this is known as the 'Access condition'. This condition is normally associated with NBCD States 1 and 2. When action is thought to be imminent the 'venting condition' may be considered more appropriate. These conditions can be ordered in peacetime, for exercise purposes, by the Command.

c. In a harbour (when the ship is in NBCD State 3) the 'Security condition' is appropriate.

Notes:

1. Unlocking of compartments does not imply that they may be left open. The door and other openings to magazines affected by the 'Access condition' must conform to the particular watertight or gastight condition that the ship is in, according to their markings.

2. The condition of magazines, ie 'Security' or 'Access' should be recorded in the Ship's Explosive Log.

0423. Hatch Guardrails

Hatch guardrails should be removed and stowed at Action (NBCD State 1), except around those hatches designated and marked 'Open in Action'. Additionally, they should be rigged around hatches left open as part of exercise requirements, eg at OST where some hatches may be designated to be left open for staff access. If any hatches are to be left open for protracted periods then the person in charge of the area should consider the requirement to rig guardrails, taking into account the ship motion and other hazards.

0424. Ship's Company Clothing

Sufficient numbers of adequately protected personnel must always be available to be committed to damage control or firefighting duties in the event of any emergency being ordered (eg Clear Lower Deck or Emergency Stations). Whilst this is unlikely to pose a threat in temperate climates, Commanding Officers should consider the requirement for a number of personnel to be in flame retardant clothing when operating in tropical areas. Whenever the normal Dress of the Day does not give the level of protection provided by the Basic Firefighting Rig (see Chapter 26), Basic Firefighting Rig is to be worn or immediately available to be donned by the following personnel:

a. All personnel nominated to close up at the Scene of the Incident (SOTI) or at FRPPs in the event of an emergency.

b. The Duty Part of the Watch in harbour.

c. Personnel as nominated by departments to ensure that adequate numbers are available in the event of an emergency.

0425. Action Carry Bags

The large amount of personal protective and survival equipment that may need to be carried by personnel at Action Stations or Defence Stations can be a significant encumbrance. Action Carry Bags, which are normally kept in Naval Stores, may be issued to the Ship's Company, when authorised by the Command. This will enable personnel to have the items immediately at hand without wearing them about the body.

Table 4-1. NBCD States of Readiness

Guidance for Damage Control and Firefighting only (see Chapter 5 for NBC guidance)

Considerations	**State 3** **Normal peacetime state at sea and in harbour. (Non action damage possible at any time)**	**State 2** **Normal war state at sea and in harbour. (Action possible with little warning)**	**State 1** **Action state (Action imminent)**
Preparations for war	None	All preparations for war completed iaw BR 2170(1) and FCD1.	
Watertight condition	X (Y for situations of increased risk).	Y	Z
Gastight condition	None.	None or A.	
Dress	Dress of the day. (but see Para 0424)	As State 1 but with anti-flash hoods down, lifejackets and survival suits to hand.	Full action dress iaw Chapter 26.
Manning	Fire and Emergency Party (in harbour/Standing Sea Fire Party (at sea). Patrols active with SSD. SCC manned.	HQ1 and FRPPs manned iaw Quarter Bill (defence watch manning) patrols active, HFEP/ SSEP detailed in each watch.	Full NBCD teams closed up iaw Quarter Bill, patrols active, dispersal of personnel.
Fire and repair equipment	Equipment in normal stowages. FRPP lockers locked.		At each FRPP dress one 4-man team in full firefighting rig, off air, communications equipment to hand. Fire and repair lockers unlocked and contents checked; on completion doors should be closed and secured with a drop-nosed pin but not locked.
	In all states fire hoses with nozzles are to be connected to hydrants.		
Non watertight doors (except fire doors)	Normal use		All cabin doors and doors to unmanned compartments to be secured in the open position.
Locked compartments and keys (except magazines)	Mortice locks and padlocks locked. Duplicate keys in normal stowage.	As for State 3 but duplicate keys held at FRPPs.	All compartments unlocked, unmanned secure storages to be re-secured with soft padlocks only.
Magazines	Security condition or access condition.	Access condition.	Access condition.
Escape ladders	Secured in the useable position (unless this interferes with normal access)		Secured in the useable position.
Ramset explosive power tool	Explosive charges in small arms magazine	Ramset Tools to be accessible. Explosive charges to be issued to Mobile Repair Party.	
Thermal Lance	In normal stowage.	Accessible to Mobile Repair Party.	
Cutting & Spreading Equipment	In normal stowage	Immediately accessible to Mobile Repair Party.	
Smoke Curtains	Stowed	Stowed	Rigged, checked, then restowed
Hatch Guardrails	Rigged	Rigged	Removed and stowed, except hatches marked: 'OPEN IN ACTION'.

Table 4-1. NBCD States of Readiness (continued)

Considerations	**State 3** **Normal peacetime state at sea and in harbour. (Non action damage possible at any time)**	**State 2** **Normal war state at sea and in harbour. (Action possible with little warning)**	**State 1** **Action state** **(Action imminent)**
High Pressure Sea Water (HPSW) System	As ordered, checked on going to sea.	The system may be de-isolated to an extent dictated by the threat. In general, the number of running fire pumps should be reduced and the HPSW main isolated into the same number of sections as there are fire pumps running. main systems board is maintained. In harbour the system is run as ordered. Pump starter over-ride switches to be unlocked.	1. Divide HPSW main into as many sections as there are serviceable pumps. Run one pump to each section. 2. Ensure main and duplicate supplies to magazines are from separate sections. 3. Pump starter override switch to be closed. 4. All CFHR de-isolated
Magazine floods and sprays	a. **Manual Systems** (1) Main spray isolating valve - LOCKED OPEN. (2) Operating valve - LOCKED SHUT. b. **Automatic/Semi-automatic Systems** (1) Main spray and system isolating valves - LOCKED OPEN. (2) Spray shut off valve - LOCKED OPEN.	a. **Manual Systems** (1) Main spray isolating valve - OPEN*. (2) Operating valve - SHUT*. b. **Automatic/Semi-automatic Systems** (1) Main spray isolating valve - OPEN*. (2) Spray shut off valve - OPEN*. *Padlock opened with hasp re-inserted in the valve locking pin/cotter.	
Portable DC/FF pumps (less than 100 kg)	Available consistent with maintenance.	Checked and tested and ready for immediate use.	
Mobile DC/FF pumps (more than 100 kg)			
Emergency electrical equipment	Equipment secured.	Equipment checked. Emergency cables ready for immediate use.	
Main machinery	As ordered, consistent with maintenance.	Sea: Full power available. harbour: As ordered.	Full power available.
Auxiliary machinery	As ordered, consistent with maintenance.	Sea: As ordered. Harbour: As ordered.	
Fresh water	Normal use.	Normal use.	Pumps stopped. System isolated.
		Notes: *a. Before the pumps are stopped plastic jerry cans are to have been filled with fresh water and distributed to FAPs and SMPs.* *b. Pumps may be restarted at the discretion of the Command to provide essential facilities such as bridge window washing, cleansing stations and essential domestic services.*	
HP Air	Main de-isolated.	Main isolated. Compressors run as necessary (but not from compartments affected by smoke)	
Refrigeration and air conditioning	Operating except as required for maintenance.	Operating unmanned.	Operating unmanned.
		Note. *In Condition ALFA tested regularly for leaks by personnel in BA.*	

Table 4-1. NBCD States of Readiness (continued)

Considerations	State 3 Normal peacetime state at sea and in harbour. (Non action damage possible at any time)	State 2 Normal war state at sea and in harbour. (Action possible with little warning)	State 1 Action state (Action imminent)
Main generators	Sea: Sufficient running to ensure adequate power if one fails. Harbour: As ordered.	Sea: On load as required. All other generators at immediate notice. Harbour: As ordered.	All generators running and supplying their own sections.
High power electrical distribution system	As ordered in the BR 6500 series, Main Supply System Handbook, NBCD Class Book or BR 2000 series. It is important that interconnecting cables are isolated whenever possible and always in State 1.		
Emergency generators	At immediate notice except during overhauls.		
Changeover switches	All automatic COSs to be in the 'auto' mode. Both hand and automatic COSs should select the Normal supplies.		
Converted electrical supplies	Enough conversion to meet the load, (consistent with maintenance). LP battery floating.	Enough conversion to meet the load. LP battery floating.	All conversion machinery available. LP battery floating.
Hydraulic ring main	Pumps running and system pressurised as required.	As for State 1. De-isolated and pressurised if required for use as required by HQ1.	Pumps shut down. System de-pressurised and isolated iaw system BR.
Chilled water	Sea: As for State 2. Harbour: As required.	As for State 1 unless maintenance requirements dictate otherwise.	All plant available. System isolated iaw system BR.
Galleys, bakeries, etc	Normal use.	Normal use, emergency food at hand for action messing (not to be used without Command approval).	Shut down except as ordered for action messing. Galleys, etc. not to be used without Command approval. (Action messing details in BR 93.)
Naval store rooms	As for State 1 consistent with storing.		Stowed to meet the NBCD threat (see BR 4).
Victualling store rooms	As for State 2 consistent with storing and maintenance except stocks of RU provisions not required.	As for State 1 consistent with storing.	As for Naval store rooms. About 7 days provision to be stowed high in the ship (consistent with stability).
Secondary Medical Position (SMP)	Unrigged. Equipment stowed in normal stowage.	Equipped but unrigged, unmanned and gear stowed.	Unmanned. Equipment checked and resecured. To be rigged and manned as required following triage.
Sickbay	Normal use.	Flammable stores not required moved to the medical store.	Used as medical HQ but not as FAP. Equipment should be made ready as standby
First Aid Posts (FAP)	Unmanned. Gear stowed in lockers. Morphine in Controlled Drug cupboard.	Posts and contents of first aid lockers checked periodically. Morphine issued to selected Officers and Senior Rates.	Manned. Morphine issued. Medical personnel dispersed throughout the ship.

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CHAPTER 5

NBCD CONDITIONS, RISK AND CONTROL MARKINGS

CONTENTS

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CHAPTER 5

NBCD CONDITIONS, RISK AND CONTROL MARKINGS

0501. Introduction

Resistance to flooding depends on watertight integrity; protection against NBC contamination entering a ship depends on gastight integrity. Both, in turn, depend on:

a. Continuous maintenance and routine checks, including air testing, to ensure the watertight and gastight efficiency of bulkheads, decks and the fittings that pierce them (see Chapter 36).

b. Disciplinary control of all doors, hatches, ventilation valves and other openings.

0502. Structural arrangements in ships are described in Chapter 29. Watertight integrity, to a greater or lesser degree, is maintained at all times while a ship is water-borne. Gastight integrity is achieved by closing down the ship when NBC attack seems probable or an alarm is given. The object of closing down is to prevent the ingress of NBC contamination into the ship and thus protect personnel stationed, or taking cover, between decks and also to minimize internal contamination, so that normal living can be resumed and the ship can be a fully fighting and efficient unit as soon as possible after an attack.

0503. When prepared for, or undergoing NBC attack, many of the compartments and spaces closed down must be manned, and adequate oxygen and tolerable temperatures must be maintained. These requirements depend largely on the internal arrangements of the ship (eg efficiency of the air-conditioning system, number of NBC filter units fitted, remote control of machinery) and the climate. When a ship is in the closed-down condition, all practicable means must be taken to avoid fouling of the air (see BR 2170(2)). Bad odours must be suppressed as much as possible, the smoking of tobacco restricted and all sources of heat that are not essential to fighting or machinery installations must be eliminated or reduced to a minimum; examples are heaters, hot cupboards and main cooking arrangements in the galley. It is also necessary for free movement to be possible through the main body of the ship and, for this reason, a Citadel is established to include as many compartments as possible.

0504. Discipline

Although it is vitally important to maintain the watertight structure and fittings in an efficient condition, experience has shown that progressive flooding has almost always been due to inadequate control of openings. All personnel must be fully conversant with the system of markings used to make this control effective, both for watertight and gastight integrity, and a record must be kept of the watertight and gastight condition of the ship at all times. The watertight condition is recorded on the NBCD Door and Hatch Board and in the Watertight Integrity Log; the gastight condition is recorded on the NBC Ventilation Board. The requirements of watertight and gastight integrity must inevitably conflict with habitability, routine and freedom of movement. The condition of the ship is thus tied in some ways to the states of readiness dealt with in Chapter 4. The system of markings described in this chapter is intended to meet these conflicting requirements as far as possible and to allow the necessary degree of flexibility.

0505. Spare.

SECTION 1 - RISK MARKINGS

0506. Watertight Risk

A ship sustaining major underwater damage will probably either sink very quickly (30 minutes or so) or, if the first hour is survived and good damage control is exercised, be saved. Realistic estimates can be made of the maximum flooding, attributable to major damage, which would not sink the ship in a short time. This flooding can then be related to the increase in draught, heel and trim for such damage occurring at different places in the ship. These calculations give a zone (called the Red Risk Zone) which extends from the keel to somewhere above the deep waterline, rising higher at the ends and, in a broad ship, at the sides.

0507. The Red Risk Zone is defined by the Ministry of Defence at the design stage of a ship. It provides a guide for the flooding risk area of a ship, where there is a need to exercise strict control of openings.

0508. Red Risk Markings

Openings to all compartments within the Red Risk Zone are deemed to be, when open, of immediate risk to watertight integrity. These are known as Red Openings, and are marked as follows:

a. **Doors and Hatches.** By a red triangle across the upper corner furthest from the hinges.

b. **Valves and Scuttles.** By a red disc (with or without an arrow) on or near the fitting.

0509. Emergency Control of Red Openings

In an emergency (such as unexpected damage or imminent collision) these openings can be rapidly identified and closed by broadcasting the order 'CLOSE ALL RED OPENINGS'. The broadcast of this order indicates an emergency and that speed is vital. The order overrides any previous watertight order or concession, such as 'May Be Left Open' tallies or 2 clip markings. When the order is in force, no Red Opening must be opened without specific permission from NBCD headquarters. The broadcast order may specify openings in one particular part of the ship or may apply to the whole ship. On hearing the broadcast 'CLOSE ALL RED OPENINGS', it is the duty of all personnel, not only the NBCD teams, to shut all Red Openings in their vicinity. The relationship between the broadcasts 'CLOSE ALL RED OPENINGS' and 'EMERGENCY STATIONS' is explained in Chapter 7.

0510-0511. Spare.

SECTION 2 - CONTROL MARKINGS

0512. Watertight Control

The main watertight control markings are:

a. X (X-ray) Y (Yankee)	In black on doors, hatches, drain cocks, valves, some ventilation fans and ventilation openings (including slide valves) which affect watertight integrity. Required generally only in the Red Risk Zone.
b. Z (Zulu)	In black on similar openings to above. Required generally only outside the Red Risk Zone to give watertight integrity and protection against blast, flash and fire.

0513. May Be Left Open (MBLO) Tallies

Watertight control can also be exercised by the use of MBLO tallies, the purpose of which is indicated on the tally. These tallies and their fastenings must be made from a fire resistant material. The number of MBLO tallies allowed in a ship is to be detailed in the Ship's NBCD Orders. In addition to the standard markings, tallies are to be permanently marked FORWARD or AFT (small ships) or with the section number in a large ship. There are three types of MBLO tallies:

a. **May Be Left Open.** To be used on certain openings which would normally be shut in a particular watertight condition but which may need to be open for periods without being attended, eg a door which provides passage in almost continuous use by day but which can be shut at night, or a hatch in frequent use during working hours but where it cannot be guaranteed that someone is always on hand to shut it instantly. Tallies should not be left on openings for long periods merely to gain entry to compartments with difficult access. The number of tallies issued must be kept to a minimum and they are not to remain on openings for indefinite periods. The tally should permanently bear the printed words MAY BE LEFT OPEN. The location marking of the opening and the condition(s) for which it is authorized are to be added, by marker pen, at the time of issue. It is to be hung over the normal control marking. In conditions other than that or those for which the tally is authorized, the tally must be withdrawn and the opening controlled by its normal marking. When a tally has been issued, responsibility for the opening rests with HQ1 (normally through its NBCD patrols).

b. **May Be Left Open in Action.** Openings (generally only a few) which would normally be shut but may need to be open and possibly remain open for action purposes, should have a tally hung or screwed on, not covering the control marking, and bearing the words MAY BE OPEN IN ACTION. At all times other than those authorized in the Ship's NBCD Orders, the opening must be controlled by its normal marking.

c. **May Be Left Open - Man Below.** Hatches (and some doors) that need to be open during the course of routine rounds (eg gland spaces and plummer block compartments) but which are marked with a watertight control marking X or Y, may remain open for the duration of the rounds inspection by the use of a tally bearing the words MAY BE LEFT OPEN, MAN BELOW. The tally is issued to the department concerned and is to be hung on the top hatch (or door) when rounds of the space commences and removed when rounds are complete and the hatch(es)/door(s) are shut.

Note. *See Volume 2 for details of the tally for use on Alfa doors between sub-citadels.*

0514. Keeping in mind the control markings of openings and the general routine which the ship works (or is to work), the NBCD Officer should examine the actual watertight state of the ship in each of the three watertight conditions (X, Y and Z) making allowance for any MBLO tallies that are authorized and for MBLO - MAN BELOW tallies that have been issued to departments for their rounds. Such an examination should place the ship in the most pessimistic state authorized for each condition. The NBCD Officer should then decide how many more openings he can allow to be open in each condition, giving consideration to the need to live and work in the ship.

0515. If a routine is laid down for opening the various compartments that have to be visited regularly, the number open at any one time can be kept small. For example:

FORWARD	
3C Canteen Store	0945-1015
3D Naval Store	1015-1045, 1400-1430
4E Naval Store	1115-1145, 1500-1530
4G Magazine	0800-0830
4H Magazine	0915-0945
3J Provision Room	0930-0900
4J Beer Store	1045-1115
AFT	
4P Magazine	0830-0900
4P Naval Store	1015-1045
4Q Naval Store	0915-0945, 1430-1500
4R Provision Room	0800-0830

Such a routine allows all personnel concerned to know that they may receive permission to open their particular compartments at the times stated, but permission to open must still be obtained from HQ1. In addition to the regular openings as above, allowance must also be made for casual requirements to open compartments. The total number of openings permitted to be open at any one time should be worked out on the basis of at least two intact transverse bulkheads between each applied MBLO tally. Once decided, the allowances should be laid down in the Ship's NBCD Orders, and a copy should be inserted in the Watertight Integrity Log or prominently displayed in HQ1/SCC.

0516. Watertight Control Qualifying Symbols

The only qualifying symbols used in conjunction with watertight control are:

a. 2-CLIPS — On doors and hatches where the normal volume of traffic makes full clipping impracticable; it may also be used on openings selected as routes to shelter positions. The openings to be so marked are decided by ship's officers. All clips are to be put on in emergency. Rules for the use of the 2-clip marking are given in later paragraphs.

b. VENT 2-CLIPS / VENT NO CLIPS — Required in some ships on venting routes from magazines. The openings to be so marked are decided by the Ministry of Defence at the design stage. In wartime the venting condition is ordered when action is imminent (NBCD State 1). In peacetime it is ordered in ships which are in the proximity of a hostile shore line, or boat, or where the threat from dissidents/saboteurs creates a potentially dangerous situation. All clips are to be put on in an emergency.

0517. Gastight Control

Gastight control is exercised by the assumption of condition A (Alfa), which is superimposed on the watertight condition (Z or Y) as required. Gastight control markings are letters A, M and R (painted orange) and the following qualifying symbols:

a. CITADEL IN / CITADEL OUT — On airlock doors/hatches specified for citadel entry/exit in condition Alfa. They are marked CITADEL IN on the outside and CITADEL OUT on the inside of the citadel. They may be used for access to and from the citadel prior to contamination, after which they are for exit only and access to the citadel is via the cleansing station only. The markings are painted in orange and the openings so marked are decided by the Ministry of Defence.

b. CLEANSING STATION — Entry into the citadel after the ship becomes contaminated must be made only through the cleansing station, the outer door of which (leading into the undressing area) is marked CLEANSING STATION (painted orange).

c. SHELTER — Routes, on and below the weather deck, to shelter positions are indicated by an arrow and the word SHELTER, both in orange. A door on the route is thus indicated by signs on the bulkhead on either side pointing to it; the door then has on it only the usual risk and control markings, and possibly the 2-CLIP symbol. If a hatch on the route has no adjacent bulkhead, the symbol is placed on the hatch cover. The broadcast 'SHELTER SHELTER SHELTER' is an emergency order allowing any route so marked to be used.

d. SUB-CITADEL

Airlock Division. Where passage between sub-citadels is via an airlock, the doors/hatches forming the airlock must bear the appropriate watertight risk and control markings and the words SUB-CITADEL IN/OUT on each side. In condition Alfa the doors/hatches must be shut except for passage. If required to remain open, permission must be obtained from HQ1 and a sentry posted.

Single Door/Hatch Division. Where passage between sub-citadels is via a single door/hatch, the door/hatch must bear the appropriate watertight risk and control markings, the gastight marking A and the words SUB-CITADEL on each side. In the sub-citadel condition, the door/hatch will be controlled by the gastight marking A. In the whole-citadel condition, the A marking should be covered by a disc bearing the words OPEN FOR PASSAGE ONLY and the appropriate location marking of the door/hatch.

e. OPEN IN ALFA

Fitted on the supply flaps to NBC filter units, which are to be open in Condition Alfa.

0518. Citadel and Gas-free Spaces

With regard to gastight integrity, compartments can be placed in four categories:

a. **Citadel.** The citadel is defined as the main group, or groups, or interconnecting compartments which can be included together within unbroken gastight boundaries and in which air can be recirculated. Movement must be possible throughout the citadel without the need to leave its confines. In some ships, large parts of the superstructure are included in the citadel. The citadel is shown in ships' drawings and in the appropriate NBCD Class Book, outlined in orange.

b. **Citadel - Risk of Contamination.** Certain compartments included in the citadel can, in some circumstances, become contaminated as a result of failure of structure or equipment, or because temperature rise necessitates ventilating the space. These are chiefly main or auxiliary machinery spaces, and are shown in ships' drawings and in the appropriate NBCD Class Book, as CITADEL, RISK OF CONTAMINATION within the citadel but indicated by a brown wash.

c. **Gas-free Compartments.** Isolated compartments from which gas can be excluded but which, owing to the layout of the ship or for some other reason, cannot be included in the citadel, are called GAS-FREE COMPARTMENTS or GAS-FREE SPACES. They are shown in ships' drawings and in the appropriate NBCD Class Book outlined in purple.

d. **Gas-free, Contaminated if Used Compartments.** Certain compartments, eg fuel storage tanks, some magazines, workshops, can be kept gas-free if not used but will become contaminated if used or ventilated during an NBC attack or in a contaminated atmosphere. They are shown in ships' drawings and in the appropriate NBCD Class Book as GAS FREE, CONTAMINATED IF USED, outlined with a broken line in alternating orange and purple.

0519. Rules for Watertight and Gastight Control Markings

Observance of the rules for the control of watertight and gastight openings is the responsibility of all personnel, and they must be continually aware of which watertight and gastight condition is in force and also of the requirements of each condition. Watch on the maintenance of the condition set is kept by NBCD patrols or by frequent rounds by the Watch on Deck or Duty Watch according to the state of readiness (see Chapter 4), and the type and size of ship. The rules for control markings are:

X SHUT IN ALL WATERTIGHT CONDITIONS. To be opened only by permission. If required to be kept open, a sentry must be posted or other arrangements made for the opening to be shut instantly on order, or a MBLO tally must be used.

Y SHUT IN CONDITIONS Y AND Z. May be open in Condition X-ray. When shut may normally be opened for passage or use but must be immediately shut again. If required to be kept open in Conditions Yankee or Zulu the rules as for X-ray openings apply.

Z SHUT IN CONDITION Z. May be open in Conditions X-ray and Yankee. When shut, the rules as for Yankee openings apply.

A SHUT IN CONDITION A. When Condition Alfa is in force, openings so marked are not to be opened without specific permission from HQ1.

M In Condition Alfa only, openings so marked are under the control of the user department. User departments must ensure that the orders regarding their M openings are clear and fully understood by their personnel.

R Fittings or equipment so marked must continue to run or remain open for recirculation.

Note. *'Shut' or 'Closed' means fully clipped, except for openings bearing 2-CLIP or venting symbols (in the venting condition). Such openings are to be fully clipped in emergency or, on shelter routes, when the last man is through to shelter. Y 2-CLIP doors (except those on shelter routes) are to be fully clipped in Condition Zulu.*

0520-0521. Spare.

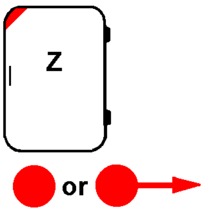
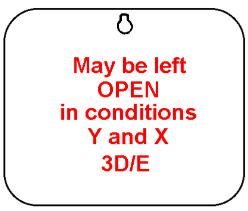
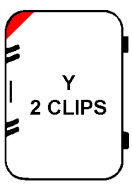
EXAMPLE AND COLOUR	SIZE	APPLICATION
RISK MARKINGS 	Equal sides 250 mm painted 50 mm Transfer	Red on both sides of door or hatch, upper corner opposite edge to hinges. On or near valve, ventilation closure, flap, fan, etc, scuttle.
CONTROL MARKINGS	Embossed Aluminium Tallies	
Watertight **X Y Z** Gastight **A M R**	Door or Hatch; 75 mm	Watertight. Upper centre of door or hatch. Gastight. Immediately below watertight control.
Watertight **X Y Z** Gastight **A M R**	Valve, Ventilation Closure, Flap, Fan, Scuttle; 40 mm	As needed on or near fitting
CLEANSING STATION **CITADEL IN/OUT** **SUB-CITADEL IN/OUT**	40 mm Block Letters Embossed Aluminium Tallies	Over or beside outer door of undressing area on selected doors/hatches. At sub-citadel dividing boundaries.
MBLO TALLY 	150 mm Square OPEN - 40 mm Block Location - 15mm Remainder - 25 mm	Three types: a. Slotted screw hole for hanging over existing marking. b. Screwed on hatch cover. c. With loop for hanging on hatch. May be left OPEN May be left OPEN in Action May be left OPEN, MAN BELOW
QUALIFYING SYMBOLS 2 CLIPS 	40 mm Block Letters Two Parallel Black Lines 125 mm long, 6 mm wide and 15 mm apart - water slide transfer.	Control markings. 'Vent 2 clips' and 'Vent no clips' are similar. On 2 clip doors and hatches the parallel lines to be adjacent to clips to be used and angled to show direction clips should be put on.

Fig 5-1. Risk and Control Markings

SECTION 3 - PRINCIPLES OF APPLICATION

0522. Designation of Openings

Risk and control markings for all new construction ships are decided by The Ministry of Defence, and are mandatory. After ship acceptance, standardization of watertight control markings is achieved by the Administrative Authority, in conjunction with The Ministry of Defence. Watertight risk markings and gastight control markings cannot be changed, but if seagoing experience indicates that a change of certain watertight control markings is considered essential, Commanding Officers are to submit their proposals to their Administrative Authority giving full reasons in support of the proposals. Subject to their agreement, the Administrative Authority will forward details of the proposals to The Ministry of Defence for approval before authorizing implementation by ships.

0523. Within the Red Risk Zone, openings that affect watertight integrity should generally be X-ray or Yankee. Zulu is acceptable only where the need for free access at all times, other than in the highest state of readiness, is paramount. Above the Red Risk Zone, openings that need to be shut to prevent ingress or spread of blast, flash or fire should generally be marked Zulu. Doors normally kept locked (eg storerooms) should be marked Zulu since they can then be opened by the responsible person without reference to HQ1. There may be, exceptionally, in some ships, a few doors and hatches high in the ship which are much used, do not immediately affect watertight or gastight integrity, and have little value in the restriction of blast, flash or fire; these may be left unmarked, and if required to be shut for any reason they can be shut by order.

0524. Citadel Boundaries

Principles of application of watertight and gastight markings for openings in the boundaries of citadels and gas-free spaces are:

a. **Doors and Hatches.** X-ray, Yankee or Zulu markings with an orange Alfa (or M or gastight qualifying symbol) secured immediately below the watertight control marking.

b. **Ventilation.** This must be marked according to the needs of the compartment served. Some ventilation openings, valves and fans can bear the same risk and control markings as the access to the compartment concerned (eg some magazines and storerooms). Other systems must continue in operation in a high watertight condition and would then normally be controlled by a gastight control marking (A, M or R) but should bear in addition the appropriate watertight risk marking. To reduce the chances of spreading fire, flood or contamination through ventilation systems, it is important that non-essential ventilation is so marked as to reduce its use in the high NBCD conditions to a minimum.

c. **Scuppers, Drains and Soil Pipes**

(1) Any scupper, drain or soil pipe that has no opening into the citadel needs no marking other than the watertight risk marking (red) on the screw-down storm valve and its remote handwheel.

(2) In ships with citadels, all scuppers, drains and soil pipes opening into the citadel should be fitted with 150 mm water seals. No gastight marking is then needed but the storm valves and their handwheels should have the appropriate watertight risk marking.

d. **Discharge Overboard Valves**

(1) All discharge overboard valves are to be painted black and require a watertight risk and gastight control marking as necessary.

(2) If the valve is inside a compartment or hidden behind ship's side linings then a notice stating DISCHARGE O/B Vv (50 mm black lettering on the background paint scheme) must be clearly displayed on the door or adjacent structure to the door leading to the compartment, or on the lining panel leading to the valve. Risk and control markings are not required at this position.

0525. Scuttles and Windows

a. All scuttles (including those for emergency escape) and windows in the citadel boundaries are a risk to gastight integrity, and those within the Red Risk Zone are a risk to watertight integrity. Consequently all opening scuttles, windows and deadlights to fixed side scuttles in citadel boundaries should bear the appropriate gastight orange control marking (used to denote risk); it will then be mandatory for them to be shut on assuming Condition Alfa.

b. All opening scuttles on ships' sides or internal within the Red Risk Zone, including deadlights to fixed scuttles, should bear the watertight red risk marking in addition to any gastight control marking. They should not, however, be given a watertight control marking.

c. The opening and closing of scuttles should be under the direct control of the Command through the NBCDO/DCO. In an emergency, the order 'CLOSE ALL RED OPENINGS' overrides any permission which may have been given to open scuttles so marked.

d. Light-excluding plates fitted to viewing ports in watertight doors and hatches for darken ship arrangements do not require watertight or gastight markings.

0526. Bolted Manhole Covers

These bear no risk or control markings. They are considered to be part of the structure in which they are situated. However, should they be removed for any purpose (eg maintenance, inspection, upkeep period, etc) the fact must be reported to and recorded in HQ1 with the times opened and resecured and the Tag Out procedure must be followed.

0527. Escape Hatches and Scuttles

a. Escape hatches and scuttles do not, normally, bear risk or control markings. Chapter 3 details the identification colours and markings to be used for all escape routes.

b. Escape hatches are not to be covered by carpet or any fittings likely to interfere with their use. Carpets surrounding an escape hatch are to be correctly fitted and secured clear of the hatch cover.

c. With the exception of emergencies, HQ1 is to be informed prior to an escape hatch being left open whilst unattended, and the area is to be cordoned off to prevent accidents.

0528. Spigot Openings in Watertight Doors

Spigots are incorporated in doors at various locations in T42s (2 deck) and CVSs (5 deck) in order to provide a means of air flow/pressure equalization when the doors are shut, thus reducing the likelihood of injury to personnel on opening. Spigot caps are usually to remain off and stowed in their respective stowages (T42), or unscrewed (CVS), whenever the ship's NBCD condition requires the parent door to be shut. They are to be on (T42) or closed (CVS) as follows:

a. When the parent door is part of a smoke boundary.

b. Whenever the door forms a sub-citadel boundary.

c. As a State 1 preparation (not at Air Raid Warning Red).

d. When the order 'CLOSE ALL RED OPENINGS' has been made and the spigot bears a red risk marking.

0529. NBCD markings on spigots should be as follows:

a. All 2 deck (T42) or 5 deck (CVS) door spigots should have an R gas control marking.

b. Spigots should bear a red risk marking consistent with their parent doors.

0530. Ship's NBCD Orders must contain a standard operating procedure, for any NBCD state/condition, to ensure that in the event of an incident, the spigot caps appropriate to the incident/smoke boundary are closed without delay.

0531. Examples of Typical Markings

The following are typical of the markings that might be found on various accesses, mainly in the red zone:

Magazines	X or Y (possible use of a MAY BE LEFT OPEN IN ACTION tally).
MEO's rounds spaces	X or Y (possible use of a MAY BE LEFT OPEN - MAN BELOW tally).
Bathroom in Red Risk Zone	Y door or Y hatch with Z manhole.
Gangway door, Red Risk Zone (see Note 1)	Y (2-clips if necessary).
Gangway door, above the Red Risk Zone	Z (2-clips if necessary).
Workshops, hatch access	Y if spring loaded or manhole fitted; Z if no manhole or not able to be opened from below.
Mess spaces and cabin flats with manhole (see Note 2)	Y hatch, Z manhole.
Mess spaces and cabin flats without manhole (see Note 2)	Z hatch.
Messdeck, small ship (see Note 2)	Z (generally).
Messdeck, door access (see Note 2)	Y or Z according to traffic.
Main Naval Store (see Note 2)	Y hatch, Z manhole. Z if no manhole.
Other stores, working spaces, cable passages, etc (see Note 2)	Y or Z.
Main Machinery Space (see Note 3)	Where two accesses, one Y, one Z.
Generator Room (see Note 3)	X or Y.
Pump Space (see Note 3)	X or Y.
Sonar Compartment, manned (see Note 3)	Y if openable from below; if not, X and MAY BE LEFT OPEN - MAN BELOW disc.
Hangar access door	Y or Z with A.

Notes:

1. In some ships, gangway doors in the Red Risk Zone are in such continual use that even Y 2-clip markings are not acceptable. With careful consideration, such doors may be marked Z or, in extreme cases, where frequency and rapid passage is needed even in State 1, Z 2-clip might be more appropriate.

2. In war, it may be necessary to post orders at the entrance to ensure that if the space is in the Red Risk Zone, and occupied, the last man out shuts the opening.

3. These openings may need an M in addition. Doors and hatches that give access between machinery spaces and citadels or gas-free spaces, must bear a gastight marking in addition to the watertight marking.

0532. Watertight and Gastight Conditions

Watertight conditions are normally used as shown below, but this does not preclude the Command from ordering a higher condition when it is deemed to be necessary. Watertight conditions govern the watertight integrity of the ship and, since there is always a threat to watertight integrity, there is always a watertight condition in force. The condition ordered depends on the calculated risk of damage and, to facilitate ship's routine and habitability, should always be the lowest condition consistent with the risk. Watertight conditions are normally used as follows:

a. **In peace:**

Condition X-ray	(X openings shut)	Harbour and normal cruising.
Condition Yankee	(X and Y shut)	Dangerous circumstances (eg navigational hazards, exercises).
Condition Zulu	(X, Y and Z shut)	As required for exercise.

b. **In war:**

Condition Yankee	(X and Y shut)	Harbour and normal cruising.
Condition Zulu	(X, Y and Z shut)	Action or relaxed action.

The gastight condition Alfa is superimposed on watertight conditions Zulu and Yankee as required. Condition Alfa is the only gastight condition; it is the fully closed down condition which gives complete collective (citadel) protection against NBC hazards.

0533. Relaxations to Condition Alfa

In certain circumstances relaxations to Condition Alfa may be permitted. Guidance is given in BR 2170(2). To improve habitability when condition Alfa is in force for lengthy periods, certain specific Alfa openings may be opened at the discretion of the Command when the ship is in either NBCD State 1 or State 2. The openings selected must not form a set gastight condition but, if the operational situation permits, should satisfy only the immediate requirement, eg main galley ventilation to allow the cooking of a main meal, or the heads ventilation as and when possible. The openings which may be opened may vary depending on the tactical situation and/or the climate. When it is considered that the NBC threat allows certain relaxations to condition Alfa, the Command should inform HQ1. HQ1 must then order the required openings to be open specifically by name/location marking, the order being given to the appropriate Fire and Repair Party Post or Section Base (large ship). This routine must be followed on each occasion of allowing relaxations to condition Alfa. the openings selected must be capable of being shut immediately on order, by a sentry if necessary.

Note. *When a ship is in Condition Alfa it is vitally important that the citadel pressure remains positive, even when relaxations to the condition are in force and one or more Alfa openings are open. Because firm guide lines cannot be laid down, it is recommended that ship's officers take every opportunity to check citadel pressures with various combinations of Alfa openings open (those most likely to be used in a relaxation of condition Alfa), supply and exhaust fans running, cleansing station in use, etc, and record the results.*

0534. Relationships Between NBCD States and Conditions

As explained in Chapter 4, NBCD states of readiness used in conjunction with watertight and gastight conditions, are the means by which a ship can be prepared to meet all the varying circumstances of service in peace and war. It must be borne in mind that states and conditions are completely separate and must be ordered separately. The following gives practicable relationships between states and conditions and the circumstances under which they would generally apply. They are neither mandatory nor rigid, but are intended as guidance in producing the best working arrangements. The gastight Condition Alfa must never be used alone, but must be superimposed, when needed, on a watertight condition, usually Zulu or Yankee.

a. **NBCD State 1**

Action state. The highest state of NBCD preparedness, with all NBCD positions fully manned and relaxations for meals, etc, ordered as necessary and when circumstances permit.
Assumed as far as practicable when 'EMERGENCY STATIONS' is broadcast.
Normal for Awkward State 1.
Probable watertight condition: Zulu.
Gastight condition: None or Alfa.

b. **NBCD State 2**

Normal war state at sea and in harbour.
Normally associated with the weapon state Defence Stations (two watches).
Normal for Awkward State 2.
Probable watertight condition: Yankee.
Gastight condition: None or Alfa.

c. **NBCD State 3**

Normal peace state at sea and in harbour.
Gastight condition: None
Probable watertight condition:

(1) *Sea.* X-ray (under circumstances of navigational hazard, eg fog, gale, narrow waters, RAS, entering and leaving harbour, etc, the watertight condition can be upgraded to Yankee with the addition of 'Special Sea Dutymen' who would include any special provision for the particular hazard, for example, HQ1 patrols when entering harbour in very poor visibility).

(2) *Harbour.* X-ray (with latitude for maintenance, etc).

0535. Method of Control

In all ships in the higher states of NBCD readiness, overall control of the watertight and gastight conditions must be exercised from HQ1. In the lower states, control is exercised from HQ1 through its watchkeepers, from the SCC through its NBCD watchkeepers, or the OOW/OOD (usually through the Quartermaster), depending on the size and type of ship. NBCD states and conditions should be set by broadcast or, in harbour, they may be set by routine Daily Orders. Although the state alone, or the condition alone, can be changed at any time, it is better than both should be mentioned, eg.:

a. In State 3, Condition X-ray - pipe 'ASSUME NBCD STATE 3 CONDITION YANKEE'.

b. In State 3, Condition Yankee - pipe 'ASSUME NBCD STATE 1 CONDITION YANKEE ALFA'.

c. In State 2, Condition Yankee Alfa - pipe 'REVERT TO NBCD STATE 2 CONDITION YANKEE'.

0536. Control of Openings in the Lower NBCD States

The object of controlling watertight openings in the lower states of NBCD readiness is to maintain as high a degree of watertight integrity as possible, consistent with the working of the ship, and so limit the extent of flooding in the event of sudden damage. Such control serves also to limit the number of openings that need to be shut to achieve NBCD State 1 Condition Zulu. The NBCD Door and Hatch Board should be used to show the openings that are opened.

0537. The number of MBLO tallies provided corresponds to the number of openings allowed to be open at any one time. When a particular watertight condition is assumed, the watchkeeper in HQ1, or the Quartermaster, is issued with the appropriate number of MBLO tallies. Anyone seeking to open an X-ray opening, or keep open a Yankee opening in Condition Yankee may be given permission by the watchkeeper, provided that a tally is available to be issued, and at least two intact transverse bulkheads exist between the intended opening and any other approved tallied, opening. The tally should be hung on the opening concerned as an indication to patrols that permission has been obtained for it to be open. The tally must be returned to the watchkeeper as soon as the opening is shut. The OOW/OOD need be approached only if it is thought essential to exceed the number of openings authorized to be open in that condition in that part of ship.

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CHAPTER 6

ROYAL FLEET AUXILIARY

CONTENTS

ANNEXES

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CHAPTER 6

ROYAL FLEET AUXILIARY

0601. Design Requirements

Ships of the Royal Fleet Auxiliary (RFA) are constructed to Merchant Navy standards. They are required to comply with the Safety of Life at Sea (SOLAS) regulations, issued by the International Maritime Organisation (IMO). The IMO is a specialist agency of the United Nations which aims to provide cooperation between governments on technical matters affecting international merchant shipping. SOLAS is enforced through the Maritime and Coastguard Agency (MCA), along with other statutory requirements particular to the United Kingdom. Additionally, because of their operational commitments and tasks in company with ships of the Royal Navy, many RFAs are fitted to conform to RN requirements for NBC collective protection, eg citadel and prewetting arrangements. A large percentage of RFA ships are fitted with an automatic firefighting water spray system (quartzoid bulb) throughout their accommodation and stores areas, and a drenching system (CO_2, halon, foam or steam) in their machinery compartments and other high risk spaces. Specialized ships, ie those which carry particularly flammable cargo, are fitted with specialized systems for fire suppression and extinction. The RFA conforms to RN standard of NBCD, modified to suit circumstances which are peculiar to RFAs.

0602. Location Markings

Location markings follow the standard RN practice as set out in Chapter 3 of this manual. The only difference is that the numbering of frame spaces is from aft to forward in accordance with merchant ship practice (frame spaces in a warship are numbered from forward to aft), but this does not affect the use of the RN system of location markings.

0603. Risk and Control Markings

The RFA Flotilla uses a risk and control marking system which is different to that used in Royal Navy vessels. There are two categories of markings:

a. **Watertight.** Coloured red.

b. **Gastight.** Coloured orange or green.

0604. Watertight Markings

Watertight openings on or below the first continuous deck above the deep waterline present the greatest risk to watertight integrity, and are marked by a red disc (red disc opening). These openings are to be kept closed at all times, except when access is required. ‘Red disc openings’ covers all statutory watertight openings.

0605. Watertight openings higher in the ship present a lower risk, but must be closed during periods of increased risk to preserve the reserve of buoyancy. These openings are marked by a red triangle (red triangle openings).

0606. Gastight Markings

Gastight openings which need to be closed for collective protection against NBC contamination, and which may normally be left closed without degrading habitability or access, are marked by an orange disk (orange disc openings).

0607. Other gastight openings, which need to be closed for collective protection, but are normally required to be open for habitability or access, are marked by an orange triangle (orange triangle openings).

0608. Gastight openings which would normally be closed, but are required to be open for recirculation when the ship is closed down for collective protection, are marked by a green disc (green disc openings).

0609. Control of Watertight Openings

The Officer of the Watch (OOW) or Officer of the Day (OOD) is to maintain the Watertight Integrity Board/Log, which indicates the status of red disc openings at all times. The Engineer Officer of the Watch (EOOW) may authorize temporary opening of red disc openings which provide access to machinery spaces. The EOOW need not obtain permission from the OOW/OOD, unless there is a specific order to do so, provided that the opening is closed immediately after transiting through it.

0610. NBCD Conditions

The NBCD Condition reflects the posture of the ship's equipment, 'shut-down' and machinery state. It encompasses the various levels of watertight and gastight integrity. There are four conditions: 1, 2, 3 and 4. Each one of these conditions may be suffixed by the letter N (November) to indicate collective protection from an NBC threat. Additionally, Condition 1 indicates that machinery and equipment preparations for Action have been completed. The four condition are defined as follows:

a. Condition 1 - Immediate risk of damage.

b. Condition 2 - War cruising.

c. Condition 3 - Peacetime cruising.

d. Condition 4 - Harbour

0611. The relationship between NBCD Conditions and the closure of watertight and gastight openings, when there is no NBC threat, is shown at Table 6-1. The relationship when an NBC threat exists is shown at Table 6-2. The control of openings for each situation is explained in greater details at Annexes 6A and 6B.

Table 6-1. NBCD Conditions - No NBC Threat

COND	SHUT	OPEN	SITUATION
1	● ▲ ● (▲)		Immediate Risk of Damage
2	● ▲ ●		War Cruising
3	● ▲		Peacetime Cruising
4	●		Harbour

Table 6-2. NBCD Conditions - With an NBC Threat

COND	SHUT	OPEN	SITUATION
1N	● ▲ ● ▲	●	Immediate Risk of Damage
2N	● ▲ ● ▲	●	War Cruising
3N	● ▲ ● ▲	●	Peacetime Cruising
4N	● ▲ ● ▲	●	Harbour

0612. NBCD States

In RFAs, NBCD States relate to the state of manpower and machinery to meet the expected threat. There are various manning requirements which will be given separately depending on the threat:

a. Action Stations - Condition 1 or 2.

b. Defence routines, high/low threat - Condition 1 or 2.

c. Harbour routine/stations, sea going routine, Emergency Stations - Condition 3 or 4.

0613. Ship Safety Plans (Fire Control Plans)

Under SOLAS all RFA ships should have Ship Safety Plans displayed for the guidance of the Ship's Staff. All ships should hold a duplicate set of plans permanently stored in a prominently marked weather-tight enclosure outside the deckhouse for the assistance of shoreside fire fighting personnel. The information on the plans should show clearly for each deck the control stations, various fire sections enclosed by 'A' and 'B' class divisions (see Para 2920) together with particulars of the fire detection and fire alarm systems, the sprinkler installation and fire extinguishing appliances. A fuller description of the requirements can be found in the consolidated version of SOLAS. Attention is drawn to the requirement for these plans to be kept up to date. For RFAs the plans are produced and supplied by SSA/ADS(RFA)/DASG; any amendments are to be addressed through COMRFA in accordance with NBCD Amendments.

0614. BR 875

BR 875 is COMRFA's Quality and Safety Management System. It meets the requirements of IMO's International Safety Management Code. BR 875 contains the procedures to be used by the RFA flotilla in respect of NBCD. Where no procedures exist in BR 875 then the RN standards are to be adopted as detailed in the BR 2170 series and in BR 4007.

0615. Water Fog Lance

There is a SOLAS/MCA requirement that Class 1 (passenger) ships be equipped with water fog lances for firefighting. They are therefore carried in LSLs, although they are not codified for general naval use. The water fog lance (see Fig 6-1) produces an elongated spherical cloud of very fine water mist/fog and it is used for fighting fires in inaccessible areas such as under vehicles. The fine water fog is suitable for extinguishing fires in Class A (solid) materials and small pools of high flash point fuels, such as DIESO or AVCAT. The lance is fitted with a male instantaneous connection and a ball valve for controlling the flow. Its capability and performance can be considerably extended by feeding it with an AFFF solution, using an inline inductor.

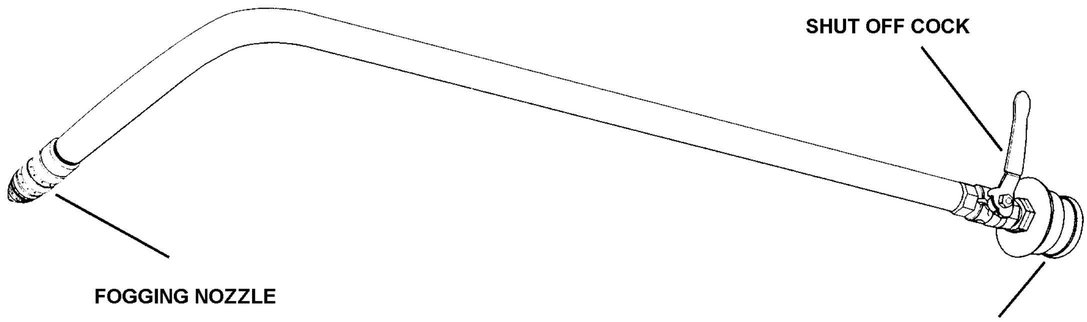

Fig 6-1. Water Fog Lance

0616. Signalling/Guide Lines

SOLAS/MCA require RFAs to carry signalling/guide lines. A technical description for the line can be found in SOLAS and MSN 1665(M), Schedule 5: Breathing Apparatus. The lines are fire proof, wire cored, stored wrapped around BA stowages. One end is fitted with a brass quick release clip the other has secured to it instructions for signalling. The wire core of the line is susceptible to corrosion and is not readily accessible for inspection. The outer wrap of the line is to offer better grip in wet conditions and does not contribute to the line's strength

Note. *The lines are only to be used for signalling and as guides, they are not to be used for lifting equipment.*

0617. International Shore Connection

There is a SOLAS/MCA requirement for all RFAs to be equipped with an international shore connection constructed to exact dimensions. One end is to have a standard international shore connection flange (178mm OD, 64mm ID, eight 132mm PCD holes slotted to flange periphery) and the other is to have a coupling that will fit the particular ship's hydrants and hoses. (2½ in instantaneous male coupling in the majority of RFAs). The connection is to be kept onboard each RFA, ready for immediate use, together with its gasket, bolts and washers. The connection is illustrated at Fig 6-2.

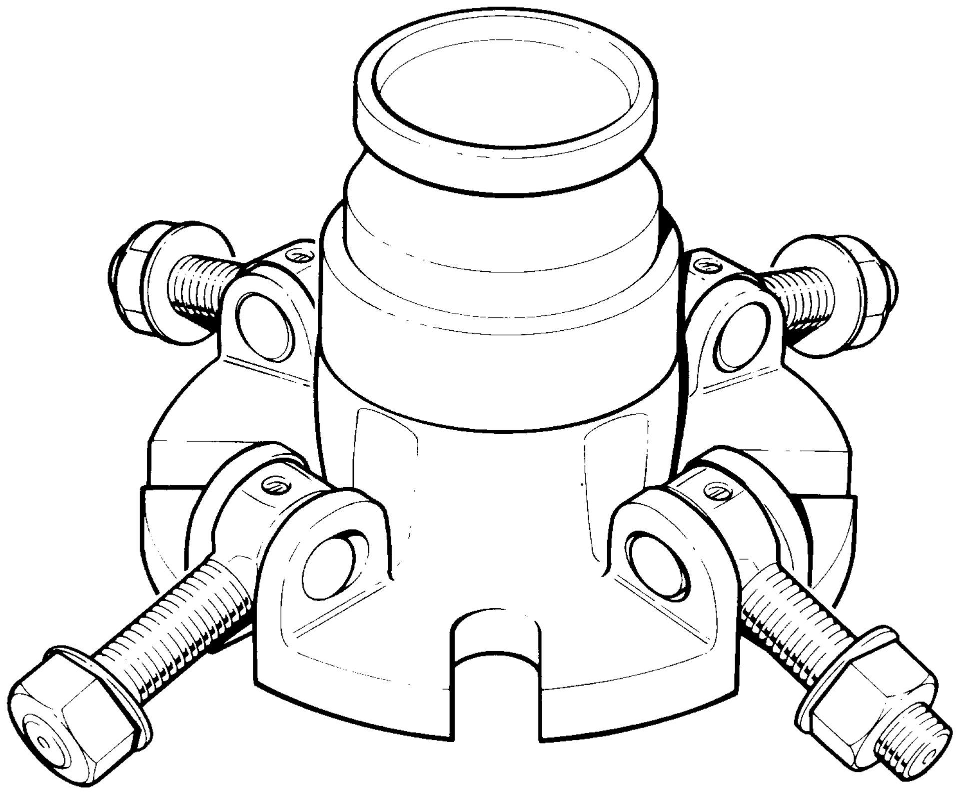

Fig 6-2. International Shore Connection

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ANNEX A TO CHAPTER 6

CONTROL OF RFA OPENINGS - NO NBC THREAT

1. Condition 1

Immediate Risk of Damage.

CONVENTIONAL WEAPONS THREAT.
NO NBC THREAT.
The highest condition of Watertight integrity.
All Red openings closed and secured.
Orange Disc openings, closed and secured.
Orange Triangle openings designated for a conventional threat closed and secured.
No requirement for the ship to be fully shut down for gastight integrity, however the maximum number of Orange Triangle openings are to be closed to reduce the spread of fire and smoke.
Ship closed up at Action Stations, weapons manned, habitability disregarded.
Precursor to Condition 2.

COND	SHUT	OPEN	SITUATION
1	( )		Immediate Risk of Damage

2. Condition 2

War Cruising.

CONVENTIONAL WEAPONS THREAT.
NO NBC THREAT.
The highest condition of Watertight integrity.
All Red Disc and Red Triangle openings closed and secured.
Orange Disc openings closed and secured.
Ship closed up at Defence Watches.

COND	SHUT	OPEN	SITUATION
2			War Cruising

3. Condition 3

Peacetime Cruising.

NO WEAPONS THREAT.
NO NBC THREAT.
Relaxed watertight integrity, except during evolutions which require an increase in watertight integrity.
All Red Disc openings closed and secured.
Red Triangle openings shut to effect increased watertight integrity and/or darken ship.

COND	SHUT	OPEN	SITUATION
3			Peacetime Cruising

4. Condition 4

In Harbour Condition.

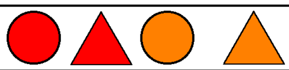
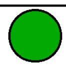
NO WEAPONS THREAT.
NO NBC THREAT.
Relaxed watertight integrity.
Red Disc openings relaxed during working day for access, to be closed at the end of the working day.
Red Disc openings in machinery spaces - the EOOW/Duty Engineer is charged with ensuring that these openings are only opened for passage of personnel.
Red Triangle openings relaxed.

COND	SHUT	OPEN	SITUATION
4			Harbour

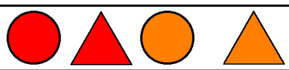
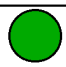
ANNEX B TO CHAPTER 6

CONTROL OF RFA OPENINGS - WITH AN NBC THREAT

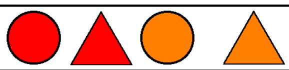
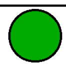
1. **Condition 1N**
Immediate Risk of Damage
CONVENTIONAL AND NBC WEAPONS THREAT.
The highest condition of Watertight integrity.
All Red openings closed and secured.
The highest condition of Gastight integrity.
All Orange openings closed and secured.
All Green Disc openings open.
Ship closed up for collective protection, AFUs running, citadel pressurised.
Ship closed up at Action Stations.
Precursor to Condition 2N

COND	SHUT	OPEN	SITUATION
1N			Immediate Risk of Damage

2. **Condition 2N**
War Cruising
CONVENTIONAL AND NBC WEAPONS THREAT.
The highest condition of Watertight integrity.
All Red openings closed and secured.
The highest condition of Gastight integrity.
All Orange openings closed and secured.
All Green Disc openings open.
Ship closed up for collective protection, AFUs running, citadel pressurised.
Ship closed up at Defence Watches.

COND	SHUT	OPEN	SITUATION
2N			War Cruising

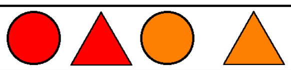
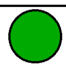
3. **Condition 3N**
Peacetime Cruising
NO CONVENTIONAL WEAPONS THREAT.
WITH AN NBC THREAT (Terrorists, chemical plant/nuclear plant incident).
The highest condition of Watertight integrity.
All Red openings closed and secured.
The highest condition of Gastight integrity.
All Orange openings closed and secured.
All Green Disc openings open.
Ship closed up for collective protection, AFUs running, citadel pressurised.

COND	SHUT	OPEN	SITUATION
3N			Peacetime Cruising

4. Conditon 4N

In Harbour Condition

NO CONVENTIONAL WEAPONS THREAT.
WITH AN NBC THREAT (Terrorists, chemical plant/nuclear plant incident)
The highest condition of Watertight integrity.
All Red openings closed and secured.
The highest condition of Gastight integrity.
All Orange openings closed and secured.
All Green Disc openings open.
Ship closed up for collective protection, AFUs running, citadel pressurised.

COND	SHUT	OPEN	SITUATION
4N			Harbour

CHAPTER 7

EMERGENCY PROCEDURES AT SEA AND IN HARBOUR

CONTENTS

SECTION 1 - EMERGENCY STATIONS

SECTION 2 - EMERGENCY IN HARBOUR

SECTION 3 - CASUALTY ALARMS

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CHAPTER 7

EMERGENCY PROCEDURES AT SEA AND IN HARBOUR

SECTION 1 - EMERGENCY STATIONS

0701. Purpose

EMERGENCY STATIONS have been developed over many years to provide a simple standard procedure that will bring a ship to a high state of manning and material preparedness to deal with any hazardous situation in which Action Stations would not be appropriate. The routine thus evolved is a rapid and effective countermeasure which will provide the Command with an organisation capable of regaining the initiative in the event of:

a. Fire.

b. Collision or grounding.

c. Aircraft or explosive accident.

d. Flood.

e. Unexpected mine explosion (MCMV in State 2 mine hunting operations).

0702. Action

It must be specified in Ship's Standing Orders that the broadcast of EMERGENCY STATIONS requires the following actions to be carried out:

a. **Manning**

(1) Personnel on watch are to remain closed up until relieved or otherwise ordered.

(2) Personnel engaged in first aid measures to combat the hazard are to continue with their task until relieved by the NBCD team.

(3) NBCD teams are to close up as for NBCD State 1. Firefighters are to dress in full firefighting rig ready for deployment. ME and WE officers and senior rates are to close up, as detailed in departmental orders, to provide the fullest control over machinery.

(4) Additional messengers are to close up at the Command position.

(5) Additional internal communication numbers are to close up at positions detailed in the Orders.

(6) First aid parties are to close up.

(7) The remainder of the hands are to act as ordered by the Command, either to remain in their present position or to proceed to stated muster points. The NBCD teams are not to be impeded. Hands are not to return to their mess decks to collect lifejackets, but should carry them if immediately available (all ships have emergency lifejacket stowages on the upper deck).

b. **Material**

(1) Additional electrical power is to be made available from standby generators.

(2) All sea water service pumps are to be run up, discharging to the HP sea water main. System isolation is to be strictly controlled by HQ1.

(3) Fire and repair parties are to carry out the following State 1 preparations if time permits:

(a) Unlock and check damage repair, fire and electrical lockers.

(b) Check compartment locks and keys.

(c) Ensure that there are no suction strainer hazards in the lower compartments.

(d) Check state of openings, including ventilation.

(4) Main machinery is to be controlled from the machinery control position.

0703. Authority

The authority to initiate EMERGENCY STATIONS rests with the Command. He may wish to delegate this authority in his Standing Orders to the Officer of the Watch at sea in the event of:

a. Imminent collision or grounding.

b. Helicopter crash on deck.

c. Main machinery space fire in MM/PP (piped by ANBCDO if SSEP is already activated).

0704. Procedure

The pipe EMERGENCY STATIONS should be made personally by the Executive Officer if the circumstances permit. It should always be preceded by the general alarm (but see Para 0707). The pipe ‘EMERGENCY STATIONS’ must be followed by ‘CLOSE ALL RED OPENINGS’ if there is a risk of flooding (eg imminent collision or grounding). At other times the pipe ‘CLOSE ALL RED OPENINGS’ is not required because its application will cause unnecessary restriction of access. Care should be taken to broadcast any additional orders or information that will clarify the situation and improve response. The broadcast should include any special instructions for the mustering of spare hands in order to reduce interference with the work of the NBCD parties (see Para 0702a(7) above).

0705. Control

Circumstances may dictate that Command and HQ1 teams cannot operate from their primary positions. They must ensure that their locations are known, especially to their subordinates, and that messengers are properly briefed. The spare hands at muster points (see Para 0702a(7) above) are to be mustered by divisional officers or senior ratings, and reported to the Officer of the Watch. They are then to be controlled by the Executive Officer, normally through the Officer of the Watch.

0706. Exercises

EMERGENCY STATIONS should be exercised frequently and it should be borne in mind that the evolution is not, and should not be viewed as, a prelude to 'abandon ship'.

0707. Audible Alarms

a. **The General Alarm.** This is to precede the emergency broadcast on the following occasions of **real** emergency:

(1) Hands to Action Stations (to combat a **real** threat).

(2) Hands to Emergency Stations/Emergency Clear Lower Deck.

(3) Fire.

(4) Flood.

(5) Collision or grounding imminent.

(6) Emergency landing/crash on deck (but not precautionary landing).

The general alarm is **not** to be used for **any** other emergencies, nor during any exercises. The only time the general alarm is to be sounded, other than in one of the six **real** emergencies above, will be during alarm testing when a suitable prefix pipe is to be made.

b. **Chemical Alarm.** The chemical alarm is to be used in an operational NBC context. It may also be used in an NBC exercise. It is not to be used for any other purpose. Tests should be prefixed by an appropriate pipe.

The use of these alarms, as detailed above, is to ensure immediate awareness of all personnel onboard as soon as the alarm is sounded, followed by the swift and correct response by those involved in combatting the emergency or taking specific action for personal safety or survival.

0708. RFA Audible Alarms

To comply with statutory regulations, audible alarms in RFA vessels will be sounded as necessary both in the Action and Exercise scenario.

0709 SANDOWN Class MHC - Smoke Alarm System/General Alarm

When the fire detection system initiates a fire alarm indication at the SCC which is not accepted by the operator, an output from the fire detection panel in the console will activate the General Alarm after a delay of approximately two minutes.

Note. *If muted, the detection system must be closely monitored, and all new annunciations accepted and the appropriate pipe made, ie 'SMOKE ALARM, SMOKE ALARM, SMOKE ALARM' and location. It is unacceptable for the General Alarm to be automatically activated during exercises, or through the negligence of operators who fail to monitor the system correctly.*

0710 to 0719. Spare.

SECTION 2 - EMERGENCY IN HARBOUR

0720. Purpose

While most of the emergencies listed in Para 0701 could happen in harbour, the use of EMERGENCY STATIONS would generally be inappropriate as a number of key ratings may be ashore. Therefore, a different system for dealing with emergencies in harbour is required.

0721. Personnel

Initially, the Duty Part of the Watch will be used to deal with any harbour emergency. Should the Duty Part be unable to cope with the situation it will be necessary to muster all hands remaining on board (including civilian personnel where appropriate) in order to:

a. Have all hands available to brief and employ as required.

b. Ensure all personnel are accounted for.

The pipe is to be used is 'EMERGENCY EMERGENCY EMERGENCY - EMERGENCY CLEAR LOWER DECK. MUSTER ....'. As the Local Area Fire Brigade will normally want all personnel not engaged in fighting the fire to be cleared from the ship, the jetty area adjacent to the main gangway should be considered the preferred location for mustering if circumstances permit.

0722. Action

It must be specified in Ship's Standing Orders that the pipe 'EMERGENCY EMERGENCY EMERGENCY - EMERGENCY CLEAR LOWER DECK' requires the following action to be taken:

a. **Manning**

(1) Duty Part of the Watch remain closed up to deal with the emergency.

(2) Personnel engaged in first aid measures to combat the hazard are to continue with their task until properly relieved.

(3) All remaining hands are to muster at a point stated in the pipe. If possible they should take warm clothing with them, particularly at night, but they are not to waste time in returning to their messdecks in order to obtain the clothing.

(4) Damage control and first aid personnel should be mustered apart from the remainder of the hands in order to be more easily detailed to support the Fire and Emergency Party.

b. **Material.** As far as possible and as applicable, material arrangements should be as given in Para 0702b.

c. **MM/PPs.** In the event of an emergency in harbour, the Officer of the Day is to establish HQ1 at the QMs gangway position. To enable him to effectively muster hands, account for personnel, liaise with external emergency services and coordinate assistance from adjacent ships, the recommended muster point for all hands and visitors is on the jetty adjacent to the gangway. The gangway peg-board, visitors log and 'ashore on duty' book should all be used to account for personnel.

0723. Procedure

The pipe 'EMERGENCY EMERGENCY EMERGENCY - EMERGENCY CLEAR LOWER DECK' should be made personally by the Officer of the Day, or the senior officer on board if circumstances permit. The pipe should always be preceded by the main broadcast alarm and followed by the location of the safe area where the hands are to muster. Care should be taken to broadcast any additional orders or information that will clarify the situation and improve response. Departmental nominal lists should be compared with leave boards/cards to ascertain the names of those who should be onboard, and an officer or rating should be nominated from available personnel to muster non-duty personnel and report back to the OOD.

0724. Control

The Officer of the Day is to remain in charge of dealing with the emergency until relieved by a more senior officer. The allocation of extra hands is normally to be coordinated by the officer or senior rate in charge at the muster point.

0725 - 0729. Spare

SECTION 3 - CASUALTY ALARMS

0730. Casualty Alarm Procedure

Upon a casualty being discovered, the following loud vocal alarm (LVA) is to be used: 'CASUALTY, CASUALTY, CASUALTY'. This is to include the location of the casualty/casualties and is to be repeated until acknowledged.

0731. In peacetime it is appropriate to make a Main Broadcast pipe, to include the relevant information. This will ensure that the Medical Branch Rating/Duty First Aider/Standing Sea First Aid Party respond quickly. In the Action State casualties should not be piped. The information should be passed through MHQ.

0732. In ships without MHQs (MM/PP/1PBS) casualty alarms are to be made over the Main Broadcast in the Action State since the Coxswain/XO may not be in a position to respond to casualty information being passed by telephone.

0733. The Casualty Alarm should not detract personnel from their duty to raise a Fire/Flood Alarm (LVAs), but should be included in it.

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CHAPTER 8

NBCD COMMAND AND CONTROL

CONTENTS

SECTION 1 - ACTION ORGANISATION

SECTION 2 - CONTROL POSITIONS

CONTENTS (Continued)

CHAPTER 8

NBCD COMMAND AND CONTROL

SECTION 1 - ACTION ORGANISATION

0801. This chapter describes the NBCD command and control organisation in a fully manned warship, at sea, in a war environment. The damage control and firefighting (DC&FF) aspects are also applicable to peacetime incidents which would require implementation of Emergency Stations. The procedures are based on a ship of DD/FF size, but can easily be adapted to other vessels. Guidance on the NBCD State 2 organisation is provided in Section 3 of this Chapter.

0802. The Command Team

At the top of the NBCD Command Team, is the CO who is supported by the Command Adviser in the Ops Room (WEO) and the Action NBCDO in HQ1 (MEO). These two maintain a liaison using a 'hot line' hardwired communications link, which provides the Action NBCDO's only link with the Command. This link is essential to:

a. Continuously monitor the damage picture and assess the implications.

b. Maintain a close liaison with each other, keeping each other aware of the internal and external picture.

c. Set and review agreed priorities for damage repair teams which will maximise achievement of the Command Aim.

d. Discuss and agree requests for manpower re-allocation, seeking Command approval as required.

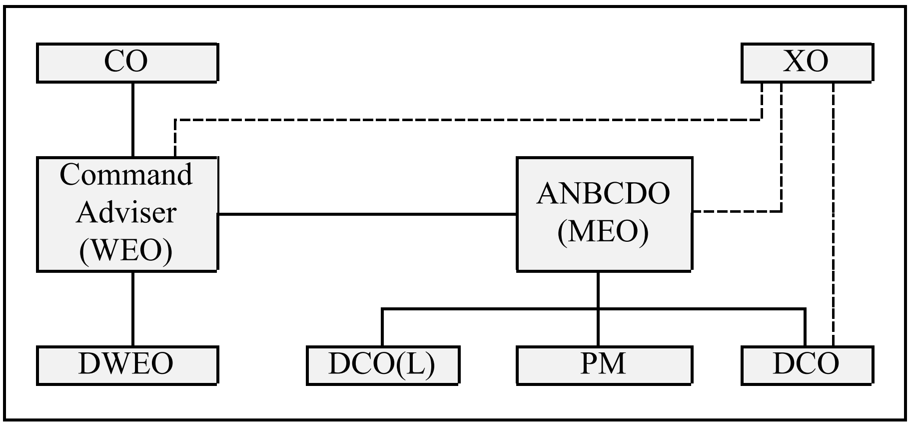

Fig 8-1. The Command Team

0803. The Command Aim

The Command Aim is derived from the pre-eminent principle of war, identification and maintenance of the aim. The Commanding Officer (CO) should set the Command Aim to bind together the efforts in all Warfare environments, be they external (NBC, ASW, AAW, ASuW) or internal (DC&FF). The CO must express his aim in a single clearly focussed sentence. This should then be transmitted through the command and control chain in two ways: direct to the WEO in the CO-WEO discussions, for onward transmission to the MEO and DWEO; and also by the CO, or PWO, via main broadcast during sitreps to the Ship's Company. Although only one sentence, the Command Aim should contain sufficient information to make incident and equipment priorities readily apparent to members of the NBCD Command Team. The widespread knowledge of the Command Aim will allow use of 'command by veto', improving leadership efficiency and avoiding overload.

0804. Command Adviser

The role of Command Adviser will normally be filled by the WEO. His position in the Ops Room is a node on the DC telling line (see Chapter 9), not only to receive information, but also for the input of DC&FF information which may be fed to the Ops Room from other areas such as the bridge, flight deck or weapon crews. WEO mans Command Open Line to monitor the external battle and the tactical situation, and to pass high priority information quickly to the CO and the warfare team. WEO's briefings to the CO must be appropriately timed within the tactical situation and the format of the brief should be agreed beforehand with the CO. Items should be briefed in overall ship priority order using a portable briefing board and must include: advice on courses of action, any change to the Command Aim and the priorities derived from it, as well as fallback or reversionary modes of operation of damaged equipment. While weapon systems are often the highest priority, the brief must include DC&FF, propulsion/systems and casualty and logistics information. The WEO is supported by an assistant, a junior engineer officer or a senior rating, who must have good knowledge of whole-ship mechanical and electrical systems in addition to weapon and sensors. The assistant will manage the overall picture and maintain the Command Stateboard, also providing direction to the WSB in accordance with WEO's aims and policy.

0805. To assist him in collating information, the Command Adviser has, at his position in the Ops Room:

a. A Command State Board, an example of which is at Annex 8C.

b. An Incident Board, reflecting the board in HQ1.

c. A Command Briefing Board. This is a portable board to allow the WEO to take a concise brief to the Command. An example is at Annex 8D.

d. A Casualty State Board. This is to indicate the name, rate, location, position and type of injury of all casualties. This board should have a cover to protect the information.

0806. Action NBCDO (ANBCDO)

The role of ANBCDO, which is normally filled by the MEO, is coordinator of the HQ1/SCC team to achieve cohesive progress towards the Command Aim. His responsibilities are listed in Chapter 2. It is essential that he keeps an overall view of all DC&FF, NBC, electrical repair and propulsion incidents, while delegating authority to make full use of the specialists around him.

0807. The ANBCDO must decide on movements of personnel from less to more hard pressed areas and give the necessary orders. He also, if necessary, requests assistance through the Command from quarters who may have hands to spare. He must advise the Command on any restrictions, eg in speed, which may need to be imposed. If damage is accompanied by NBC contamination, or the threat of contamination, the situation facing the ANBCDO is more complicated. For example, the ship would be in condition Alfa, hands may be in shelter positions (see BR 2170(2)) and the citadel may be breached. The NBC Protection Officer must be consulted to assess the hazard to personnel. Actions to deal with fire and flood must take precedence and NBC countermeasures may be limited by this requirement.

0808. Command Rover

The XO fulfils a Command Rover function, providing essential support to the Command Adviser (WEO), the Action NBCDO and the DCO, in providing an expert audit of the overall picture and a Command level physical link between the Command Team and the scenes of incidents. He brings to bear a high level of leadership and decision-making at the scenes of action to overcome communication difficulties or differences in interpretation. His tasks include:

a. Roving as directed by the Action NBCDO or DCO to act as their 'eyes and ears'.

b. Extracting the maximum information from each damage scene.

c. Assessing whether any damage scene is under control and taking/directing remedial action.

d. Checking the quality of information flow between all command nodes (Ops Room, Bridge, WSB, HQ1, FRPPs, MHQ) and eliminating confusion.

e. Keeping abreast of the tactical picture and the Command Aim and disseminating this information; maintaining impetus and morale about the ship.

f. Contributing to the 'Command Huddle' in HQ1 when possible.

0809. The XO may be on the bridge at the time of damage. Having ensured that the Bridge Team have made the initial damage report, the Rover should head for the most damaged area of the ship if this is apparent. As well as incidents, FRPPs and HQ1, periodic visits should be made to the Ops Room and bridge to gather a tactical update, not forgetting to update incident boards in these locations. This should allow the XO to assume conduct seamlessly if the CO is incapacitated. Arrival in HQ1 should be announced ('XO in HQ1!') and DCO should then be briefed, with ANBCDO listening, ensuring the Incident Board Operator (IBO) plots the information. If incidents visited are under control, the Rover should ensure the impetus is maintained throughout the regrouping and restowing phase.

0810. Directors of Internal Warfare

The next element of the Command Team are those who will actually direct and coordinate the damage repair activity. The directors of internal warfare are the Damage Control Officer (DCO), Damage Control Officer (Electrical) (DCO(L)) and Propulsion Manager (PM) all in HQ1, and the DWEO in the Weapon Section Base. Their aim is to achieve an effective recovery from the damage by acting in accordance with the priorities and instructions given to them by the WEO and MEO, ensuring that these priorities are the focus of activity at the scenes of incidents. The tasks of these directors overlap in several areas and therefore it is essential that they communicate with each other. This is achieved by effective inter-desk liaison within HQ1, often using a 'chit' system, and the 'green line' between the WSB and HQ1 'L' desk.

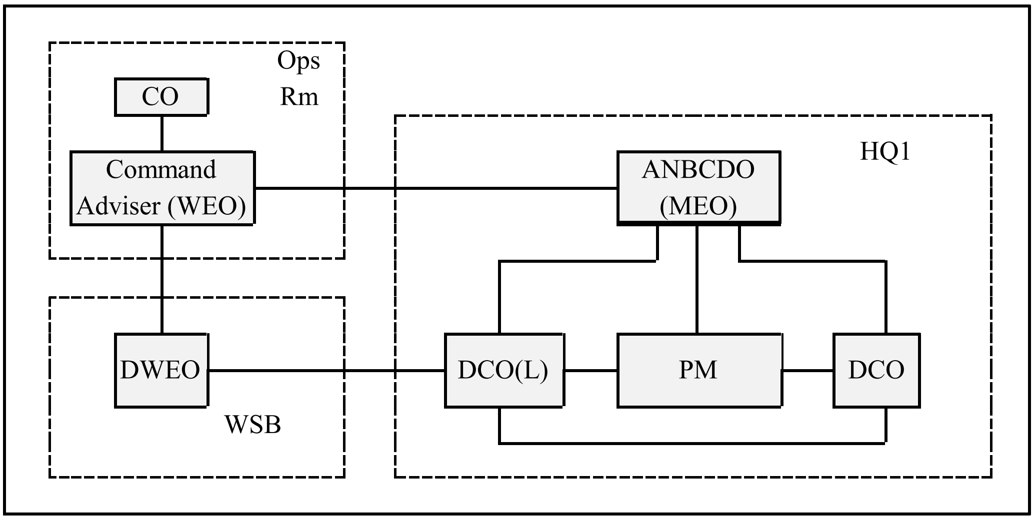

Fig 8-2. Ops Room/HQ1/WSB Liaison

0811. Damage Control Officer (DCO)

The DCO provides an assessment for the Action NBCDO of the overall damage picture in the ship. He coordinates the efforts of the Fire and Repair Parties (FRPs) and medical teams. The damage picture is maintained using the Main Incident Board and it's associated operator (IBO), who is linked to the incident boards at all the command nodes (both FRPPs, Ops Room, WSB and AHQ) by the DC telling line. DCO is also directly responsible for the management of essential services in support of the DC effort (ventilation, firemain, eductors etc) and he will need to liaise with DCO(L) and PM to achieve this. DCO directs the actions of the FRPs in a management and coordination task, identifying and prioritising incidents and maximising the use of his personnel and material resources, or identifying when resources must be re-allocated. His priorities may lie in dealing with incidents, or in incident boundary management, or in containing incidents to allow other damage repair tasks to be carried out. The Logistics Support Cell (see Para 1208) is under the control of the DCO, but will normally liaise directly with the repair teams. Similarly, the Medical Headquarters (see Para 1304) will liaise directly with various control positions.

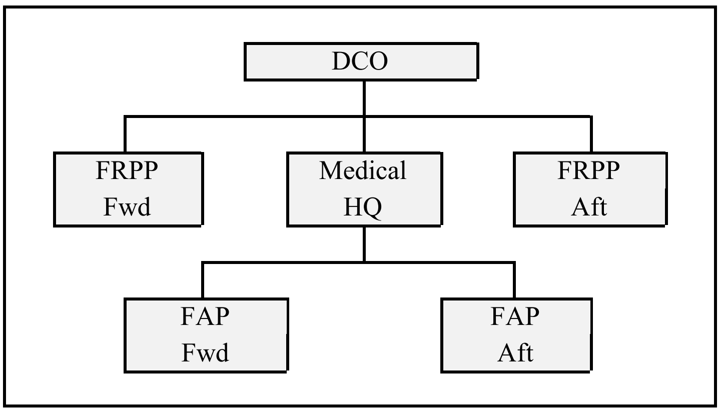

Fig 8-3. DC&FF Incident Management

0812. Damage Control Officer (Electrical) (DCO(L))

The DCO(L) is responsible for the integrity of the main electrical power system and converted supplies. His team must quickly build an accurate picture of damage to electrical services and the effect on key systems. DCO(L) then directs the electrical and switchboard teams in their repair efforts using the dedicated communications net ('green line') to the switchboards and the Electrical Repair Teams. DCO(L) has a key liaison function, both to the WSB via the 'green line' and inter-desk within HQ1.

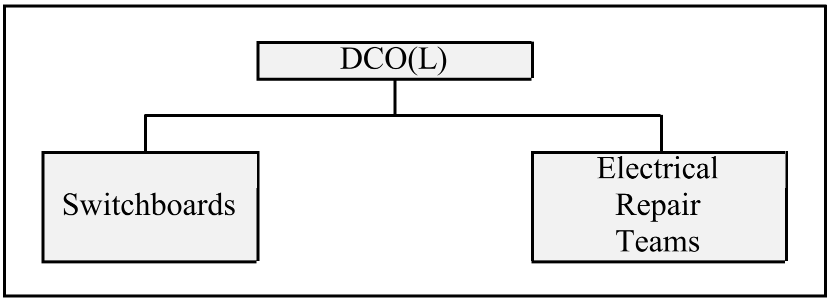

Fig 8-4. Electrical Damage Repair Management

0813. Propulsion Manager (PM)

The PM is located in HQ1/SCC. He must maximise propulsion and key ship's systems to the Command by overseeing the actions of watchkeepers and machinery space crews, and directing the actions of the Mobile Repair Party. He coordinates the reactions to damage of the propulsion plant and then directs repair efforts to maximise the return of propulsion to the Command in accordance with the priorities set for him by the Action NBCDO. He has broadcast communications with machinery spaces and a dedicated line to the Mobile Repair Party, which is deployed as required by him to assist in machinery space incidents. He must ensure machinery space fire and flood information is plotted on the Main Incident Board in HQ1, as this information needs to reach all command nodes.

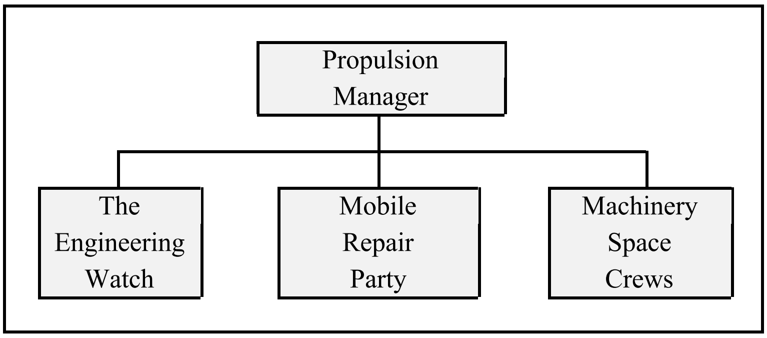

Fig 8-5. Propulsion Management

0814. Officer in Charge of the Weapon Section Base (OIC WSB)

The OIC WSB is normally the DWEO. He coordinates and directs the Weapon Repair Team (WRT) made up of WE senior ratings, dispersed at strategic locations throughout the ship. To assist him he will have a small team in the WSB, normally including both CCWEAs. The WSB task is to build and validate the weapon and sensor damage picture and pass it to the WEO in the Ops Room, with appropriate assessments. The WSB is on the NBCD telling line to monitor fires and floods and allow it to organise efforts to assist establishment of fire and flood boundaries. It also continuously monitors the Command Open Line by speaker in order to keep abreast of the tactical situation. DWEO has a 'hot line' to the Command Adviser position in the Ops Room.

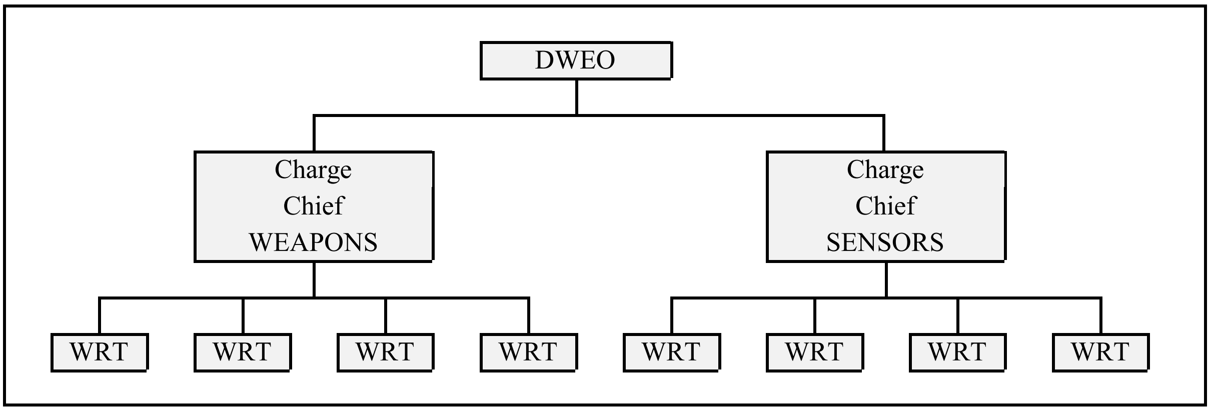

Fig 8-6. Weapon Section - Base Management

0815 Command Huddles

The Command Huddle is an assessment tool which may be used in HQ1 by the ANBCDO and his key advisers. Its purpose is to determine whether the Command Aim can be sustained, to assign incident priorities in support of it and focus the management of these priorities. The Huddle should begin with a statement by the ANBCDO of the Command Aim and WEO's top three weapon repair priorities. Each desk then gives a short brief summarising the desk picture in priority order and offering estimated repair times. This is then followed by a summary from the ANBCDO confirming (or otherwise) the desk priorities and stating the overall ship priorities and a reminder of the Command Aim. The target time for a Huddle is 2-3 minutes; 30 seconds for each desk (and XO if present) and 30 seconds for the ANBCDO to introduce and conclude.

0816. ANBCDO should give a 1-2 minute warning for the Huddle, allowing his directors to chase updates and assess their priorities. The Huddle should only be disturbed by other HQ1 personnel for 'Flash' messages. XO should participate in the Huddle if present, interrupting to correct briefs if required and giving an update after the three directors have completed their briefs. The Command Huddle will invariably dictate where the Rover should head next.

0817. The Bridge Team

The Bridge Team is often in a unique position and indeed may provide the first notice of an attack and make the 'BRACE' pipe. After damage the bridge can supply vital information on the type of damage and area of impact. In order to do this, someone must be nominated to watch the aircraft/missile/torpedo while others avert their eyes. This information should then be broadcast as soon as possible after 'STAND TO', preferably on main broadcast if available, and backed up on the AHQ Incident Board Operator's communications line and on Command Open Line. A good description of the incident is essential, to provide guidance to personnel below decks, eg: 'Bomb through focsle port side and large explosion/no explosion seen'.

0818. Following action damage, initial reactions must concentrate on ship safety. This will invariably mean dealing with any propulsion and steering defects first: the Action OOW must know instinctively the initial actions for steering failures and Emergency Slow/Stop, including the override drill. If a propulsion defect and steering failure are indicated simultaneously, then the Navigating Officer (NO) should be ready to assist by dealing with one of the breakdowns on the OOW's behalf, or detail an appropriate person to help. The level of involvement from the NO in these reactions will depend heavily on the navigational situation. In open water the NO will be immediately available to take an active role, whereas in constrained waters, such as a swept channel, the needs of navigational safety may prevent the NO from direct involvement. Whatever the case, rapid restoration of propulsion and steering in the highest control state available is essential, particularly when in confined waters, in order to achieve the Command Aim.

0819. After any immediate actions, Mini-SOCS must be initiated if not already in progress. Engineering defects should be monitored closely. After the immediate actions have been conducted, a concise brief on the problem and estimated time to repair should be obtained. For steering defects, a report on the status of power supplies to each motor and control system should be given. A running tally of defects should be kept, which should include Estimated Time Back On Line (ETBOL), in order to allow the OOW to assist in maintaining the drive to restore machinery. There must be frequent liaison between the bridge and SCC/MCR to ensure that momentum is not lost, as well as keeping the Ops Room aware of the key points.

0820. Fire and Repair Parties

Section Bases and FRPPs are pivotal to the success of NBCD, and the Officer/Rating in Charge must ensure that the team is fully conversant with their individual responsibilities, and that all equipment and documentation is at a high standard. Manning levels should be in accordance with the Quarter Bill to achieve the right balance of expertise. Documentation should include the following as a minimum:

a. Manning check list.

b. Full check list for State 1 preparations.

c. A set of Kill Cards for compartments covered by the FRP.

d. Full set of smoke clearance plans.

e. Electrical 'underground maps'.

f. Set of 'aides memoire'.

g. FRPP locker layout (BR 2170(3)) plasticised and stuck to reverse of door.

h. Clear and accurate set of closing down cards.

i. Briefing cards for DC Patrols.

j. Dispersal plan for FRPP Team members.

k. Briefing cards for Boundary Coolers.

0821. The role of leading a Fire and Repair Party is a dynamic and responsible position. From here raw information is fed up through the lines of communication so that HQ1 can manage the whole-ship NBCD effort effectively. The actions to deal directly with fires and floods are normally well known and understood. However the management of boundaries can be critical in maintaining the Command Aim. In addition to the containment of a fire by boundary cooling, limitation of the spread of smoke using well-controlled smoke boundaries is a separate task and can be more vital. The rapid establishment of flood boundaries can be the key factor in indicating to the ANBCDO whether the Command Aim theme needs to switch from Fight to Survive. In establishing boundaries, priority should be given to protecting the command nodes and those compartments linked to the achievement of the Command Aim. Indeed, DCO may allocate a boundary as the top priority for a FRP (eg: 'Prevent the smoke from reaching the Ops Room').

0822. The 2 I/C must rove between section incidents and the FRPP, feeding to the IBO and the FRPP Leader the relevant information, incident location, type and size, actions in hand and name of the incident manager, boundary management status, and his opinion on whether the incident is under control. He must physically return to the FRPP at regular intervals to update the OIC, view the incident board and check that the picture is correct.

0823. The leader directs operations at the FRPP, controlling the quality of information received and questioning that which is doubtful. His specific tasks include the management of his personnel, equipment, fixed firefighting systems and HPSW, seeking authorisation from HQ1 where required. He must use the Command Aim, threat warnings and allocated priorities to shape the way he drives incidents within the section. This may mean re-entry actions are delayed while weapon or 'L' repair teams carry out tasks, sometimes within a smoke boundary using BA.

0824. The tendency to relax must be avoided until post incident actions are complete. There are 4 principal tasks:

a. **Smoke Clearance.** The clearance of smoke must be thought of early and the plan discussed with and authorised by HQ1. The smoke route must be known and as with smoke boundaries, sentries must be placed to control the route and protect other personnel.

b. **Restow/Replenish.** Check and restow equipment, recharge BA and extinguishers, to ensure everything is ready for immediate use.

c. **Regroup.** Account for all team members, re-disperse and provide drinks where required, particularly for fearnought teams.

d. **Restore.** Restoration of watertight and gastight integrity.

0825. Composition of a Fire and Repair Party

The recommended composition given below is based on the number of personnel available for NBCD duties in a fully-manned DD/FF. To maximise NBCD training exposure the OICs of FRPPs should be DMEO and Captain's Sec/SASO (or OOW3 where no Captains Sec is borne). In smaller ships it will be necessary to make adjustments to the numbers while retaining the overall concept of the organisation (the tasks given in the 'Recommended Duty' column must be the guide to the manning requirement). The organisation is equally applicable to a Fire and Repair Party in a large ship.

Manning	Recommended Duty
Officer	Overall charge of the Fire and Repair Party
An ME branch senior rating	2nd i/c FRP
An able rate	Communications
Senior/Leading rate	In charge of the Fire Party
LMEM	2nd i/c Fire Party; in charge of Repair Party
Able rates (2)	Firesuitmen/as required for repair
Able rates (2)	Fire back-up/as required for repair
Able rate	Pumping and leakstopping/as required
Able rate	Pumping and leakstopping/as required
Able rate	Pumping party/as required
Able rate	Pumping party/as required
Able rate	Pumping party/as required
ME(L) senior rating	In charge of electrical repair/as required
ME leading rate	2nd i/c electrical repair/as required
ME able rate Able rate (any)	Working pair/as required
ME able rate Able rate (any)	Working pair/as required

0826. DC&FF Patrols

When a ship is closed up in NBCD State 1 or 2, patrols should be detailed from the Fire and Repair Parties to patrol specified routes. They are responsible for ensuring that watertight and gastight openings conform to the NBCD condition set and for maintaining a continuous watch for fire hazards and isolated incidents. To enable minor leaks to be tackled immediately each rating carries a patrol bag containing softwood wedges, bungs and a hammer. Each patrolling rating should also carry a torch and an ELSA. For their own safety and to facilitate reporting, each patrol should consist of two ratings whose duties are:

a. To visit all compartments and spaces on their nominated route and report any incidents.

b. To look for signs of flood, fire, machinery overheating, malfunction or electrical failure and to apply the correct drill for entering compartments in which damage may have occurred. When an incident is discovered one rating must report the fact to the FRPP/Section Base by the quickest possible means, while the other tackles the incident using the material in the patrol bag, or other equipment to hand, aided by the first rating once his report has been made. As soon as the incident is taken in hand by the repair or fire party, the patrol resumes its patrolling duties, unless ordered otherwise.

0827. Dispersal of FRP Personnel and Blanket Search when at NBCD State 1

A blanket search is a search carried out by all personnel not actively engaged at Action Stations to locate and identify action damage. The following is intended to amplify the dispersal and blanket search requirements for personnel directly involved in NBCD countermeasures at State 1:

a. Fire and repair parties, after mustering and completion of State 1 preparations, should be briefed and, (at Threat Warning Red), be dispersed in pairs to nominated positions within each main sub-division of their sections. The identity and locations of the dispersed personnel should be recorded.

b. The positioning of the dispersed personnel is to be influenced by the availability of suitable locations with means of escape and communications with the FRPP. The five-man firefighting team (fearnought suitmen) and the first-aid party within each section should be included in the paired dispersal.

c. The fundamental starting point for building a comprehensive action damage picture is a well organised and coordinated blanket search organisation. To achieve this aim, clear areas of responsibilities for blanket searching personnel must be defined. Also, to ensure that the blanket search routine is effective and comprehensive, personnel carrying out the searches must be aware of the search requirements. Initially this is achieved by sound training and good ship knowledge of FRP personnel. However, to assist personnel in their task, they should be issued with pictorial blanket search route cards. These should detail the route to be taken, and what to look for. Blanket search cards should not be too large, A5 size is ideal. They should be plastic laminated and copies should be retained at each FRPP and HQ1.

d. A blanket search must be carried out as soon as an attack has ceased. When the order ‘STAND TO’ is broadcast by the Command, this should be closely followed by a broadcast from the DCO: ‘ALL POSITIONS CARRY OUT BLANKET SEARCH’. There will be occasions when, due to action damage, personnel will have to use their discretion in deciding when to commence their blanket search. The search, both upwards and downwards, within the nominated section must be quick and efficient, carrying out the indicator test plug drill where necessary.

e. When an incident is discovered, one of the search party must report the facts (location of incident, type, fire, flood, electrical, etc) to the FRPP/Section Base by the quickest possible means, while the other tackles the incident to the best of his ability, aided by the first person once the report has been made.

f. The search party must stay at the scene of the incident until relieved by a team sent from the FRPP/Section Base and then resume its search unless instructed otherwise.

g. The officer or senior rating in charge of the FRPP/Section Base should, on receiving reports from a blanket search party, tick the areas searched and mark up the incidents reported on his incident board, thereby quickly compiling a visual picture of the damage within the section.

h. The five-man firefighting team (fearnought suitmen) should not take part in the blanket search and should be instantly available to tackle any fire discovered.

i. The spirit of this dispersal policy should also apply to other groups of personnel not manning essential action equipment at NBCD State 1.

0828. Machinery Operating Team

The prime objective of the Marine Engineer Officer of the Watch (MEOOW) at Action is to maintain and maximise the availability of propulsion power. He should also support and advise the PM as necessary. He should use the MMS Action Crews to augment the information from within the SCC, sustain maximum power to the Command (equipments should not be shut down prematurely), provide innovative means of restoring power, and try to provide the PM with accurate and appropriate information. He may often be the first to hear of machinery damage and must collate all information and demand a full picture before briefing PM or liaising with DCO(L).

0829. The main distribution system should be operated from the secondary switchboards (exempt T23s). This reduces the manning in the SCC/MCR and ensures that any load transfers can be carried out using manual operation of breakers if necessary, without the need to close up additional personnel. It should release one senior rating to act as 'Controls Rover'. The switchboard operators should reconfigure as necessary keeping him informed. DCO(L) must be prepared to put cable running teams into BA in order to achieve a high priority task, (see Chapter 19).

0830. Main Machinery Space Action Crews are responsible to the MEOOW. If the space is manned, one Senior Rate plus one Junior Rate should be the minimum. The controlling engine room should be run by an MEOOW1 qualified person and other engine rooms by an MEOOW2 qualified person. Action Crews must be capable of operating all systems (in reversionary modes where applicable) and have a good knowledge of other spaces. On closing up they will conduct State 1 preparations and will conduct blanket searches when ordered. Action Crews will benefit from on-site 'Table Top' discussions on how they will conduct their business and what the PM needs.

0831. Mobile Repair Party (MRP)

The MRP will vary in strength depending on the ship class - generally a minimum of 2 CPOs (CMEM and ADHULL), a PO and 2 can be achieved. However, MRP size will be balanced by the number of personnel that are allocated to the MMS Action Crews. The MRP is under the control of the Propulsion Manager and a good line of communication is essential. Whilst the MRP will generally be used to provide assistance to the MMS Action Crews, ANBCDO may require their expertise outside the MMSs (hull/structure repair and system reconfiguration are examples, or even calling for stores). The MRP needs to be effectively equipped, including immersion suits, and have access to the Ramset tool, thermal lance, cutting and spreading equipment and toolbags. The MRP may be used to deal with a wide range of incidents. A good level of ship and system knowledge are essential along with being well versed in DC&FF (include GT module re-entry techniques) and a variety of hull and system repair techniques. They may also need to use breathing apparatus, so a BA Controller is to be nominated for them.

0832. Weapon Repair Organisation

An efficient weapon repair team requires good organisation and careful preparation as well as the education and training of weapon repair personnel and operators. The organisation of weapon repair parties is illustrated in Fig 8-7. The objectives of the organisation are to:

a. Advise the Command on the material state of the ship's equipment and the ship's ability to survive and fight before and after action damage.

b. Monitor, maintain and repair weapon equipment in Action and at Defence Stations, and Cruising Watches.

c. Combat battle damage as an integral part of the NBCD organisation.

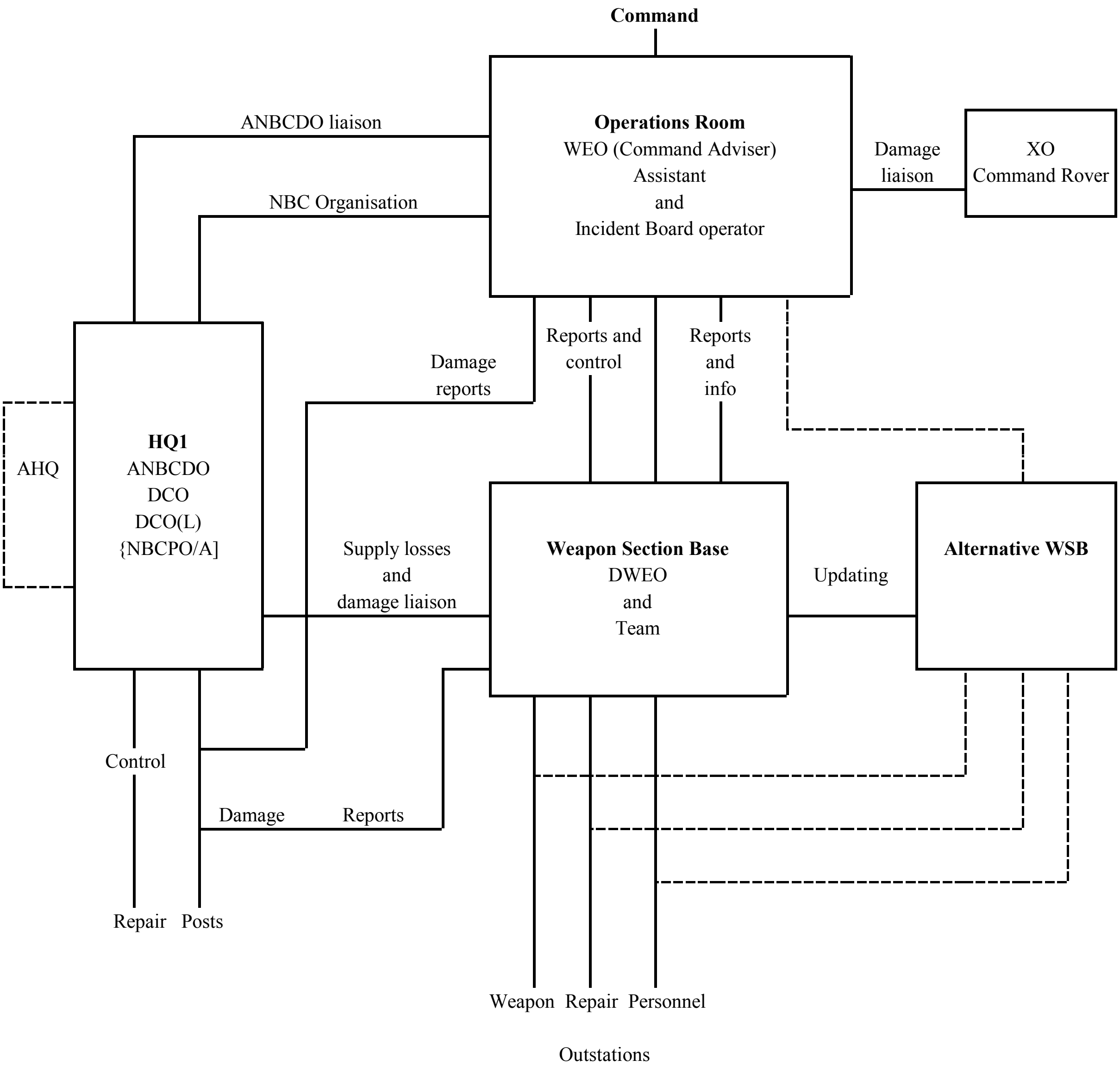

Fig 8-7. Weapon Repair Organisation

0833. The Weapon Section Base (WSB)

The functions of the Weapon Section Base are:

a. Providing an information centre, holding information on equipment, supplies, critical routines and present conditions and advising the WEO as required.

b. Receiving and recording reports from the Operations Room, HQ1, Repair Posts and weapon repair personnel.

c. Organising weapon repair personnel at action and during Defence Watches, paying particular attention to the completion of rounds.

d. Maintaining communications with weapon repair personnel.

e. Interpreting the Command Aim received from the WEO and initiating any actions required of the weapon repair personnel.

f. Interpreting equipment state reports in terms of their effect on the ship's fighting characteristics and advising the WEO.

g. Interpreting necessary changes to reversionary or emergency modes of operation in terms of effect on the ship's fighting characteristics and advising the WEO.

h. Initiating weapon repair as the need arises and weapon maintenance as the opportunity occurs.

j. Advising the WEO of any deterioration of weapon equipment performance.

k. Advising the WEO when an essential check or routine is overdue and weapon performance standard can no longer be guaranteed.

l. Informing the WEO of the options of repair and any associated penalty after failure of, or damage to, weapon systems.

m. Advising the WEO on explosives risk.

n. Providing technical advice and back up as the need arises.

o. Liaising with the stores department to provide spares as required.

p. Liaising with HQ1 to ensure:

(1) The effects of damage on weapon systems or their supplies are identified quickly.

(2) HQ1 receives damage reports from weapon repair personnel.

(3) HQ1 is aware of damage to weapon system supplies and support services and the actions required to meet the Command Aim.

(4) The deployment and use of weapon repair personnel in meeting the Command Aim allows for the current damage state.

(5) The Command Stateboard and the Incident Board in the WSB are kept up to date.

q. Updating the Alternative Weapon Section Base to allow for the easy transfer of control when required.

r. Advising weapon repair personnel of damage which could effect them or their equipment.

0834. Tasks of Weapon Repair Personnel

The tasks of weapon repair personnel deployed in direct support of weapon systems and equipment under the direction of the WSB are:

a. Maintaining communication with the WSB and ensuring the WSB is aware of their movements.

b. Monitoring the performance standards of the equipment.

c. Monitoring the availability of all forms of normal, alternative and emergency supplies and support services.

d. Advising operators and the WSB of any changes in equipment performance.

e. Advising operators on the need to carry out SOCS or mini SOCs, assisting them as required, ie periodically, when the ship has been subject to shock or damage, and when the equipment has been returned from repair.

f. Advising or assisting operators on any adjustment required to meet changing environmental conditions.

g. Carry out routine maintenance when due, and when the opportunity or threat allows.

h. Carrying out repairs as the need arises, informing the WSB of progress and of any limitations imposed by the repair.

i. Call for technical support from the WSB when required.

j. Checking the equipment areas conform to the NBCD condition set as directed by the WSB.

k. Locating damage control facilities and support stores in equipment area.

l. Checking equipment areas for damage after the ship has been hit or subject to shock and reporting the effects to the WSB.

m. Identifying hazardous materials or conditions in the equipment areas and taking or advising the appropriate safety measures when damage control actions or repairs are in hand.

n. Act in support of the damage control organisation as directed by the WSB.

o. Carry out rounds in Action or Defence States as required by the WSB.

0835. The manning of the weapon repair organisation must be commensurate with the task. The reduced staff available during Defence Watches has to be capable of advising the Command, monitoring and maintaining weapon equipment and communications whilst initiating repair action, calling out the appropriate section senior rating as required. Weapon repair personnel, allowing for the task, should be deployed as widely as possible to reduce the vulnerability of the organisation to action injuries. Specialist maintainers should not keep formal watches but remain as daymen, available at any time, unless:

a. There are duplicate experts for an equipment.

b. The maintainers have an operator function.

Table 8-1. Deployment of Key WE Personnel

	Action Stations	**Defence Watches**	**Cruising Watches**	**Peacetime Emergency**
Operations Room	Command Adviser. Assistant. Incident board Operator.	**Larger ships (CVS T42)** Section Officer **Other Ships** CCWEA	Section Officer, CCWEA or other senior rating as WE manager for all major serials	WEO and his Assistant will close up with Captain, usually on the Bridge
Weapon Section Base	DWEO. CCWEAs IBO. Command State Board operator. Messenger	**Larger Ships** The base of the on-watch CCWEA **Other ships** Nominated WE ratings	Not normally manned. Computer watchkeeper may be present in some ships.	CCWEAs WE ratings nominated as OOQs
HQ1				DWEO/WSO.

0836. Damage Reports

All reports must be made in the first instance to the Fire and Repair Party Post/Section Base, from where it will be reported to HQ1/SCC (in a large ship, where an officer is in charge of a Section Base, the initial reports must be carefully filtered and a concise report made to HQ1/SCC). Every incident must be reported to HQ1/SCC, but not necessarily all the detail. The types of report required are:

a. First reports from any source (patrols, search parties, Command, machinery control room, electrical control positions, Ship's Company) of incidents discovered, eg structural damage, flood, fire, damage to electrical or other services and casualties.

b. Reports from search parties on the extent of damage and, if possible, more detail regarding loss of services and the aid considered necessary.

c. Reports from fire parties on the nature and extent of fire and, if possible, the location of the seat of fire.

d. Reports of failure or disruption of electrical services.

e. Reports from electrical control positions giving an initial assessment of the effects of damage on electrical power and equipment (electrical damage affecting only weapons may be reported direct to the WEO in the Operations Room).

f. Reports from the Machinery Control Room giving loss or reduction of main and important auxiliary machinery.

g. In a CVS or LPH, from the hangar and flight deck control positions giving all necessary detail on major incidents.

Table 8-2. Information Required by Action NBCDO (not in order of priority)

Type of Information	Information Supplied by	Method
Type of attack expected, eg current threat.	Command	Telephone
Imminence of attack, eg missile launch, coming within range.	Command/OOW	Telephone or broadcast
Engaged side (applicable mainly to larger ships).	Command/OOW	Telephone or broadcast
Information on hits and/or near misses	OOW and/or OOQ of exposed weapons	Broadcast or via armament communications
Priorities for power or repair.	Command	Telephone
Detection of chemical spray attack.	OOW and/or OOQ of exposed weapons	Broadcast
Nearby air or surface nuclear burst.	OOW/Command	Broadcast (take cover)
Defects, eg power failure, steering breakdown.	Operations room, OOW, etc.	Telephone or conning

Table 8-3. Information Required by the Command

Type of Information	Information Supplied by	Method
Restrictions on manoeuvrability or speed imposed by mechanical/electrical damage, structural damage or fire.	HQ1 (Action NBCDO)	Telephone
Course to assist damage control operations or reduce smoke nuisance.	HQ1 (Action NBCDO)	Telephone
Defects affecting ability to employ countermeasures, eg pumps for prewetting, citadel defects.	HQ1 (Action NBCDO)	Telephone
Limitations on ability to employ weapons systems caused by defects, damage or contamination, including delays in reaction caused by contamination.	HQ1 (Action NBCDO) Ops Room (WEO)	Telephone In person
Power failure to any system.	HQ1 (Action NBCDO)	Telephone
Damage affecting any system.	HQ1 (Action NBCDO)	Telephone
Serious numbers of casualties or impending radiation casualties among personnel serving any system or main machinery, or in NBCD parties which may need reinforcement from other quarters.	HQ1 (Action NBCDO)	Telephone
Need to shelter or deep shelter	HQ1 (NBCPO)	Telephone
Requirement for decontam/cleansing, eg: additional loading of cleansing station.	HQ1 (NBCPO)	Telephone
Time likely to elapse before restrictions stated above can be lifted, and progress reports as necessary.	HQ1 (NBCPO)	Telephone
Progress in watch changes and similar movements of personnel across the citadel boundary.	HQ1 (NBCPO)	Telephone
Amplifying reports on the general situation and casualties.	HQ1 (Action NBCDO, XO)	Telephone or in person

0837. Follow-up Reports

Early reports should be followed by more detailed reports as soon as the information is available. These follow-up reports may amplify or correct previous reports and/or specify new areas of damage. Brief statements concerning casualties should be included. As soon as the NBCD parties are working to control or repair damage or to fight fire, HQ1/SCC must be kept informed of the actions being taken, the numbers of hands involved, the progress being made towards the containment of the incident and the flood/fire boundaries that have been established. All this information must be recorded in HQ1/SCC (mainly on the incident board).

0838. Narrative of Events

A full HQ1 narrative of events is to be kept in all NBCD State 3 incidents, either by the Incident Board Operator on his board or at some other suitable position in HQ1.

0839. Incident Assessment by the Command Rover

The following questions will help the Command Rover to assess incidents:

AT THE INCIDENT SCENE	
FIRES	**FLOODS**
Where is the seat?	Where is the damage (ships side, deckhead or deck) and what type (splinter holes, fractured pipes etc)?
What type of fire (oil based/carbonaceous)?	What is the level of water? Is it rising/falling/steady?
Which team is attacking it and with what?	Is the flood contaminated?
How long before re-entry (if applicable)?	Has initial leak stopping taken place?
What hazards are in the vicinity?	Are pumping requirements in place?
Are there casualties? Are they being dealt with?	
Is there an incident manager?	
What is the fire/smoke/flood boundary status?	
Which boundaries are priorities?	
Is the incident under control?	

AT THE FRPP
Are incidents shown correctly?
Are boundaries shown correctly?
When are reliefs due in?
What other incidents are there in the section?
Does the OIC have the right priorities?
Does the OIC have things under control?

0840. In order to gain this information the Command Rover must get as close as possible to an incident. For a flood this includes sighting the damage. Additional information should be gathered, for example the state of lighting in the ship. There is a lot to take in and good use of pocket size deck plans and 'aides memoire' are essential.

0841. Standard Operating Procedures (SOP)

SOPs allow regular practice to develop instinctive reactions which are less likely to become degraded by the confusion of battle or peacetime incident. Some examples of SOPs are:

a. Firefighting.

b. Machinery breakdown drills.

c. Mini SOCs.

d. Blanket searches.

0842. Mini-SOCs and blanket searches are the SOPs used to ensure that the extent of damage is accurately established. There are 2 key areas which must be included in this process:

a. **Damage Boundary.** Precise determination of incident boundaries is vital to the Command and Control process. For a fire or flood, high value compartment boundaries should be established first. For an equipment defect, the exact boundaries of the damage are required, or the report will be almost worthless. This includes whether the equipment is repairable, which power supplies are unavailable and whether faults are in cables or breakers, what functionality still remains and what reversionary modes are available. If the exact nature of the defect is not known, then a report of, 'investigating, sitrep at minute ....' is much more useful than no report.

b. **Implications.** Once the damage boundary is established, the task of assessing the implications is straightforward, using the Command Aim and an awareness of the Threat State. For these, the significance of the incident should be readily apparent.

0843. Estimated Time Back on Line (ETBOL)

Control positions, such as HQ1 and WSB should be given an estimate of the time at which damaged equipments and services will be back 'on line'. ETBOLs should always be used on Command Stateboards and are always expressed as an absolute time, ie '1145', or 'minute 45', never as the repair duration. If it is difficult to provide an ETBOL, then either a best guess should be given or, if still investigating, then a time to the next sitrep.

0844. NBCD Command and Control Communications

The NBCD communications systems are detailed in Chapter 9. They will vary between large and small ships, but Fig 8-8 shows the links in a typical DD/FF.

0845. NBCD Communication Procedures

Much confusion is created in action or peacetime incidents through the misinterpretation of common terms, and the failure to recognise that busy internal communications circuits and lines require exactly the same kind of voice discipline as used on radio circuits. The flow of information often relies on a junior rating, of limited experience and possibly in a state of shock, finding a number of defects or incidents and then reporting them accurately to the appropriate outstation. The scope for error is immense during this fast moving initial phase. A mistaken incident or incomplete report can cause incidents to be incorrectly prioritised with potentially catastrophic effects on the fighting and operational efficiency of the ship. The process is further complicated by the sheer volume of information which needs to be assimilated amidst the chaotic environment following a weapon hit or damage incident. Fires, floods, smoke, violent manoeuvring, high pressure system leaks and noise all combine to add confusion and provides a breeding ground for poor communication and flawed decisions. This requires considerable forethought, practice and critical self-analysis by NBCD Command Team members.

0846. When operating under stress, Command and Control discussions can be better focussed if leaders prefix sentences with key descriptive words, to tell the listener the type of message being passed. The most important examples are: 'Command Aim', 'Question', 'Order', 'Request Sitrep', 'Standby Sitrep', 'Incident Priorities'. For example:

a. 'Question? Status of the 3 Juliet fire?'

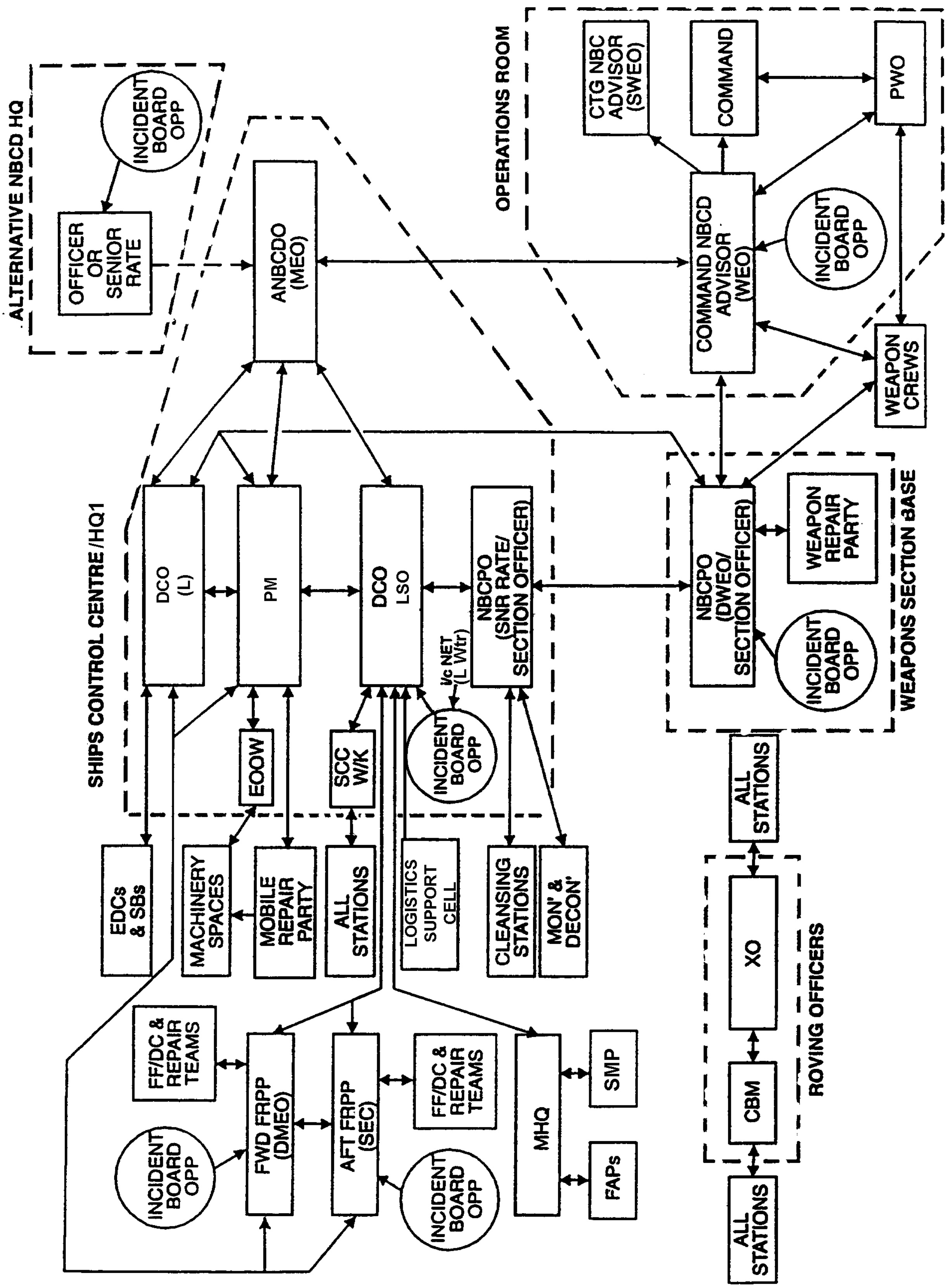

Fig 8-8. NBCD Command Control and Communications Team for a Typical DD/FF

b. ‘Order! send a firefighting team from the Aft FRPP to support For’d.’

c. ‘Standby Sitrep: ....’

d. ‘Incident Priorities! Your first priority: fire in 3 Juliet. Your second ...... etc.’

0847. All references to ship location letters should be by use of the phonetic alphabet to avoid misunderstanding (eg ‘Fire in Two November Galley’).

0848. Initial Contact Report

After a Loud Vocal Alarm is raised, the first leader at the scene (eg WRT leader, MMS SR, fire/flood team leader) should make an Initial Contact Report (ICR), following the What, Where, Whither and When format; noting that Whither indicates whether the incident status appears to be improving or worsening. The status of an incident should be qualified as follows:

a. **Minor.** Relatively small scale incident, whose solution is containable within local DC&FF resources.

b. **Significant.** Larger scale incident, which has the potential to affect key ship’s fighting and survival systems, but which is presently containable within local DC&FF resources.

c. **Critical.** Major incident which already prejudices the survival of the ship or her key fighting systems.

0849. Defining the status is initially the role of the local NBCD team leader, who should take this decision bearing in mind the Command Aim. For example, if the Command Aim is ‘to provide goal keeping air defence’, then an incident (fire, flood, smoke, power loss, equipment damage) which affects Vertical Launch Sea Wolf could be ‘Significant’ or ‘Critical’. The status will allow those higher up the Command chain, notably DCO and ANBCDO, to prioritise resource allocation. When reported from FRPP/Section Base level to HQ1, these reports may be qualified with an indication of whether extra assistance will be required. If none is requested then it will be assumed that the incident is containable within local resources.

0850. Flash Procedure

Flash reports are designed to gain urgent attention of the Command Team. As such they must be used sparingly. The following occasions are usually the only ones where a Flash report will be appropriate:

a. ICR of a ‘Critical’ or ‘Significant’ incident.

b. Sitrep of a ‘Critical’ or ‘Significant’ incident, especially where the situation is deteriorating.

c. Change in the Command Aim, or broad incident priorities.

d. Key system or equipment restored or brought back on line.

| **0851. Message Chits**

A chit system should be used to improve interdesk liaison in HQ1. The ‘What, Where, Whither, When’ format recommended for ICRs is also ideal for chits. Chits may be made up as a tailored form, but the standard blank ‘Post-It’ can be just as effective and has the advantage of being self-adhesive.

| **0852-0860.** Spare.

SECTION 2 - CONTROL POSITIONS

0861. HQ1

HQ1 should be sited in a position near the centre line, co-located with the ship's electrical distribution and machinery control centre. This combined space should be designated the Ship Control Centre (SCC). For the purpose of integrated management, the SCC is designed to allow display and dissemination of NBCD information, in conjunction with other systems, and must enable the Action NBCDO to control the various functions from a single position. The following should be provided in HQ1:

a. The communications links specified in Chapter 9.

b. NBCD information boards and control documentation, as detailed in Annex 8A.

c. A whole-ship NBCD Incident Board, as detailed in Annex 8B.

d. Emergency lighting.

e. A desk on which documents can be consulted.

f. Fire, flood and NBC monitoring remote warning equipment.

g. Main broadcast microphone and alarm buttons.

h. Citadel pressure manometer(s), for each sub-citadel.

i. Duplicate key stowage.

j. Heel indicator.

k. Pressure gauges, for each leg of the HPSW System.

l. A clock.

m. Stowage for NBCD documentation and 'may be left open' tallies.

0862. Secondary NBCD Headquarters (HQ2)

In large ships with an HQ2, it should be separated from HQ1 by at least two main transverse bulkheads, and should be fitted with equipment and information boards in a manner similar to HQ1 to allow takeover should HQ1 be put out of action. In addition, it should be fitted with the necessary instruments and repeats to indicate the state of machinery and systems.

0863. Alternative NBCD Headquarters (AHQ)

In DD/FFs a fully provisioned HQ2 is not available. An AHQ is identified. In most ships the AHQ position will be on or near the bridge. An alternative whole-ship incident board which may be portable, or fixed if space permits, with a lockable cover, as appropriate, is fitted at this position and illuminated by low voltage, battery operated lighting. Communications links with HQ1, FRPPs, Ops Room and WSB must be available, along with copies of the more important control documents from Annex 8A (Kill Cards and Smoke Clearance Plans in particular).

0864. Section Bases

Section Bases in large ships should be sited on the deck that affords fire and repair parties the easiest fore and aft movement. They should be as well protected as possible by the ship's structure and should be remote from the ship side. They should be in communication with their own outstations and with HQ1 and HQ2. Each section base should contain or be fitted with:

a. A whole-ship Incident Board.

b. A Section Electrical Information Board.

c. A Section HPSW System Board.

d. A Section NBCD Door and Hatch Board.

e. A Section Ventilation Board.

f. Kill Cards for compartments in that Section.

Note. *Ships of DD/FF size and below are single NBCD Section ships (see Chapter 1). In these ships the role of the Section Base is subsumed into that of HQ1.*

0865. Fire and Repair Party Posts (FRPP)

These consist of grouped damage control, fire party and electrical repair party lockers, or combined built-in stowages, sited with communication with HQ1 and a manometer for citadel pressure. The following information boards are required at FRPPs:

a. Whole-ship Incident Board.

b. Whole-ship HPSW System Board.

c. Whole-ship Electrical Information Board.

d. Safety Plan (RFAs only).

e. The FRPP documentation listed at Para 0820.

0866. Upper Deck Re-entry Fire Party Post (UDRFPP)

An UDRFPP is located on the upper deck of all DD/FF sized vessel (T23 and subsequent vessels have a dedicated compartment within the superstructure). The Post comprises a stowage for sufficient equipment to effect a re-entry into the ship, should it be necessary to withdraw firefighters to the upper deck. Breathing apparatus and the TIC are susceptible to damage from exposure to weather, so they are sighted at sheltered, but easily accessible locations within the superstructure.

0867. Weapon Section Base (WSB)

The information held in the WSB is the basis upon which action is taken. Information has to be presented in such a way that it is easily available and easily understood. Information boards should be equipped with emergency lighting and be portable to allow for easy transfer should the compartment have to be evacuated. The material required includes:

a. Weapon Section Base Handbook.

b. State 1 Preparations Check-off List.

c. Manpower control Board (an example is at Fig 8-9).

d. WSB Command State Board.

e. Weapons and Sensors State Boards (examples are at Annex 8E and 8F).

f. A Whole-ship Incident Board.

g. Weapon Repair Monitoring Cards (an example is at Fig 8-10).

h. WE Compartment Information Cards (WE Kill Cards).

i. System supporting documentation.

j. Weapon machinery conditions for 'quiet' states.

k. Internal communications schematics.

l. Misfire routines.

m. Ordnance disposal routines.

n. Watch and Station Bill.

o. Sleeping locations of maintainers.

p. Defence watch maintenance plan.

q. System standards.

r. CB 8844 - Weapon Effect (effects of explosives on ship's structure).

s. WE Defect Book.

Name	Rank/Rate	Action Station	Telephone Number	Time of last Check in	Time of next Check in	Notes/movements
	Lt Cdr	Operations Room	304			
	Lt	Surveillance Office	289			
	CPO					
	CPO					
	CPO					
	WEM(R)					
	WTR					
	CPO	MCO	225			
	CPO					
	CPO	UAA1	252			
	CPO	Test and Assembly Magazine	268			
	LWEM(O)					
	LWEM(O)					
	CPO	Fwd Gyro Room	254			
	CPO	Fwd S.I.S.	269			
	CPO	Fwd tracker Office	305			
	PO	Fwd Launcher Office	261			
	PO	Aft Tracker Office	306			

Fig 8-9. Example of WSB Manpower Control Board

Line No	EQUIPMENT	MAINT INFORMED	ETBOL
DEFECT DESCRIPTION AND REPAIR ACTION			

Fig 8-10. Weapon Repair Monitoring Card

0868. Alternative WSB

The alternative WSB should be large enough to accommodate all WSB personnel with stateboards. the location of the alternative site will depend on the extent and location of damage or smoke. The final decision has to be made at the time. Two locations should be pre-designated to allow for flexibility. They are to be as for apart as practicable, and should be displaced laterally and vertically from the main WSB and from each other. Ideally, the two spaces should have the communications indicated in Fig 9-1.

0869. Moving the WSB to its alternative location should be a pre-planned SOP. DWEO and CCWEAs should ensure that all personnel (each with an ELSA) are safely evacuated from the compartment, and as much portable equipment as possible is taken with them.

0870-0880. Spare.

SECTION 3 - NBCD STATE 2 ORGANISATION

0881. State 2 Considerations

NBCD State 2 should be considered if the operational task requires more personnel on watch than can be generated at State 3 or if the external threat warrants further precaution. When reviewing the State 2 posture, invariably utilising the Command Estimate process, the following factors should be included:

a. Likely threat weapon warning time.

b. Typical reaction time for the ship to assume heightened NBCD postures, eg State 1 Condition Zulu from State 2 Condition Yankee.

c. Required response to non-hostile incidents, eg internal fire, collision.

d. Successful maintenance of the State 2 posture requires strength of leadership and teamwork which in turn relies heavily upon individual knowledge of ship, drills, procedures and systems (including reversionary modes of operation), eg when assuming Condition Zulu in an unfamiliar part of ship.

e. The psychological importance of being at State 2, as opposed to State 3, should not be underestimated. State 2 provides a whole-ship focus to the task in hand and subconsciously causes people to mentally prepare for combat and damage, however remote that possibility might be. State 3 is synonymous with peacetime cruising and encourages that mindset. Personnel may require days to mentally adapt to State 2 and the real possibility of combat and trauma.

0882. Sustained Periods at State 2

During a sustained period of State 2 operations, a more loosely and generically applied Command Aim may be appropriate. Where the threat warning time allows sufficient reaction time for the ship to assume Action Stations, NBCD State 1 Condition Zulu should be adopted to counter battle damage.

0883. Maintenance of Readiness

Where the threat warning time does not allow sufficient reaction time for the ship to assume Action Stations, or closing down to Condition Zulu could interfere with movement of the Ship's Company thereby hampering the ability to deal with a non-hostile incident:

a. State 2 Standard Operating Procedures (SOPs) must be promulgated and understood at all levels. Example State 2 SOP algorithms are at Figs 8-11 and 8-12.

b. A Defence Watch Emergency Party (DWEP), capable of reacting to a non hostile incident or battle damage, should be nominated for each Defence Watch. Where practicable, key State 1 personnel should not be allocated a role in the DWEP that is different from their role at State 1. An example of the composition of a DWEP is at Table 8-4.

Table 8-4. Example of a DWEP

HQ1 TEAM DCO ME ADVISER HQ1 WATCHKEEPER COMMS/IBO ME ISOLATIONS	**CONTAINMENT** I/C CONT 1 CONT 2 KEYS/CONT 3 PATROL/CONT 4 PATROL/CONT 5 CONT 6
EMERGENCY PARTY I/C FCP ATTACK ATTACK ATTACK BA ATTACK BA SUPPORT PARTY I/C SUPPORT (Firefighter) SUPPORT (Waterwall) SUPPORT (Hose Tender) SUPPORT (Ship Protector) BA CONTROLLER	**FIRST AID** I/C FA FA1 **OPS ROOM** IBO

Notes:

1. These positions are to be covered by both Port and Starboard Watches and some positions may have to be split into 1st and 2nd Watches.

2. It is recommended that the Containment Group muster at the nominated FRPP and use the FRPP Incident Board. This will allow an easier handover to the FRPP personnel if the ship goes to State 1.

c. Ships should practise the various scenarios so that key personnel can make the correct broadcast and personnel know the right response for an incident.

d. All personnel, particularly the DWEP, must be prepared to fulfil unfamiliar roles.

e. DWEP briefs, conducted at watch changes, must reinforce individual and team roles, the need to respond instinctively and remain closed up and on task until relieved by State 1 personnel.

f. HQ1 Watchkeepers must be fully conversant with, and endorsed in the use of, HQ1 systems, communications and SOPs.

g. Ship's Company messing and accommodation should be reviewed to ensure personnel are dispersed as close as is practicable to their Action Station thereby reducing movement and therefore time to achieve State 1. Sleeping in full AWD greatly assists individual protection and improves personnel response times. Implications of mine warnings on accommodation are also worthy of consideration.

h. It is recommended that the DWP wear surcoats to enable easy identification in relieving State 1 personnel.

i. To minimise the time accounting for personnel when assuming State 1, detailed DWEP/State 1 personnel cross-reference muster lists are to be produced.

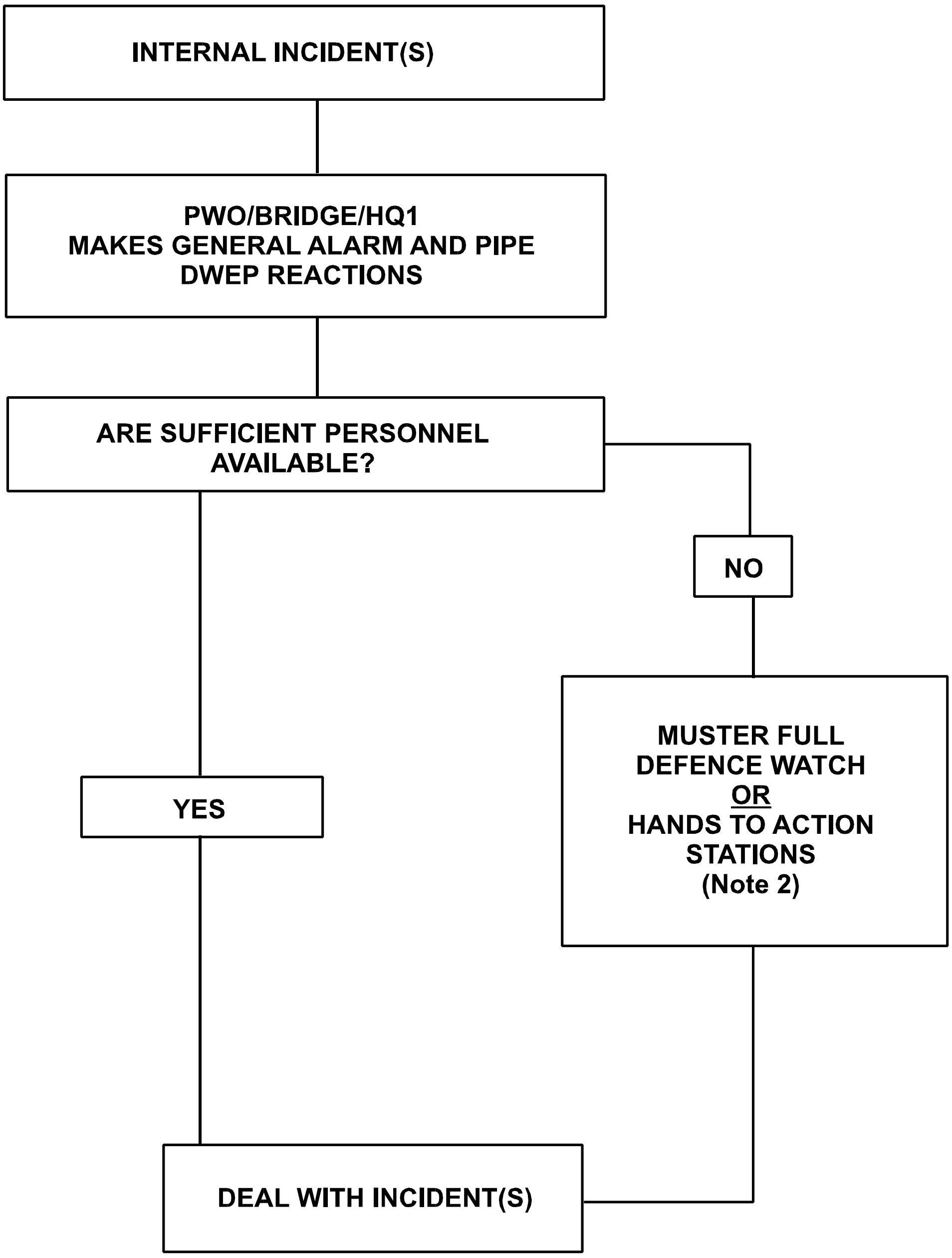

Fig 8-11. Internal Incidents

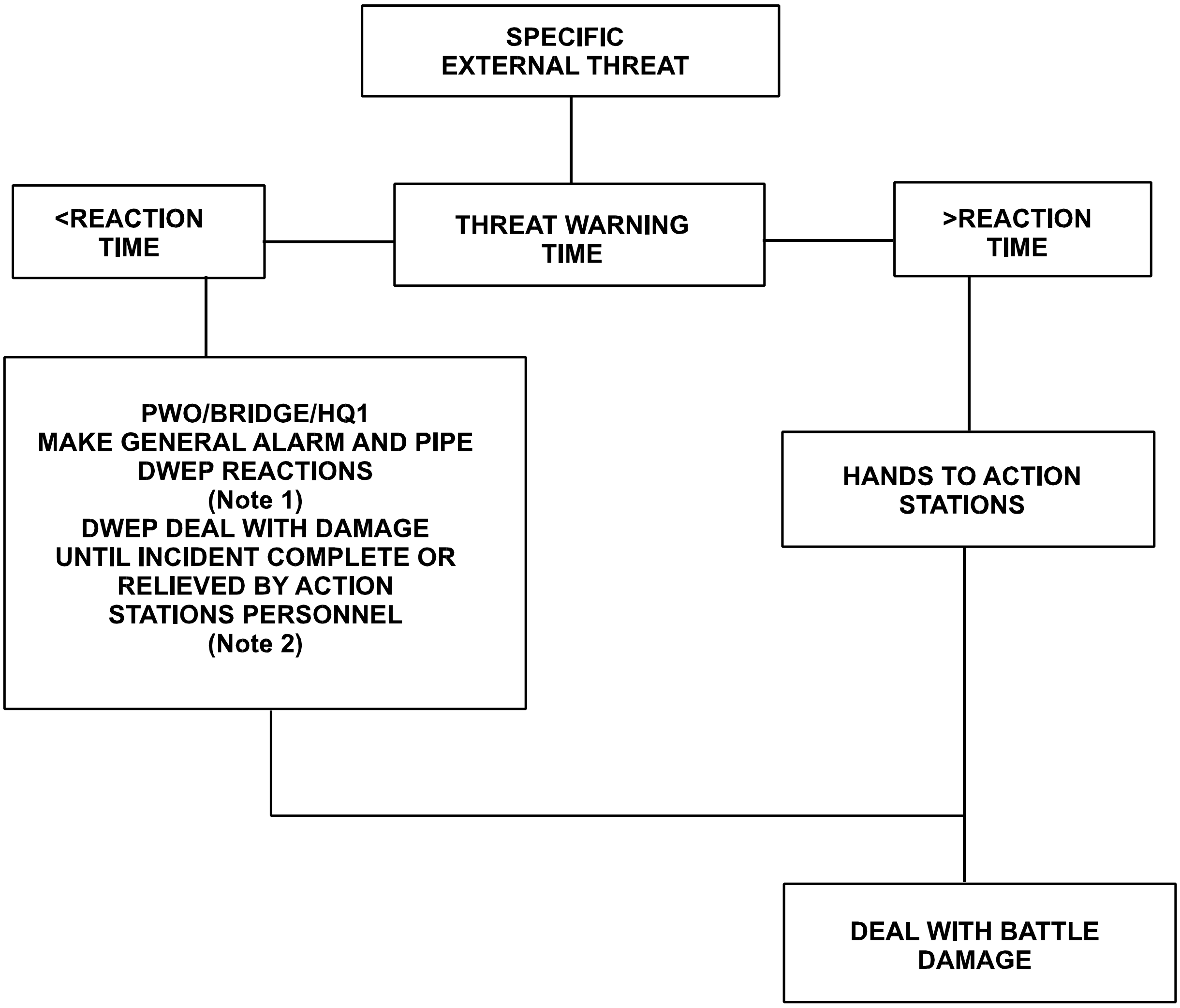

Fig 8-12. External Threat

Notes:

1. Personnel are to remain dispersed until 'Stand To' is piped. The DWEP should then be piped to muster. Contrary to State 3 practice. DWEP Support teams should muster at the FRPP nearest the incident. There may be a requirement to pipe 'Hands to Action Stations' but add 'Stand Fast, Brace, Brace, Brace' prior to impact.

2. Where Action Stations are ordered to counter the internal, rather than the external, threat careful consideration should be given to:

a. Remaining at State 1 Condition Y.

b. Employment of warfare personnel.

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ANNEX A TO CHAPTER 8

HQ1 INFORMATION BOARDS AND CONTROL DOCUMENTATION

1. To assist the Command and Control team in HQ1 an outfit of information boards is to be provided in accordance with Naval Engineering Standard (NES) 119 and Table 8A-1:

a. NBCD Incident board (see Annex 8B).

b. NBCD Command State Board (see Annex 8C).

c. Pumping and Flooding board (DD/FF and larger ships only).

d. HPSW System Board.

e. Fuel and Fresh Water State Board (Multiple NBCD section ships only).

f. NBCD Door and Hatch Board.

g. NBCD Ventilation Board.

h. NBC Protection Officer's Incident and Information Boards.

i. NBCD Electrical Information Board (see Chapter 19).

2. In newer ships, these boards may be replaced by electronic displays.

3. Command State Board

The HQ1 Command State Board, an example of which is at Annex 8C, is identical to the board maintained by the Command Adviser (WEO) in the Ops Room and by the DWEO in the Weapon Section Base.

4. Pumping and Flooding Board

This board consists of a series of deck plans up to at least the highest survivable static waterline. On it are shown the watertight subdivision of the ship, and various stability data for each compartment if flooded. Each compartment is bordered as follows:

Green	Watertight compartment
Orange	AVCAT
Brown	DIESO
Blue	Fresh and Sea Water
Red	Magazines
Yellow	Store rooms
Silver grey	Machinery Spaces

5. Each compartment may contain some of the following information. The effect on the heel and trim of the vessel when the compartment is filled and the capacity of each compartment in tonnes of seawater. In addition the compartment may contain the change in GMF for the worst case scenario, it may also contain information about other pumping and flooding arrangements for that compartment, for example the location of salvage eductors or cross flooding lines.

6. The information provided on the board gives guidance to the operator on the affects of various floods. Hence the board can be used to assess what counter flooding is required to recover from a damage incident and to provide guidance on how counter flooding might affect the available reserve of stability. The board is to be operated by the DCO, NBCDO or Command Stability Advisor (large ships) who must have an intimate knowledge of the pumping and flooding arrangements of the ship.

7. HPSW System Board

This board shows, in broad outline, the ship's HPSW system. The numbering of isolating valves and hydrants is detailed in para 0333. Red pegs can be inserted in provided holes at the valve positions to indicate the valves are shut. Green pegs can be inserted in provided holes at the pump positions to indicate the pumps are running. Other colour pegs may be used to indicate, say, 'Pump defective' or 'Valve defective'. The board is operated under the supervision of the DCO.

8. Fuel and Fresh Water State Board

The board is in the form of a tabular statement indicating clearly, in the case of fuel, the machinery units for which the tanks are providing. The statement should indicate:

a. 95 per cent capacity of each tank in tonnes and the location of the tank.

b. State of tank at any given time and the time at which the state was last determined.

c. Whether the tank is in use or 'standby'.

9. NBCD Door and Hatch Board

This board should include all the deck plans of the ship on which are shown:

a. The position of all watertight and gastight doors, hatches, manholes and access trunks with their location markings.

b. The NBCD risk and control marking for each opening.

c. The regulations for watertight and gastight openings and the number of openings allowed to be open in each NBCD condition.

Coloured pegs can be inserted to indicate the openings which are open at any given time and those pegs should be the predominant feature of the board.

10. NBCD Ventilation Board (Fig 8A-1)

The NBCD ventilation board is an essential aid for firefighting, smoke removal and watertight and gastight control, and is designed to enable use by non-technical personnel. It consists of a series of deck plans showing the areas served by each supply, exhaust and conditioned-air system using colour codes of blue, scarlet and orange respectively. Each system is identified by the number of the fan or ATU serving it with directional arrows, indicating the direction of air flow, adjacent to each fan number. Each compartment served by an ATU has its boundaries delineated by a continuous orange line, and contains the number of the ATU serving it. The related tabular statement (Fig 8A-2) is an integral part of the ventilation board.

11. NBC Protection Officer's Information Boards

These consist of:

a. A scaled down reproduction of the Main Incident Board.

b. A Total Dose Record Board (see Volume 2).

c. A Dose Rate Graph (see Volume 2).

d. A Radiological Monitoring and Decontamination Board (see Volume 2).

e. A Chemical State Board (see Volume 2).

12. NBCD Electrical Information Board

This is maintained by the DCO(L), as detailed in Chapter 19.

13. Kill Cards

A full set of compartment Kill Cards, as detailed in Annex 21G, are to be readily available in HQ1.

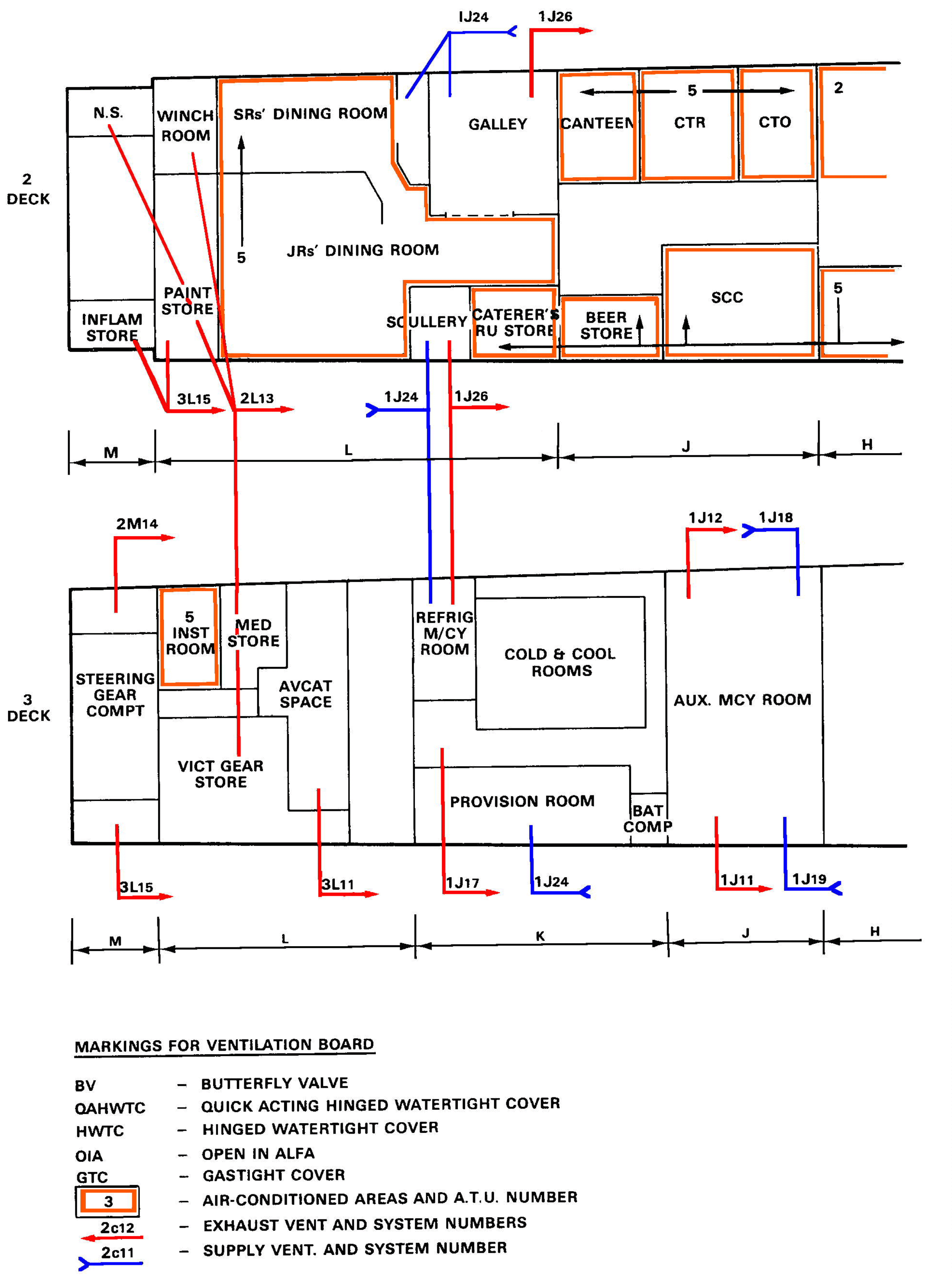


Fig 8A-1. Example of Ventilation Board

SUPPLY						SERVICE	EXHAUST					
EXTERNAL CLOSURE AND CONTROL MARKING		INTERNAL CLOSURE	STARTER POSITION AND CONTROL MARKING		FAN & SYSTEM NUMBER		FAN & SYSTEM NUMBER	STARTER POSITION AND CONTROL MARKING		INTERNAL CLOSURE	EXTERNAL CLOSURE AND CONTROL MARKING	
01 DECK 64:65(P)	A	BV	2L GALLEY O/S	A	1J24	RATING GALLEY SERVERY AND SCULLERY 2L, FRIDGE SPACE PROV ROOM 3K						
						RATING GALLEY AND SCULLERY 2L, FRIDGE SPACE, RATINGS DINING HALL	1J26	2L GALLEY O/S	A	BY FIRE FLAP	01 DECK 65:p65(P)	A
						HANGER 1J	1J15	01G PASSAGE	A		1 DECK 58:59(S)	A
						NAFFI BEER AND SPIRIT STORE	1J17	3K FLAT	A	BV	1 DECK 61:62(S)	A
						WINCH ROOM 2L, VICT STORE AND MED STORE 3L, NO 5 NAVAL STORE	2L13	2L LOBBY AFT	A	CHANGE OVER & SHUT OFF FLAP	2 DECK 78:79(S)	A
						FLAM STORE 2M, PAINT ROOM 2L	3115	21 LOBBY	A	BV	2 DECK 78/79(S)	A
						STEERING GEAR COMPT.	2M14	3K FLAT	1	BV	2 DECK 78/79(P)	A
01 DECK 61:62(S)	M	BV	5J AAMR (P)FORWARD	M	1j19	AFT AUX MACHINERY ROOM	1J11	5JAAMR (P)FORWARD	M	BV	01 DECK 57:58(S)	M
01 DECK 61:62(P)	M	BV	2H PASSAGE (P)O/S GW MAG	M	1J18		1J12	2H PASSAGE O/S GW MAG	M	BV	01 DECK 57:58(P)	M

Fig 8A-2. Ventilation Board - Associated Tabular Statement

Table 8A-1. NBCD Information Boards and Control Documentation

		Multi Section Ships				Single Section Ships			WE	
		HQ1	HQ2	SB	FRPP	HQ1	AHQ	FRPP	WSB	Ops Rm
Incident Board		1:150	1:150	1:150	1:200	1:150	1:300	1:200	*	*
Command State Board		*	*			*	*		*	*
Weapons & Sensors State Boards	600 x 600 mm	*							*	
Main Systems Board		*	*	*	*	*	*	*		
NBCD ‘L’ Information Board	1000 x 600 mm	*	*	*	*	*	*	*		
NBCD Door & Hatch Board	1:200 or 1:100	*	*	*		*				
NBCD Ventilation Board		1:200	1:200	1:200		1:100	1:100			
Pumping & Flooding Board	1:200 Length	*	*			*				
Fuel & Fresh Water State Board		*	*							
Total Dose Record Board	750 x 500 mm	*	*			*				
Chemical State Board		*				*				
NBCPO’s Incident Board	600 x 600 mm	*	*			*	*	*		
Kill Cards	A4	FF	FF	FF		FF	FF		WE	
Closing Down Route Cards		*	*	*		*				
Safety Plan (RFAs only)					*			*		

Note. *The Scales shown are the minimum requirement.*

ANNEX B TO CHAPTER 8

INCIDENT BOARDS

1. Incident boards are used for the visual recording of information regarding damage, flood, fire or contamination. Marking is carried out by each incident board operator (IBO) who is constantly in communication with other IBOs to gain information. The incident board consists of deck plan drawings of all decks, arranged one above the other, on a single board which is covered in clear plastic (perspex) on which the operators can indicate incidents using marker pens. This is sited such that the complete picture of the ship can be seen by the NBCD Command Team. These and other NBCD information boards must be securely fastened to a fixed structure, preferably by bolts or stud bolts, in order to minimise the risk of dislocation when subjected to shock loading. All incident boards are prepared in accordance with Naval Engineering Standard (NES) 119, of which Table 8B-1 is a summary.

2. Marker Pens

Incident boards are annotated, as detailed below, using fine-tipped permanent OHP marker pens. These have a finer point then chinagraph markers and they resist smudging. Markings may be removed by using a normal rubber eraser.

Table 8B-1. Incident Board Symbology

FEATURE	SYMBOL
Watertight structures, doors, hatches, trunks, etc.	Thick black line
Non watertight structure	Thin black line
Compartment names	Abbreviated in fine lettering not over 3 mm high
Location markings	Bold type 4 mm for deck and section 3 mm for remainder. No markings for doors hatches or trunks, eg **5Ea**
NBCD zone boundaries	3 mm black and white broken line
Fire and Repair Party Posts	Segmented concentric rings filled equally with red, green and blue enclosing identification, eg **aft**
The number of personnel stationed in each compartment at NBCD State 1.	Indicated by the number contained in a black circle.
Modularized Machinery (with Halon or CO_2 drench)	Black rectangle with symbol **GTM** or **DGM**
Capacities (in tonnes) of all watertight compartments below 1 deck (ships without pumping and flooding boards only)	Enclosed in a black rectangle in the compartment.
Aluminium structure	Bordered blue.
Unbacked Melamine	Continuous Emerald green line (when unbacked MPL is removed then these lines must be deleted)
NBCD Section boundaries	3 mm blue and white broken line
Citadel boundaries	3 mm Continuous Orange line

Table 8B-1. Incident Board Symbology (Continued)

FEATURE	SYMBOL
Sub citadel boundaries	3 mm Broken Orange line
Cleansing stations Citadel In/Out airlocks NBC store	Tinted Orange
Gas Free - Contaminated if used spaces	Purple/orange dotted line
Gas free spaces not included in the citadel	3 mm continuous purple line
NBCD, HQ1, HQ2, AHQ Section bases and Command shelter station	Bordered in red
Switchboards and EDCs	Tinted green
Magazines, weapon stowages, launchers, all explosive stowages and handling areas and petrol stowages.	Tinted red
Main machinery spaces and associated trunking	Pink or blue wash, adjacent spaces alternatively coloured. Common trunking to be dual coloured stripes.
Upper deck re-entry fire locker	Red border and symbol **RFL**
Zonal DC Boxes	Black box around the letters **DCBZ**
Weapon Section Bases	Letters **WSB** inside a pink circle
Medical Stations	Red Cross in a circle with annotation **SMP, MHQ** or **FAP** beneath
Air filtration units	To be identified by the letters **AFU** with the location and zone number. Tinted blue.

3. Recording of Information on The Board

The board principally concerned with the recording of damage is the Incident Board and it is to be marked boldly by marker pens using the colours and methods shown in Figs 8B-1 and 8B-2 and as stated below:

a. **Errors and Erasures.** A significant error in board marking (eg fire identified and marked in the wrong compartment) should be erased and marked correctly. An incorrect word(s) should be lined through and the correct word(s) inserted. Errors must be logged prior to their erasure.

b. **Additional Information.** Should be marked in black in the appropriate space between deck plans (this does not include the timetable of fire, flood or contamination (see sub para d below).

c. **Boundaries.** Lines to denote fire/flood boundaries are not to be used unless the deck plan compartment-marking does not identify the boundaries sufficiently (eg fire in a cabin area). Marking for contamination is to include boundary lines (see sub-Para i. below).

d. **Marking of Times.** The timetable of a fire, flood or contamination incident should be marked in red, blue or yellow marker respectively as follows:

(1) *Initial Report.* Time is to be marked in the top left-hand corner of the compartment/space concerned or, if the space is very small, immediately outside the top left-hand corner of the boundary.

(2) *Containment.* The time of containing the incident is to be marked in the top right-hand corner of the compartment/space concerned or, if the space is very small, immediately outside the top right-hand corner of the boundary.

(3) *Completion.* The time when action taken to deal with the incident is completed is to be marked in the bottom right-hand corner of the compartment/space concerned or, if the space is very small, immediately outside the bottom right-hand corner of the boundary.

e. **Fire.** Is marked by a red cross in red circle with red hatching. Times are marked in red.

f. **Free Flood, Slow Flood, Free Surface.** Is marked by a blue FF, SF or FS respectively in a blue circle with blue hatching. Times are marked in blue (see Para 1471 for definitions).

g. **Boundary Cooling.** On a deck or deckhead, a blue BC in a blue circle with qualifying wording in black. For bulkheads, a blue wavy line against the bulkhead over the length concerned.

h. **Splinter Holes.** A black V(s) for hull and bulkheads; black dot within a black circle for decks. These markings may be superimposed over other incident markings.

i. **Contamination**

(1) *Vapour.* Contamination from without is marked by yellow circle divided horizontally with CHEM or BIO in black in the top half and chemical agent designator in the lower half. The circle is to be surrounded by hatching within a yellow boundary (which denotes the new citadel boundary). Contamination from within is to be marked by brown hatching within a heavy yellow boundary and qualified by black wording to indicate the nature of the contamination (eg FREON). Times to be marked in yellow.

(2) *Liquid.* A brown circle divided as in Fig 8B-1 showing time of discovery, agent type and CAM reading, if known, with an arrow indicating the point source of the liquid.

j. **Shoring.** A black T(s) either vertically or horizontally against the deck/bulkhead/hull over length concerned.

k. **Distorted Bulkhead.** Marked as a black wavy line through the length of the bulkhead concerned.

l. **Distorted Deck.** Marked by black wording with a black arrow if necessary.

m. **Movement of Hands.** Those movements, especially hands from the Command and their disposition, are recorded on any suitable blank space on the incident board, in black.

n. **Smoke Boundary**

(1) *Doors and Bulkheads.* A solid black line drawn along the line of the bulkhead containing the door and extending beyond the line of the ship's side.

(2) *Hatches.* A solid black diagonal line through the hatch extending beyond the line of the corners.

o. **Flooding Boundary**

(1) *Bulkheads.* A solid blue line drawn along the line of the bulkhead containing the door and extending beyond the compartment, both athwartships and fore and aft as appropriate.

(2) *Decks.* A solid blue diagonal line through a hatch extending beyond the line of the corners.

(3) *Updating.* The flooding boundary marking is to be moved as incidents are dealt with and compartments closer to the primary zone of damage become tenable.

Note. *Hatching (Fire Flood or contamination) covering adjacent compartments is to be alternated as illustrated in Fig 8B-2.*

4. Electronic NBCD Information Systems

Electronic NBCD information systems conform as far as practicable with the foregoing colour coding.

5. Ship Protection Incidents

The Incident Board may be used by the Ship Protection Organisation in harbour. The markings to be used are detailed in BR 8988 - Royal Navy Manual of Military Training, Operations and Tactics.

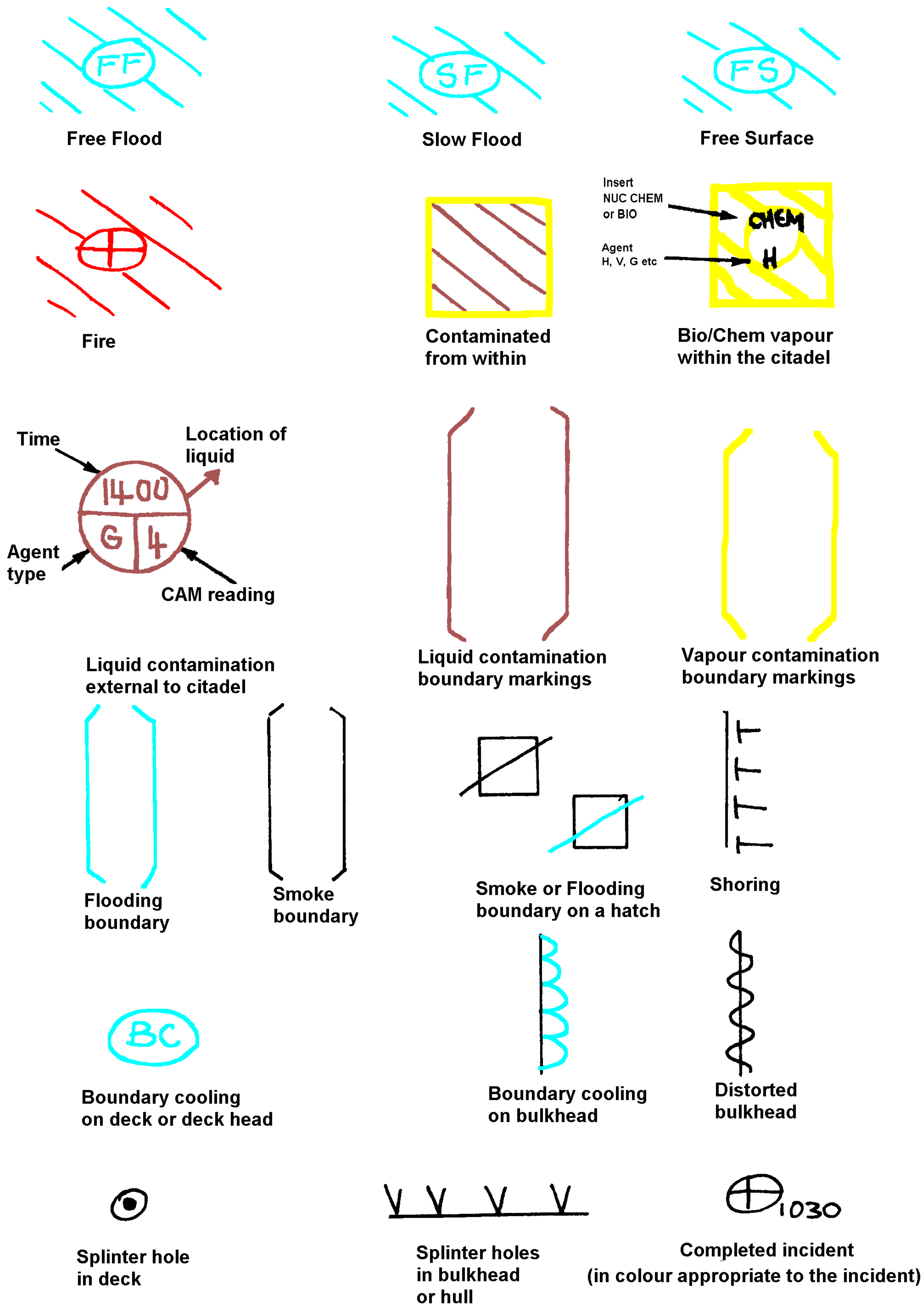


Fig 8B-1. Incident Board Markings

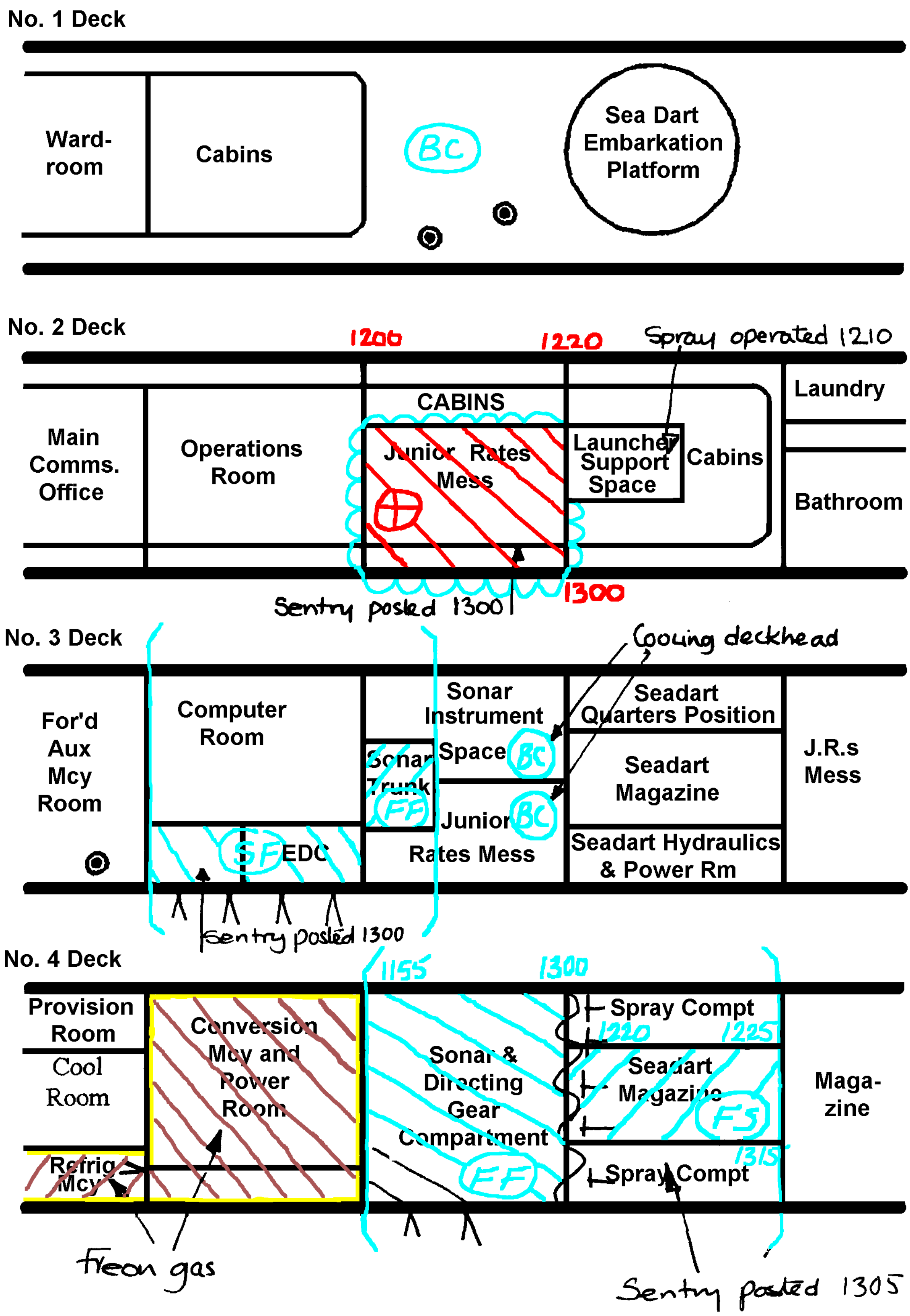


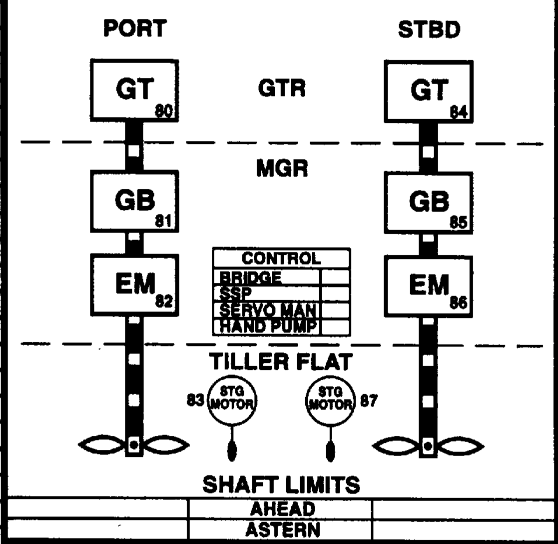
Fig 8B-2. Incident Board Markings

COMMAND STATEBOARD

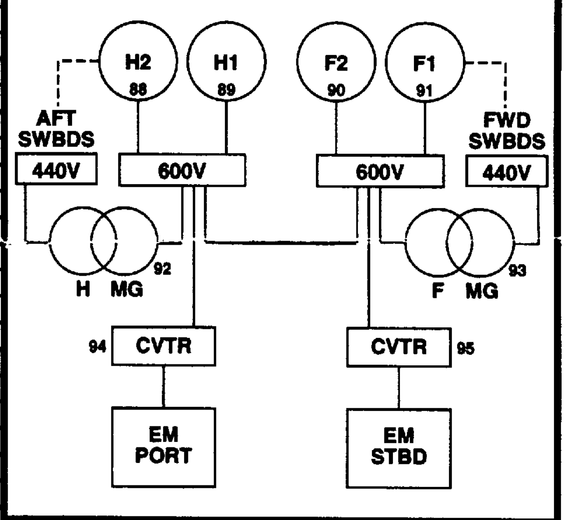
COMMAND AIM

No		EQUIPMENT	Status	ETBOL	REMARKS
1	AIO (ORS)	996 / LFA			
2		1007 / LFC			
3		1008			
4		RRB			
5		JUF / JQA / CTD			
6		1010 /1011			
7		SNAPS			
8		CSH			
9		DNA 1			
10		ROLE			
11		PDT			
12		COMMS / MISC			
13	EW (EWD)	UAF / T			
14		DLB (P & S)			
15		CRE			
16		DLF			
17		COMMS / MISC			
18	AWW (MD)	911 (FWD)			
19		911 (AFT)			
20		VLSS			
21		GWS 60			
22		GSA 8			
23		GPEOD			
24		4.5 MK 8			
25		TDS (P & S)			
26		30mm/GPMG's (P&S)			
27		COMMS / MISC			
28	UWW (ASWD)	2031 / 2087			
29		2050			
30		2013 / 2090 / SEPADS			
31		162 / 182			
32		2008 / 2009			
33		MTLS			
34		AW HE			
35		HVME			
36		COMMS / MISC			
37	COMMS (RS)	SCOT			
38		INMARSAT			
39		VHF / UHF			
40		MF / HF			
41		KMY / BIDS			
42		DIMPS			
43		SECURE SPEECH			
44		TELEX			
45		VIS SIG			
46		COMMS / MISC			
47	BRIDGE (OOW)	NCS 1 (A & B)			
48		PDM 2			
49		AGILOG			
50		WS & D			
51		NAVAIDS			
52		SNAPS			
53		778			
54		DG			
55		COMMS / MISC			
56	AIR (FDO/HC)	HELO			
57		AV FACS			
58		HANDLING			
59		COMMS / MISC			
60	NBCD	SICS / SIRS			
61		COMMS / MISC			
62	ENHANCEMENTS	JOTS			
63		ASMA			
64		NSTN (MHS)			
65		CHIRPSOUNDER			
66		TACSAT			
67		CLANSMAN			
68		1254 / DAMA			

PROPULSION

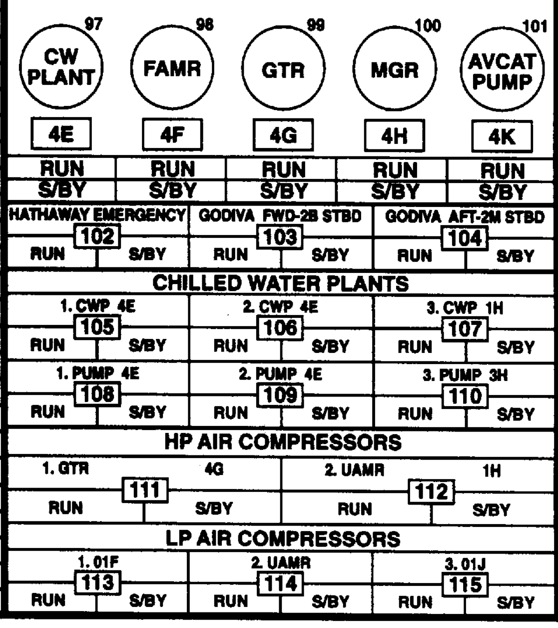


GENERATION



EMERGENCY SALVAGE GENERATOR 96	RUN	S/BY

HPSW



THREAT WARNING			
AIR	R	Y	W
SURFACE	R	Y	W
SUBMARINE	R	Y	W
MINE	R	Y	W

NBC THREAT	LOW	MED	HIGH

EMCON	RSI

CITADEL PRESSURE			
FWD		AFT	
1A		3	
1B		4	
2			

NOTES / CASUALTIES

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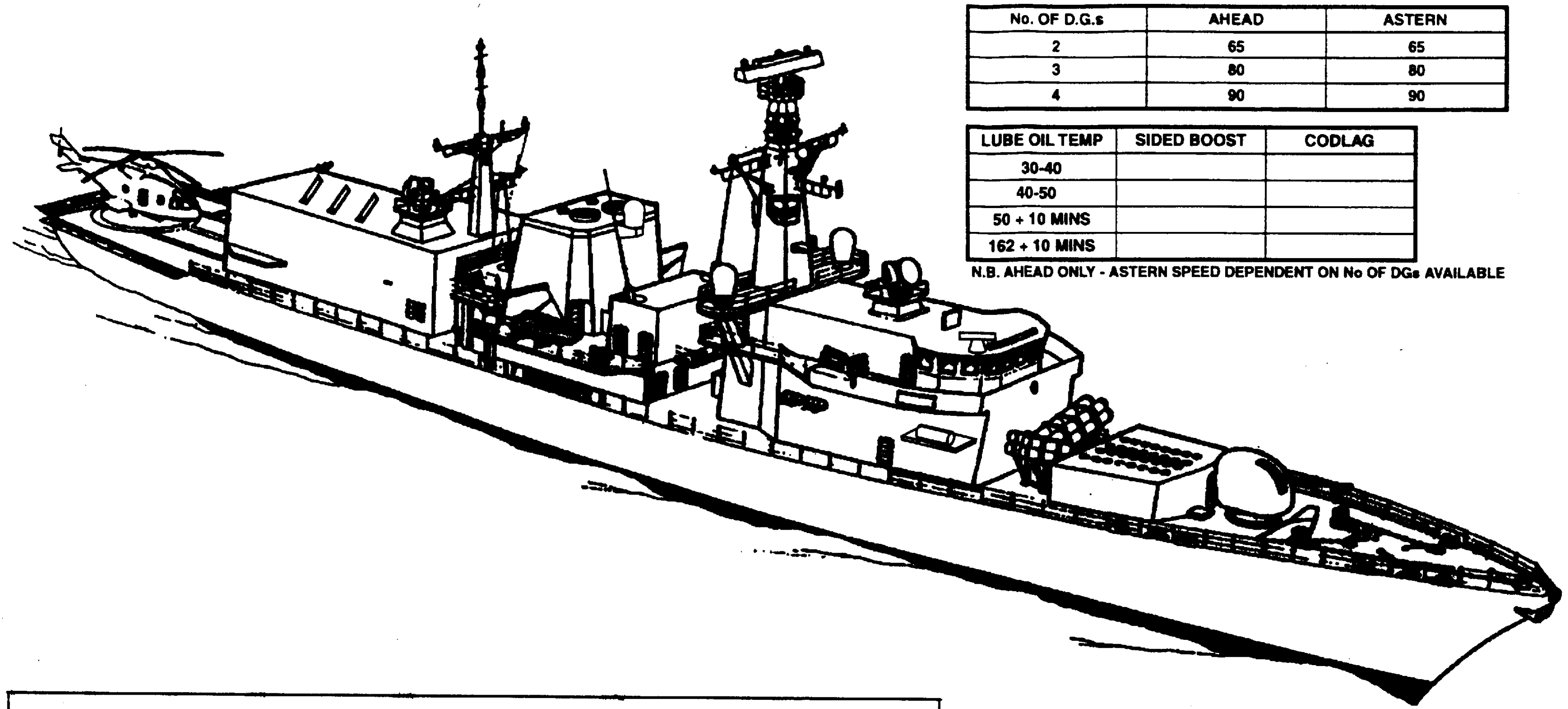
ANNEX D TO CHAPTER 8

EXAMPLE OF COMMAND BRIEFING BOARD



No. OF D.G.s	AHEAD	ASTERN
2	65	65
3	80	80
4	90	90

LUBE OIL TEMP	SIDED BOOST	CODLAG
30-40		
40-50		
50 + 10 MINS		
162 + 10 MINS		

N.B. AHEAD ONLY - ASTERN SPEED DEPENDENT ON No OF DGs AVAILABLE

CONFIG.	CODLAG	SIDED	EM	EM	EM
4		BOOST	4 DG	3 DG	2 DG
3	28	24	15	14	12
4		18	8	8	8

COMMAND AIM

CASUALTIES

RATE	NAME	POSITION	INJURY

NOTES

REPAIR PRIORITIES

	SYSTEM	ETBOL
1		
2		
3		
4		

THREAT WARNING

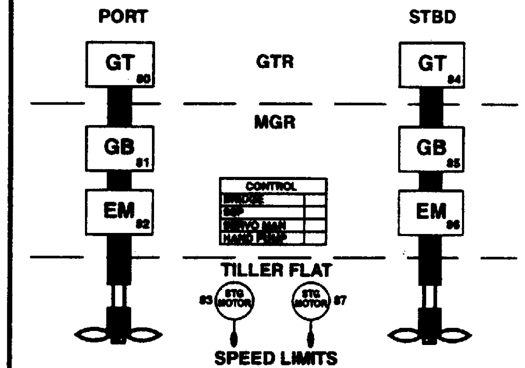
AIR	R	Y	W
SURFACE	R	Y	W
SUBMARINE	R	Y	W
MINE	R	Y	W
NBC THREAT	LOW	MED	HIGH

EMCON	RSI

CITADEL PRESSURE

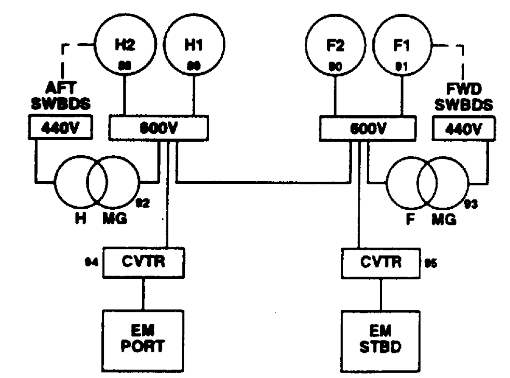
FWD	1A		1B		2	AFT	3		4

PROPULSION



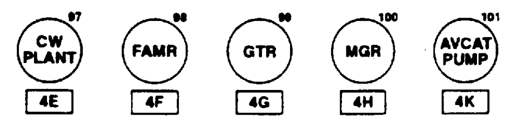
AHEAD	
ASTERN	

GENERATION



EMERGENCY SALVAGE GENERATOR	RUN	S/BY

HPSW



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THREAT WARNING			
AIR	R	Y	W
SURFACE	R	Y	W
SUBMARINE	R	Y	W
MINE	R	Y	W

WEAPONS

COMMAND AIM

		EQUIPMENT	STATE	EDC	CONVERTED SUPPLIES	VENT ATU No	OTHER SERVICES	RUN UP TIME	SURVIVAL TIMES WITHOUT: WATER	SURVIVAL TIMES WITHOUT: AIR	HAZARDS	REMARKS
GWS 26	18	911(F) / DBF		E-A-4 / C-A-1 & 4	115 / 400 - FP5 (01E) 200 / 400 - SFC (CMR)	1	DDU 2, CSH, LP Air, 996, Chilled Water	10 min	1 Hr *	LOSE RADAR A	Radhaz Panacide M Beryllium High Voltage	Supplied from Sw & FP in O.R.A. DBF EITHER Fwd or Aft. DICOLL fed from E-R2-5-1. DICOLL fed from J-R-3-5 at 2H. Loss of MDE - System will not fire - P 1 both Trackers. (*x Battle override).
	19	911(A) / DBF		J-A-1, 2 & 4	115 / 400 - FP 10 (2J) 200 / 400 - SFC (CER)	11 & 12		10 min	1 Hr *	LOSE RADAR A		
	20	VLSS / MFU's		E-A-7			911(F) / (A), MDE	0 min			MISSILES	
		MDE		E-A-8	115 / 400 C & C SWBD			10 sec				
SURFACE WEAPONS	21	GWS 60		E-A-7	Mk 42 SFC 28V 115/400 C & C SWBD	1	DDU 1	10 min	.		Ammunition Efflux	
	22	GSA 8		C-A-1 / C-R-3	115 / 400 - FP1 (CMR) 24v - FP2 (CMR)	6 &16	DDU 2, INA (Ops)	10 sec				
	23	GPEOD					GSA 8, INA (CMR)	THIM 5 min			Movement Laser	
	24	4.5" Mk 8		C-R-1, 4, 10 & 11.		6	GSA 8	15 sec	20 min		Movement, Ammunition, Noitrogen Bottle, OEP 8, Anti-Freeze, Rust Veto.	Loss of ECH will necessitate EMERGENCY RE-SUPPLY.
	25	TDS (P&S)		C-R-3	24v - FP11 at 2H 115 / 400 - PDM 2		Harpoon (ITV)					
	26	30 mm (Port)		G-A-4	Battery Charge 115 / 60			7 sec			Ammunition Movement	Emergency Batteries re-charge from F-05 in 30 mins.
		30 mm (Stbd)		G-A-4	Battery Charge 115 / 60			7 sec				
		GPMG PORT FWD									Ammunition	
		GPMG PORT AFT										
		GPMG STBD FWD										
		GPMG STBD AFT										
UW WEAPONS	33	MTLS		C-A-7 / L-A-3 / J-A-2	115 / 400 - FP 1 24v - FP14 at 2L	4	HP Air, CSH, DDU2.	0 min			HP Air, Thallium, Torpedoes.	Max. No of firings if breeches fully charged.
	34	A.W.H.E.					HP Air	0 min		INOP	Movement, HP Air, Ammunition.	Finish movement manually (V-Slow).
	54	Degaussing		C-A-7,8 & 10		11 & 12	DDU3				High DC Current	Controlled via CCU (Bridge) - Power loss alarms at SC.
	56	HELO									AVCAT, Rotors, Ammunition	
	57	AVFAC 28V TRU		L-A		4		5 sec			High Current	
		AVFAC Lights						0 min				
		AVFAC MG Set		K-R				2 sec			High Current	
		AVFAC Door/Fuel						0 min			AVCAT	
	58	HELO HANDLER		H-R-1				10 sec			OX40, Movement	
NAVIGATION	47	NCS 1 GYRO A		E - A	115 / 400 - SFC in Gyro Room. Emerg. batteries (30 mins)	17	LOG	2.5 Hr				1. Gyro B, DDU B, SFC B, DDU's 1 & 2 can be supplied in EMERGENCY with cables via HCOS in Gyro Rm. 2. DDU's A & B, SFC's A & B and EP's A & B have internal battery life of 30 minutes. 3. When DDU A & B on batteries, Ship's heading in Synchro form only passed to major Navigation aids. 4. DDU 1 alternative from G-A via HCOS in Gyro Rm.
		NCS 1 GYRO B		G - A			LOG	2.5 Hr				
	48	PDM (2) A GYRO Room		E - A	All DDU's 115V 400Hz From MK 34 SFC's in GYRO Room		NCS 1					
		PDM (2) B GYRO Room		G - A			NCS 1					
		DDU's 1 GYRO Room		E - A			NCS 1					
		DDU's 2 Ops Room		G - A	.	16	NCS 1/LOG/WS&D					
		DDU's 3 Bridge		E - A		1	NCS 1					
		DDU's 4 Bridge					NCS 1					
	49	AGILOG		C-A-1	115 / 400 - FP1 (CMR)			3 sec				EM Log readout on Bridge fed from E-A-1.
	50	Wind S & D		C-A-2	115 / 400 - FP1&13 (CMR)		DDU2	3 sec				
		Mag Compass		C-R	24v - FP 11 at 2H							
ENHANCEMENTS	62	JOTS		E-R1-4		16	SCOT					
	63	ASMA				15	SCOT					
	64	NSTN (MHS)				15	SCOT					
	65	CHIRPSOUNDER				15	AVK					
	66	TACSAT				16					RADHAZ	
	67	CLANSMAN				16					RADHAZ	
	68	1254 / DAMA				15					RADHAZ	

Note. This is only a generic example, not to size. Each board is to be made up to represent the individual ship, at least A3 size

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THREAT WARNING			
AIR	R	Y	W
SURFACE	R	Y	W
SUBMARINE	R	Y	W
MINE	R	Y	W

SENSORS

COMMAND AIM

		EQUIPMENT	STATE	EDC	CONVERTED SUPPLIES	VENT ATU No	OTHER SERVICES	RUN UP TIME	SURVIVAL TIMES WITHOUT: WATER	SURVIVAL TIMES WITHOUT: AIR	HAZARDS	REMARKS
AIO	1	996		ACOS N-F-02 A-H-03	115 / 400 - FP6 at 01E 24v - FP4 at 01G & Ops Room	1	CW, LP Air, CSH, DDU's 1 & 2	10 min	O	Till Trip	Radio Active (ADQ) EHT (TWT)	Battle override bypass CW fail. 996 will work without LP Air until Ae VSWR Trip operates - can be Battle overridden.
		LFA							O	Till Trip		
	2	1007			115 / 400 - FP5 at 01E		DDU 2	3 min			Viton Cadmium Batteries and Plating Tantalum Beryllium Radhaz	
		LFC										
	3	1006										
	4	RRB			115 / 400 - FP5 at 01E	1	1007 AAD Rotation					
	5	JUF / JQA			115 / 400 - FP5 at 01E	1 & 16						
	6	1010 / 11			115 / 400 - FP5 at 01E 24v - FP6 in Ops Rm	1	996 ADQ Rotation					
	7	SNAPS		E-A-2 & 6	115 / 400 - PDM2 24v - FP7 in Ops Rm	16	NCS, SFC(A), DDU3	5 min				
	8	CSH	F / A	C-A-7 / J-A-2		6 / 12						
	9	DNA 1		E-A-6		16		15 min	30 min	1 Hr	Beryllium, EHT, CRT, Cadmium, Tantalum	Fibre Optic Hazard
	10	ROLE			24v SW & FP in Ops Rm Annex		NCS1, LOG, DDU1, UHF/HF COMMS	1 min				
	11	PDT					HF RX	3 min				
	5	CTD									EHT	
EW	13	UAF (1)		E-A-2 & 7	115 / 400 - FP5 at 01E	1 & 16	DDU2, LP Air, CW.	5 min			EHT	UAF(1) will run without water when battle override selected. Will run indefinately but system accuracy degraded. Fed from DLB P8U.
	14	DLB (P & S)		ACOS N=F2 A=H3		1					Radio-Active Ind Lights (LCP)	
		DLB (I / F Unit)			24v - FP7 in Ops Rm	16	DDU1					
	15	CRE		E-A-1		15						
	16	DLF										
SONAR	28	2031		E-A-8 / L-A-3	24v C.SW & FP in Ops Rm Annex	16	DDU2	2 min			Kerosene Gel	
		WINCH		L-A-5 / K-R-3			SW Cooling	10 sec			OX 40, Movement	Can run without cooling, must be monitored.
	29	2050 (TX 1)		J-A-3 / C-A-3	115 / 400 - FP1 (CMR)	6	DDU2, CW	5 min	20 min	<70°	Beryllium, Tantalum	Cabinet: Temp at 55C Warning
		(TX 2)		C-A-7	(SIG PRO CAB)						EHT	
	30	2013 / 2090				16		0 min				Cabinet: Temp at 70C Auto shutdown.
	31	162			24V FP OPS Rm Anx	6		0 min				
	32	2008 / 2009				16		0 min				
	53	778		E-A-2		1		0 min				
EXT COMMS	37	SCOT		E-R1-1 / E-R2	115 / 400 - SFC in CMR (1 & 2)	1	DDU 1, CW	20 min	15 min		EHT, Cadmium	Clanaman UHF/HF Emergency.
	38	INMARSAT		E-R1-4		15	GYRO I/P					2 in No. HF broadband wire Ae fed by either Port/Stbd Ae. Emergency Ae Runs - Changeover time 30 mins.
	39	V / UHF		E-R1-1							Beryllium, Cadmium, High Voltage	
	40	HF		E-R1-1 & 2	CCR (LP) SW & FP CCR (HP) SW & FP			5 min				
	41	KMY		E-R1	C & C SWBD			2 min				
	42	DIMPS (MFP A) (MFP B)		E-R1 / E-R2				15 min				
	43	SECURE SPEECH		E-R1				2 min				
	51	GPS Navstar QYF		E-A-1								
		MNS 2000			FP3 BRIDGE LOBBY	1	DDU 4	0 min				
		SQB		E-R1	115V / 400Hz 24V CCR	15		0 min				
		NAVTEX		C-R-3 / E-A-2	115V TRU 1 C & C SWBD							
	60	SICS / SIRS		E-A-1 / L-A-3 / J-A-2 / J-S-3								
INT COMMS		Main B'cast Fwd		C-A-2	115 / 60	12						Battery Backup (1 Hr each Broadcast).
		Main B'cast Aft		J-A-2								
	44	TELEX		C-A-2	24v - C & C SW 17	8						
		TRU 1 / FDB 1 (CRO)		ACOS N=F2 A=H3	24V DC, 10 Amp Output	1					High Current Batteries	TRU Emergency battery (duration 1 hr.)
		TRU 2 / FDB 2 (CER)		J-R		12						
		TRU 3 / FCC (OPS Rm Annex)		E-A-6		16						
		TRU 4 / FDB 3 (CMR)		C-A-8		11 & 12						
	45	VIS. SIG.		E-A-2	15" = 440v 5" & 10" = 115v						Heat & Light	

Note. This is only a generic example, not to size. Each board is to be made up to represent the individual ship, at least A3 size

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CHAPTER 9

NBCD COMMUNICATION SYSTEMS

CONTENTS

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CHAPTER 9

NBCD COMMUNICATION SYSTEMS

0901. The main form of communication used in the NBCD organisation is a mains-operated, battery-maintained, point-to-point interphone system in which the battery operation takes over automatically and immediately if the main power fails. In addition a number of group intercom lines are provided for use between NBCD outstations, HQ1 and the Command.

0902. The communication systems used in NBCD are as follows:

a. The Rationalized Internal Communication Equipment (RICE) which includes the Versatile Console System (VCS).

b. Main broadcast system.

c. Ancillary broadcast systems (eg Machinery Broadcast).

d. Main exchange telephones.

e. Messengers (whose value in communications must never be underestimated).

f. Firefighters' communication sets (helmet-mounted and hand-held radios).

g. Standard Short Range Portable (SSRP) radios.

h. Sound powered field telephones.

0903. Rationalized Internal Communication Equipment (RICE)

The RICE is a system which embraces all direct internal speech communications, with or without call up, with the exception of the automatic telephone exchange, main broadcast, sound reproduction equipment and loud-hailing systems. Outstation terminal equipment includes the following.

a. Microphones (with carbon, electromagnetic or noise-cancelling inserts as applicable); these may be hand-held, stalk-mounted or headset mounted.

b. Handsets (with carbon, electromagnetic or noise-cancelling inserts as applicable).

c. Headsets (single ultra-lightweight; double ultra-lightweight, lightweight, noise excluding or inductive loop for use on magnetic broadcast loops; split ultra-lightweight, lightweight or noise excluding, as applicable).

d. Loudspeakers, muted or non-muted, 1, 4 or 16 W output.

e. Switching elements.

f. Amplifying elements.

g. Plug and socket connections.

h. Headset, handset and microphone stowages.

i. Extensible cords.

j. Miscellaneous elements, eg non-amplifying mixers, etc.

0904. At each outstation all the terminal equipment necessary to the outstation is installed. In certain instances, the facilities terminate in other equipment such as the versatile console system (VCS) units. The cabling from each outstation unit or assembly is wired via junction boxes as necessary to connection boxes sited in the Electrical Distribution Centres (EDCs) and Operations Room. In association with each connection box, a transformer, rectifier, filter and battery is fitted for the provision of the necessary 24 V dc power supply.

0905. Versatile Console System (VCS)

The instrument panel (console) is formed by the grouping of selected units to satisfy control, indication and communication requirements of the operator. Each unit can perform a single function or a series of associated functions, is designed in a fixed range of sizes and can exist as a separate or complete unit.

0906. VCS units can be used in conjunction with interphones, telephone exchange systems, main broadcasts and intercoms. Matching units are fitted in some consoles for sound-powered telephone system, whereby the incoming call from the sound-powered hand generator is converted to the power call-up of an interphone and vice versa.

0907. Group Lines

Multi-way group (conference) communications, utilising handsets/headsets between key positions and personnel, are provided as follows and shown schematically at Fig 9-1:

a. **Command Hot Line** - Permits information exchange between specified officers

Users: Command (Ops Room)
MEO (HQ1)
WEO (Ops Room)
DMEO (HQ2 in large ships)

b. **Damage Control Hot Line** - Permits information exchange on Damage Control and Firefighting between specified officers. (In larger ships additional, dedicated DC Hot Lines are provided between FRPPs and their controlling Section Base).

Users: DCO (HQ1)
All Section Bases OIC (large ships)
All FRPPs OIC (small ships).

c. **DC Telling line** - Enables NBCD information to be exchanged between Incident Board Operators. (In larger ships additional, dedicated DC Telling Lines are provided between FRPPs and their controlling Section Base.)

Users: HQ1 Incident Board operator(s).
All Section Base/FRPP Incident Board Operators.
Ops Room Incident Board Operator.
Weapon Section Base Incident Board Operators.

d. **'L' Reporting Group ('Green Line')** - Permits information exchange on electrical distribution between specified positions.

Users: SCC Electrical Control Desk
HQ2 Electrical Control Desk
All Switchboards & EDCs
Weapon Section Base CCWEA
Alternative Weapon Section Base CPOWEA
FRPPs

e. **Weapon Repair Hot Line** - Provides communication to manage the Weapon Repair Organisation in the Action and Defence states.

Users: WEO (Ops Room)
DWEO (Weapon Section Base)
OIC/RIC (Alternative Weapon Section Base)

f. **Weapon Repair Group** - Provides communication to coordinate Weapon Repair in the Action and Defence state.

Users: CCWEA (Weapon Section Base)
CPOWEA (Alternative Weapon Section Base)
All Weapon Repair Outstations
WEO's Assistant (Ops Room)

g. **Cleansing Station Intercom** - Permits information exchange within individual Cleansing Stations and adjoining citadel entrances.

Users: Cleansing Station Entrance (weatherdeck)
Cleansing Station First Stage
Cleansing Station Second Stage
Cleansing Station Exit (Citadel)

h. **Command Open Line** - Enables the NBCD and Weapon Repair Organisation to monitor the tactical situation as required.

Users: Command
WEO (Ops Room)
Command Team (Ops Room)
WSB (Loudspeaker watch only)
HQ1 (Loudspeaker watch only)
Alternative WSB (Loudspeaker watch only)

		CIRCUITS							POSITION/PERSONNEL																		
		HOT LINE	OPEN LINE	DC TELLING LINE	'L' REPORT GROUP	WEAPON REPAIR GROUP	WEAPON REPAIR HOT LINE	DC HOT LINE	WEO - OPS ROOM	WEO ASSISTANT	MEO - HQ1	DCO - HQ1	NBCPO ASSISTANT	'L' DESK HQ1	DMEO ALT HQ1	DWEO WSB	OIC ALT WSB	CCWEA	CWEA	WEAPON REPAIR PERSONNEL	NAVAL STORES	OIC REPAIR POSTS	COMMAND SHELTER	CLEANSING STATION	MONITORING POSITIONS	WEAPON REPAIR WSB 1	WEAPON REPAIR WSB 2
OPS ROOM	COMMAND	X	X						X		X																
	PWO		X						X																		
	WEO	1	X				1				X		X		X	X	X										
	WEO'S ASSISTANT					3												X	X							X	X
	INCIDENT BOARD			X																							
HQ1	MEO	1													X								X				
	DCO							3														X					
	NBCPO ASSISTANT	1/4																					X	X	X		
	INCIDENT BOARD			X																							
	'L' DESK				X													X	X								
AHQ	OIC	1							X		X																
	INCIDENT BOARD			X																							
	'L' BOARD				X									X				X	X								
WSB	DWEO/CCWEA		2			3	1		X								X										
	CCWEA																		X	X	X						
	'L' BOARD				X									X													
	INCIDENT BOARD			X																							
	WPN/SENSORS BOARD					3																					X
ALT WSB	OIC		2			3	1		X							X											
	CPO/PO WEA																	X		X	X						
	'L' BOARD				X									X													
	INCIDENT BOARD			X																							
	WPN/SENSORS BOARD					3																				X	
WPN REPAIR PERSONNEL						3												X	X								
NAVAL STORES OFFICE																		X	X								
FRPP	OIC											X															
	INCIDENT BOARD			X				3																			
	'L' BOARD				X																						
SWITCHBOARD (L)					X																						
COMMAND SHELTER				X							X		X														
CLEANSING STATION													X														
MONITORING POSITION													X														

KEY X COMMUNICATION LINK

1 EXCLUSIVE PERSON TO PERSON INTERPHONE LINE SEPARATE FROM OTHER COMMUNICATIONS AND ABLE TO OPERATE WITHOUT SHIP'S SUPPLIES.

2 LOUD SPEAKER ONLY

3 A DEDICATED WEAPON REPAIR GROUP AND A DC HOT LINE, NOT FITTED IN OLDER SHIPS

4 COMMUNICATION LINK WHEN UNDER N, B OR C THREAT

Fig 9-1. NBCD Minimum Communication Requirements

0908. Main Broadcast

Microphones with input to the entire Main Broadcast system are fitted at HQ1 and HQ2 with alarm pushes for both the General and Chemical Alarms.

0909. Main Exchange Telephones

The exchange telephone system is robust and well-fitted with alternative and emergency power available and may include battery power back up. It must be borne in mind that any system of internal communication is a good channel for NBCD information.

0910. Messengers

Messengers should be nominated in case of complete communication failure. The messages they carry should be in a written format wherever possible. They are a useful means of relaying lengthy or complicated messages which might easily be misunderstood or take too much time on the telephone.

0911. Firefighter's Helmet with Built-in Communications (FFHBC)

The FFHBC is described in Chapter 26 and full details are contained in BR 9215. The helmet contains a built-in radio, a bone-conducting microphone, a press-to-talk switch and earphones, enabling the members of a firefighting team to communicate with each-other. A hand-held radio (see Fig 9-2) is provided to enable the I/C at the Forward Control Point (FCP) to communicate with the team.

0912. The radios have ten channels. In the standby condition, all hand-held and helmet-mounted radios are to be set to Channel 1. At NBCD State 1, each FRPP is allocated discrete channels (eg odd channels forward and even channels aft); these channels are to be specified in the ship's NBCD Orders. The hand-held and helmet-mounted radios have a function switch which may be set to the FF or TL positions. The Team Leader's radio is to be set to the TL mode, allowing him to override the other radios on the same channel. The remainder of the firefighting team and the I/C at the FCP are to set their radios to the FF mode. Exceptionally, the I/C at the FCP may have to switch to the TL mode, eg for emergency withdrawal of the team. For Damage Repair Parties, communications may be between two hand-held radios.

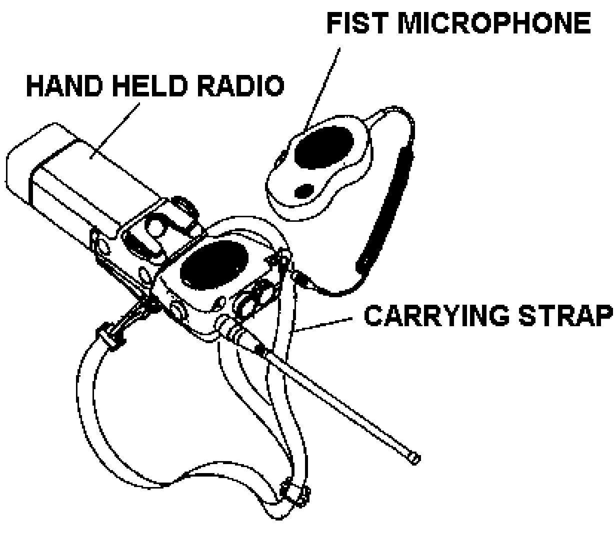

Fig 9-2. Hand-held Radio

WARNING

THE HELMET-MOUNTED AND HAND-HELD RADIOS ARE NOT TO BE USED INSIDE MAGAZINES.
THIS APPLIES TO BOTH THE STANDARD AND INTRINSICALLY SAFE VERSIONS.

0913. Intrinsically Safe FFHBC

The standard helmet-mounted and hand-held radios are not certified safe for use in dangerous spaces in RFAs, such as cargo tanks, cofferdams, pump rooms and areas within a tanker's gas envelope. Intrinsically safe versions of the FFHBC and hand-held radio, with an explosion-proof rating of 'Ex i', are supplied to RFAs. These can be identified by a blue band on the helmet, the hand-held radio and their special batteries.

0914. Standard Short Range Portable (SSRP)

These are a small transistorized portable radio transmitter/receives (eg Cougar) used for NBCD purposes and other ship activities. The case is splash- and dust-proof and contains the transmitter and receiver circuits with their controls, a speaker-microphone, a ship rechargeable battery, and built-in aerial. They are not intrinsically safe but they are acceptable for general use in HM ships (those sets supplied to RFAs are intrinsically safe). Their use must be subject to the following precautions:

a. The set must not be used where an explosion hazard exists, as in the presence of petrol vapour or in empty fuel tanks.

b. Although the set is splash-proof, if it is used in an excessive water spray it should be contained in the plastic cover provided.

0915. Sound Powered Field Telephones

Two field telephones with a drum of connecting cable are provided at each FRPP to provide communication between it and the Forward Control Position (FCP). In harbour, field telephone communications and a guide line are run out from the upper deck to the FCP along a route decided by the Senior Fire Officer of the LAFB and the OOD. A field telephone link is established between HQ1 and the FCP when the location of the FCP is known.

CHAPTER 10

NBCD PREPARATIONS FOR WAR AND ACTION

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CHAPTER 10

NBCD PREPARATIONS FOR WAR AND ACTION

1001. NBCD Preparations for War

It is difficult to establish with certainty those actions which should be taken by ships on or before the outbreak of hostilities in order to improve NBCD arrangements. The difficulties are:

a. To establish those actions which appear desirable from a damage control and firefighting viewpoint and those which could, over a realistic period of time, prove to have a degrading effect on habitability and morale.

b. To establish those actions which will take time to complete and which should therefore be started at an early stage in a period of tension, and other actions which, once completed, might prove a distinct source of embarrassment to ships and bases, were tension to be relaxed (this latter category includes actions which could involve financial loss).

1002. The Force Commander or individual Commanding Officer must be given guidance on what is desirable and what is considered acceptable under certain broad circumstances, and they must be free to decide their action according to the prevailing conditions. For example:

a. The removal of ship's side linings was found to be necessary during the Second World War to make easier the control of possible damage to the hull, but their removal in a modern ship could have a marked effect in the Arctic or tropics, as well as possibly depriving the side of lining/lagging provided for the limitation of noise.

b. Some preparations may be obvious to an outside observer who might interpret them as an escalation of the situation. The rules of engagement in force at the time must therefore be taken into account.

1003. Preparations can be undertaken in three stages. The first stage contains those actions which can be carried out covertly and later reversed at little cost. The second stage comprises actions to be taken during a hardening of the situation. The third stage should be put into effect on completion of the second stage preparations if the situation continues to deteriorate and, hopefully, to be completed before the start of hostilities. In some situations (eg operations other than war) it may be necessary to merge or adjust the following staged preparations to ensure that the ship's operational posture is fully tailored to the overall situation. This will be decided by the Command, based on guidance from the CTG and from internal 'table-top' planning.

1004. First-stage Preparations

a. Conduct 'table-top' planning for likely NBCD scenarios and adjust preparations accordingly.

b. Check main and duplicate key boards/drawers are correct and make good any shortcomings.

c. Check holdings and serviceability of NBCD equipment and stores, special attention being paid to BA, firefighting equipment and that NBC stores are adequate and in date for use.

d. Review planned maintenance on NBCD, and associated, equipment, bringing forward as necessary.

e. Review NBCD contents of Ship's and Departmental NBCD orders.

f. Check all smoke curtains for operation and effectiveness.

g. Check all escape hatches operate correctly.

h. Check all escape ladders function correctly.

i. Order the removal of facial hair.

j. Review the Jettison Bill.

k. Review medical arrangements:

(1) Order war stores.

(2) Check that the Ship's Company are in date for medical/dental checks.

(3) Check that all blood groups are known.

(4) Accelerate the first aid training programme.

(5) Disperse first aid equipment and stores around the ship.

(6) Check Chemical Field Sets are complete and in date.

l. If at sea, defuel all boats except the seaboat(s).

m. Review the arrangements for locking compartments, other than magazines and storerooms (for which other arrangements already exist), to ensure ease of access in the event of damage.

n. Review arrangements for, and identify, compartments and spaces available for the stowage of additional NBCD and other equipment and stores.

o. Ensure that the combinations to security containers are held by a suitable officer whose place of duty is remote from that of the officer normally responsible.

p. Promulgate 'gash' disposal policy and organisation.

q. Check respirators and haversack contents (see BR 2170(2)).

r. Order identity discs to be worn.

s. Review holdings of NBCD stores. Order additional DC shoring timber and steel plate.

t. Fit anti-shatter film to all glass mirrors and unbacked melamine paper laminate linings.

1005. Second-stage Preparations

a. Ensure that victualling, NAAFI and medical stores are safely and adequately dispersed throughout the ship.

b. Disperse the sleeping and messing arrangements of key personnel as much as possible.

c. Order respirator canisters to be changed using the spare one carried in the haversack.

d. The following stores should be issued in accordance with current allowances and as necessary, and indicated by the threat assessment:

(1) Action coveralls.

(2) Once-only suits.

(3) NBC inner and outer gloves, overboots and suits.

(4) Additional respirator canisters.

(5) Chemical agent detector paper.

(6) DKPs 1 and 2.

(7) RVDs and CAMs.

(8) Dosimeters and radiac instruments.

(9) NAPS, BATS and Combopens. (Orders for the issue and use of these items will normally be given by the Chief of Joint Operations (CJO), the Joint Task Force Commander (JTFC) or by the CTG.)

(10) Action carry bags, when authorised by the Command.

e. Order respirators and lifejackets to be carried.

f. Activate SICS/NAIAD, SIRS and INBDS if fitted and relevant to the threat. Run up CAMs to confirm serviceability. (Equipment activation will need to balance the threat level against the consumption of consumables for some equipments.)

g. Prepare Secondary Medical Position (SMP).

h. Land the following, non-essential, items:

(1) Curtains, loose covers and bunk overcases (except those covering foam rubber or plastic material).

(2) All surplus furniture.

(3) Non-fireproofed timber (excluding timber needed for DC and emergency repairs).

(4) Gangway furniture eg screens, lifebelts, stands, covers etc.

(5) Ship nameboards, boat nameboards and badges.

(6) All awnings and stanchions.

(7) Recreational boats.

(8) Loose carpets.

(9) Glass-fronted pictures, crests and non-essential decorative items.

(10) All trophies, silver and associated cases.

(11) All non-Service items of personal baggage including civilian clothes and shoes.

(12) Reduce holdings of paint (minimum to 'touch up' rust patches and external surfaces) and other flammables.

(13) Funnel badges.

(14) Private radios/recording equipment which cannot be securely stowed in lockers. (Mobile phones are so small that they can easily to stowed but EMCON/security considerations may require some action to be taken.)

i. Remove perspex/glass fronts to notice boards etc and, where necessary, replace with wire mesh.

j. All books except BRs etc in use, to be kept secured in lockers. Books on bookcases/shelves to have arrangements for restraining contents.

k. Ensure, wherever possible, that items of equipment and stores which are normally not secure, and could be accelerated under shock/whip conditions, are adequately secured.

l. Make checks to ensure that the ship is best able to resist shock, as follows:

(1) Check that all shock mounts are free to move and are in good condition.

(2) Check that items which are shock mounted have adequate clearance around them and that stores, books etc are not stowed on top of them.

(3) Check that shock mounted items are not 'shorted out' by bights in cable or pipe connections. Minimum clearance are given in BR 3021, Volume 2.

(4) Check that all store rooms are stowed correctly with all battens in place and items lashed in position where necessary.

(5) Check that all fire extinguishers, hoses, portable pumps and associated equipments are in their correct stowage positions and cannot be displaced by shock or whip.

(6) Check that all gas/air bottles are in their correct stowages and are not free to move.

(7) Check that all equipment secured to benches, bulkheads and other fixed structures are bolted in position.

m. Distribute plastic jerrycans and similar containers, filled with fresh water, around the ship.

n. Accelerate and intensify the training of NBCD teams.

o. Personnel to be briefed and practised on how best to protect themselves from the effects of weapons.

p. Issue morphine to officers/ratings i/c First Aid Parties.

1006. Third-stage Preparations

a. Ensure that the Ship's Company have access to, and are encouraged to read:

(1) BR 4007 - Guide to Ship Firefighting.

(2) BR 1329 - Survival Handbook.

and that NBCD personnel have access to:

(3) BR 2170 Vols 1, 2 and 3 (Vol 4 for submarines).

(4) Ship's NBCD Class Book, CB 4538 series.

(5) Ship Stability and Survivability Book, CB 9500 series (not all ships).

b. Issue lengths of line for securing bedding, furniture etc in place before going to NBCD State 1.

c. Consider draining deep fat fryers when not in use.

d. The use of hot water heating urns should be controlled and restricted to reduce ‘wild heat’ and the risk of scalding.

e. Issue the maximum number of torches.

f. Cabins, messdecks and public areas to be secured (bedding, lockers, drawers, furniture, etc) when not in use.

g. Servery, galley and food or other lift hatches/shutters/doors to be closed when not in use.

h. Rimlocked doors to be left unlocked and closed. Where security is necessary hasps, staples and lightweight padlocks should be fitted.

1007. Jettison Bill Preparation

A Jettison Bill is to be prepared in accordance with QRRN and included as part of the ship’s NBCD Orders. It should list all those items which are comparatively heavy, sited above the centre of gravity (usually superstructure, 1 and 2 decks only) and which can be removed and jettisoned with reasonable ease. Ideally, the Jettison bill should contain the following information:

a. The item of equipment.

b. Its position by location marking and distance from the centreline.

c. Its weight and mobility.

d. The tools, if any, needed for its removal.

1008. Jettison Bill items must be peculiar to the particular ship, but the types of equipment which can usually be included are as follows:

a. Anchors, but not the cables which should be dropped into the lockers.

b. Ship’s boats, which can be put into the water and secured to the ship.

c. Aircraft, which can be flown off.

d. Ready use ammunition lockers (but not the ammunition) and other weatherdeck lockers.

e. Equipment such as wires and reels, hawsers, awning gear and canvas, spare gear for weapons, machinery boats, etc, cable working gear.

f. RAS stump mast.

g. Potatoes from their weatherdeck stowage.

h. MCMVs - Mine sweeping equipment, loops, reels, etc, compression chamber.

1009. Identity Discs
All RN personnel are to be in possession of four identity discs on personal loan:

a. Two stainless steel identity discs with nickel plated metal neck chains and connectors are to be secured inside the respirator haversack. These discs are engraved with the name, official number, blood group and religion of the owner. They are to be worn around the neck of the owner when ordered.

b. Two red, fibre identity discs. They are normally issued at the same time as the NBC respirator, One is to be attached to the bottom of the Primary Speech Module by a brass split ring. The other is to be attached to the D ring on the outside of the haversack. Both are to be stamped showing the owner's name to identify the respirator after cleansing.

1010 to 1029. Spare.

1030. NBCD Preparations for Action
In applying these recommendations, or before consideration is given to making any or all of them mandatory, account must be taken of the situation(s) in which the particular ship(s) may be involved.

1031. In a general war situation a ship is likely to spend a large part of the time in NBCD State 2 with the majority of the Ship's Company in Defence Watches. Under such circumstances messdecks and cabins are being lived in and workshops are being used, and will continue to be right up to the moment when NBCD State 1 is ordered, which may be as a result of:

a. A change in the overall threat which probably requires the rapid assumption of Action Stations in addition to NBCD State 1.

b. Sudden and unexpected damage which could require the immediate assumption of Action or Emergency Stations.

c. Knowledge that the operations into which the ship is about to enter will mean prolonged periods of Action Stations and/or NBCD State 1 with a high possibility of damage.

1032. In the types of situation which give rise to the sudden and unexpected assumption of Action Stations/Emergency Stations/NBCD State 1, it is neither reasonable nor realistic to expect that all desirable precautions will have been taken before personnel close up at their stations. However, when some warning is to be expected, precautions can and must be taken beforehand.

1033. It is more probable that a ship will find it necessary to go to NBCD State 1 from State 2 with no prior warning and that occupants of compartments (messes, workshops, etc) will be unable to complete all the desirable preparations before closing up. The training of the Ship's Company must therefore stress the importance of tidy living at all times and the particular training of the NBCD teams must emphasize the need to correct any obvious faults in preparations as part of their closing up drill.

1034. If the preparations for war have been carried out, preparations for NBCD State 1 should normally be limited to the following, unless there is special reason for further measures:

a. Carry out the State 1 preparations listed in the ship's NBCD Orders.

b. Empty waste paper baskets and gash buckets.

c. Cover TV and VDU screens not required in Action.

d. If the warning time permits, all personnel dress in clean clothing.

e. Stow away all loose clothing and ensure that doors to kit lockers and drawers in offices and cabins are securely closed.

f. If towels cannot be safely stowed within kit lockers they should be firmly knotted on the towel rails.

g. Bundle curtains together and stow them or lash them securely in their positions.

h. Lash and secure movable furniture except, for example, the Wardroom table and fittings where the Wardroom is the Secondary Medical Position (SMP).

i. Check the smaller compartments which are not covered by the normal key regulations.

j. Switch off unnecessary heaters, heating and electrical circuits.

k. No hot fat/cooking oil in galleys.

l. All personnel carry respirators and lifejackets.

m. Check that plastic, fresh water containers are full, and stowed safely. All water bottles to be filled.

1035. The Command should have a clear understanding of the time taken for key personnel to close up from State 2, and the time taken to achieve full State 1. In some situations these times may be crucial in determining whether to order State 1 as a threat materialises or remain at State 2 until after damage is sustained, in order to ensure highest feasible level of damage control integrity as the 'hit' is taken.

CHAPTER 11

SABOTAGE ATTACK AGAINST SHIPS - NBCD COUNTERMEASURES

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CHAPTER 11

SABOTAGE ATTACK AGAINST SHIPS - NBCD COUNTERMEASURES

1101. BR 8988 and JSP 440 RN Supplement provide guidance to Commanding Officers on defence against sabotage and terrorist attacks made on their ships both above and below water, giving background information on the factors which have to be considered, the preparations which must be made in advance and on dealing with the threat when it materialises. They also identify a number of possible means of attack ranging from mortar attacks, to car bombs, to underwater swimmers. The potential for ships to be targeted with biological or chemical weapons poses a newer, albeit highly unlikely, threat in certain operational theatres. The following paragraphs provide supplementary guidance on the damage control and NBC Defence considerations arising from a terrorist or sabotage threat.

1102. The Threat

Threats to ships in harbour will normally be countered by the procedures instituted under the relevant BIKINI or AWKWARD Alert State. BR 8988 states that an attack will fall into one of two categories, alerted or unalerted. In the case of the former, the ship may be alerted to the possibility of a threat before its arrival in port (presuming there is an overriding requirement to enter harbour) or at a subsequent point in its period alongside, anchored or moored.

1103. When a ship is alerted to the possibility of a threat, the ship will need to tailor its preparations to the likelihood that an attack will be made and to the level of warning that can be expected. This is reflected in the various levels of BIKINI and AWKWARD alert states. If a ship is alerted prior to entering harbour, as many material preparations as possible should be completed prior to entry, although certain aspects may need to be modified in order to maintain an impression of normality on the upper deck and in areas used by visitors. When intelligence information is received after arrival that requires an increase in the general alert state, due consideration will need to be given to the limitations imposed by the reduced number of personnel onboard. Whilst the priority must be to achieve and maintain the required state, DC&FF and/or NBC Defence preparations for the next higher state should be started early in order to reduce the impact of manpower shortages. It should be noted that it may not be possible to achieve the full State 1 and consideration will need to be given to deployment of the reduced manpower.

1104. In the event of an unalerted attack, the DC&FF response will vary according to the type of attack and damage sustained. In all such situations the DC&FF effort will have to be undertaken without those ratings who are part of the Ship Protection Organisation (SPO). Additional non-duty personnel will need to be mustered and briefed in an area clear of the upper deck and the area of damage. The OOD may need to delegate his SPO or DC&FF responsibilities to another officer or senior rate.

1105. Main Broadcast

When calling an AWKWARD state, main broadcast should only be used when beyond audible range of land. If alongside, or in audible range, either mute all upperdeck loudspeakers or advise the requirement by a less obvious pipe (‘Clear lower deck of all officers and senior rates, muster in ...’ maybe appropriate, followed by a briefing). The Action Alarm should only be used if the ship has to react to a direct attack without warning.

1106. Awkward and Bikini

The AWKWARD Alert System is intended to provide guidance on the defence posture required to counter possible sabotage activity during periods of tension, TTW or war. The Bikini Alert System is concerned with the measures to be taken on receipt of a warning of terrorist attack. Both encompass a wide range of means of attack and thus potential damage. Preparations will need to be guided by available intelligence assessments.

1107. Underwater Attack

If the primary threat is of underwater attack the focus of activity should be to ensure that the maximum degree of watertight integrity is maintained commensurate with the level of threat. Consideration should be given to restricting access to compartments on or below the waterline. A large underwater charge could result in whip action and thus full securing for action is essential. If the ship is on her own power supplies the possibility of (some of) them being lost should be included in the planning as should the potential for fires caused by damaged running machinery. Should an underwater charge explode, it will be necessary to obtain an early estimate of the damage and commence DC&FF efforts. However, the number of personnel committed to the task will need to be carefully controlled in case of damage from further charges.

1108. Surface Attack

If this is the primary threat, then damage sustained in the event of an attack is likely to be similar to that from a shell or missile. Fire is potentially the greatest hazard, although splinter damage could cause localised flooding and casualties. The general guidance is to increase the watertight integrity with the alert state and, while risk of significant flooding may not be a concern, a higher NBCD state will permit better control of smoke boundaries in the initial stages. Again, early identification of the extent of the resulting incidents is essential but, in some circumstances, it may be necessary to ensure, through use of the SPO, that it is safe to move personnel onto the upperdeck to deal with incidents there.

1109. Pre-emptive Action on Discovery of Unexploded Sabotage Charges

BR 8988 contains general guidance on the actions to be taken when a charge is found before it activates. The principle requirements are to isolate all supplies to the vicinity and provide a vent route for the blast. Personnel will need to be moved clear of the area, including those adjacent compartments which could suffer splinter damage. Careful consideration should be given to the state of fuel tanks in the vicinity, noting that full tanks are safer than partially empty ones. The proximity of magazines to the device should be reviewed and the status of the flood and spray arrangements checked. The possibility of the device triggering a magazine incident should not be discounted. It may be prudent to flood a magazine if it is estimated that there is a high risk of a serious magazine incident being initiated by the device. All portable DC&FF equipment should be removed from the area of the device if time permits, although this may not be prudent if it is in the vicinity of a FRPP or Section Base. Fire and repair parties should be mustered clear of the anticipated danger area but ready to respond quickly.

1110. Other Attacks

The possibility of attacks using BW or CW against ships is remote, although in some theatres it may rise during periods of tension. The threat can range from tear gas type aerosols discharged into ventilation systems by terrorists/activists or more serious attacks which might even have been directed at adjacent land forces. The appropriate level of defensive measures will need to be determined based on available intelligence assessments and guidance from higher authorities. There are limited counters available to terrorist attack as, except in exceptional circumstances, it will not be possible to achieve an effective gas-tight citadel and some personnel will need to be exposed on the upper deck. During periods of tension or greater it may be possible to consider maintaining a citadel at very high threat states. Prior to that some preparatory closing down could be achieved although the benefits would need to be weighed against habitability, access, maintenance and operational considerations. In such a situation it is most likely that the threat will also apply to adjacent land forces and thus the ship's posture, including dress states, should be guided by theirs. Where no UK land forces are present, the ship's posture will need to take account of local sensibilities. If possible, a more prudent course of action may be to sail, avoidance being a primary defence against BW or CW for ships.

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CHAPTER 12

SUPPLY DEPARTMENT

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CHAPTER 12

SUPPLY DEPARTMENT

1201. The normal responsibilities of the Logistics and Supply Officer (LSO) for provisions, naval stores, their respective storerooms and feeding the Ship's Company must include consideration of the problems imposed by the NBCD threat which, in conjunction with the NBCD Officer and the NBC Protection Officer, also include certain aspects of the cleansing stations.

1202. The LSO organises the Supply Department to maintain the supply of food and stores before, during and after action. LSO must also take the necessary precautions to restrict the impact of secondary damage, fire and flooding in Supply related compartments. With this in mind, dispersal plans, accessibility and stowage of all stores ranges should be considered for all Supply spaces (See Chapter 10). Routines for ventilating storerooms must also be established with the NBCD Officer.

1203. Stores and Storerooms

Special arrangements are made for the stowage of delicate, high value, flammable stores and foodstuffs liable to contamination by NBC agents or noxious fumes. Detailed information, in these respective areas is contained in BR 96 - Stores Accounting Instructions, BR 5 - Catering Manual and BR 1754 - Safety Regulations for Storing and Handling Petroleum, Oils, Lubricants and Certain Other Hazardous Stores in HM Ships.

1204. Accessibility of Stores

Stores supplied to ships for NBCD purposes are drawn from the LSO by the Marine Engineer Officer or the NBCD Officer and stowed in, or near to, FRPP lockers, the NBC store, or other authorized stowages.

1205. Provisions

When operating under war conditions, ready-use stocks of provisions are to be deployed in secure places as high as practicable within the citadel, so that they are readily available as a reserve against damage to storerooms or for action messing. Any provisions or clothing not packed in impermeable containers must be sufficiently covered to protect them from gross NBC contamination.

1206. Stowage of Storerooms

All storeroom locations should always, in peace and war, be properly stowed and secured with appropriately fitted securing arrangements (see Chapter 4). Gangways, ship's side, bulkheads and approaches to storerooms should be kept clear of stores as far as practicable. If the space available does not permit this when the ship is fully stored, the stores must be stowed so that those on the perimeter of the storeroom are used first, enabling access to be gained to the boundaries after the shortest time at sea. To preserve the contents of standard packaged stores and equipment, the special wrappings should not be removed until the articles are required for use. In any event, packages incorporating waterproof or moisture-proof/vapour-proof barriers should not have these barriers removed.

These are normally labelled either:

'NOT TO BE OPENED UNTIL REQUIRED FOR USE'
or
'METHOD II PACK. NOT TO BE OPENED UNTIL REQUIRED FOR USE EXCEPT FOR RENEWAL OF DESICCANT. DATE OF LAST CHANGE ....'

All loose wrappings and containers should be removed from storerooms, and textiles tightly bundled, to reduce the risk of fire and of choking pump suctions (see Chapter 4).

1207. Storeroom Security

Storerooms have duplicate locking arrangements (see Chapter 4). Supply ratings are responsible for transferring the duplicate keys from HQ1 to FRPPs when NBCD State 2 or State 1 is ordered, and their return on assuming State 3 (see Table 4-1).

1208. Action Logistics Support Cell

When operating in the Action State, an efficient logistics support organisation needs to be in place to ensure sustainability issues are correctly addressed in relation to the Command Aim. This assumes particular importance should the ship suffer secondary damage.

a. **Primary Functions.** The Action Logistics Cell (ALC) should normally be in a compartment that can provide access to good, whole-ship communications (ie adjacent to, or integrated with the Weapon Section Base (WSB)). The Main Stores Office is not the ideal location because of the potential for damage (and low recovery time) to the main broadcast and exchange telephones. A Secondary Action Logistics Cell (SALC) should also be identified in the event of having to evacuate the ALC, within or close to the alternative WSB. The position of both Cells, and the routines to be used for retrieving stores are to be made known to the Ship's Company through a regularly reviewed LSOTEM and by exercising the retrievals process. The primary functions of the Primary Logistics Coordinator (PLC) or his Stand-by are to:

(1) Provide swift and accurate briefings to personnel tasked to retrieve spares. The PLC should not make the issue(s) personally, as he is to be in a position to provide the wider logistics advice to the Command.

(2) Evaluate the impact of battle damage incidents and be prepared to provide the Command with sustainability information.

b. **Personnel.** With the LSO invariably employed as Damage Control Officer (DCO) at State 1, responsibility for providing logistics advice and coordination is assumed by the Stores Senior Rate (SSR), who functions under the PLC title. In the event of the PLC being incapacitated a Stand-by Logistics Coordinator (SLC) should be nominated. The SLC should be employed in a flexible role that will allow him to be released without impacting on the primary role. (ie AMT and not an IBO.)

c. **Store Retrievals.** Efficient stores retrievals are essential and may need to be prioritised, as a number of stores requests may be received simultaneously. The PLC SLC must therefore be fully aware of the Command Aim and Equipment Repair Priorities in order to determine the precedence of issues. A safe transit route should be given to the person retrieving the stores, and this is best achieved through the WSB Incident Board Operator (IBOI). Retrievals should form part of NBCD circuit training.

d. **Documentation Required.** Both the ALC and SALC must be equipped to fulfil the full logistics support function at Action. In support of this aim, an Action Logistics Information Log should be held in both cells, and contain the following:

(1) The Ship Plan, highlighting the following locations by colour code:

(a) Naval storerooms.
(b) Provision storerooms.
(c) Medical stores locations.
(d) RAS equipment
(e) Aircraft Spares (hangar).
(f) NBCD equipment.
(g) NAAFI storerooms.
(h) Ready-use stores.
(i) Safety equipment.

(2) A Command Priorities page (see format at Annex A) detailing:

(a) The Command Aim.
(b) The top three ME and WE repair prioities.
(c) The threat.

(3) Incident Log pages (see format at Annex B), to include:

(a) The date of the incident.
(b) The time of the incident.
(c) The location of the incident.
(d) The incident.
(e) The logistical implications.
(f) Time reported to the Command/Command huddle.
(g) The final assessment.

(4) A configuration breakdown of each storeroom and sustainability implications in the event of losses.

(5) Issues Log pages (see format at Annex C), to include:

(a) The date of issue.
(b) The time of issue.
(c) The equipment effected.
(d) The description.
(e) The stock number.
(f) The location.
(g) The name of the person collecting the item.
(h) The time at the storeroom.
(i) The time at the repair point.

(6) A layout plan of all the Naval storerooms and contact numbers for the respective ALC and SALC.

e. An up-to-date 6 monthly fall-back print (no more than a month old during periods of OST or in times of real tension), should also be held at each cell, together with emergency lighting (for use either within the WSB or by stores retrievers, ie torches and batteries), good communications within and external to the WSB (ie Telephone, IBO or other headset) and sufficient writing implements. Finally, a lap-top computer containing NAVCAT and fallback documentation is required at the ALC, which can be easily moved (if convenient and time allows), to the SALC.

f. **Logistics Advice.** The PLC must assess the implications of direct or secondary damage to the range of stores listed at sub para 1208.d.(1) above. In order to achieve this, he is to insert details of each incident on the Incident Log page(s), together with any logistical impact. This information should be passed to the Command via the WSB, either before or during Command huddles using the ‘Flash’ procedure if necessary. The Incident Log page(s) should be used thereafter to monitor the currency of information received and any subsequent updates.

g. **Conclusion.** It is fundamental that continued and effective support is available from the logistics organisation at Action. Swift retrieval of spares and the ability to provide the Command with an assessment of the implications in relation to the Aim are therefore seen as important elements to sustaining the Ship’s fighting capability. The PLC/SLC coordinates these activities and is an integral part of the State 1 team in a warship: it is therefore most important to exercise the Action Logistic Support from either the Primary or Secondary Cell during ‘in-house’ training.

1209. Action Messing Organisation

The pre-deployment of 'action snacks' at State 2, and the swift distribution of hot and cold drinks to pre-ordained positions when State 1 is piped, is the most effective method of ensuring the short term sustenance of personnel.

1210. In a period of tension, it is highly likely that the ship will remain closed up at Action Stations for prolonged periods, and so one of the major considerations of the Command must be to ensure that all personnel are sufficiently fed and hydrated to sustain their fighting efficiency, either by quarters or centralised messing. This can only be achieved by a dedicated team, who are immediately available to prepare, provide and distribute snacks, or hot/cold drinks to upper deck crews and personnel between decks. As soon as the Command decides that the tactical situation allows, then a team must be in position to ensure that quick provision of a hot meal, either at State 1 or as the ship reverts to Defence Watches (State 2). The LSO must therefore ensure that a dedicated Action Messing Team (AMT) is detailed on the Watch and Quarter Bills for State 1.

1211. It is entirely appropriate for the AMT to conduct 'Blanket Searches' of their immediate areas and to be used as spare hands to assist in the damage control effort when the situation and Command priorities dictate. Nevertheless, they should not be deployed automatically to another role at State 1, as this will inevitably prevent them from carrying out their primary task. This applies equally to war and peacetime exercises, where it is essential that the AMT is allowed to train with the reality of operational combat.

1212. Should the Command decide that the tactical situation allows for the provision of a hot meal, while remaining at State 1, it is imperative that 75% of personnel remain closed up at their Action Station. This can only be achieved by strict manpower control, and for this reason it is recommended that a 'card relay' system be used. Only 25% of personnel receive cards, under the direction of the I/C at the local FRPP or Action Station. As the first wave return, the cards are handed over to those nominated to be fed next. Utilising a strong personality in the dining area to check cards and hasten personnel, the 'bogey time' employed by FOST (75 minutes from initiation by Command to re-secure to State 1), is considered achievable in all classes of ship.

1213. Prior to operational sea training and during times of tension, ships' companies must be educated in the role of the AMT, how to effect re-supply of drinks at State 1 and the routine for Action messing.

1214. Emergency Feeding Station (EFS)

Type 23 frigates benefit from a secondary feeding position that can be utilised in an emergency. It is imperative that sufficient canned provisions are held in order to feed the entire Ship's Company from the EFS, complete with the appropriate quantities of messgear and crockery/cutlery (this should be permanently held in the compartment). The ME Department must also ensure the availability of the EFS equipment at all times.

1215. As the entire Ship's Company of a T23 needs to be fed from the EFS in an emergency, Action messing from this compartment is a regular serial for these ships at OST. The relay card messing system is appropriate for the evolution and its successful completion is achievable within the time detailed at Para 1212.

1216. Fallout Messing

Plans are to be made for the siting of tinned food and water stocks at designated shelter positions to sustain the Ship's Company for a 3 day period.

ANNEX A TO CHAPTER 12

ACTION LOGISTICS CELL COMMAND INFORMATION SHEET

<table>
<tr><th colspan="4">ACTION LOGISTICS CELL
COMMAND INFORMATION SHEET</th></tr>
<tr><td></td><td>DATE</td><td></td><td>TIME AT STATE ONE</td></tr>
<tr><td></td><td colspan="2">COMMAND AIM</td><td></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td></td><td colspan="2">COMMAND PRIORITIES</td><td></td></tr>
<tr><td>1</td><td colspan="3"></td></tr>
<tr><td>2</td><td colspan="3"></td></tr>
<tr><td>3</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="2">THREAT WARNING</td><td></td></tr>
<tr><td>AIR</td><td>R</td><td>Y</td><td>W</td></tr>
<tr><td>SURFACE</td><td>R</td><td>Y</td><td>W</td></tr>
<tr><td>SUB SURFACE</td><td>R</td><td>Y</td><td>W</td></tr>
<tr><td>MINE</td><td>R</td><td>Y</td><td>W</td></tr>
<tr><td></td><td colspan="2">WE REPAIR PRIORITIES</td><td></td></tr>
<tr><td>1</td><td colspan="3"></td></tr>
<tr><td>2</td><td colspan="3"></td></tr>
<tr><td>3</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="2">ME REPAIR PRIORITIES</td><td></td></tr>
<tr><td>1</td><td colspan="3"></td></tr>
<tr><td>2</td><td colspan="3"></td></tr>
<tr><td>3</td><td colspan="3"></td></tr>
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ANNEX B TO CHAPTER 12

INCIDENT LOG

INCIDENT LOG			
DATE		TIME	
LOCATION			
INCIDENT			
LOGISTICS IMPLICATIONS			
TIME REPORTED / COMMAND HUDDLE			
FINAL ASSESSMENT			

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ANNEX C TO CHAPTER 12

ISSUES LOG

ISSUES LOG

DATE	TIME	EQUIPMENT AFFECTED	DESCRIPTION	STOCK NUMBER	LOCATION	NAME OF PERSON COLLECTING ITEM	TIME AT STOREROOM	TIME AT REPAIR POINT

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CHAPTER 13

EMERGENCY MEDICAL ORGANISATION

CONTENTS

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CHAPTER 13

EMERGENCY MEDICAL ORGANISATION

1301. The ship's emergency medical organisation is outlined below. Further details are available in BR 1991 - Instructions for the Royal Naval Medical Service. Medical countermeasures and casualty care in an NBC environment are covered in BR 2170(2)

1302. Principles

A ship's emergency medical organisation is designed to provide rapid and effective medical care to casualties in peace or war to ensure that personnel efficiency, and hence the ship's efficiency, is maintained at the highest possible level. This involves casualties receiving immediate life saving and first aid treatment and being removed from danger, treatment by specified First Aid Party members, and treatment by the ship's medical staff. Each individual in the Ship's Company is potentially a member of the medical organisation and all RN personnel should have received some basic first aid training. Immediate treatment of minor injuries may enable personnel to remain at their posts. The Casualty Alarm procedure is detailed in Section 3 of Chapter 7.

1303. During peacetime a Standing Sea First Aid Party (SSFAP) is nominated to respond to incidents. The exact response will vary and is laid down in Medical Department Standing Orders, but essentially involves ship's medical staff and one First Aid Team of two closing up at the Sickbay, and a second first aid team attending the incident or a prearranged location.

1304. At action, First Aid Teams of two are deployed from First Aid Posts to provide immediate life saving care and to stabilise injuries prior to evacuation to one of the medical positions. Ship's medical staff adopt a roving role to provide support to First Aid Teams at First Aid Posts or throughout the ship as required. The medical organisation at action is coordinated from a Medical Headquarters (MHQ), which is usually located in the Sickbay. At action much of the emphasis is placed on treating those less seriously injured personnel who may be able to return to duty, even if this is in a limited capacity.

1305. The manpower and facilities available to the medical organisation will depend on the size and function of the ship. Most ships have a limited medical capability to treat more serious or complex injuries. Evacuation to more advanced care facilities ashore or afloat is needed for the more seriously injured and this will need close coordination with the ship's Command.

1306. Medical Positions

During routine peace-time operations the Sickbay is the focus of the ship's medical organisation. Its purposes are:

a. To maintain the health of the Ship's Company.

b. To treat illness and injuries.

c. To organise and promote first aid training to Ship's Company and first aid teams.

d. To formulate and exercise the ship's medical plans for emergencies and war.

e. To maintain medical positions, stores and administration.

1307. Alternative medical positions are prepared and maintained during peace and war. These are First Aid Posts (FAPs) and a Secondary Medical Position (SMP). These areas provide emergency medical equipment and adequate space for treating large numbers of casualties.

1308. First Aid Posts

The allocation of FAPs is specified in NES 106 and varies according to the size of ship. They are to be clearly marked (see Table 3-1). FAPs are sited within the Citadel; the basic requirements are:

a. Accessible from manned stations and quarters without obstructing other traffic or compromising the watertight integrity of the ship.

b. Adequate working space of 3000 mm x 2500 mm.

c. Easy access for stretchers.

d. Protection from weather, flooding, blast and shrapnel splinters.

e. Close to hot and cold fresh water supplies.

f. Close to sanitary facilities.

g. Good ventilation and lighting, including emergency lighting.

1309. Each FAP is to be provided with the following:

a. First aid cabinet, bulkhead mounted, in a readily accessible position.

b. A glass fronted key box, bulkhead mounted alongside the cabinet, to retain the cabinet key.

c. Stretcher and blanket cabinet.

d. First aid box, bulkhead mounted, with a glass fronted key box built into the first aid box door.

1310. Secondary Medical Position

The SMP is a designated area, normally in a Wardroom or Ratings' Dining Room, where special facilities are provided remote from the MHQ. The full specification, in NES 106, includes an operating table and supporting equipment/stowages. A Casualty Sorting Area is designated, adjacent to the SMP.

1311. Emergency Ward

In large ships, such as CVS, an Emergency Ward is designated, usually in a large mess deck.

1312. Facilities During Peace Time

During peacetime emergencies the Sickbay remains the Primary Medical Position, and any casualties will usually be brought here for treatment initially. However, if a large number of casualties are involved, or in a major incident, alternative medical positions may be utilised.

1313. Facilities During War

At Action the Sickbay retains its peacetime roles, but with greater emphasis on training and preparation for war. At NBCD State 1 FAPs are manned and become the primary locations for collection and treatment of casualties. The SMP is prepared and in some instances it may also be manned. The Sickbay is generally used as the MHQ to control and coordinate the medical effort and would be manned by the Canteen Manager. It is not usually used for treating casualties at action. Casualties with minor injuries may be treated at or near to incident scenes and returned to duty. If there are more serious injuries or a large number of casualties, then immediate treatment may be given at or near incident scenes, to save life or stabilise injuries prior to evacuation, with permission from MHQ, to the most appropriate first aid post. Following the action, individual casualties may be moved to the Sickbay or SMP for further or definitive treatment.

1314. MM/PPs

MM/PPs do not normally carry a Medical Branch Rating (MBR) or Medical Officer, and the Coxswain is responsible for the duties of Senior Rating in Medical Charge. The ship has two FAPs but no SMP. The Wardroom is designated as the primary FAP (FAP1) and is manned by the Coxswain and the First Aid Party. FAP2 is not normally manned and is used as an alternative position should FAP1 become untenable. All casualty reports, including triage priority are assessed by the I/C at FAP1 (Coxwain) and passed to ANBCDO in HQ1 for information and further action.

1315. First Aid Training

In CVS/LPD/LPH/DD/FF and in MM/PP/FPS and Survey Ships carrying permanent Medical Branch Ratings, least 10% of the Ship's Company (officers, senior rates and junior rates) are to be trained to the Level 2 first aid standard. For MM/PP/FPS and Survey Ships not carrying a MBR this requirement is 25%, and in the First Patrol Boat Squadron it is 100%. A minimum of 5% of the Ship's Company is to be included in the medical organisation for Action and should receive Level 3 first aid training. This is generally conducted on board if the MBR is a qualified first aid instructor. Level 3 task books are issued and must be completed within three months of joining the ship. Details are in BR 1991. In minimally manned ships, members of cleansing station parties or action messing teams are to supplement the medical organisation, and must also be trained to Level 3.

1316. Notwithstanding the requirements for first aid training, ships are to encourage first aid training at every opportunity and to ensure that medical aspects of the NBCD response are exercised. Training all Level 2 trained personnel in Level 3 skills will increase flexibility in manning, and basic training for all personnel (particularly groups such as boats' crews, divers and personnel responsible for electrical supplies or equipment) will enhance the ship's ability to rapidly and effectively deal with any casualties.

1317. First Aid Equipment

First aid equipment should be widely distributed around the ship to ensure its proximity to any incident scene, and to prevent potential for loss of a significant amount of medical equipment in a single incident. First aid boxes and stretchers are located throughout the ship for emergency use. FAPs and the SMP contain locked cabinets with first aid and emergency medical equipment. All First Aid Party members are issued with first aid bags. Scales of medical equipment are promulgated in the annexes to the Medical Equipment Table for RN Service Afloat (NSN 6545-99-898-0006).

1318. Peace Time Medical Organisation

Ships alongside in harbour are to have a Level 2 first aid qualified member in their Duty Watch. Consideration should be given to deconflicting this individual's first aid duties from other emergency duties.

1319. All ships have a Standing Sea First Aid Party (SSFAP). This party should be included within the ship's emergency organisation and should consist of a Medical Branch Rating (MBR), where borne, and four other Level 2 trained first aiders. If a MBR is not borne, a suitably qualified I/C should be nominated. They should be day workers and are to be correctly dressed and equipped at all times. They should muster whenever the emergency party are required.

1320. The SSFAP are to be under the direct control of the I/C at the Forward Control Point (FCP). They are to muster for all emergencies in the following manner:

a. MBR + 2 first aiders to the Sickbay
2 first aiders report to I/C FCP.

b. It is recommended that the MHQ Coordinator closes up at the Sickbay.

1321. On other occasions that the SSFAP are required to muster, such as for man overboard, the point of muster will be designated by the Officer of the Watch. Ship's Medical Standing Orders should include details of the SSFAP response to specific incidents.

1322. In MM/PPs the SSFAP is made up of the Coxswain and members of the First Aid Party (day work S&S Department).

1323. Medical Organisation at Action

In war, the ship's wartime complement may include additional medical staff. Normally each First Aid Post is manned by a team of five - an I/C and two teams of two qualified first aiders. This allows medical teams to be deployed in support of incidents and to maintain adequate medical care to casualties already in medical positions. First Aid Parties should be deployed in teams of two. MHQ is manned by a suitably qualified Coordinator, or team depending on the size of the ship. All Medical Department and First Aid personnel are to wear white surcoats with a red cross in NBCD States 1 and 2.

1324. Initially the senior member of the medical staff will close up at MHQ and other medical staff will disperse to the FAPs. Medical staff at action will adopt a roving role in support of their medical teams. The exact areas of responsibility will vary according to different ships but, in general, qualified medical staff should cover specified areas of the ship and should not congregate in one area unless there are extenuating circumstances.

1325. Close liaison is necessary between I/Cs of FAPs and the Medical Coordinator in MHQ, and between MHQ and the DCO in HQ1/SSC (see Chapter 8). Maintenance of an accurate casualty state and knowledge of the location of all medical assets are essential information for the Command. Liaison between MHQ and HQ1 is also necessary to coordinate casualty evacuation and relocation of medical positions should this be necessary.

1326. Watch and Station Bills of minimally manned ships may not be able to identify an adequate number of personnel to man medical positions as recommended. (In this case, FAPs should all be manned but none should fall below a minimum manning level of an I/C plus one first aid team of two.) They are to be supplemented as the situation dictates. Personnel from Cleansing Station Crew or Action Messing Teams may be used if this does not detract from their primary role. This minimal manning risks a slow medical response to incidents, or a decrease in the care afforded to casualties already in the FAP. Medical coordination and control becomes more important, with a greater need to identify the most appropriate team to respond to an incident.

1327. All members of the Ship's Company have a responsibility to assist casualties to the best of their ability. However, this must not distract them from the ship's damage control or firefighting effort, or from 'fighting' the ship.

1328. Medical Branch personnel, when in a roving role at Action, are to carry ELSA, but First Aid Parties do not need to carry it.

1329. Controlled Drug Keys at Action

Whilst strict adherence to civilian drug laws must be maintained in peacetime, at Action Stations quick access to Controlled Drugs (CD) (strong analgesia) must be available to Medical Branch staff, particularly where no Medical Officer is available. When ships are required to go to Action Stations, Medical Branch Ratings are to obtain the CD Keys from the Commanding Officer, to allow them access to the CD cabinet in the Sickbay and main medical store. During training (OST, MTT) procedures are to be exercised but there is no requirement for the CD keys to be handed over. The issue of morphine auto-injectors at Action must have Command approval.

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CHAPTER 14

FIRE AND DAMAGE

CONTENTS

SECTION 1 - FIRE

SECTION 2 - DAMAGE

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CHAPTER 14

FIRE AND DAMAGE

SECTION 1 - FIRE

1401. Fire Hazards

Fire is an ever-present risk in ships, with the risk being greater in war and upkeep periods. As always, prevention is better than cure and, excepting those caused by enemy action, most fires on board ship can be prevented by clean and tidy living, keeping things in their proper places, being fire conscious and obeying the relevant regulations. Listed below are some of the more common causes and aids to propagation of fire:

a. Carelessness with naked lights; lighted pipes and cigarettes left about, and cigarettes thrown over the side. Clothing hung to dry on a hot surface or lying about when it should be stowed. Bunks left unmade, mattresses stacked in messdecks, and mattresses with their fireproof covers removed.

b. Rags left lying about, especially if oily; canvas, etc, stowed away wet (all materials of vegetable origin, if wet or oily, can generate enough heat to start a fire spontaneously).

c. The careless stowage of bundles of rags in the vicinity of hot exhausts and exhaust ducting such as funnel uptakes.

d. Papers and books left about in offices, cabins and messdecks, or tucked away near sleeping billets.

e. Paint and oil splashes in contact with heat; paint pots not returned to store at secure; too many coats of paint on surfaces; indiscriminate use and stowage of aerosols.

f. Cooking fat, especially in deep-fat fryers, allowed to overheat, left unattended, or contaminated with water.

g. Timber stowed near sources of heat or soaked with flammable liquid.

h. Bilges, flats, workshops, etc, allowed to remain oily, untidy and dirty.

i. Misuse of electrical apparatus or use of defective apparatus.

j. Non observance of the requirement that all private electrical appliances must be checked safe in accordance with BR 2000(52).

k. Sparks from dirty incinerator uptakes.

l. The use of plastic containers as dustbins, waste-paper baskets or gash bins. Only metal bins should be used.

m. Servery, galley, food or other lift hatches/doors/shutters left open when not in use. (Tally plates reading WHEN NOT IN USE, THIS HATCH IS TO BE CLOSED should be fitted.)

n. Non-observance of the regulations for handling flammable liquids, and for stowing and handling explosives (BR 1754 and BR 862).

1402. Additional Hazards in War

Heat from an explosion, including the heat flash from a nuclear weapon, and unspent missile propellant can start 'primary' fires. 'Secondary' fires, as an indirect consequence of damage, may be caused by:

a. Hot splinters striking combustible materials.

b. Flammable liquid fuels brought into contact with hot surfaces (eg on the surface of rising flood water).

c. Combustible material thrown by blast or shock against a source of heat.

d. Damage to electrical circuits, causing sparks or overheating and ignition of insulation.

1403. Additional Hazards in Upkeep Periods

Fire precautions and firefighting in Upkeep Periods are covered in Chapter 24. The main hazards are:

a. Welding and burning operations, (the safety regulations concerning 'open flame' heating are contained in BR 2000(20)).

b. Numerous temporary electrical/air leads passing through doors and hatches.

c. Difficulty in maintaining control of smoking and the use of electrical equipment.

d. The arisings of waste material which would normally not be allowed to accumulate.

e. The use of flammable substances such as adhesives and paints.

f. Civilian personnel who are not familiar with the ship layout.

g. Possible disruption of normal firefighting equipment and communications.

1404. DIY Improvements

Despite general improvements in habitability in ships, there remains a desire to overcome minor deficiencies and provide personal touches, by DIY. However, DIY presents many potential fire dangers and it is essential that DIY installations are closely controlled. FLAGO provides guidance on the exercising of this control.

1405. Explosives and Fuel

It must always be borne in mind that fire in the vicinity of stowed explosives or fuel (including weapon fuel/propellant) is an immediate and grave risk to the safety of the ship.

1406. Flash Point and Ignition Temperature

Warships contain considerable quantities of flammable liquids, so it is important to understand the significance of the terms flash point and ignition temperature.

1407. Heat raises the temperature of a combustible substance to the point where fuel in the substance gives off vapour. When enough vapour is formed to support a flame the substance is at its flash point. If the vapour is heated further, it ignites when combined with enough oxygen and the substance is then at ignition temperature. Flash points and ignition temperatures vary with different substances. Fuels such as DIESO and AVCAT are known as high flash point fuels because their flash point is above normal ambient temperature. However, low flash point fuels such as gasoline (petrol) have a flash point below normal ambient temperature, so must be handled with greater care to avoid sources of ignition.

1408. DIESO and AVCAT in the form of an atomized spray (eg a ruptured, pressurised system) may ignite below their respective flash points when in contact with a flame.

Fig 14-1. Fire Caused by an Anti-Ship Missile

1409. Toxicity of Smoke

The smoke produced by ship fires and burning weapon propellant (see Fig 14-1) is highly toxic. If inhaled, it will quickly become fatal. Smoke management procedures are detailed at Annex K to Chapter 21.

1410-1449. Spare

SECTION 2 - DAMAGE

1450. Causes of Damage

Like fire, material damage can occur in a ship in peace as in war, though in war the chances are, of course, greater. A collision or a grounding may cause the underwater hull to be ruptured with the consequent flooding of compartments and damage to equipment in the immediate vicinity (Primary Zone damage) with possible additional damage remote from the incident (Secondary and Remote Zones of damage). In peace, explosions can normally be discounted, but if they do occur, they are generally internal. In war, explosions may occur outside and inside the ship. The extent of damage from an explosion cannot be forecast since it will depend on such variables as weight and nature of the explosive, the position of the explosion relative to the ship, the type and size of ship, her subdivision and hull strength. General information regarding the effects of weapon attack on surface ships is provided in CB 8844 - Weapon Effect. Damage posters (Form S.3075(1)-(6)) show examples of damage sustained by ships in Operation Corporate in 1982. Reports on ship damage are in BR 8362 and CB 8362(2). Whenever damage is sustained in action, collisions or from any other cause, reports must be rendered in accordance with QRRN. The required forms of report are covered in Chapter 37.

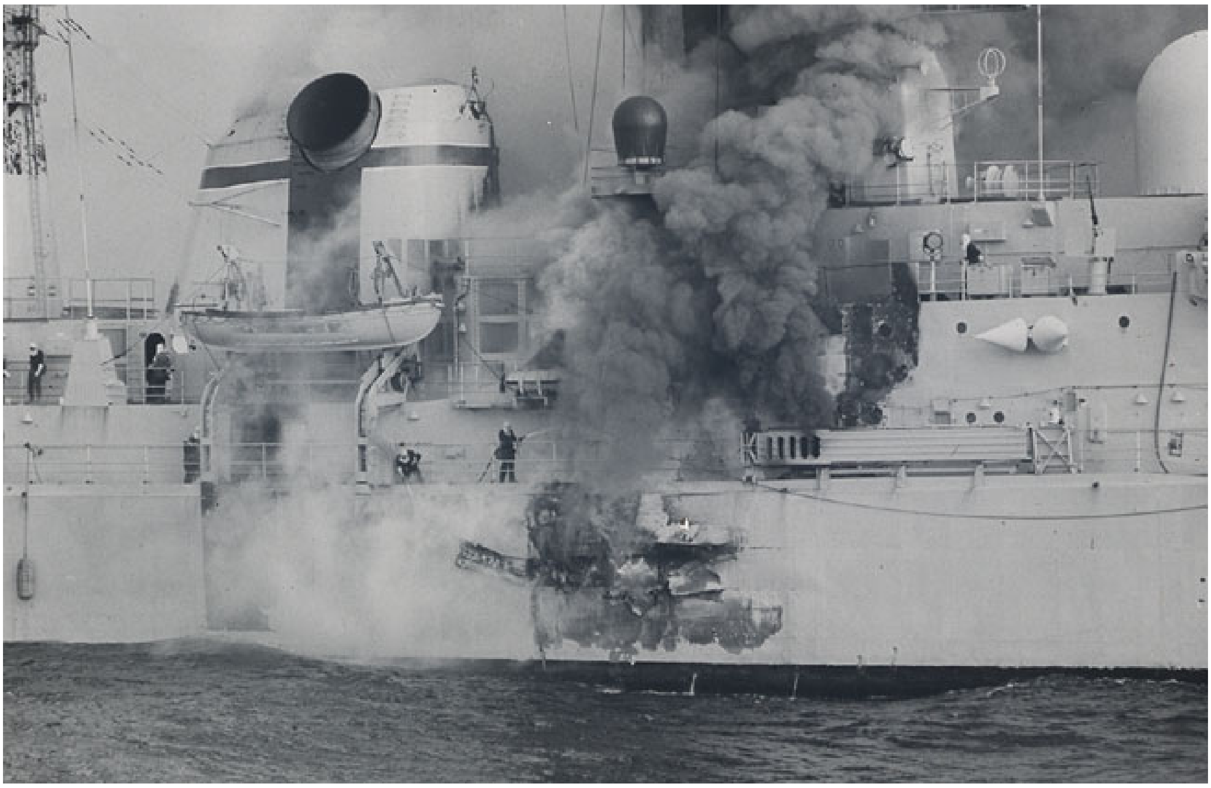

Fig 14-2. Above Waterline Damage Caused by an Anti-Ship Missile

1451. Explosive weapons are classed as conventional or nuclear. The term conventional normally refers to bombs, shells, missiles, rockets, mines or torpedoes that are filled with any type of chemical explosive which does not rely on nuclear reaction to produce its explosive power.

1452. Damage from Conventional Weapons Above Water

Weight for weight, weapons designed to explode on impact carry a larger charge than those designed to pierce structural protection. The explosion of a weapon above the waterline can cause extremely heavy local damage, with widespread secondary damage (by splinters, shock and whip) with probable loss of watertight and gastight integrity. Subsidiary effects of damage can be serious and some examples are:

a. Blast entering funnels and uptakes can cause damage to machinery.

b. Riddling, ie multiple holes in the freeboard from near-miss splinters, will cause loss of reserve buoyancy.

c. Fires may be started in the vicinity of the explosion and remote from it.

d. Heavy casualties may result from splinters and objects, including personnel being thrown violently by shock and blast.

Fig 14-3. Aircraft Cannon Fire Damage

Fig 14-4. Weapon Entry Hole, Showing Petalling of Plating

1453. Internal Explosions

The explosion of a weapon inside a ship will cause very heavy local damage with complete destruction of structure and services. The venting of explosion gases will create a formidable secondary zone of damage. In addition to the immediate primary and secondary effects, there will most probably be fire, loss of watertight and gastight integrity, failure of pipe systems, electrical and other services in other areas of the ship. Should the weapon explode below the waterline and rupture the outer hull plating, flooding can spread back through the compartments and spaces wrecked by its passage and detonation. (The results of any accidental internal explosion will be similar, in type if not in degree, except that there will be no entry path.)

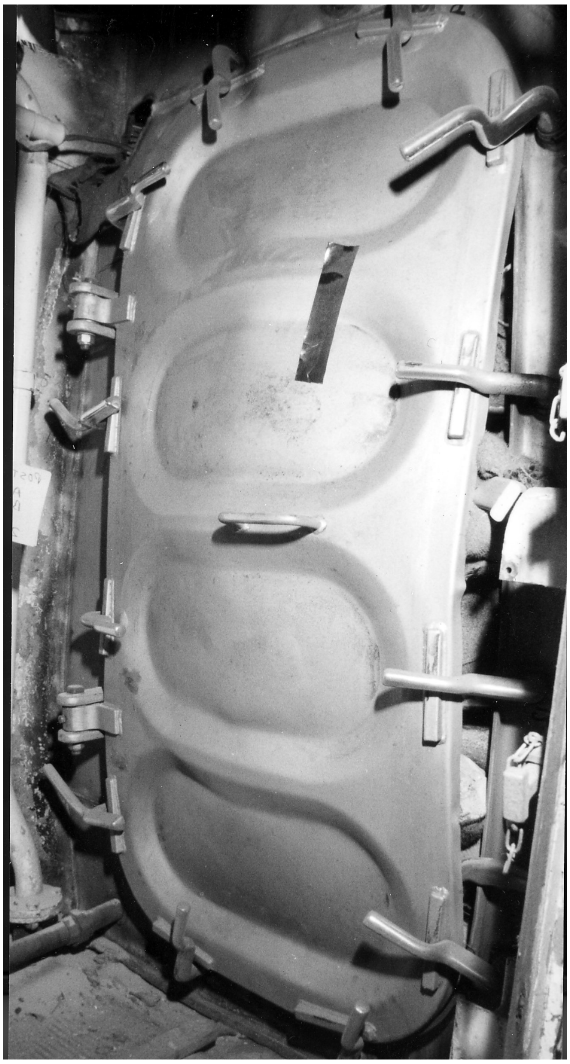

Fig 14-5. Damage to Fully Clipped Door Caused by Internal Explosion

1454. Blast Routes

a. **Magazines.** Arrangements are made in magazines to allow for any build up of pressure, due to a rapid 'burn-off' of a weapon, to be vented off to atmosphere. In the event of a detonation this arrangement is inadequate, and will not prevent extensive damage.

b. **During Action.** Deliberately opening up blast venting routes prior to and during Action is not practicable, or advised, for the following reasons:

(1) The position of explosions cannot be predicted before the weapon enters the ship.

(2) Opening doors and hatches in the structure is detrimental to the watertight integrity of the ship and could facilitate the passage and spread of flash, fires, smoke, NBC contamination and possibly floods.

c. **Post Action.** When the presence of unexploded enemy munitions is confirmed in a ship post-action, opening up a blast venting route may be beneficial. While this will have little effect on the degree of damage at the point of an explosion, it may ameliorate the effects as blast spreads through adjacent compartments. In the case of a slower burn-off the opening of a blast route would be beneficial. The blast venting route should be arranged to take the most direct path to the weather deck. However, it should be borne in mind that the passage of the blast may cause damage to structure, systems and fittings as it passes along the venting route. Due account should be taken of any compartments adjacent to the venting route which might present a hazard by reacting adversely to the blast. Personnel are to be kept clear of the blast venting route until the munition has been dealt with.

d. **Improvised Explosive Devices (IEDs).** IEDs should be treated as unexploded ordnance. The ship should be brought to the highest state of watertight integrity and a blast venting route opened up as described in Sub Para c above.

1455. Underwater Contact Explosion

An underwater explosion is effectively tamped by the water and when it happens against the hull of a ship it causes very severe local damage (a charge of just one or two kilograms against the hull is generally enough to penetrate the plating). Outside the radius of severe damage there is normally little effect other than flooding and possible splinter damage. Shock is usually only of minor importance and fire is seldom caused directly by underwater explosion. A contact mine or torpedo exploding against the hull will destroy a large part of the hull structure, the internal structure, fittings and equipment. Fig 14-6 shows Second World War torpedo damage. The resulting flooded area may be extensive. Most of the structure in way of the hole will be seriously weakened and could result in the ship breaking in two. Flooding could result in a serious loss of stability and produce heel (loll or list) and/or trim.

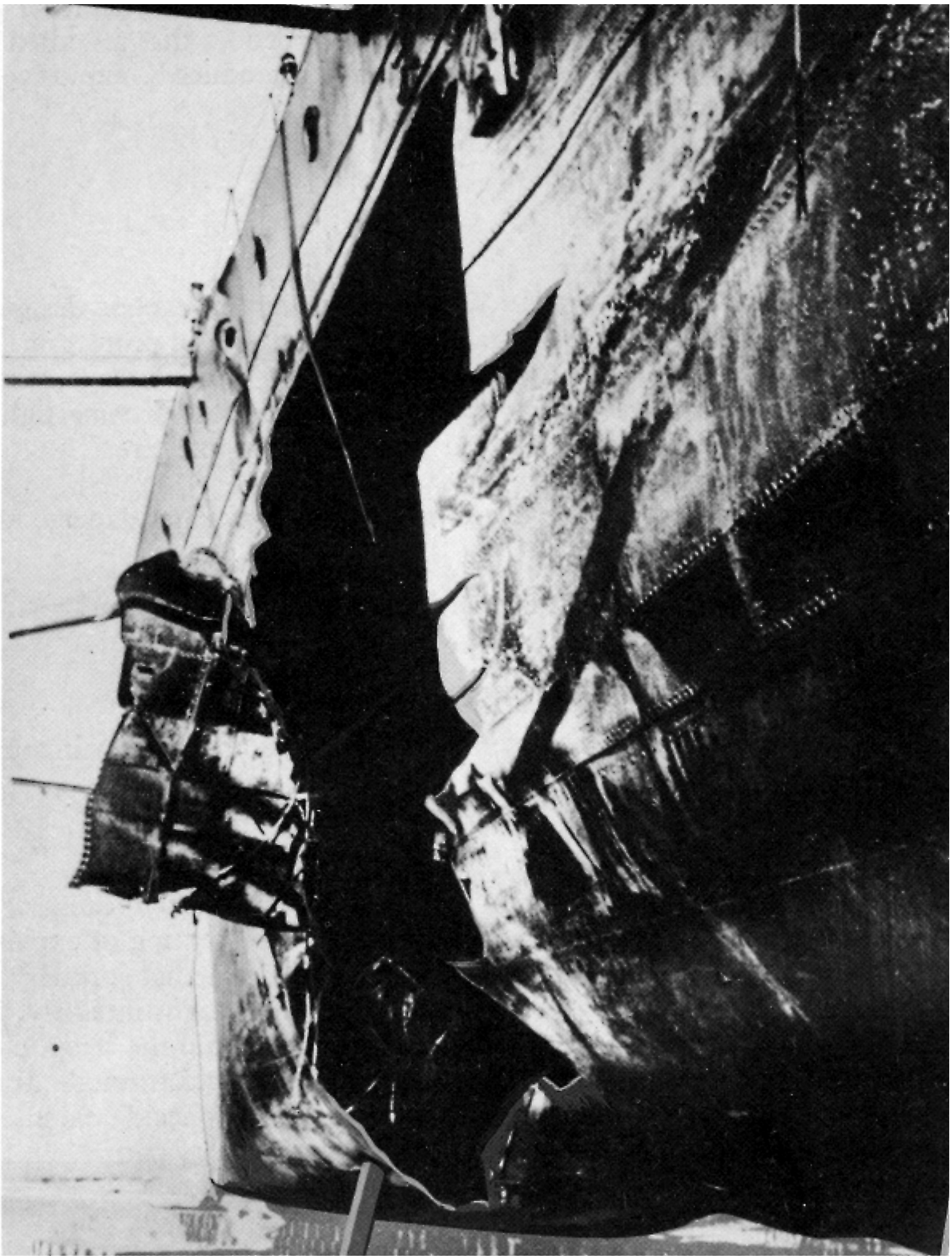

Fig 14-6. Underwater Damage - Contact Torpedo

1456. Underwater Non-contact Explosion

The pressure pulses from this type of explosion cause damage to an extent depending on the size of charge, its distance from the hull and, to some extent, the depth of water (Fig 14-7 shows Second World War non-contact mine damage). If the explosion is outside the hull-splitting distance, dimpling or buckling of the plating between frames and distortion of the frames is probable. Successive pressure pulses striking the ship may lead to longitudinal bending, known as ‘whip’ (Fig 14-8), with the possibility of breaking the ship’s back.

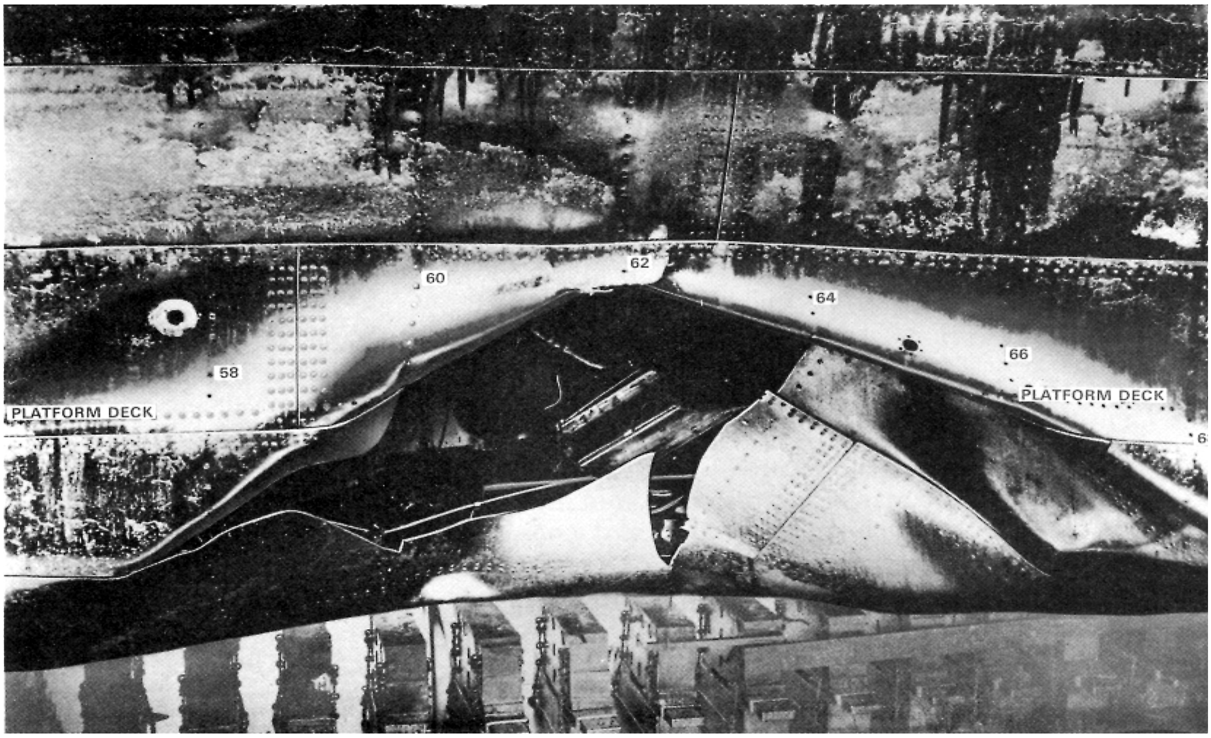

Fig 14-7. Non-contact Mine Damage

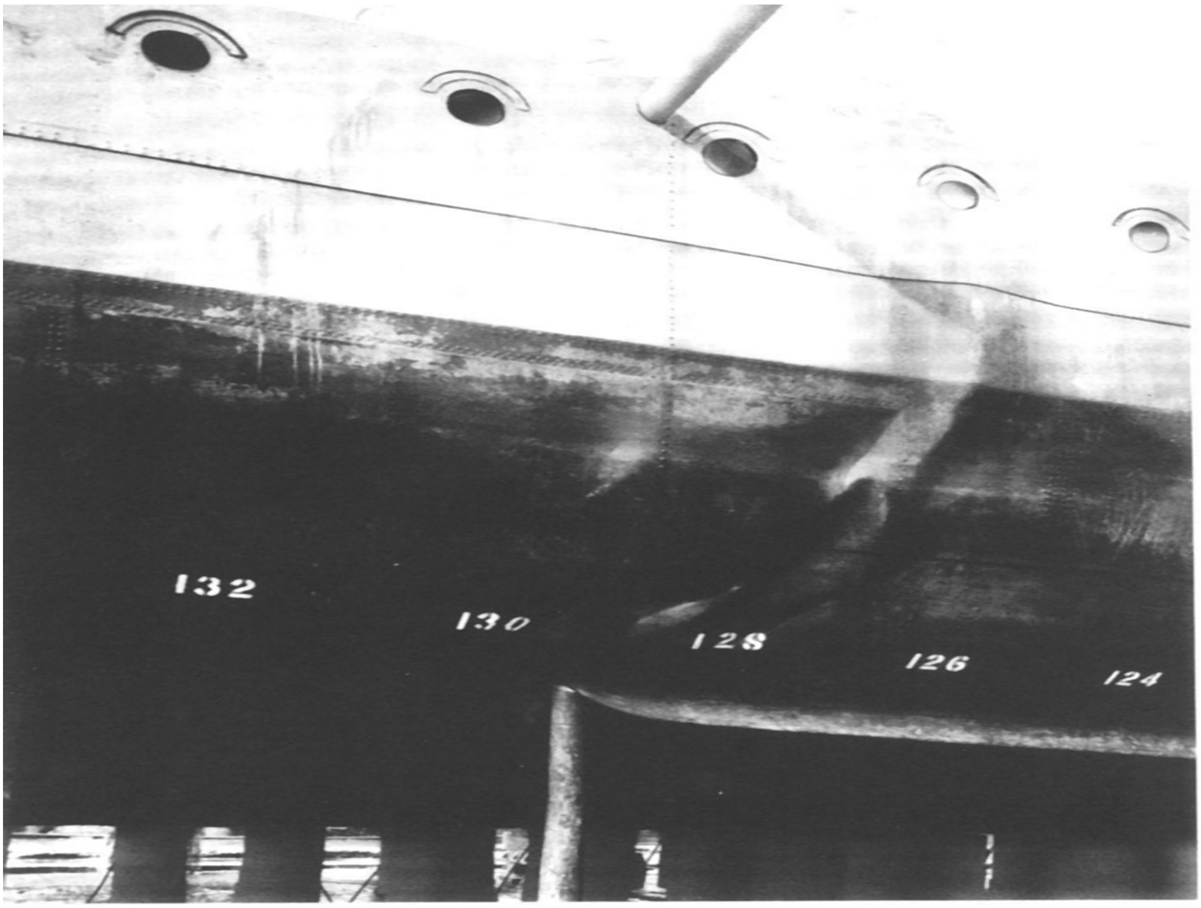

Fig 14-8. Whip Damage

1457. Collision and Grounding

Ships are constantly at risk of damage from navigational incidents, but prompt damage control measures will normally save a ship in these circumstances. Fig 14-9 shows typical grounding damage.

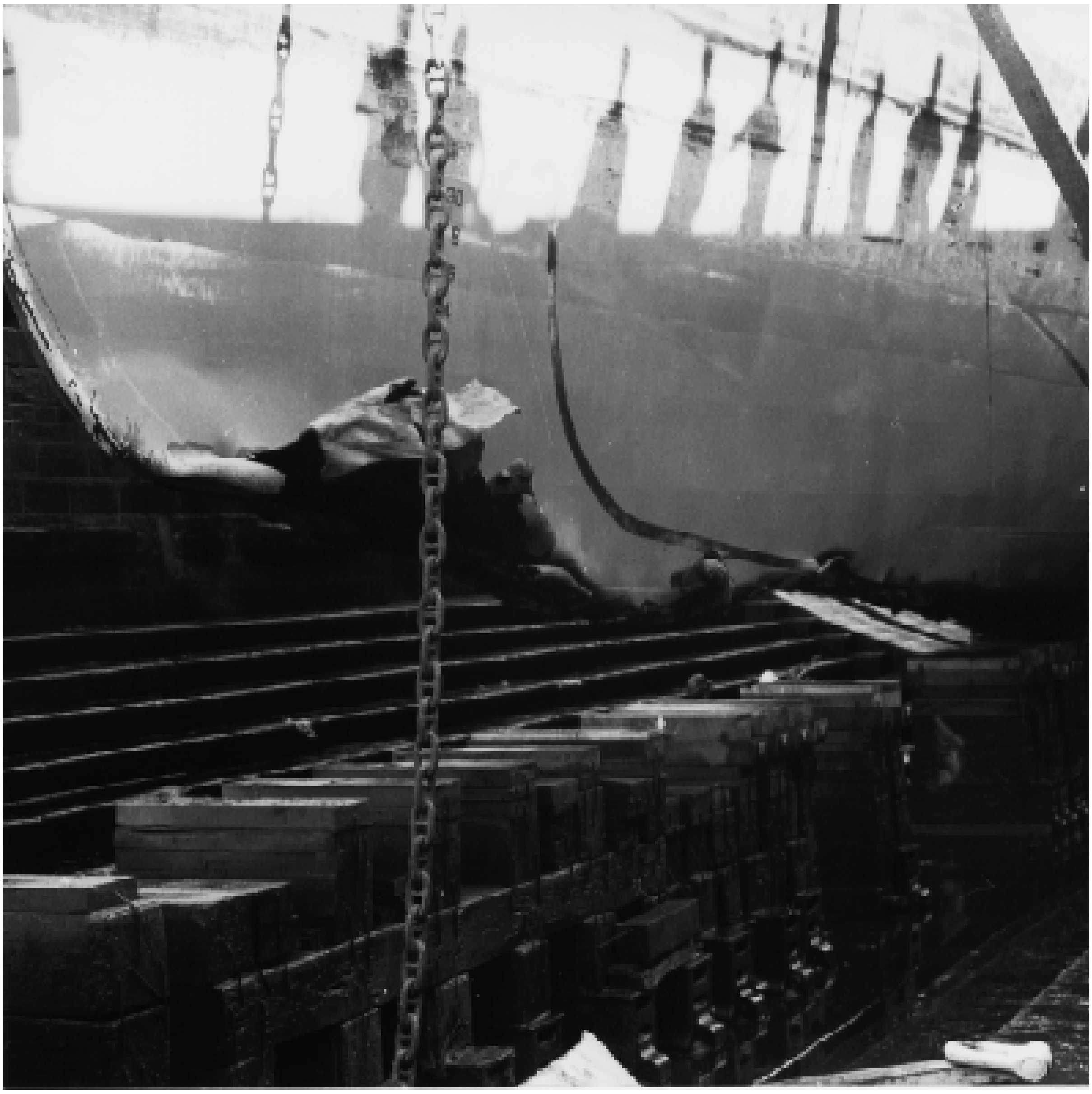

Fig 14-9. Grounding Damage

1458-1460. Spare.

1461. Nuclear Explosions - Above Surface

Nuclear Weapon yield is explained in Volume 2 of BR 2170. Table 14-1 gives a rough approximation of the ranges at which damage of different degrees of severity will be likely for a 20 kT and 10 MT airburst, assuming that the weapons are exploded at the height that gives the greatest blast effect for the weapon yield. The table also gives approximate distances at which exposed combustibles are likely to ignite. Table 14-1 is only a generalization because blast effect depends on such variables as height of burst, direction of the ship's head relative to burst, atmospheric conditions (which modify the effects of heat) and the nature of materials. As used in the table, 'severe damage' means that the ship could be sunk, or put out of action with damage enough to require major reconstruction; 'moderate damage' means the ship will be immobilized and need much repair, especially to shock sensitive machinery and electronic equipment; 'light damage' means that although the ship may be still capable of operating, there will be damage, especially to electronic and other equipment, even though it may be repairable with ship's resources.

Table 14-1. Approximate Range of Effects - Nuclear Airburst

Damage Sustained	Range (km)	
	20 kT	**10 MT**
Severe	0.8	3.2
Moderate	1.2	6.4
Light	2.0	11.2
Damage to aerials and parked aircraft	3.2	12.8-16.0
Exposed combustibles ignited	2.4	24.0

The significant part of the intense heat pulse lasts for about one-and-a-half seconds from a 20 kT weapon and 30 seconds from a 10 MT weapon. As weapon yield increases, the distance at which the heat is effective increases more than the ranges of other effects. The arrival of the heat pulse is virtually instantaneous so that some of the fires caused by it may be extinguished by the following blast. However, this will be off-set by the indirect or secondary fires that are almost certain to follow. A low airburst or surface burst will cause similar damage, but the ranges of effects will be less.

1462. Nuclear Explosions - Underwater

The shock wave from this type of explosion lasts much longer than from a conventional non-contact weapon; long enough, in fact, for the pressure to be exerted all round the hull at once (crushing or squeezing effect). This will cause widespread damage to the whole of the underwater hull, the amount and severity of which will vary with the yield of the weapon, distance of explosion from the ship, depth of burst, depth of water, strength of structure and the attitude of the ship to the explosion. Water waves developed after an underwater explosion may cause damage to structure, flooding through weatherdeck openings and loss of external fittings and equipment. Wave formations will vary with the yield and depth of explosion, the depth of water and the topography of the sea-bed.

1463. Spare.

1464. Zones of Damage

Damage to a ship can be divided into three zones:

a. **Primary Zone.** This is in the immediate vicinity of the cause of damage (explosion, collision, grounding) and, particularly in the case of explosion, will be the zone of complete destruction. That part of the Primary Zone below the waterline will probably be completely flooded and nothing can be done except to try to contain the flood water within its original bounds.

b. **Secondary Zone.** The area surrounding the Primary Zone will most probably suffer from split and leaking structure, doors and hatches, fractured pipes, damaged electrical circuits and fittings, fires, smoke and possibly toxic fumes. It is unlikely that this zone will flood immediately, but slow and progressive flooding is probable because of damage to hull and bulkheads/decks surrounding the Primary Zone.

c. **Remote Zone.** Explosion, collision or grounding, particularly explosion, will cause a shock wave to travel through the ship's structure and may cause a violent whip, with resultant damage and possibly fire. Whip can cause extensive rippling and distortion of structure, damage to equipment, fittings and services, and often slow flooding over a large area.

1465. Shock

The large accelerations and decelerations imparted to equipment directly or indirectly connected to the hull may result in shock damage (Fig 14-10). Most of the important machinery and equipment in warships is either designed to be shockproof or is fitted with shock-resistant mountings. Even so, the shock forces may overcome these features and cause failure in an item of equipment because of fracture (usually in the securing arrangements). Damage from shock may be caused by:

a. **Relative Movement between Separate Components.** This may lead to collision between components, failure of mechanisms, opening or closing of contacts. Extensive power failures may result from the accidental opening of switchgear. Damage to electronic equipment and displacement of fuses, telephone handsets and similar fittings may also occur.

b. **Relative Movement between Different Parts of the Same Item.** Excessive strain caused by large bending moments may result in distortion of fittings which are made of ductile materials or fracture in those which are brittle. This is the most frequent cause of damage to machinery.

c. **Passage of Stress Wave.** An intense stress wave, with its associated strain, passing through the material may cause failure in its path.

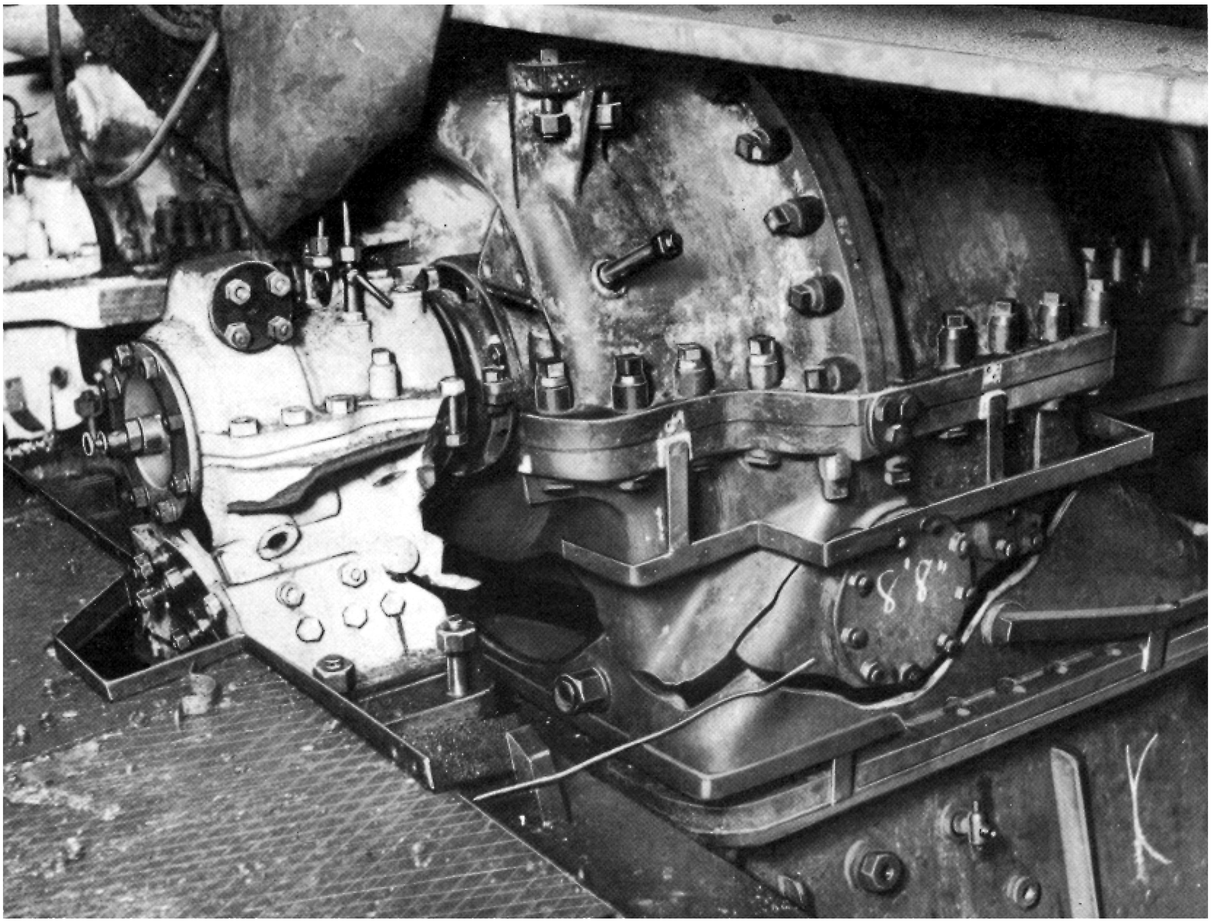

Fig 14-10. Shock Damage to Machinery

1466. All portable and semi-portable equipment, fittings, ladders, stores etc must be properly secured or stowed as a precaution against shock or whip effects. Warships incorporate the following design features to reduce the effects of shock or whip:

a. The use of non-brittle materials.

b. The support of overhanging masses.

c. Special securing arrangements to absorb accelerating and decelerating forces.

1467. Destruction

Structure, services and equipment may be completely destroyed by the force of an explosion and may be severely damaged by collision or grounding. In addition, the area of explosion damage may be greatly extended by fragmentation and the projectile effect of debris. Splinters may cause fragments of plating and equipment to act in turn as splinters. The effects of flying debris vary greatly, depending on whether the explosion occurs, how near it is to vital equipment and power supplies and the thickness of interposed structure. The penetration of decks and bulkheads always destroys watertight and/or gastight integrity. The limitation of damage from blast and splinters, and from a bows-on collision is in the first place a matter of design (eg collision bulkhead). Vulnerable equipment is protected as far as possible by structure and other equipment and, in large ships, side and deck protective plating.

Whenever possible, alternative power supplies are provided for important machinery and services, and arrangements are made to enable systems to be isolated from damaged areas. According to size and type of ship, main machinery and associated systems are designed as far as practicable to operate as separate units. Provision is made for emergency power to be supplied if alternative supplies fail.

1468. Reduction of Splinter Hazards

The fitting of anti-shatter film to all glass mirrors and the removal of unbacked melamine laminates will reduce the splinter hazard to personnel. Covers for TV and VDU screens should be available to be fitted at State 1.

1469. Flooding

Flooding causes loss of buoyancy and the failure of non-watertight equipment in the flooded spaces. It impairs ship stability and may cause heel and/or trim. In a small ship the heel will probably be loll which may lead to capsize, and excessive trim may cause a small ship to plunge. Excessive heel (which may be list or loll) in a large ship gives serious risk of capsize. In all ships, a large heel impairs the operation of weapons and other equipment and has a serious effect on flying operations. Immediate measures are necessary to restore a ship to a stable and upright condition (see Chapters 15, 16, 30 and 31). Countermeasures such as leakstopping, pumping and shoring must be promptly applied and the main flooding boundary quickly established. Extension of flooding to large spaces high in the ship has a most adverse effect on stability, and the forming of free surface in any compartment will give a loss of initial stability. As heel and trim increase, it is likely that further holes in the freeboard are brought below water; the effects are cumulative and hence the need for prompt action. Shock or whip damage may cause flooding in spaces removed from the actual incident (Remote Zone) and a careful search must be made after damage, with particular attention given to compartments low in the ship.

1470. Rate of Flooding

The speed with which a compartment will flood can be appreciated from the fact that, for example, a hole 150mm in diameter and 1.8m below the waterline will admit about 30m^3 of water in five minutes. In other words, this small hole would lead to the complete filling of a compartment 6m x 3.7m x 2.4m in less than 10 minutes.

1471. Flooding Definitions

The categories of flooding in ships are defined as follows:

a. **Slow Flood.** Ingress of water/liquid into a compartment from either an internal or external source, which can be controlled by fixed or portable pumping equipment or by the same on completion of first or second stage leakstopping.

b. **Free Flood.** Ingress of water/liquid into a compartment from either an internal or external source, which cannot be controlled by fixed or portable pumping equipment and where first aid leakstopping actions have failed or have not been attempted due to the rate of ingress. A free flooded compartment will not necessarily become completely filled with water/liquid; this is dependent on several factors including the source of the flood and the position of the compartment with respect to the waterline.

c. **Free Surface.** A description of free surface and its effects are at Paras 3033-3035.

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CHAPTER 15

DAMAGE CONTROL PRACTICE

CONTENTS

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CHAPTER 15

DAMAGE CONTROL PRACTICE

1501. Immediate Action in HQ1

If flooding from damage results in heel of more than a few degrees, the most urgent task confronting the Action NBCDO and the DCO (see Chapter 8) is to restore the ship to a stable and, if possible, upright condition. If the upright condition is impossible, the aim must be to obtain a heel which is acceptable to the operation of weapons, including aircraft. (It should be borne in mind that heel caused by floodwater is probably loll in a small ship and list in a big ship (see Chapter 30)).

1502. Immediate Action at the FRPP

In conjunction with the urgent requirements of reporting and passing information, countermeasures must be started. Generally, personnel nearest to an incident, or discovering it, should start tackling the job themselves. Their priorities are:

a. Raise the alarm.

b. Initiate a continuous and aggressive attack on a fire.

c. Ascertain and limit the extent of damage and flooding.

d. Carry out first aid repairs.

1503. Speed is vital in the early stages of combatting damage. Although search and investigation of compartments and spaces must be done thoroughly, it must also be done quickly. Much damage will be readily apparent and the immediate plugging of a visible leak may well prevent a compartment from flooding when the leak would be no longer visible. Firefighting, leakstopping, clearing away debris, etc, are immediate actions.

1504. Hazards

Damage, particularly fire, is likely to be accompanied by smoke, perhaps dense, or by toxic or combustible gases. If the officer or senior rating in charge considers that a dangerous atmosphere exists, breathing apparatus must be worn by those personnel dealing with the incident. Structural damage is likely to be the cause of further personal danger - sharp broken edges at head height, holes in decks, ladders missing, etc. Such dangers should be roped off and illuminated as soon as possible, but until this can be done, a sentry with a torch should be stationed to warn of the danger.

1505. Power Failure

Damage to electrical supplies will probably result in failure of lighting circuits. The restoration of lighting may be delayed because of more urgent work to be undertaken by the Electrical Repair Party, but it should be given reasonable priority for its marked effect on morale as well as progress of work. If power to essential equipment and machinery is lost and cannot be restored through alternative supplies, the supply of emergency power to equipment must be prioritised by the DCO(L), in consultation with the Action NBCDO and DCO, reflecting the Command Aim.

1506. Follow-up Action

Following the initial countermeasures, the urgent requirement is the establishment of fire/flooding boundaries, leakstopping, pumping, shoring weakened structure and the restoration of services.

1507. The repair and control of damage in action is largely a matter of improvising to meet circumstances that cannot be foreseen exactly or in detail. The sole purpose of a warship is to be a fighting unit and her capability to fulfil this role must not be reduced unless such a reduction is essential to enable her to be kept afloat and moving. Apart from this, all the resources of the ship must be made available to deal with damage. If it proves necessary to use items (eg mess tables and cushions) for purposes for which they were not intended, authority should be given without hesitation. Firefighting excepted, the most urgent need is to combat flooding, ie stop the leaks and pump out flood water. Speed is of the utmost importance because:

a. Extension of flooding must be stopped as soon as possible to preserve buoyancy and stability, and to prevent the loss of equipment and services essential to the ship's seagoing and fighting efficiency.

b. As compartments fill, the plugging of holes becomes progressively more difficult.

c. The ship may heel and/or trim and bring above-water holes below the new waterline.

1508. Zones of Damage

An early appreciation of the zones of damage (see Chapter 14) is essential before coordinated action can be taken. To this end, blanket search parties must be sent out immediately.

1509. Indicator Test Plugs

When a search is being made great care must be exercised not to spread flooding by the incautious opening of watertight doors and hatches. To enable tests for flooding to be made without opening compartments, indicator test plugs (ITP) are fitted to the crown of every watertight compartment (except those normally containing liquid in bulk) within the Red Risk Zone (see Chapter 5). ITPs are generally fitted to the hatch or manhole giving access to a compartment, but they may be fitted to any suitable and accessible part of the structure. The plug is a hollow bolt with a small hole at the side leading to the central bore. The bolt should be cautiously unscrewed until the hole at the side of the thread is exposed. If water spurts out the compartment is obviously full-flooded and the plug should be screwed home. If air is heard to hiss out, the compartment may be flooding and great care should be taken if it is decided to open the hatch (hissing air could simply be caused by imbalance of ventilation systems). If nothing is seen or heard the hatch may be cautiously lifted and the compartment examined. Test plugs to magazines and flammable storerooms have an elongated thread and are fitted with a nut and split pin to prevent complete withdrawal of the plug. Fig 15-1 illustrates a plug in the venting condition and also shows in section a plug fitted with a nut and split pin.

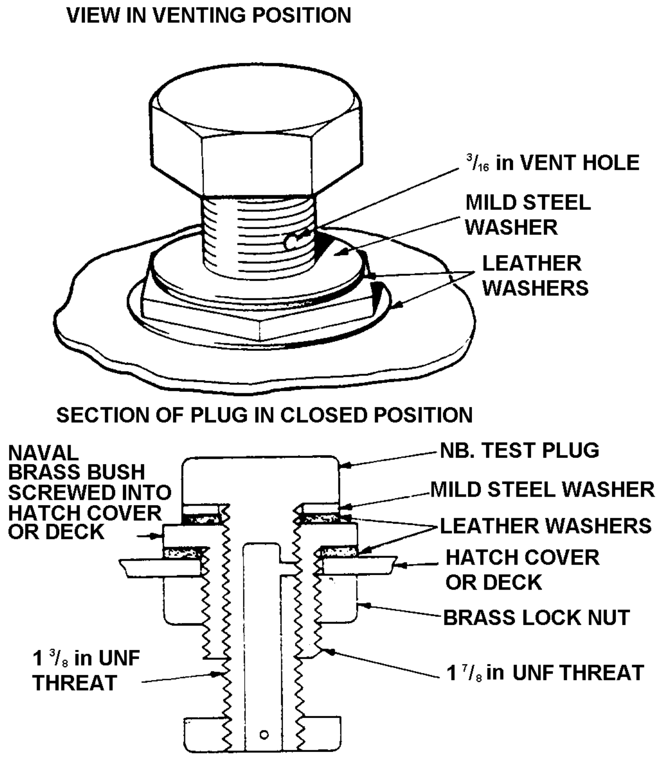

Fig 15-1. Indicator Test Plug

1510. Flooding Boundary

When a ship is damaged below water, the need for rapidly establishing the flooding boundary cannot be too highly stressed. Initially, the limits of the flooding boundary are the limits of the intact structure surrounding the area of the damage, ie inside the Secondary Zone and probably towards its outer edges. The immediate aims of the Repair Parties must be the reduction and eventual elimination of the slow flooding in the Secondary Zone. The ultimate objective is to reduce the flooding boundary until it coincides as nearly as possible with the Primary Zone. Unless the measures taken are prompt and effective, the Secondary Zone may become completely flooded. In deciding which bulkheads and decks are to form the flooding boundary it is necessary to:

a. Ascertain which compartments are flooding or flooded as a direct result of damage.

b. Inspect adjacent compartments to locate progressive flooding, its cause and to make certain what structure is sound.

c. Decide in which compartment(s) the flooding can be stopped or controlled.

1511. When the initial flooding boundary has been decided, energetic action must be taken to establish it and ensure its integrity by:

a. Stopping leaks in the structure and isolating pipe systems until temporary repairs are carried out.

b. Concurrently with leakstopping, rigging and working portable pumps and eductors (operating fixed pumping/draining/salvage systems if fitted).

c. Shoring leaking doors and hatches.

d. Shutting ventilation systems and drainage systems as necessary.

e. Supporting strained/weakened/bulging bulkheads and decks with shores.

1512. When the initial flooding boundary has been established, the next most urgent task is to reduce the area flooded as much as possible. Stopping leaks to bring the ingress of water to within the capacity of available pumps will allow the eventual reclamation of the compartment.

1513. Leakstopping and Shoring

Details of leakstopping, initial repair and shoring are contained in Chapter 16.

1514. Pipe Systems

Generally, the restoration of pipe systems is an after-action job to be tackled in slow time. Damage to the HP Sea Water Main, however, must be dealt with more urgently, even if only by temporary measures and these are described in Chapter 16.

1515. Cofferdams

Cofferdams are structures of wood and/or steel built to form temporary watertight barriers. They are generally constructed of tongued and grooved planking between 38mm and 75mm thick, secured to a framework of shoring timbers, but they can be made of steel plates suitably stiffened and welded. The usefulness of a cofferdam is mainly restricted to the waterline area and some uses are as follows:

a. To restrict the spread of water from large holes in the ship's side at or above the waterline, until repairs are made.

b. As dwarf bulkheads to break up free surface area.

c. To restrict the flood water that might come up through a damaged deck.

d. To allow access to a partially flooded compartment by blanking off the lower part of the door opening.

1516. In most circumstances, a cofferdam needs to extend only about 500mm above the damaged waterline but, in some cases, it might need to extend almost to the deckhead, leaving only enough space for access, suction hoses, etc. A cofferdam acting as a trunk between two hatches must obviously be made watertight throughout its length, and strength of construction must be carefully watched to prevent breakdown under pressure.

1517. Wreckage

When a ship sustains damage to the hull or internal structure it usually means a lot of distorted, torn and loose plating, beams, frames, etc, and before any form of watertight repair can be attempted, eg the fitting of a cofferdam, this torn and loose structure must be cut away or brought reasonably together. To cut the structure away quickly will require the use of a thermal lance cutting equipment as there will invariably be too much 'spring' in the metal to allow the use of cold chisels or hacksaws. If the edges of broken plating can be brought reasonably together it may be possible to weld or strap them. Weakened structure can be strengthened with doubling plates or stiffening angles secured by welding or the use of a Ramset explosive-powered tool. Flapping plating in the hull is extremely dangerous and every effort must be made to cut it away or lash it securely. Damaged cables, lockers and fittings can be cut away for access, by the cutting and spreading equipment.

1518. Damage Repair Equipment

Some equipment in ships is carried specifically for damage control purposes, (eg shoring material and thermal lance) and must not be used for any other purpose. It must be borne in mind, however, that all the equipment and tools carried for normal daily maintenance can and should be used for the control and repair of action damage. Such equipment includes the ship's welding and burning sets, lifting equipment and the tools contained in the various technical workshops.

1519. The Ramset Explosive-Powered Tool

The Ramset tool is an explosive-powered fastening tool which is intended primarily for use in ships of comparatively light scantlings, and for the repair of damage structure above the waterline, (eg a breached citadel). It can be used in emergency, by order, for structural patching under shallow flooding provided that special precautions are taken. Use of the Ramset tool enables a patch plate and inserted rubber sheet to be 'nailed' to the parent plate. The Ramset tool has a 9.5mm bore, is 375mm in length and weighs 3.6kg. It is simple to operate and can be used by anyone after comprehensive training. However, it is dangerous if abused or mishandled and all safety precautions must be strictly adhered to. Ramset training facilities are available at Phoenix NBCD School (see BR 2170(5)).

1520. The fastening system consists of a steel drive pin (nail) which is 40mm long with a 5.5mm shank and a 9.5mm diameter head, and a fastening charge. The fastening charge is colour coded to denote its power as follows:

Brown	Sub-charge for use on extra thin plating or aluminium.
Green	Light strength
Yellow	Medium strength
Red	Heavy strength

The weakest charge must always be used for the first firing, if necessary into a test plate, and increased to the strength necessary to drive the nail flush-headed into the patch plate. A red plastic tip is fitted to all nails to guide them in the barrel when fired. A nail must never be used without this red plastic tip in place. The outfit of charges supplied to a ship is peculiar to that ship and is decided solely by the thickness and type of plating in the ship.

Fig 15-2. Ramset Tool and Operator

1521. A patch plate of up to 9mm thickness can be secured to a parent plate up to 15mm thick, provided that the total thickness of plating and rubber insert does not exceed 25mm. For the strongest possible fastening, the nail should completely penetrate the parent plate and its head should be flush with the surface of the patch plate as the Ramset nail itself is the fastening medium. The elastic properties of the penetrated steel provide a vice-like grip of the shank of the nail and the holding power varies only with the thickness of steel penetrated.

1522. The procedure for operation of the Ramset tool and the safety arrangements and precautions are as follows:

a. **Safety of Personnel.** Despite built-in safety features, it is possible for plastic shrapnel to be produced during Ramset operation. The following personnel safety equipment is therefore to be worn by the Ramset tool operator and all other personnel involved with, or in the vicinity of the work being undertaken:

(1) Overalls (correctly fastened).

(2) Ear defenders.

(3) Polycarbonate lens goggles.

(4) DMS boots.

(5) Full anti-flash.

b. Where possible personnel other than the tool operator, should be kept 5 metres from the immediate vicinity and remain out of the ‘line of fire’ from possible spalling/foreign objects which may result from the operation of the equipment.

c. **When Handling the Tool Make Sure That:**

(1) The tool is not loaded until required for firing.

(2) The tool is not carried in the loaded condition.

(3) The shield is fitted.

(4) The tool is not pointed at the operator or other people, whether loaded or unloaded, and is kept pointed down.

(5) Casual onlookers are not allowed to gather as they would be a hazard to the operator and to themselves.

d. **To Load the Tool:**

(1) Grasp the handle with either hand. Do not place the finger on the trigger at any time except when intending to fire. Grasp the lower assembly with the other hand and rotate the handle one-eighth of a turn counter-clockwise. Draw the handle directly to the rear and swing it around until it rests against the lower assembly.

(2) If reloading after firing, eject the spent charge case with the positioning rod provided.

(3) With the breech clear, examine the barrel, chamber and breech face to ensure that no obstruction or abnormal condition exists.

(4) Insert the red-tipped drive pin (nail) point-first into the barrel.

(5) Insert the charge (weakest strength for the first firing) into the chamber of the barrel. Press it firmly home with finger pressure only. Do not depend on the closing breech to seat the charge. Never attempt to lock the tool unless the rim of the charge is completely pressed into the chamber.

(6) With the charge fully seated, swing the handle and upper assembly into line with the lower and slide it forward as far as possible. Rotate the handle one-eighth of a turn clockwise to lock.

(7) The tool is now ready to fire.

e. **Before Firing:**

(1) Make sure that no flammable vapours or materials are present or are likely to be present.

(2) Whenever possible, make sure that the other side of the parent plate is clear of obstruction and personnel.

(3) Wear the goggles that are supplied in the Ramset kit.

f. **Firing:**

(1) Grasp the handle of the Ramset tool with one hand and the lower assembly with the other. Keep the finger clear of the trigger.

(2) Locate the barrel muzzle, by the location marks on the shield, with the desired fastening point.

(3) Depress the tool tight and square against the work until the yellow firing tip indicator shows flush with the top surface of the handle.

(4) Press the trigger.

Notes:

1. If the tool fails to fire do not remove it from the work surface for at least 10 seconds, then carefully withdraw it and keep the muzzle pointing in a safe direction. Unlock and open the tool, and remove the charge.

2. Make no attempt to fire the tool at an angle to the work surface (although the built-in safety measures should prevent if firing). Always hold the tool perpendicular to the work surface.

g. **Safety Arrangements.** The following safety arrangements are built into the Ramset tool:

(1) A visual yellow check button that shows flush with the handle when it is cocked.

(2) It cannot be fired at an angle to the work, it must be square.

(3) It fails safe when the shield is removed.

(4) It will not fire if the barrel is inadvertently unscrewed.

(5) The breech automatically locks when it is cocked.

(6) It cannot be fired against a soft surface, eg clothing.

(7) It can only be fired in the correct sequence, ie cocking first, then pulling the trigger.

(8) It cannot be cocked if the breech is not properly locked.

(9) The cocking action and safety pawl lie perpendicular to each other so that it will not fire if dropped.

(10) It automatically unlocks with the release of cocking pressure.

(11) Firing gases are diverted on to the face of the blow-back shield, completely eliminating bounce.

(12) The handle grip is neoprene and does not become slippery when wet.

1523. One of the main uses of the Ramset tool is the repair of a breached citadel, which necessitates gastightness in the finished work. The patch plate should have an overlap of at least 100mm more than the greatest dimension of the hole and before fitting it the parent plate should be faired as much as possible. The rubber insert must be the softest rubber available. The nails should be spaced approximately 75mm apart and are started at the middle of the edges and worked towards the corners. The patch plate can be dressed with a hammer if necessary as work proceeds. To ensure gastightness, the completed repair should be sealed around the edges with masking tape or a sealing compound such as putty, cable gland compound, etc.

1524. The Ramset tool supplied for use in the Service has some important differences to the standard tool, which allow its use under shallow flooding. These differences are as follows:

a. A special safety shield is fitted (manufacturer's part No 24203 instead of the standard part No 24168).

b. A special threat protector cap is fitted (manufacturer's part No 24202 instead of standard part No 24198).

c. A special washer is located behind the firing pin (manufacturer's part No 24205).

1525. It is important to clean a tool which has been used underwater, immediately after use, to prevent corrosion. The cleaning routine is as follows:

a. Make sure the tool is not loaded.

b. Thoroughly rinse the tool in fresh water.

c. Immerse the complete tool in a 2 per cent solution of water soluble oil. To ensure the solution penetrates all parts of the tool, open and close the breech then, pressing against a firm surface, work the tool up and down.

d. As soon as possible completely strip the tool, wash the parts in light oil, wipe the excess away to leave a thin film, and reassemble.

1526. The explosive charges, which are packed 250 in a Box M64, are to be stowed in the small arms ammunition magazine. The Marine Engineer Officer is to be responsible for the custody of the remainder of the equipment which, it is recommended, should be accommodated in the Engineers' Ready Use Store, in a secure stowage.

1527. Thermal Lance Cutting Equipment

This damage control emergency cutting equipment is portable and allows the operator to cut ferrous, non-ferrous metals and most other material rapidly, with accuracy and control. It uses ultrathermic cutting rods which are precision mini thermic lances (ie iron wires encased in a tube through which oxygen is fed). The rods are ignited by a battery ignition system arcing between the rod and the hand-held striker. One rod will cut approximately 380mm of 20mm steel (dependant on the operator) and can be used in water up to 1 metre deep. this will permit its use in personnel rescue and battle damage situations. Full details are contained in BR(F) 6589(402), Damage Control Thermal Lance Cutting Equipment.

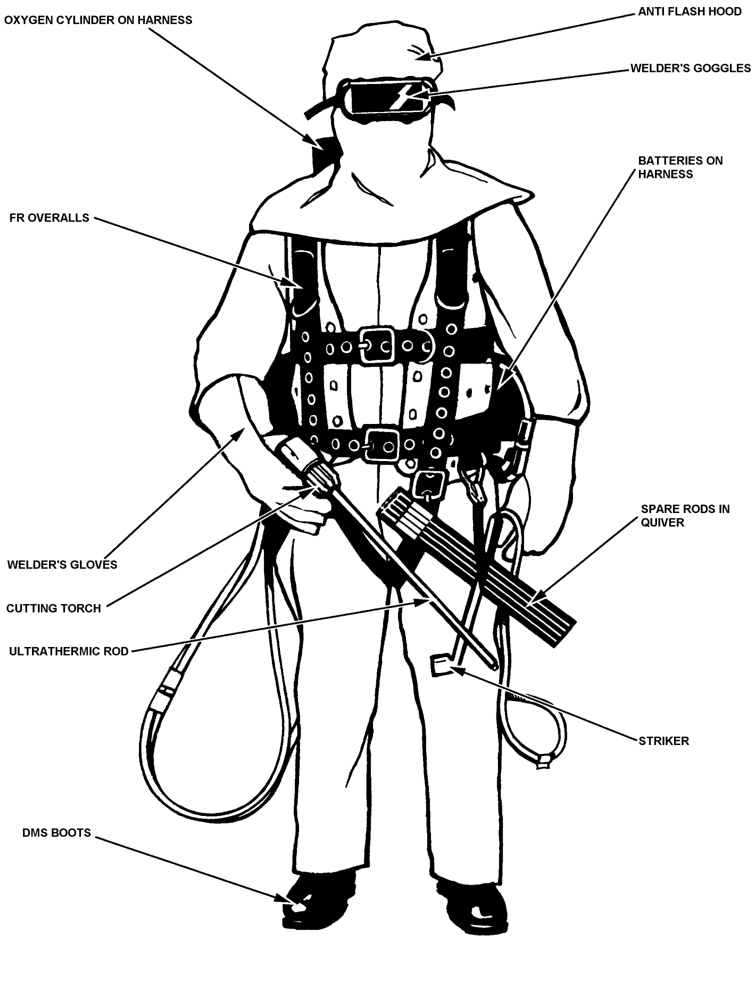

Fig 15-3. Thermal Lance and Operator

1528. The thermal lance equipment consists of six major components:

a. Aluminium storage case.

b. Body harness.

c. Oxygen cylinder and regulator.

d. Batteries and cable assemblies.

e. Cutting torch and striker plate.

f. Ultrathermic rods.

1529. Safety precautions are as follows:

a. The correct dress when using the thermal lance is:

(1) Overalls worn over No 4s and cotton underwear.

(2) DMS boots.

(3) Anti flash hood.

(4) Welder's goggles.

(5) Welder's gloves.

b. Be aware of the composition of the target material.

c. Be aware of what is behind the target material.

d. Clear the area of flammable materials.

e. Keep bystanders a minimum of three metres away.

f. Never point the torch at anybody.

g. Do not allow the positive and negative sides of the battery to contact.

h. Untrained personnel are not to use the thermal lance. (Training is carried out on the NBCD 35 Course or by special arrangement with Phoenix NBCD School as detailed in BR 2170(5)).

1530. Before using the thermal lance, the following preparations are to be made:

a. Inspect all components for damage or wear. Check the batteries and oxygen cylinder are fully charged (batteries are to be charged as a pair in series and should be kept fully charged at all times).

b. Connect the cutting torch to the oxygen cylinder and set the regulator to 90-120 psi (depending on application).

c. Connect the batteries to the harness, cutting torch and striker (cutter torch in the right hand).

d. Check the working area, remember painted and plated surfaces can give off lethal fumes to adequate ventilation must be provided.

e. Wear the correct safety clothing, including anti flash, welder's goggles/facemask and gauntlets.

1531. When commencing cutting work:

a. Open the oxygen cylinder valve.

b. With gauntlets on, undo the collet nut on the cutting torch and insert an ultrathermic rod (it will bottom out of the seating washer); tighten the collet nut.

c. Point the rod away from the operator and bring it into contact with the cup of the striker plate; when the rod top starts sparkling introduce a light flow of oxygen into the cup by gently squeezing the oxygen control lever (a circular or scraping motion may help to effect ignition). When the rod has ignited keep the oxygen flowing and move the top to the work area. Put the striker aside where it will not hinder the work.

d. The rod should be angled slightly to the direction of the cut and dragged along the cut line. The speed of movement should be slow enough to ensure the material is cut all the way through and the oxygen jet blows the molten material clear. Another technique is to use the torch like a saw. For comprehensive information on cutting methods refer to the maker's handbook.

WARNING

1. THE TEMPERATURE AT THE ROD TIP IS 5000 DEGREES CENTIGRADE. THIS MAKES IT A VERY DANGEROUS PIECE OF EQUIPMENT. EXERCISE GREAT CAUTION AND ALLOW NOBODY WITHIN 3 METRES OF THE OPERATION.

2. THE MIXTURE OF OXYGEN AND ELECTRICITY IS POTENTIALLY LETHAL, UNTRAINED PERSONNEL MUST NOT USE THE THERMAL LANCE.

1532. Cutting and Spreading Equipment

The hydraulic cutting and spreading equipment (see Fig 15-4) is provided for clearance of wreckage after Action damage. It is powered by an air-driven hydraulic pump, air being supplied from EDBA bottles, or from the ship's LP or HP air systems. If compressed air is not available, the tool may be powered by a hand-operated hydraulic pump. The tool is capable of cutting steel bar of up to 16 mm diameter and steel plate typically used for the construction of ship bulkheads, doors, etc. When used for spreading, the working arms exert a force of between 35 kN (3.6 tons) and 86 kN (8.7 tons), depending on the opening of the arms. The kit comprises an aluminium box containing the following components:

a. Combined cutting and spreading tool and associated hydraulic hoses.

b. Hydraulic hand pump.

c. Air driven hydraulic pump.(maximum air inlet pressure 8 bar)

d. 2-stage air pressure reducer.

e. Hydraulic pressure relief dust cap. (for releasing excess pressure in hoses if they have been stowed in a hot location, causing hydraulic locking of the self-sealing couplings)

f. Adaptors and hoses for connecting the hydraulic pump to bottled air or ship's air supply.

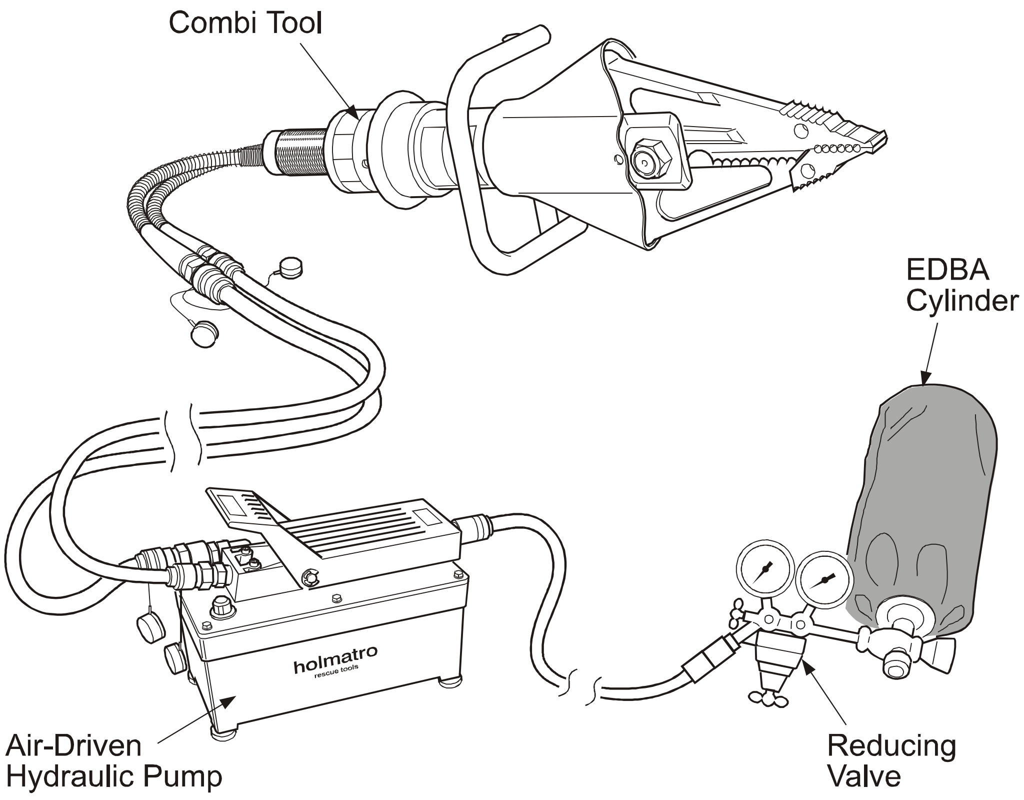

Fig 15-4. Cutting and Spreading Equipment

1533. The equipment is only to be used by trained operators, wearing overalls, safety helmet with visor or goggles, and heavy duty gloves. Training is included in all Aircraft Handler Qualifying Courses and the NBCD 35 Course, and additional training may be arranged with Phoenix NBCD School Booking Office. Detailed operation and maintenance instructions are provided in a handbook in each kit. Operation of the tool is by a 'dead man's handle' which is turned one way for cutting and the other way for spreading. When this handle is released, the tool stops operating. When used for cutting, it is essential that the tool is held at 90° to the material being sheared, to prevent the blades being forced apart and damaged. For spreading, the tips of the tool are inserted between the areas to be spread. If the gap is too small, spread the arms and insert one tip, close the arms and bend the fixed material away to provide a wider gap.

1534 Displacement of Floodwater

The loss of buoyancy due to a free-flooded compartment can be considerable. If the ship's outer bottom is holed and the damaged area cannot be reached by repair parties, consideration should be given to displacing the floodwater by:

a. Inflatable fenders or aircraft salvage bags, if the compartment is still accessible.

b. LP air via an improvised connection (eg indicator test plug) on the compartment boundary, or by ship's divers via the holes in the hull.

1535-1539. Spare.

1540. Counterflooding to Reduce List

Counterflooding to correct adverse list can be undertaken only in ships which have a fair degree of longitudinal subdivision. This will not be found in small ships but ballast tanks incorporated into the structure can be used for a similar effect. The results obtained from filling or emptying such tanks are listed in the NBCD Class Book.

1541. Counterflooding is generally used only to give an immediate correction to dangerous list or list that nullifies the ship's armament. For damage flood water to cause list it must be off-centre, which is only really possible in ships with longitudinal subdivision. Special arrangements for counterflooding are fitted in aircraft carriers. The ballast system in assault ships can be used for counterflooding if necessary.

1542. Should the total correction available by counterflooding be insufficient to bring the ship back to an acceptable level, it may become necessary to flood selected watertight compartments at the expense of the equipment they contain. This can usually be done only by hose from the HP Sea Water Main and usually entails closing down a section of the HP Sea Water Main or accepting a loss of pressure in the section concerned. Any form of deliberate flooding results in a loss of reserve buoyancy and though it produces quick and effective corrections to heel and trim it must be regarded as an interim measure only. As soon as it becomes possible to undertake the lengthier process of transferring liquid (fuel and fresh water) the deliberately flooded compartments must be pumped out and the transference and pumping out must be done together to avoid undue changes in the stability condition of the ship. Due regard must be given to the relative leverages of the compartments involved. Counterflooding and the transfer of liquid weight must be restricted to that necessary to restore the operational efficiency of the ship.

1543. Responsibility for Counterflooding

Captain's Standing Orders should allow for sufficient counterflooding to be carried out immediately to cover the most urgent requirements. The Marine Engineer Officer (MEO) is wholly responsible up to these limits. Should he consider more counterflooding to be necessary, permission must be requested from the Command who would make the decision in the light of the tactical situation, remaining freeboard, weather conditions, etc. It is important that immediately a compartment has been flooded up to its crown, the valves are shut to prevent extension of flooding, straining of the deckhead or free communication of flood water. The Action NBCDO must keep the stability condition of the ship under constant review. The DCO should give any necessary orders for transference of fuel and the working of fuel tanks to ensure an uninterrupted supply to the main engines. He must also issue any orders necessary for the isolation of the HP Sea Water Main and the operation of all pumps associated with damage control.

1544. Tactical Considerations

If the ship stops listing before the angle of deck-edge immersion is reached and is not rolling heavily, the danger of capsize is not immediate and counterflooding should be stopped. The decision to counterflood further should then be governed by the tactical situation, ie whether the use of armament or the operation of aircraft is required, or by the necessity of urgent repair work. If none of these requirements exists, the heel should be corrected by the transfer of liquid weights. Great care must be taken to differentiate between list and loll. Generally, if a ship with longitudinal subdivision is heeling, the condition is list. A ship with little or no longitudinal subdivision (transversely constructed) can rarely attain a condition of list if the heel is caused by flood water, and loll must be assumed (see Chapter 30).

1545-1550. Spare

1551. Salvage of Ships with Hazardous Cargoes

When rendering DC&FF assistance to merchant ships, the dangers from hazardous cargoes must be considered. Guidance is provided in Chapter 5 of BR 2170(2) to expedite the identification of such hazards.

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CHAPTER 16

LEAKSTOPPING AND SHORING

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CHAPTER 16

LEAKSTOPPING AND SHORING

SECTION 1 - LEAKSTOPPING

1601. General Considerations
The work falls naturally into two stages:

a. First aid leakstopping, to stop the inflow of water or reduce it to a rate which portable or fixed pumps can contain.

b. Post damage, semi-permanent repairs, to make the ship sufficiently seaworthy to continue operations or to proceed to a repair facility.

1602. Very large holes or serious damage to the hull cannot generally be repaired at either of these stages. Such damage is in the Primary Zone and is dealt with by establishing a flooding boundary. Less extensive damage, such as smaller holes and splits in the hull, bulkheads and decks, damage to pipe systems and strained or damaged doors and hatches can and must be dealt with. There are several ways to deal with these different kinds of damage; usually the simplest is not only the quickest but the best. In deciding the most suitable type of repair the following must be considered:

a. The rate of flooding and the size of the compartment.

b. The kind of hole (eg puncture or split), its size and whether the plating around it is distorted.

c. The accessibility of the damage and its position relative to the waterline.

d. The manpower, equipment and pumping capacity available.

e. The importance of the compartment, as determined by the Command Aim.

1603. Underwater Damage
Holes which are completely underwater obviously constitute the greatest danger and must be tackled immediately to slow the rate of flooding to within the scope of pump capacities. A small compartment will fill more rapidly than a large one with similar damage and leakstopping devices must be applied swiftly to all leaks, starting at the bottom of the compartment, to prevent its total loss due to free flooding. A large compartment will fill slower than a smaller one with the same damage, allowing more time for leakstopping. This, however, should not distract from the urgency of the situation. Some damage will be so severe and flooding so rapid that leakstopping cannot be carried out and pumps will not reduce the level of water. In these cases the compartment must be shut and allowed to free flood, and the boundary structure made watertight. This may require the use of shoring to support weakened or straining structure or fittings.

1604. Waterline Damage

Holes at or just above the waterline should be dealt with as quickly as conditions permit, since they are a great potential danger. The rolling, heeling or trim of the ship, or increase of flooding elsewhere, may bring them underwater, thus increasing the flooding at the waterline. This will cause free-surface flooding, which will impair stability and may hazard the ship.

1605. Leakstopping Devices and Methods

The main difficulty in leakstopping is making a watertight joint between the stopper and the edges of the damaged plate. Around an 'entry hole' the inboard surface is usually very ragged and petalled but an 'exit hole' may present a fair inboard surface. The principle in both cases is to choke the flow of water by compressing soft material into the hole and against the edges of the plating. Mattresses and bedding material are especially suitable for fairly large holes. Other materials can, of course, be used and some methods of leakstopping are described in the following paragraphs.

1606. Softwood Wedges and Plugs

Small splinter or bullet holes, and small splits can normally be plugged by hammering in softwood wedges (or bungs for round holes). These have the advantage of swelling when wet, making them grip and seal more firmly. Wedges can be used singly or in bunches, and small gaps can be filled by pieces of wedge (which can be split easily from a whole wedge along the straight grain). Wedges have a tendency to spring back when used on thin plating or in oily conditions. A recommended remedy is to cover the wedge with wet cloth before driving it in. The cloth fills the gaps between the wedges as well as providing a better grip.

1607. When using wedges in a vertical split, multiple splits or splinter holes, the lowest ones must be tackled first; work proceeding upwards. This will ease the problem of obscuring low splits by the wedges already driven in and will, in general, make the task of wedging up easier and more complete. Where splits and holes are obscured by water they can be felt for with the fingers and the wedges guided in accordingly. Wedging up is the only method of leakstopping against seawater pressure which can be carried out single-handed. All other methods will require two or more people.

1608. Large Holes

If holes or splits are too large to be filled by softwood wedges, alternative methods of leakstopping are available:

a. Splinter box.

b. Patchpack.

c. Improvised leakstopper.

d. Steel stopper plate.

1609. Splinter Boxes

These are used for patching holes with ragged edges. They are shallow GRP boxes which are available in three sizes, 300mm diameter × 175mm deep, 450 mm diameter × 200mm deep and 600mm diameter × 225mm deep. One face is open and has a rubber seal around its edge, the opposite face being closed and with a 15mm hole in its centre which is blanked off with a bolt, butterfly nut and washers. When used on a tiled deck, tiles and deck cement should be removed to allow a better seal. The box can be held in place by a shore (see Fig 16-1), when the hole is sealed by the foot of the shore or by the wooden wedge. Alternatively it can be secured by removing the bolt, etc. and using a 50 × 50 × 6mm steel angle strongback fitted with an eyebolt and a 600 × 12mm ringbolt and butterfly nut with a wooden washer. Allowances are scaled to one set of splinter boxes, (one of each size), per FRPP and one per Main Machinery Space. If needed, and the necessary equipment is available, a heavier strongback can be made by bolting or welding an eye (approximately 12mm) into the throat of a short length of channel bar. In order to maintain a low magnetic signature, GRP structured vessels are to locally manufacture eyebolts and strongbacks from aluminium, as detailed in BR 2170(3).

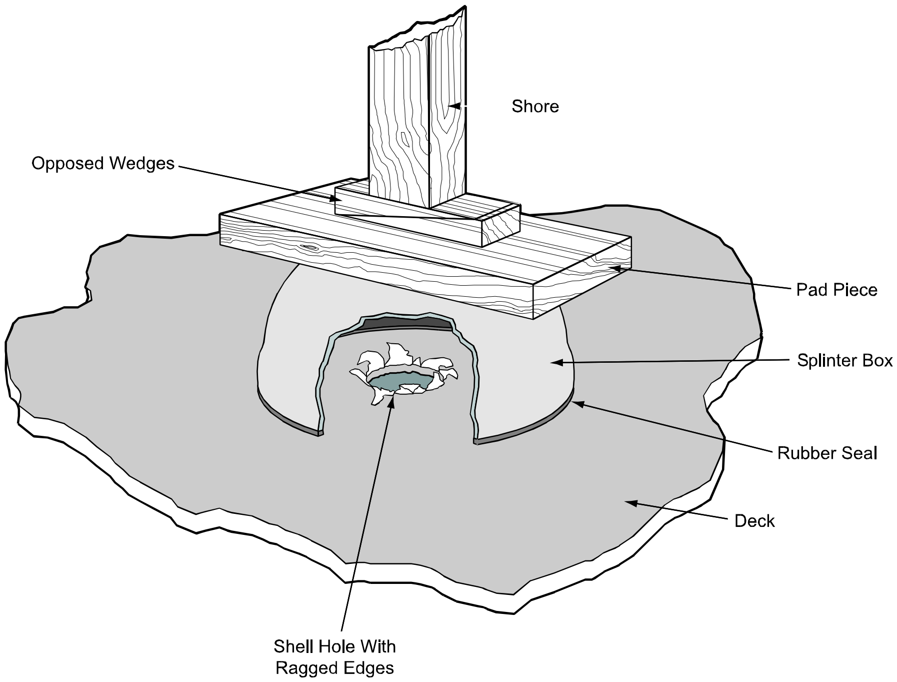

Fig 16-1. Splinter Box and Shore

1610. Patch Packs

These consist of six $^{3}/_{16}$in thick mild steel plates ranging in size from 12in × 9in to 36in × 24in with a number of eyes welded to one side of each plate. All six plates, complete with strongbacks, hookbolts and wingnuts, are tack-welded together to form one pack for ease of stowage. The plates are intended to be applied to the outside of the damaged shell plating with the 2in × ⅝in flat bar strongbacks inboard, held in place by the ½in dia. hookbolts and wingnuts, with sheet rubber or other joining material inserted between the patch and the shell plating. Allowances are scaled to one patch pack per FRPP. The 76mm × 38mm steel channel, provided at FRPP lockers can be used if the strongbacks need to be more robust.

1611. Improvised Leakstoppers

The shape and extent of holes in the hull may preclude the use of splinter boxes or patchpacks, but adequate leakstoppers can be improvised using materials readily to hand. Table tops or similar flat boards may be considered as emergency stopper plates. Sealing between the stopper and the hull can be achieved using bedding, a shot mat or soft furnishings. If entry holes are severely petalled, a ‘sausage’ of rolled material (eg blankets or carpet) should be wrapped around the jagged plating until the pad stands well clear of the edges. This type of leakstopper will normally be held in place by shoring, but an improvised strongback may be appropriate. For holes well above the waterline, where less urgency is needed, it is advisable to cut off the worst of the hull petalling to make the seal more effective.

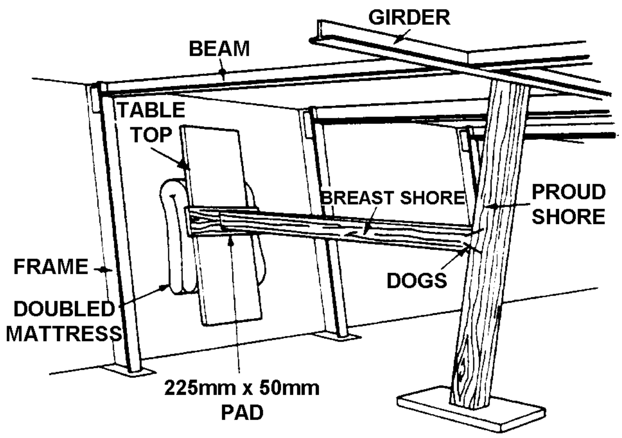

Fig 16-2. Leakstopping - Large Hole - Using Shore

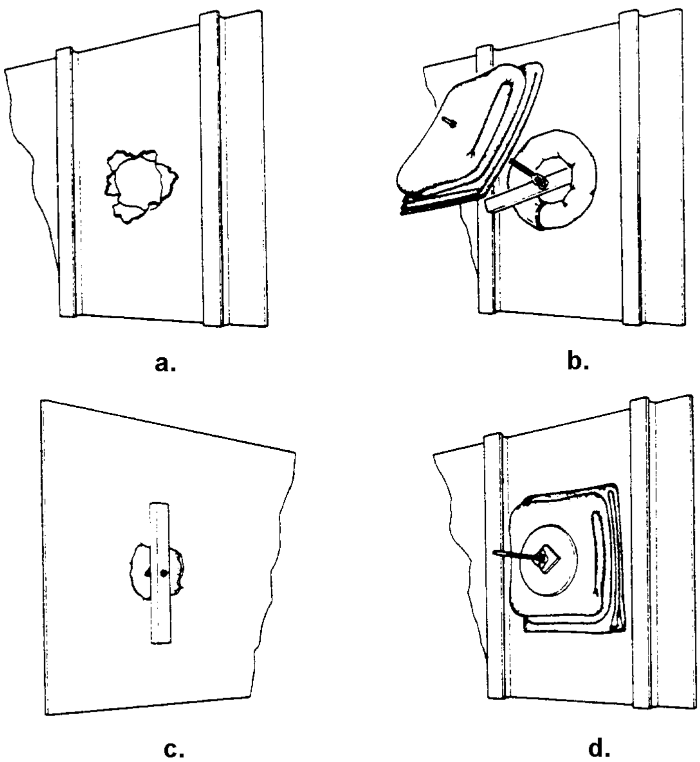

Fig 16-3. Leakstopping - Large Hole - Using Strongback

1612. In addition to the allowance of patchpacks, strongbacks and hookbolts in BR 2170(3), additional devices may be fabricated onboard, as shown in Fig 16-3 and 16-4.

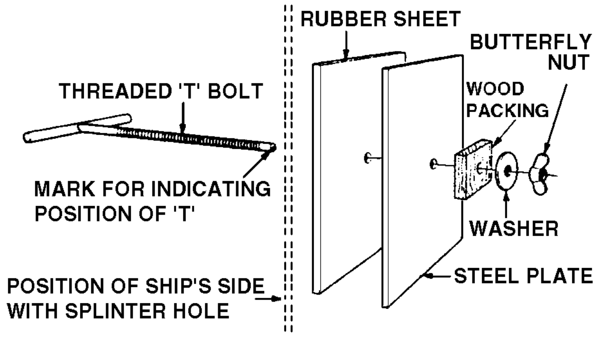

Fig 16-4. Strongback and 'U', 'T' and 'L' Bolts

1613. Steel Stopper Plates

Large ships carry an allowance of steel plate for damage repair and in smaller ships engineers' workshops will, generally, have ready-use plate available. Handling of large steel plates is difficult, so they should be cut to the required size before moving, and their use will only be practicable when the ship is no longer under attack. The plate may be secured to the hull (after insertion of packing, where required) by welding or by use of the Ramset tool.

1614. GRP Emergency Repair Pack

Ships with glass reinforced plastic (GRP) hulls carry an Emergency Repair Pack for making repairs to minor hull damage. The pack includes all materials, personal protective equipment and instructions. The two-part epoxide based repair material produces best results on clean, dry and well prepared surfaces, but in an emergency it will tolerate slight oil contamination and may be applied underwater. The pack can also be used for making temporary repairs to ruptured pipes, etc. The effectiveness of the repair can be enhanced by clamping it to the damaged surface until the epoxy resin cures. The minimum temperature for curing is 5°C, but the gel time will reduce considerably at higher temperatures.

1615. Cement Boxes

Small holes near boundaries, and in difficult corners, can be dealt with by using a small cement box. The material used as the leakstopper is rapid hardening cement (Ciment Fondu, sometimes called damage control cement), which is a semi-permanent repair material. Unlike ordinary commercial (Portland) cement, which takes some time to harden, the rapid hardening cement sets in five hours, hardens in eight hours and achieves maximum strength in 24 hours. It will also set, providing it is well contained, under static water. The leak must be stopped as much as possible using softwood wedges (or some other form of leakstopping) and the surrounding plating, which is to be covered by cement, must be cleaned of oil, grease, loose paint, etc. (GP detergent is recommended for this purpose, care being taken with its application). The cleaned steel can then be roughened with a cold chisel or similar tool to aid the grip of the cement. A cofferdam or cement box should be built around the leak using, for preference, tongued and grooved timber or heavy plywood boarding. The cement can be mixed with either salt or fresh water to provide a stiff mix. It is sometimes useful (especially if water from the leak is still coming in, or present, to fill sand bags, one third full, with mixed cement before moulding to suit the damaged area. This will reduce washing-away of the cement. The cement placed in the box must always be well tamped down, care being taken to avoid trapping air. If small amounts of running water are present it is recommended that sheet rubber or PVC be placed over the leak and taken to the bottom of the box. This will give the cement a better chance of setting and also greatly reduce the chances of any of it being washed away. A drain pipe should be set into the box at a low level in order that any water which may become trapped inside may 'bleed off'. When the cement has set this pipe can then be plugged. It should be remembered that 0.1m^3 of mixed cement weighs approximately 40.5kg and that sufficient should be made to fill the box. Fig 16-6 shows the construction of a cement box.

WARNING

CONTACT WITH THE CEMENT POWDER OR WET MIX CAN CAUSE IRRITATION, DERMATITIS OR BURNS.

EYE AND SKIN PROTECTION IS TO BE WORN.

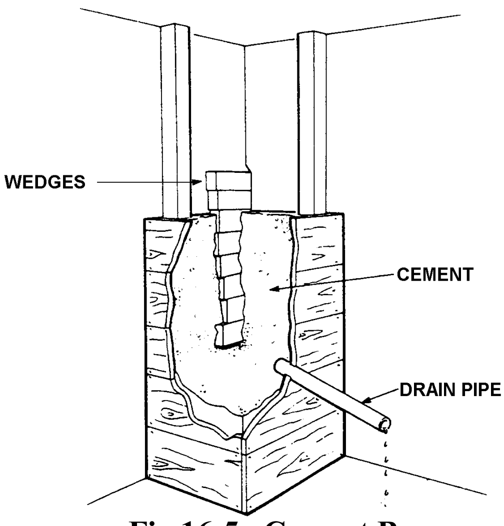

Fig 16-5. Cement Box

1616. Damaged Pipes

Softwood plugs, wrapped with cloth, can be hammered into a severed pipe if the open end is in reasonable shape. Plugs are not to be used in pressurised systems and must be secured into position, to reduce the hazard to personnel in the event of a blow-out. If the pipe is distorted, the use of blank flanges is more effective, but takes longer due to the need to isolate the system and remove bolts.

1617. Splits and small splinter holes in pipes can be repaired by isolating the system and applying the suitable size of pipe repair clamp or by a rubber patch secured by cord whipping. Small bore pipes can be repaired by use of rubber hose and 'Jubilee' clips.

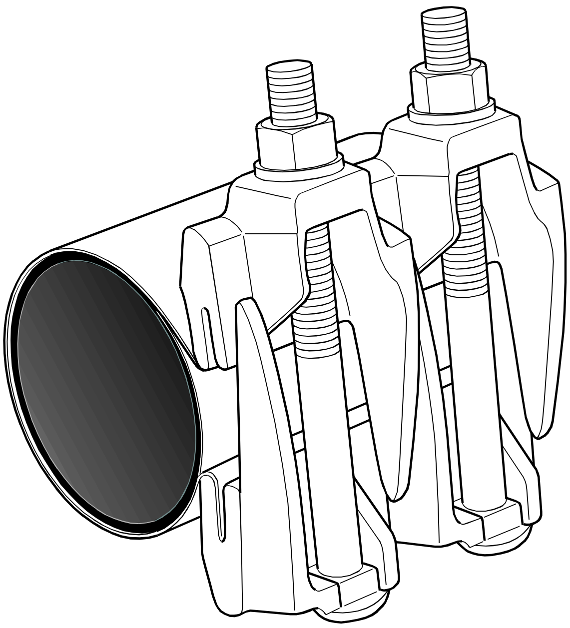

Fig 16-6. Pipe Repair Clamp

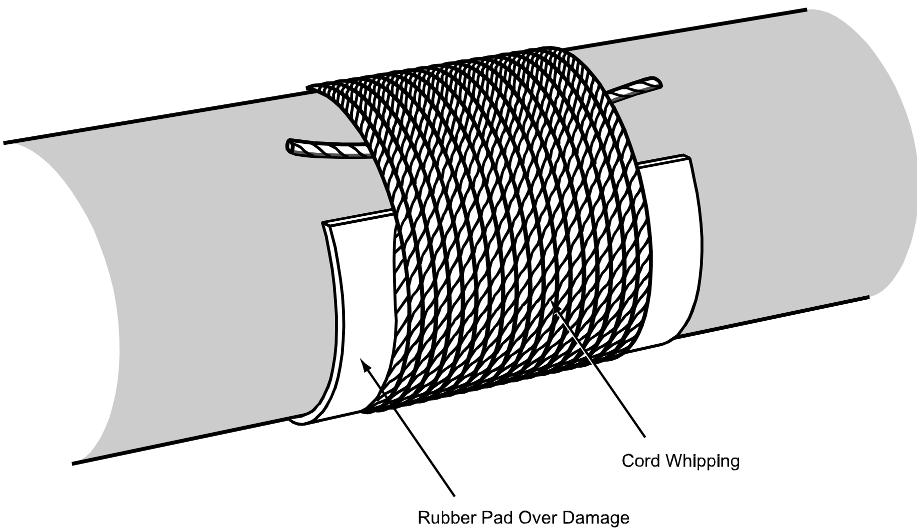

Fig 16-7. Rubber Pad and Whipping

1618. Pipe repair tape kits are carried onboard, under the control of the Hull Section (Engineers' Workshop in RFAs). Each kit includes two-part epoxy putty, repair tape, protective gloves and instructions. The resin in the repair tape is activated by contact with water and cures in approximately 30 minutes, depending on the temperature.

1619. Damaged HP air or hydraulic systems can be repaired, in emergency situations, using hose repair kits. The allowance of these kits, specified in BR 2170(3), varies between ships. Each kit contains stainless steel braided, PTFE lined hoses in 5 metre lengths and various Keelaring reducing couplings. These repairs can be applied to systems operating at pressures up to 276 bar, but should only be considered as temporary, pending permanent repairs.

1620-1621. Spare.

SECTION 2 - SHORING

1622. Shoring

Many of the leakstopping devices described above depend on shoring for their efficiency. Shores also have other very important functions in a damaged ship:

a. Support of straining bulkheads, decks, doors and hatches against abnormal pressures.

b. Support for damaged and weakened structure and fittings.

In both, the shoring is used to distribute the stress loading of straining or weakened members to sound parts of the structure. The principal watertight bulkheads are built to withstand the stresses that occur when compartments are flooded statically, and compartments are tested during building to ensure that this is so. To conserve timber, therefore, and to avoid wasting valuable time and labour, sound structure should not be shored merely because the compartment on the other side is flooded. However, extensive damage in the vicinity may have weakened the structure and made it incapable of standing up to its designed stresses; it must then be supported. Support is also needed for a bulkhead thrown open to the sea, to prevent its collapse under wave action or under pressure from movement through the water. In this case, if no strain is apparent, only a little support is needed; if strain is apparent, much more shoring is needed.

1623. Symptoms of Strain

Straining of structure is usually readily apparent and can be recognised by:

a. **Panting.** This is the alternate bulging and contraction of plating (often accompanied by a groaning or pinging noise) caused by uneven pressure or locked up stresses. It is difficult to shore panting structure efficiently and a much better job can be done if the ship's speed is reduced, or the ship's head turned away from the sea, until shoring is completed. If conditions will not permit this, the shores should be fitted to the extreme of the outward movement. Alternatively, if there is a convenient securing point (eg eyeplate) or one can be welded on, the plating can be held in by wires or chains and lifting appliances.

b. **Buckling.** Deck beams or bulkhead stiffeners may buckle; bulkheads or deck plating may bulge when under strain.

c. **Fracture or Splitting of Plating.** This may occur alongside stiffeners or where bulkheads or decks abut on hull plating. It is often difficult to detect cracks that may be hidden under paint, oil or fittings.

Great care is necessary when examining the structure and if strain is apparent shoring must be carried out immediately. It should not be postponed, because flooding may spread, causing an increase in draught with the consequent greater pressure on the structure and a further loss of compartments.

1624. Supporting Weakened Structure

When structure has been weakened by damage, or has lost its normal means of support, shoring provides the best method of giving temporary support until more permanent measures are possible. If structure has been distorted, shoring should be used only to hold it to its new position. No attempt should be made to force if back to its original shape because this would probably induce further stresses and may cause complete rupture.

1625. Timber Shoring

The main and best material for shores is softwood, ie pine or fir. It can be easily handled, cut, fastened and, compared to hardwood, has a higher strength/weight factor. The sizes most used for shores are 100mm by 100mm and 150mm by 150mm. Deal planking of sizes 50mm and 75mm by 225mm are usual for pad pieces and packing, and the usual size of tongued and grooved planking is 32mm by 150mm. Batten timber, used for tying a system of shores together, is 25mm by 75mm. Softwood wedges are used for setting up shores. Mild steel dogs (staples), and nails are used for securing shores, pad pieces and battens together. When stowed onboard, the shores, planks and battens should be cut to the greatest length that can be moved through the ship.

1626. Adjustable Steel Shores

The adjustable steel shore consists of two telescopic, tubular steel sections, supplied in two sizes, 1.75m extending to 3.1m and 1m extending to 1.68m. It is fitted with head and base plates and provided with a screw jack, with drop handle, for fine adjustments. These shores can only take loading along their lengths. Any lateral loading will distort them, so they should only be used as vertical or breast shores, never as proud shores. They must not be hit with hammers or dented, as any distortion to the outer case may prevent the inner part from sliding freely, thus making adjustments difficult or impossible.

1627. When adjustable shores are stowed (either vertically or horizontally), the pin should be located through a hole in the inner tube, below the screwed collar, which should be near to the bottom of the thread to allow for maximum adjustment.

1628. It is essential that an adjustable shore is carried correctly to avoid hazards to personnel. A shore must be carried vertically, with the threaded portion uppermost. The pin must be fully inserted just below the rotating collar. To prevent the pin from moving it must be held in place, as shown in Fig 16-8. The other hand should grasp the shore at a point one third of its length up from the base.

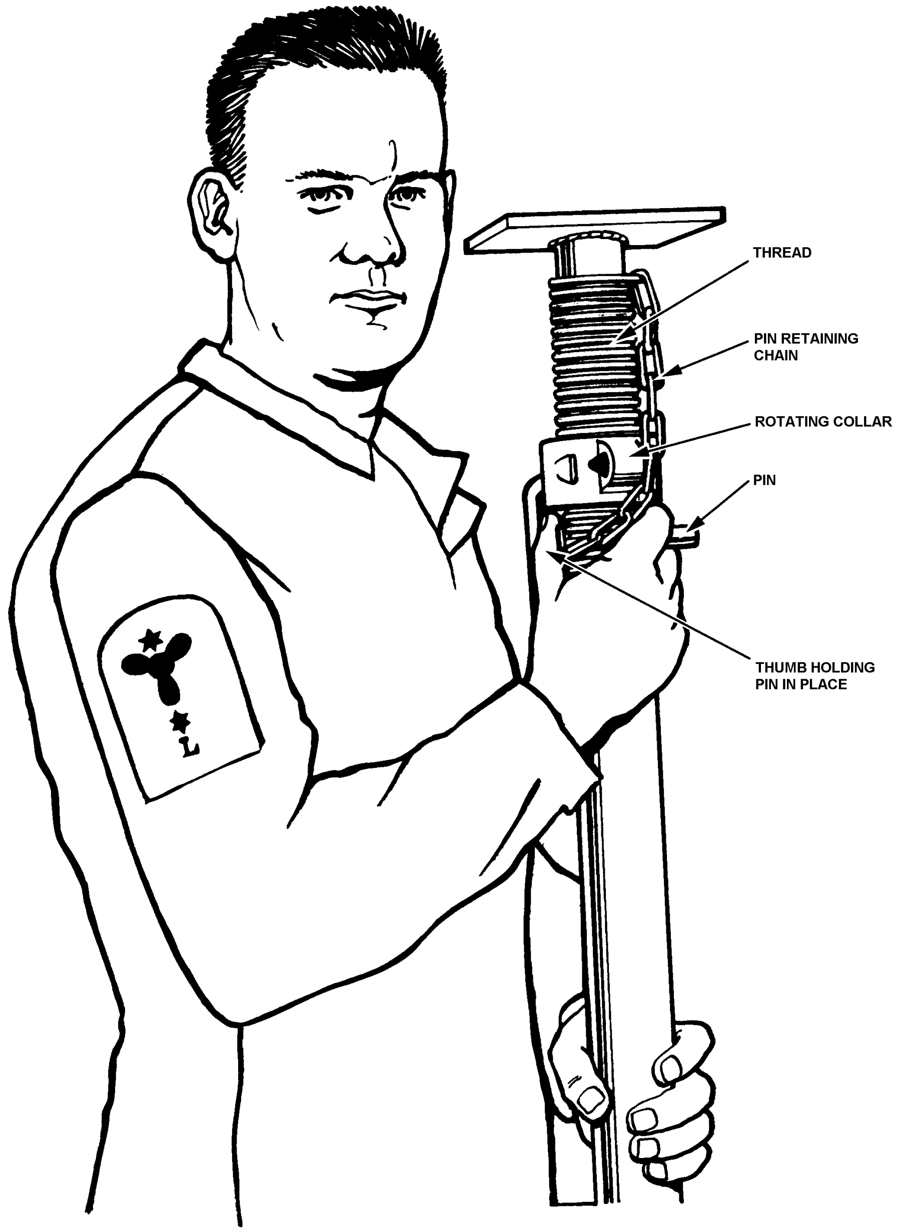

Fig 16-8. Carrying an Adjustable Steel Shore

1629. Adjustable shores may be used for permanent shoring during peace time damage situations, when ship motion is unlikely to displace them, but they must be regularly inspected. They are always to be used in conjunction with wooden pad pieces to:

a. Reduce the danger of slipping.

b. Spread loading on the structure.

c. Prevent damage to GRP splinter boxes.

1630. After use all moving parts of the shore should be lightly oiled before stowage, to prevent seizure.

1631. Tools for Shoring

The following tools, required for shoring, are stowed at FRPP lockers:

a. 7lb (3.15kg) hammer.

b. 2lb (910g) hammer.

c. Cross cut wood saw.

d. Gunter batten.

1632. Gunter Battens

Gunter battens are used for measuring the length to which shores are to be cut. Guidance for their manufacture and use is given in Figs 16-9 to 16-11. Two sizes should be made, one 1500mm long and the other 750mm.

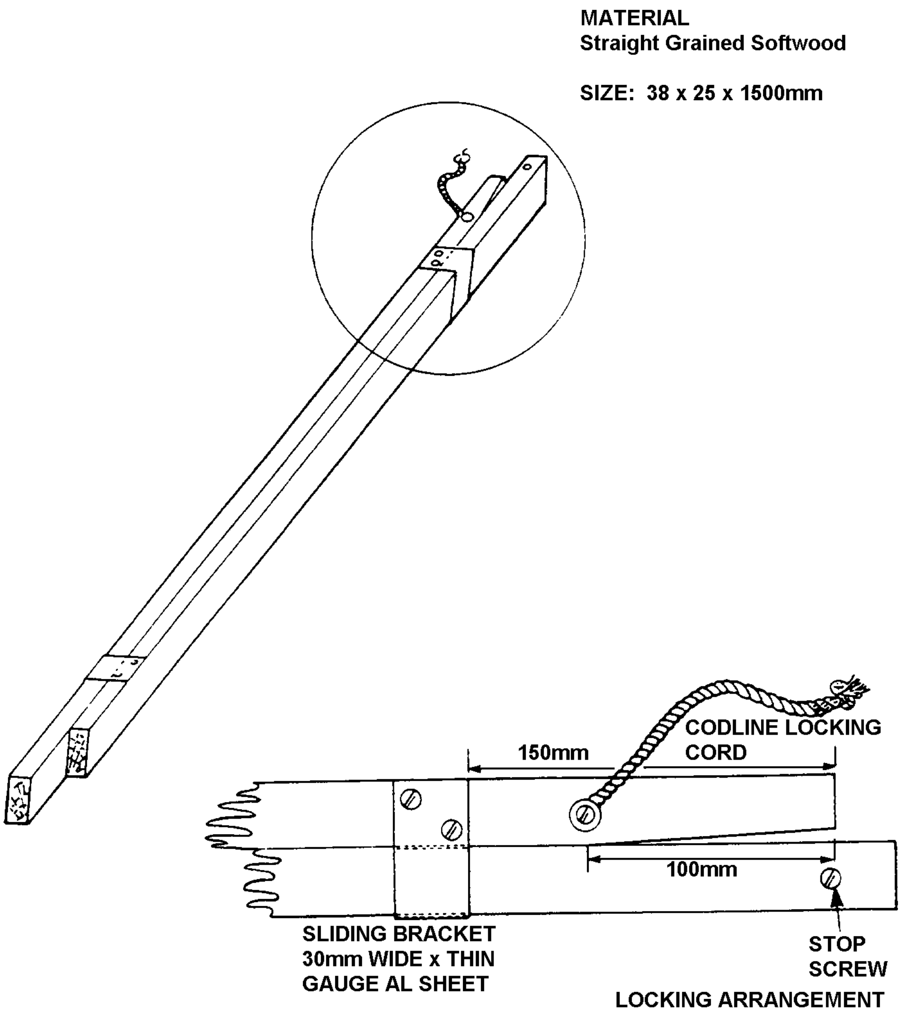

Fig 16-8. Gunter Batten - Manufacturing Details

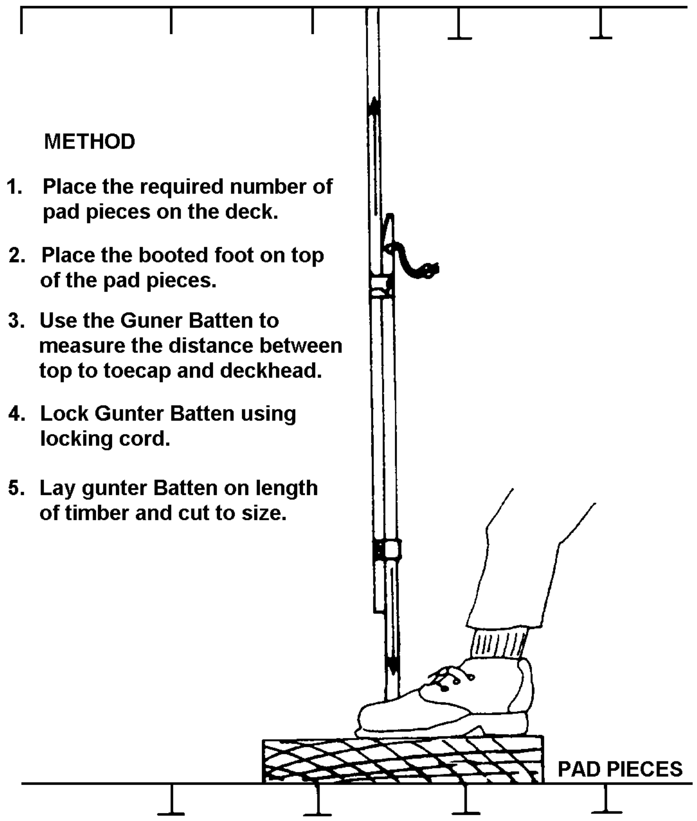

Fig 16-10. Use of Gunter Batten to Measure Length of Vertical Shore

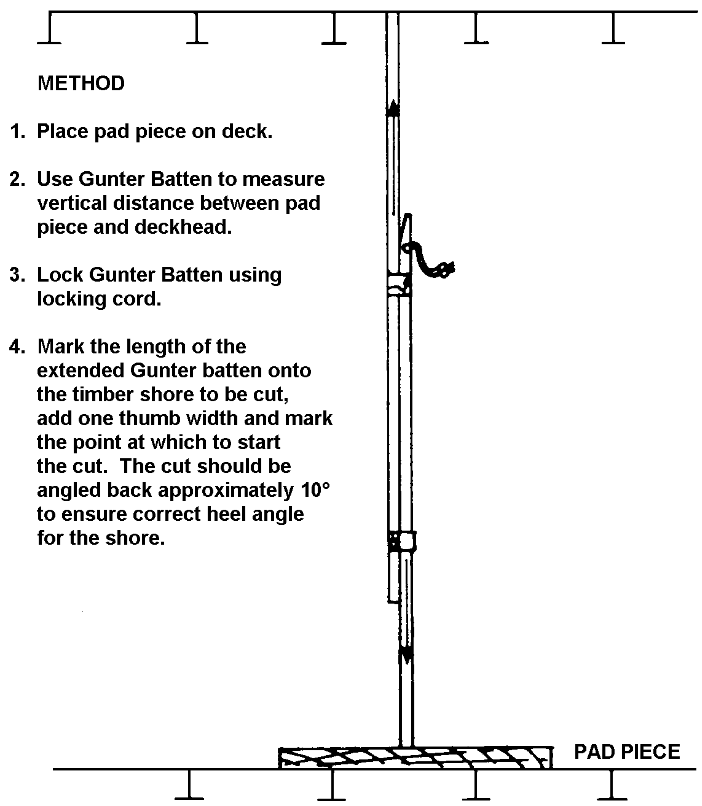

Fig 16-11. Use of Gunter Batten to Measure Length of a Proud Shore

1633. Principles of Shoring

The essentials for shoring to be effective are:

a. Strong and rigid anchorage for the shores.

b. A reasonably complete network of reinforcement.

c. Distribution of the load over as large an area as possible.

The method of shoring to be adopted depends on the extent of damage and the character of the structure in the vicinity. The aim should be to shore to the nearest strong point. If the nearest structure is not strong enough, the shoring must be continued back, through other compartments if necessary, to end at members of the necessary strength. The shoring assembly must always be kept under observation because if it becomes strained it will itself need support.

1634. General Rules for Shoring

There are certain rules generally applicable to all types of shoring, whether for bulkheads, decks, doors or hatches. They are:

a. A timber shore should never be longer than thirty times its minimum width or thickness.

b. Ideally, the head and heel of a shore should abut on stiffened plating (by a deck beam or bulkhead stiffener). This is not always possible, in which case wooden pad pieces should be used to spread the load.

c. Shores should never be cut in anticipation, for any distortion of structure would make them useless.

d. Shores must never be placed in position before damage occurs; they would transmit shock and make the damage greater.

e. Wedges should be used in opposing pairs. The two wedges should be driven in simultaneously or a heavy weight held against one while the other is driven in.

f. A system of shores should be tied together with battens and dogs or nails.

g. Careful watch must always be kept on shoring and any loosening attended to immediately.

1635. Methods of Shoring

There are three methods of shoring:

a. **Vertical Shoring**, for hatches and decks and for leakstopping devices on them. (See Figs 16-12 to 16-14.) A vertical shore must be cut approximately 50 mm shorter than the measurement between the deck pad piece and the deckhead, to allow for the wedges used to ‘harden’ it into position.

b. **Square Shoring**, for bulkheads, ship's side plating, watertight doors and for leakstopping devices on them. A proud shore is sometimes needed to achieve square shoring. A proud shore is a shore cut longer than the height between decks (add 20mm), the head placed against a girder or a welded-on lug, and the heel jammed on the deck below. A breast shore is then carefully cut to jam down as nearly horizontal as possible between the proud shore and the structure to be supported. With accurate cutting of the shores, wedges are unnecessary. However, should wedges be necessary, they are best used at the heel of the breast shore where it butts against the proud shore. Figs 16-2 and 16-14 illustrates this arrangement.

c. **V Shoring**, for vertical structures. This is not as simple as square shoring. (See Figs 16-15 and 16-16.)

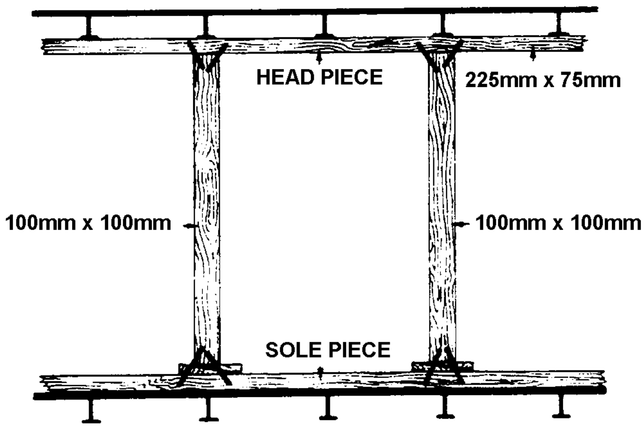

Fig 16-12. Vertical Shoring - Decks

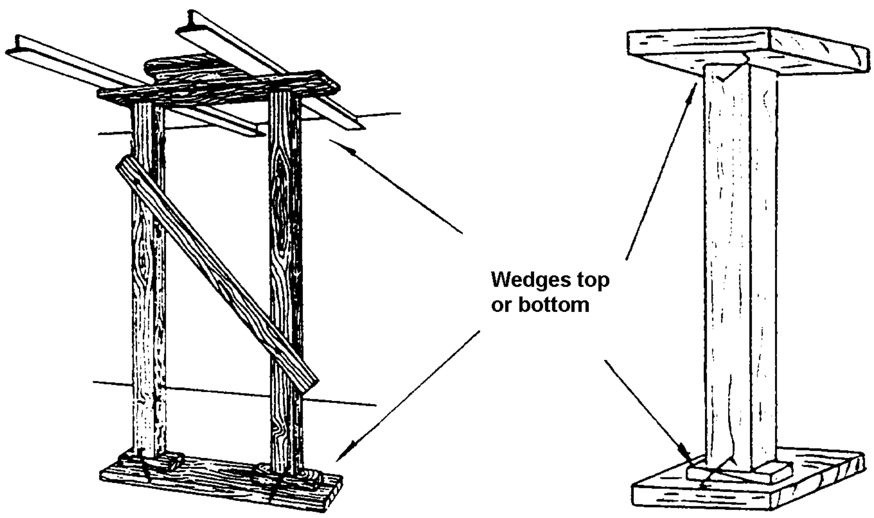

Fig 16-13. Vertical Shoring - Single and Double

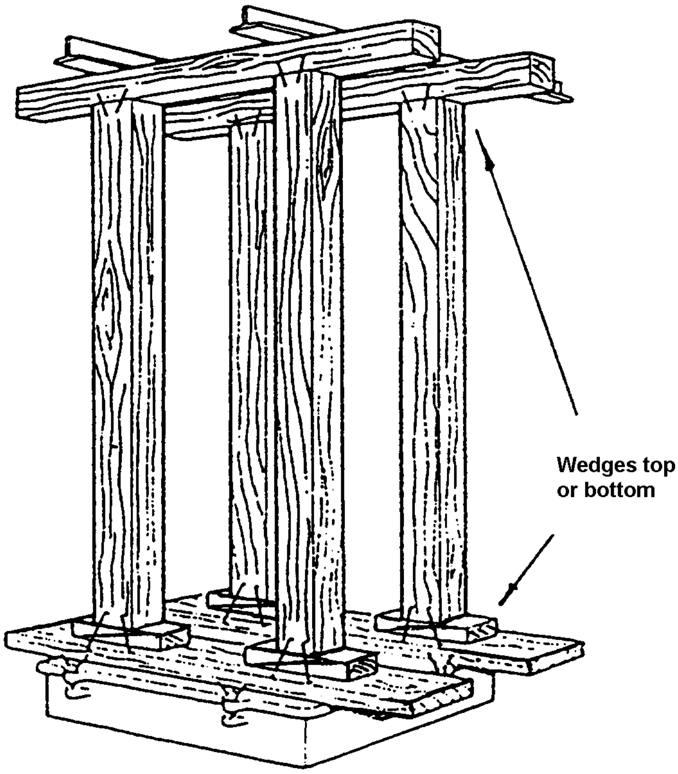

Fig 16-14. Vertical Shoring - Hatch

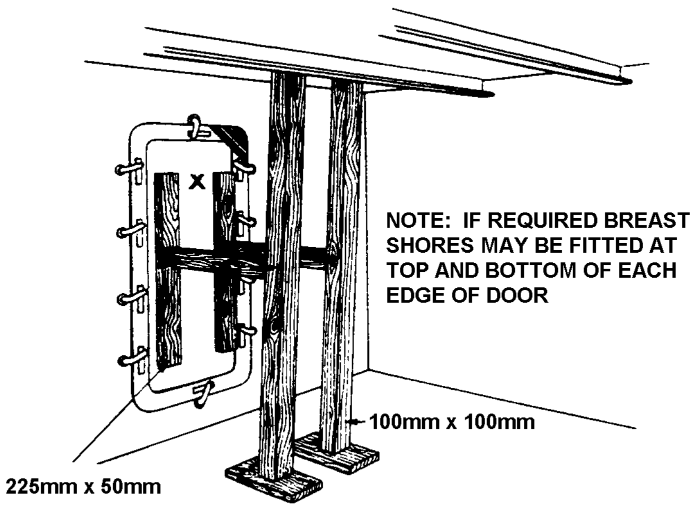

Fig 16-15. Square Shoring - Door

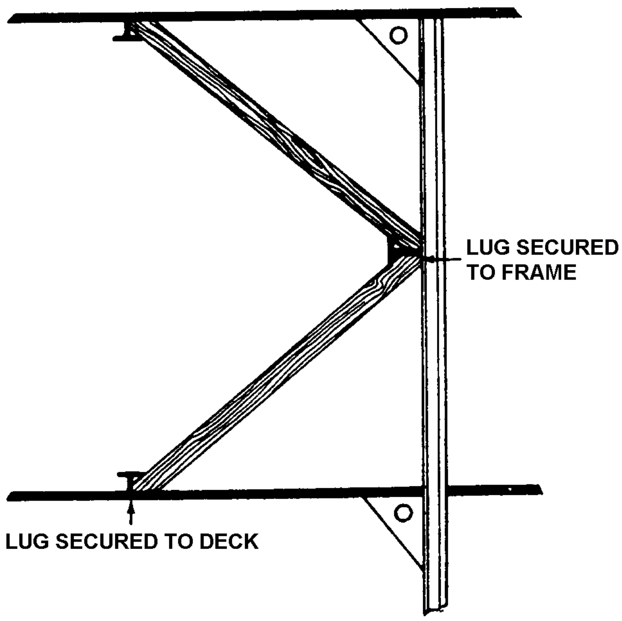

Fig 16-16. V Shoring - Bulkhead (Elevation)

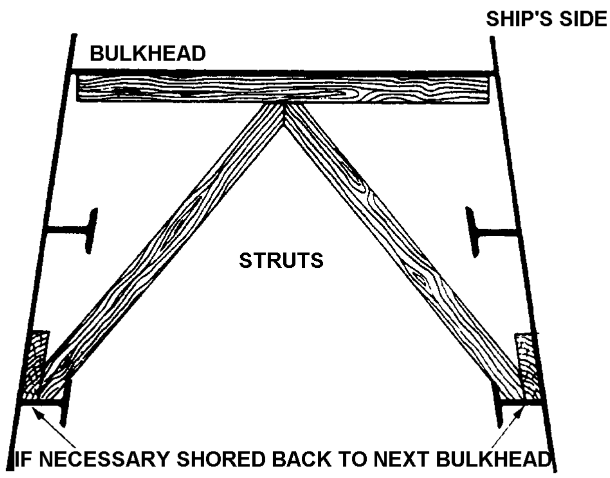

Fig 16-17. V Shoring - Bulkhead (Plan)

1636. Basic Instructions for Shoring

Details of more elaborate systems of shoring are given in later paragraphs, but the basic rules are:

a. **Bulkheads.** The first and most effective shore on an intact but straining bulkhead should be at the centre of the bulge or, if the strain is due to water pressure on the other side, at one-third of the height and at the centre of width of the bulkhead. Full advantage must be taken of beams, pillars and heavy, fixed fittings to anchor the shores.

b. **Decks.** Pad pieces will always be needed at both ends of a vertical store. For vertical shores to abut under a beam, pad pieces or shoring material must be laid across under the beams. If a deck is bulging because of pressure underneath, the foot of the shore should be over the distortion if possible. If a number of vertical shores are to be fitted in line, a length of 100mm × 100mm timber should be used as a continuous pad piece.

c. **Watertight Doors and Hatches.** The first shore should be set up on a pad piece on the door or hatch just clear of the clips along the side remote from the hinges. If needed, a second shore can be similarly set up along the side nearer the hinges. On a very big hatch, it may be necessary to set up four shores (Fig 16-14) but two will generally be enough. Shores to doors and hatches must not be set up harder than necessary, because undue pressure will only tend to increase the leaking.

1637. If a vertical shore is being set up on an oily deck, efforts should first be made to clear the oil away using GP detergents and/or suitable absorbing agents before using rough abrasive cloth/paper (doubled up to present the rough side to the surfaces in contact) or rags, under the pad piece and the heel of the shore, to improve its grip. Wedges should be set under the heel unless flood water makes it impossible, when they should be set under the head.

1638. Spare.

1639. Multiple Shoring of Bulkheads

Where no solid structure is available to take the thrust of shoring in the immediate vicinity, a system of multiple shoring must be adopted to take the thrust back to the nearest strength structure. Examples of this shoring are illustrated in Figs 16-18 to 16-21.

1640. Long lengths of shoring timber are unwieldy, difficult to set up and, in addition, may be too long to get through the door or hatch of the compartment in which they are required. With the types of multiple shoring illustrated, comparatively short lengths of timber can fulfil the purpose.

1641. Breast shores should be set up to pad pieces against the bulkhead with their heels to a proud shore and be continued back (and up and down if necessary) through other proud and breast shores, or through V shoring, to the nearest strength structure. The whole system must be cross-tied by battens, with shores, pad pieces, cross-ties, packing and wedges secured by dogs and nails. Supporting chocks under the heads and heels of breast shores give additional security against falling. Distance pieces between the heel of the proud shore and the nearest strength structure help prevent the possibility of slide-back.

1642. If slackening is observed, wedges and breast shores should be hardened-up and resecured with dogs or nails.

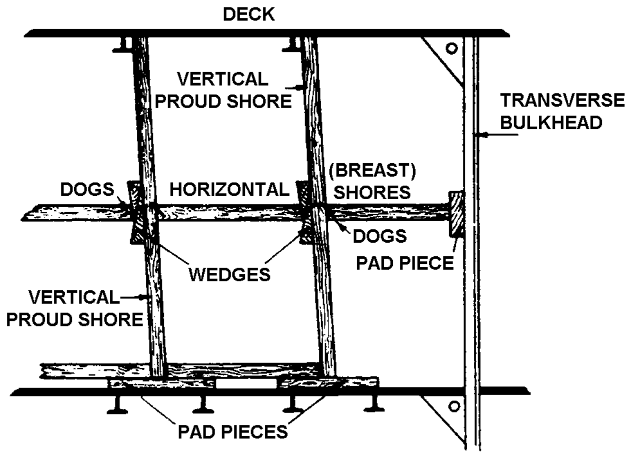

Fig 16-18. Multiple Square Shoring

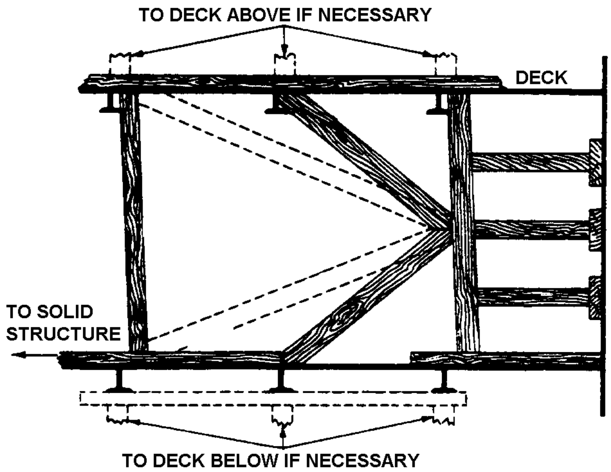

Fig 16-19. Multiple Square and V Shoring

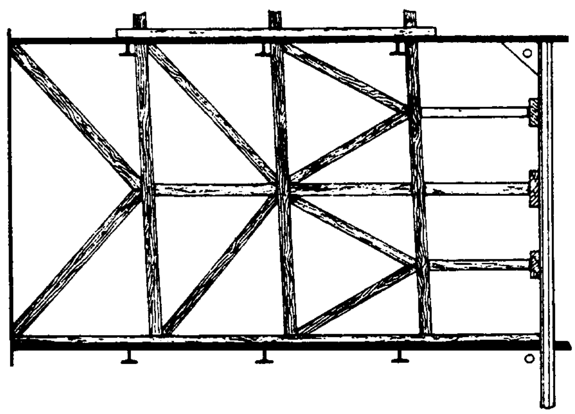

Fig. 16-20. Multiple Square and V Shoring

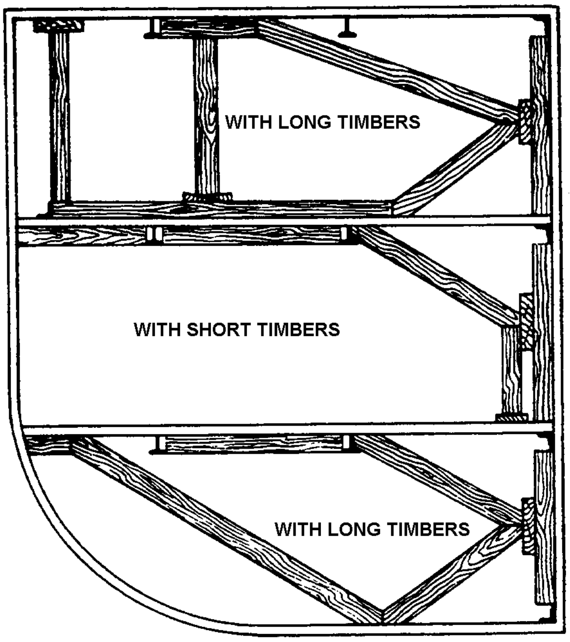

Fig 16-21. Shoring a Longitudinal Bulkhead (Various Methods)

1643. Fabricated Shore

Should it be necessary to use a long single shore in a compartment that has only a small access opening because machinery and fittings make the erection of multiple shoring impossible, the shore can be fabricated from short lengths of timber bolted together as illustrated in Fig 16-22. Each length used should be the longest length that can be passed through the access opening and the fabrication of the shore must be carried out in the compartment. Understandably, the use of a fabricated shore cannot be a first aid measure as the cutting, drilling and bolting together of the pieces will take time. A fabricated shore is not as strong as solid timber of the same dimensions.

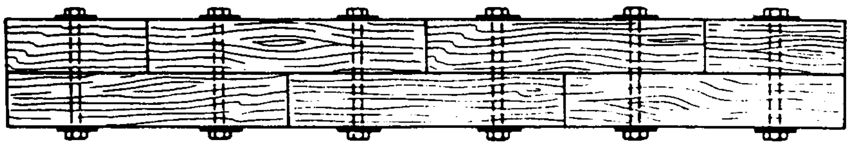

Fig 16-22. Fabricated Shore

1644. Shoring Training Allowance

The allowance of 100mm × 100mm shoring timber held at FRP Posts includes a 20% enhancement for training purposes.

1645. Machinery Spaces

The erection of shoring in machinery spaces is difficult, and is almost impossible to achieve quickly, due to the large deck heights, and machinery and pipe systems which impede such work. Structures which require to be supported need to be shored from nearby, sound structures, while patches to the ship's side, and some bulkheads, can be supported by using Emms clamps.

1646. The Emms Damage Repair Clamp

This item is designed to be used in pairs and can replace proud shoring systems when supporting patching or other leakstopping devices.

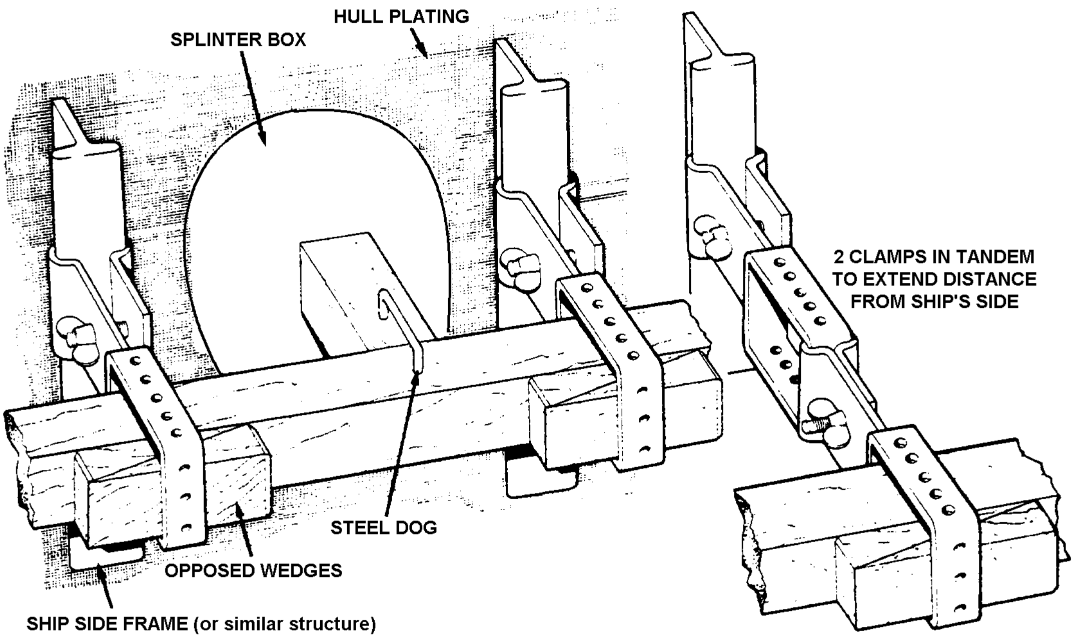

Fig 16-23. Standard Emms Clamp

Its use alleviates the problems of access and stowage associated with providing long lengths of shoring timber in such spaces, and allows shoring to be cut to shorter lengths as required.

1647. Three types of Emms clamp are provided:

a. **Standard Small.** For use with 100mm × 100mm shoring.

b. **Standard Large.** For use with 150mm × 150mm shoring or double 100mm × 100mm shoring, (in large ships only).

c. **Universal.** For use with 100mm × 100mm shoring in ships with offset bulb ('P' section) frames.

1648. The damage repair clamps for main machinery spaces (MMS) form part of the contents of the damage repair tool box, which is held in these spaces, or they may be secured to ships' frames high up in the MMS, near to the access hatch or air lock. The damage repair clamps for the FRPP form part of the contents of the damage control locker. Full details of allowances for RN and RFA ships are in BR 2170(3).

1649. The standard Emms clamp is made in two parts, each with an end shaped to fit over the flanges of either 'T' bar or bulb frames. One part is welded to a box section, and the other free section is secured to it by means of a captive, double start threaded bolt and wingnut. The two parts of the clamp can be secured to 'T' bars by fitting the shaped ends over the flange and then tightening up on the wingnut. For fitting over bulb angle the free part should be reversed and the wingnut tightened. The box section is designed to hold standard damage repair shores which are held in position with opposed wedges and, if necessary, nails.

1650. The clamps are secured to ships' frames or longitudinals either side of the damaged area. Once in position and secured, a suitable length of shoring timber can be passed through the box sections welded to each clamp, thus providing a strongback close to the damaged area against which a splinter box or patch can be shored, wedged, dogged and nailed, using a pad piece if necessary (see Fig 16-23). Two clamps can be used in tandem to extend the distance of the strongback from the damaged area.

1651. These repair clamps are not proof tested and therefore must not be used as beam clamps for lifting purposes. Consequently a tally marked 'FOR DAMAGE CONTROL PURPOSES ONLY' is fitted to each clamp.

1652. The standard Emms Clamp was designed to fit on 'T' section frames. It will not fit offset bulb frames (eg in Type 23, LPH, HMS SCOTT and RFAs). The Universal Emms Clamp (see Fig 16-24) is used in these ships. It is attached to the frame by a screwed clamp and the box section swivels to give versatility in the orientation of the shoring.

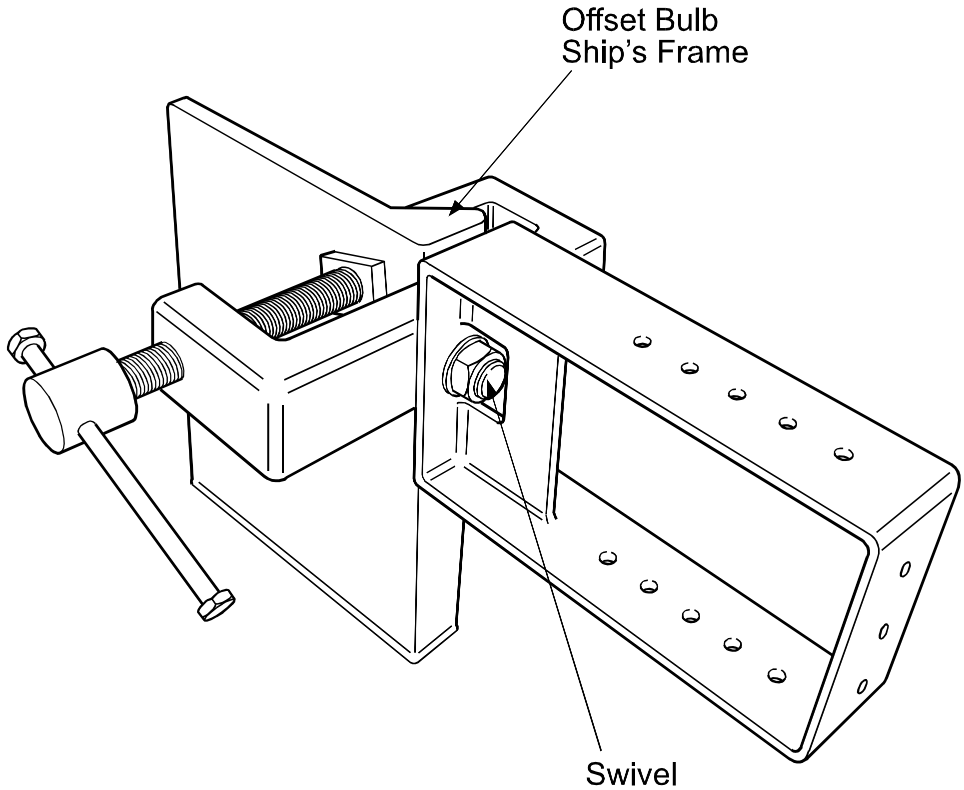

Fig 16-24. Universal Emms Clamp

1653. The small standard clamp may be clamped onto the universal clamp, in tandem. The universal clamp cannot be clamped onto either of the standard clamps.

CHAPTER 17

NBCD ARRANGEMENTS IN ICY CONDITIONS

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CHAPTER 17

NBCD ARRANGEMENTS IN ICY CONDITIONS

1701. ATP17 - Naval Arctic Manual, contains information on operating in ice. Certain aspects of NBCD can be affected by icy conditions and the following paragraphs are intended as information for ship's officers on the design arrangements called for by the Ministry of Defence (Navy) in dealing with these conditions, and the ways in which a ship can deal with them.

1702. High Pressure Sea Water (HPSW) Service

All mains and branches which are exposed to the weather, or which supply hydrant valves in exposed positions, are fitted with drain down arrangements.

1703. Whenever possible, hydrants and magazine locker flood pipes in exposed positions have an additional valve in the branch supply well inside the main structure, so arranged that the exposed length of supply pipe can be drained and left empty. PVC or polythene covers should be used to cover hydrants. Hoses and nozzles in exposed positions should be as dry as possible internally or re-located between decks.

1704. Attention is given to the insulation of all supply pipes, including flanges which, although not in exposed positions, are likely to be subjected to very low temperatures, eg those near lift openings in aircraft carriers. Similar precautions are made for the spraying arrangements to any magazines or magazine lockers in exposed positions, but some difficulty may be experienced where the spray piping is 'dead end' and has no flow-through. The main supplies to hangar spray systems are insulated as far as the control valves.

1705. Where the extreme fore and aft ends of the HP sea water system are in exposed positions, leak-offs are fitted to ensure a continuous circulation of water. The leak-offs should be 12mm diameter, well-insulated and so arranged to discharge either directly overboard or into a scupper with a warmed storm valve.

1706. Hoses and nozzles will perform satisfactorily at freezing temperatures, if the water is kept flowing and a good pressure is maintained. After use, they should be drained, taken between decks for drying and replaced by dry hoses and nozzles.

1707. Prewetting

The arrangement of prewetting systems is such that the supply pipes drain down after use. If difficulty is experienced with the complete draining of any pipe, it should be blown through with LP air. Nozzles should be cleared of ice by sea water hosing or manually.

1708. Scuppers and Drains

Decks and platforms are equipped with sufficient drains to eliminate the formation of pools of water. Arrangements are made to prevent, as far as possible, the ingress of water to exposed deck equipment, or ready drainage is fitted.

1709. Fresh Water Systems

Piping in exposed positions or in positions likely to be subjected to low temperatures is insulated and steam or electrically heated. Frost plugs are fitted in positions of ready access. Care should be taken that insulation does not interfere with any working parts of the system.

1710. Ventilation

Heating systems are designed to maintain a minimum temperature of 18.3°C in living and working spaces. Low humidities are avoided by limiting fresh air intake. Thermal insulation is fitted to cold surfaces inside the ship to reduce heat transfer losses and prevent condensation. Insulation is fitted to the weather boundaries in all living, working and other spaces where condensation must be avoided, and to all fresh air trunking where it passes through such spaces.

1711. Weatherdeck Terminals

The hinges and clips of all weatherdeck ventilation terminals should be treated with a de-icing compound.

1712. Portable Firefighting Appliances in Exposed Positions

Whenever possible, portable firefighting appliances that are likely to freeze should be stowed in sheltered positions. Diesel fuel systems in portable pumps are liable to blockage by waxing at very low temperatures. AFFF drums and AFFF extinguishers should be stowed in their heated lockers (where provided). On no account should anti-freeze be added to AFFF extinguishers because of the danger of AFFF losing its fire extinguishing properties (but see Chapter 23 for freeze protection of exposed AFFF drums in exceptional conditions). CO_2 and dry powder extinguishers are unaffected by cold weather.

1713. Stability

Heavy icing on the weatherdeck, superstructure and weatherdeck, fittings and equipment will adversely affect the stability of the ship due to the additional topweight (see Chapter 31). Every effort must be made to prevent the information of ice and to remove it as quickly as possible when it has formed. The methods used for ice prevention and removal are contained in ATP 17.

1714. Citadel Openings

Careful attention must be given to keeping the jointing portion of the door rubbers dry in order that they will not freeze to their seatings on the door coamings.

1715. Door and Hatch Clips and Hinges

All grease nipples should be charged, and clip barrels and hinges should be smeared with de-icing compound.

1716. Batteries

Low temperature reduces the output of all types of batteries, so those required for damage control purposes must be kept in a warm area.

CHAPTER 18

VENTILATION

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CHAPTER 18

VENTILATION

1801. Ventilation is needed in ships for three principal reasons:

a. To provide sufficient oxygen to ensure the health and alertness of the ship's company, in all climates and conditions of service.

b. To maintain tolerable temperatures.

c. Remove foul air, noxious and toxic fumes, smoke and combustible or explosive vapours.

1802. Methods of Ventilation (not including Air Conditioning)

a. **Fan Supply - Natural Exhaust.** The fan supply is trunked to manned positions and exhausted naturally to the open air either by trunking or through doors and hatches.

b. **Fan Exhaust - Natural Supply.** This is used for the removal of fumes, vapours, odours, wild heat and, for NBCD purposes, smoke from compartments. Some ships have dedicated smoke clearance fans.

c. **Fan Supply - Fan Exhaust.** Compartments such as machinery compartments, galleys, bathrooms and laundries, where maximum ventilation and heat dissipation are the prime requirements, are ventilated by this method.

1803. NBCD Uses of the Ventilation System

a. **NBC Collective Protection.** Ships ventilation systems, in conjunction with air filtration units (AFUs), are used by the NBCD organisation to achieve Condition Alfa and additionally in some ships to be able to achieve gastight sub-citadels (see BR 2170(2) and CB 4538 - Ship's Class Book).

b. **Re-circulation Systems.** Most ships are fitted with Air Treatment Units (ATUs) which form an important and integral part of the ventilation system. This system incorporates a continuous 'make up' supply of fresh air which is led into the recirculation system and air conditioned by the ATUs. The recirculation system uses trunking, hatches, doors, grilles and passageways to allow the air to flow around the system. In the event of a fire the smoke would quickly be circulated around the system and soon render the atmosphere irrespirable. To prevent this from happening and to restrict the supply of oxygen to a fire all ventilation systems are stopped on the report of an outbreak.

c. **Smoke Containment or Removal of Smoke from a Fire.** Information regarding this problem is to be found in Annex K to Chapter 21, Ship's NBCD Orders and the Smoke Clearance Plans associated with Forms S.3021 (Kill Cards). Details of the Ramfan portable smoke clearance fan are in Chapter 22.

1804. Zoning

To minimise the areas affected by damage or fire modern surface ships are divided into zones which are able to operate independently (see Chapter 29). To align with this policy each zone is provided with its own air conditioning and ventilation systems which do not penetrate zone boundaries. AFUs, of the required capacity, are also provided for each zone.

1805. Galley Ventilation Systems

Galley exhaust ventilation systems are fitted with fire baffles in the trunking. The levers that operate them should be:

a. A simple single-action lever directly controlling the baffle and located within 1.8m to 3m of the deep fat fryer or range canopy, and between the canopy and galley access.

b. Easily operated by a person standing on the deck.

c. Clearly marked in red lettering 'SHUT IN THE EVENT OF FIRE'.

1806. A second operating position for the baffle should be located just outside the main galley entrance, adjacent to the ventilation and galley master switches. If a galley is fitted with two or more doors, and the fire baffle control lever is sited remotely at one of them, the door(s) not having the fire baffle control lever adjacent should be clearly marked 'FIRE BAFFLE OPERATING LEVER AT .....'.

1807. Sources of Information on Ships Ventilation

More detailed information regarding the design, construction and usage of ventilation systems is to be found in the following:

a. **Naval Engineering Standards (NES)**

(1) NES 102, Part 1 - Requirements for Air conditioning and Ventilation - HM Surface Ships and Royal Fleet Auxiliaries.

(2) NES 118 - Material Requirements for the NBC Defence of Surface Ships including RFAs.

b. **Books of Reference (BR)**

(1) BR 2000(60) - Naval Marine Engineering Practice (HULL).

(2) BR 1. Refer to 'Air conditioning and Ventilation' in the alphabetical index of subjects for details of specific ships and systems.

c. **Drawings**

(1) Ship's ventilation drawings.

(2) Ship's ventilation board in HQ1.

CHAPTER 19

ELECTRICAL ASPECTS OF DAMAGE CONTROL

CONTENTS

SECTION 1 - ELECTRICAL SYSTEMS AND EQUIPMENT

SECTION 2 - ELECTRICAL DAMAGE CONTROL PRACTICE

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CHAPTER 19

ELECTRICAL ASPECTS OF DAMAGE CONTROL

SECTION 1 - ELECTRICAL SYSTEMS AND EQUIPMENT

1901. In warships, the continued supply of electrical power under all conditions is essential for maximum fighting efficiency and may well be a deciding factor in a ship's survival. Some of the important services and equipment that depend on electrical power are:

a. Control and operation of weapons and sensors.

b. Internal and external communications.

c. Steering gear.

d. Aids to navigation.

e. Ventilation and lighting.

f. HPSW and salvage pumps.

g. Lubricating oil and controlled pitch propeller pumps.

h. Ship's propulsion.

i. Chilled water.

j. HP and LP air.

1902. Main Supply System

Many important main-engine auxiliaries, ancillary equipment and ventilation fans are electrically driven. Several features in the electrical system of a ship are designed to limit the effects of damage on essential power supplies and to enable supplies to be restored with minimum delay. They include:

a. Enough generator capacity to allow for possible failure of some generators.

b. Dispersal of generators to obviate the risk of complete failure of electrical power from one hit.

c. Secondary generation of power from diesel generators when primary generators are steam driven.

d. Alternative supplies, and in some cases emergency supplies, immediately available to important services.

e. Fuses and overcurrent protection in switchgear to isolate circuits and prevent damage to generators and equipment in the event of a short circuit.

f. Shock-tested mountings and fittings to prevent the displacement of equipment, switchgear, fuses, etc, by underwater shock.

g. Duplication of conversion machinery.

h. Provision of an emergency generator in certain classes of ship.

1903. Main electrical supplies in ships are generally derived from diesel driven generators, however some older classes of ship may have steam driven generators, or a combination of both. The type of generator prime mover, generator output, and the number of generators are determined by the functions, general characteristics and operational role of the ship. The generators will meet the maximum ship's load (usually the Action load) with an adequate margin to allow for generator damage, defects and maintenance. A reserve of generation capacity is also allowed for, to meet any growth in electrical demands during the life of the ship.

1904. In the majority of warships, electrical power is generated at 440 volts (V), 3 phase (Ph), 60 hertz (Hz) alternating current (ac). However, certain classes of ship (eg Type 23 and LPD(R)), generate at a higher system voltage to supply the propulsion motors. Conversion machinery is employed to convert the higher voltage to the normal 440 V working level. Detailed information regarding the generation and distribution of the main supply system can be found in the NBCD Class Book for the particular ship, or in the main electrical system BRs.

1905. Distribution Systems

There are three different types of power and distribution systems commonly fitted in ships:

a. A simple system in which all the generators supply a common switchboard.

b. An extension of the above system, whereby the switchboard is divided, with each generator supplying its own independent switchboard section. A DD/FF normally has two such switchboards, each board having two sections. All the switchboards and sections are interconnected by breakers.

c. In modern warships, major services are no longer supplied directly from a switchboard section. Equipments located in a particular section of the ship, and fitted for a particular purpose are grouped together and supplied from either an electrical distribution centre (EDC), or an electrical distribution panel (EDP). Services are fed from these EDCs/EDPs via moulded case circuit breakers (MCCBs). Hence these may be considered to be sub-switchboards.

1906. Circuit Breakers

Each generator is connected to its associated switchboard or switchboard section through a supply breaker contained in the switchboard. A breaker is fundamentally a hand-operated or electrically operated switch. The difference between switches and breakers is that breakers incorporate protection and safety devices which enable them to open automatically should a fault condition arise. Breakers are therefore normally fitted for the protection of main generators, for all main interconnections between switchboards, and all major feeders, where switch and fuse units cannot be used. In modern ships, each EDC/EDP consists of a number of MCCBs.

1907. Main Switchboards

A ship's main switchboard provides facilities for controlling the voltage and frequency of generators, and their synchronization when needed for parallel running. In ships with remote machinery control from an MCR or SCC the switchboard is normally located in the MCR/SCC. In some instances where the main switchboard is remote from the generator, local control panels (LCPs) are provided. Secondary switchboards are also normally provided. All switchboards are 'dead-fronted' to prevent any exposure to the system voltage.

1908. Supplies to Services

All services are supplied through breakers or, for more lightly loaded circuits, by switch and fuse units. These breakers and switches are known as feeder breakers and feeder switches, and the circuits are feeder circuits.

1909. Alternative Supplies

Some electrically driven equipment in HM ships is considered to be of sufficient importance to justify the provision of two or more power supplies. These are fed via changeover switches to allow the connection of an alternative supply if the normal supply should fail. Changeover switches are sited as close to the equipment as possible to minimize the risk of power failure due to local circuit damage:

a. **Automatic Changeover Switch (ACOS).** These are provided for equipment considered vital to the safety of the ship. They will automatically change the incoming supply from normal to alternative should the normal voltage drop to 80 per cent of nominal, and will revert automatically to the normal supply should the normal supply be restored.

b. **Hand Changeover Switch (HCOS).** Automatic changeover switches must be limited in number otherwise remaining generators could be loaded beyond their capacity. If a short delay in restoring power to a particular equipment is acceptable, then a hand changeover switch is fitted (see Fig 19-1). Examples of equipments fitted with changeover switches are:

AUTOMATIC	HAND
Forced lubrication pumps	Ventilation
Conversion machinery	HPSW pumps

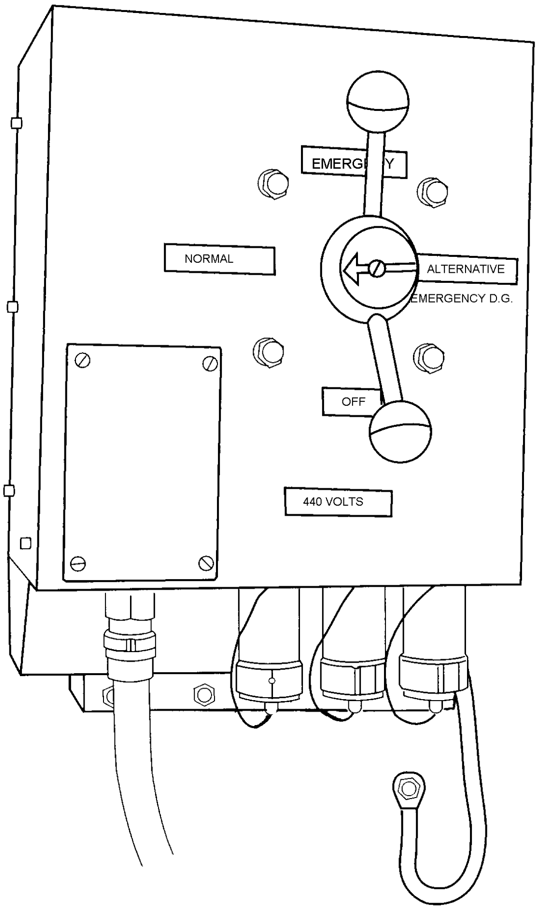

Fig 19-1. Hand Changeover Switch

c. **Electrical Distribution Panel (EDP).** EDPs that are fitted in certain classes of ships are divided into three different types:

(1) *Remotely Operated Changeover Switch (ROCOS).* This type is remotely controlled and allows an operator to select the Normal or Alternative supply from a remote position (normally the SCC), or locally at the EDP.

(2) *Automatic Changeover Switch (ACOS).* In this mode, the EDP operates as a normal ACOS.

(3) *Sheddable.* These EDPs are operated, either automatically as part of machinery operation, or manually from a remote position (SCC), forward or after switchboards or locally at the EDP.

Note. *ROCOS and ACOS EDPs have input and output emergency sockets, whereas sheddable panels have emergency output sockets only.*

1910. Converted Supplies

Lighting and small power services, including portable apparatus, lower voltage supplies at 115 V, three phase and single phase, are provided by transformer conversion from the 440 V system. Various services, eg radar and weapon control systems, need ac and dc supplies at voltages and frequencies different from those of the main supply. These are provided by conversion machinery, ie motor-driven generators, static frequency changers, transformers/rectifiers and batteries, as appropriate. Where the converted supply is peculiar to a specific equipment the necessary conversion machinery is often sited nearby. It is usual to provide a common conversion machinery room at the load centre of all services concerned.

1911. System Operation

a. The distribution system should not normally be arranged so that the normal and alternative supplies are taken from the same generator, or generators sited in the same compartment or, in steam ships, generators fed by the same boiler.

b. Generators may fail at any time without warning. When this happens, all services being supported by a failing generator, through automatic changeover switches, will be transferred automatically to the generator providing the appropriate alternative supply. Therefore, each individual generator must not be fully loaded; a margin must be left to allow each generator to accept the load thrown over when automatic changeover switches operate as a result of the failure of another generator.

c. At higher states of NBCD readiness, the main supply system must be manned and operated such that sudden failure of a generator does not hazard the ship.

1912. Breaker Colour Codes

In older ships switchboard switches and breaker controls are colour coded to indicate the importance of the service supplied by the switches and breakers, and to assist the watchkeeper in selecting priorities when load shedding. In modern ships with MCCBs and ECDs feeding multiple services, major services should be listed at the primary and secondary control positions adjacent to feeder breaker operating switches. Colour coding should be employed against each major service. The colours are:

BLUE: SEAGOING EFFICIENCY - steering, gyro, machinery space lighting and power, navigation radar, etc.

RED: FIGHTING EFFICIENCY - turret/mounting/launcher supplies, magazine lighting, ammunition hoists, sensors, etc.

GREEN: NBCD SUPPLIES - HPSW/hangar spray/salvage pumps, air conditioning units and ventilation, etc.

WHITE: LESS IMPORTANT SUPPLIES - refrigerators, galley equipment, etc.

YELLOW: UNIMPORTANT SUPPLIES - unimportant lighting and ventilation, heaters, etc.

1913. Control of The Electrical System

The complexity of the ship's electrical system requires a high degree of central control, so that the general state of supplies throughout the ship can be assessed and the supplies handled quickly and easily. This becomes increasingly important when damage is sustained and only limited supplies are available. In such circumstances the function of control is:

a. The even distribution of load among intact generators by the control of switchgear and the shedding of less important services.

b. The isolation of damage and the redirection of supplies to important services.

c. The cooperation of electricity supply and repair parties in the restoration of power to damaged areas.

1914. Switchboard Primary Control

In most modern warships the voltage and frequency of generators and the operation of supply, feeder, bus-bar linking and interconnecting breakers, are remotely controlled at a console in the MCR/SCC; this console is known as the Primary Control Position (PCP). In ships where more than one switchboard exists, communications are available between each switchboard, this communication usually being a combination of Rationalised Internal Communications Equipment (RICE), machinery space broadcast and telephone.

1915. Switchboard Secondary Control

In large ships with a second NBCD headquarters (HQ2), a Secondary Control Position (SCP) is also fitted. Its function is to assume control if the PCP is out of action. The SCP is not necessarily provided with automatic indication or remote control arrangements but the state of the main supply system may be recorded, on a hand worked mimic diagram, from information received from the PCP while active, or otherwise from outlying stations. This information enables the SCP to coordinate the remaining switchboards and outlying electrical positions to direct and maintain power supplies. In more modern warships SCPs are situated adjacent to each main switchboard. From these positions local main switchboards can be operated in the event of failure of the PCP.

1916. Operation of the Main Supply System

Instructions for the operation of the Main and Emergency supply systems of the ship are outlined in the associated NBCD Class book, and are detailed in BR 2000(52) - Electrical Power, Distribution and Utilisation, BR 300 - Naval Weapons Engineering Manual and relevant main power supply system BRs. The electrical state of readiness should conform to the ships NBCD State. At NBCD State 1, all generators are to be proved by placing on load. Generators which are running should be independently supplying their own switchboard sections via supply breakers and/or bus bar linking breakers. The sub-division of the main supply system in this way minimises the effect of any damage to the system. Switchboard operations should be kept to a minimum. Where it is required to parallel generators to transfer load, then the operation should be completed as quickly as possible. Care must be taken during the transfer to ensure that the generator frequencies do not deviate to a level likely to affect frequency conscious equipment. Consideration should be given to opening MCCBs/breakers that supply non-important services as part of State 1 preparations. This removes unnecessary 440 V from compartments, thus reducing the risk of electrical shock to firefighters and faults to the primary electrical distribution system.

1917. Action Parallelling

In the event of a generator or its prime mover becoming damaged necessitating the quick removal of its load, then 'action parallelling' should be employed. This is where the affected generator is parallelled with an unaffected generator that has sufficient spare load capacity, such that it is able to accept the load from the failing generator. Once the two generators are in parallel, the off-going generator's supply breaker is opened, this immediately transfers the load and allows for the immediate shut down of the affected generator.

1918. Electrical Supplies to HPSW Pumps

HPSW pumps are provided with both normal and alternative supplies; some classes of ship are capable of providing a third supply from an emergency generator. Under standard operating conditions the HPSW pumps should be fed from their normal supply to ensure maximum diversity of supplies. Every effort must be made to ensure electrical supplies are maintained to the HPSW pumps. In the event of possible interruptions to these supplies due to load transfer, battle damage etc it is essential that the DCO(L), via the DCO, keeps the FRPPs informed of any possible interruptions. For peacetime emergencies the Senior Rating I/C of the firefighting team will be kept informed by the DCO. In the event of a fire which requires re-configuration of the main supply system, care must be taken to ensure that, wherever possible, HPSW pumps in use are fed from separate generators or supplies.

1919. All HPSW pump starters are fitted with a lockable switch known as the 'Battle Override' switch. The purpose of this switch is to prevent the operation of the electrical safety devices fitted within the starter and thus prevent the pump from tripping under fault conditions. This switch is to be unlocked in NBCD State 2 and made in NBCD State 1.

1920. Ship's Lighting

Almost without exception, some lighting will fail when action damage is sustained. General lighting is not provided with alternative supplies but, to prevent a complete blackout:

a. In important spaces, and in gangways, two electrically separate and widely dispersed sources each supply half the lighting.

b. In some generator and switchboard rooms, a proportion of the lighting is supplied directly from the live side of generator supply breakers.

c. Switchboard rooms, radar offices, HQ1/SCC and other operational spaces may also be provided with battery-operated secondary lighting. This is in addition to the automatic emergency lights.

1921. Automatic Emergency Lights (AEL)

AELs are normally fitted adjacent to doorways and hatchways to indicate their position in the event of a power loss affecting lighting. AELs are also sited adjacent to some machinery controls, in hazardous areas such as galleys and on escape routes. They are battery fed and are operated by relays connected to the main supply system. They switch on automatically if power in the space fails but give only enough illumination for movement between decks. AELs are fitted with a special battery which is trickle charged, thus ensuring the emergency lighting is available at all times. The charging supply is indicated by a neon lamp.

1922. Emergency Lighting for Repair Parties

When normal lighting fails, the provision of emergency lighting for repair parties and others to carry out their duties is of paramount importance. Various items of equipment, details of which are in BR 2170(3), are provided for this purpose. The principal items are:

a. Moulded strip lighting circuits (DC 'necklaces') which can be connected to a source of 115 V emergency supply.

b. 115 V floodlights (see Fig 19-2).

c. Portable, battery-operated equipment comprising:

(1) Lanterns for general use of repair parties (see Fig 19-13). This equipment is splashproof but not watertight.

(2) Safety torches.

(3) Lamps for repair parties and medical parties.

(4) Right angle torches.

d. Cyalume chemical illuminators.

Note. *In areas which are suspected or known to contain flammable or explosive vapours, only safety torches or cyalume illuminators may be used.*

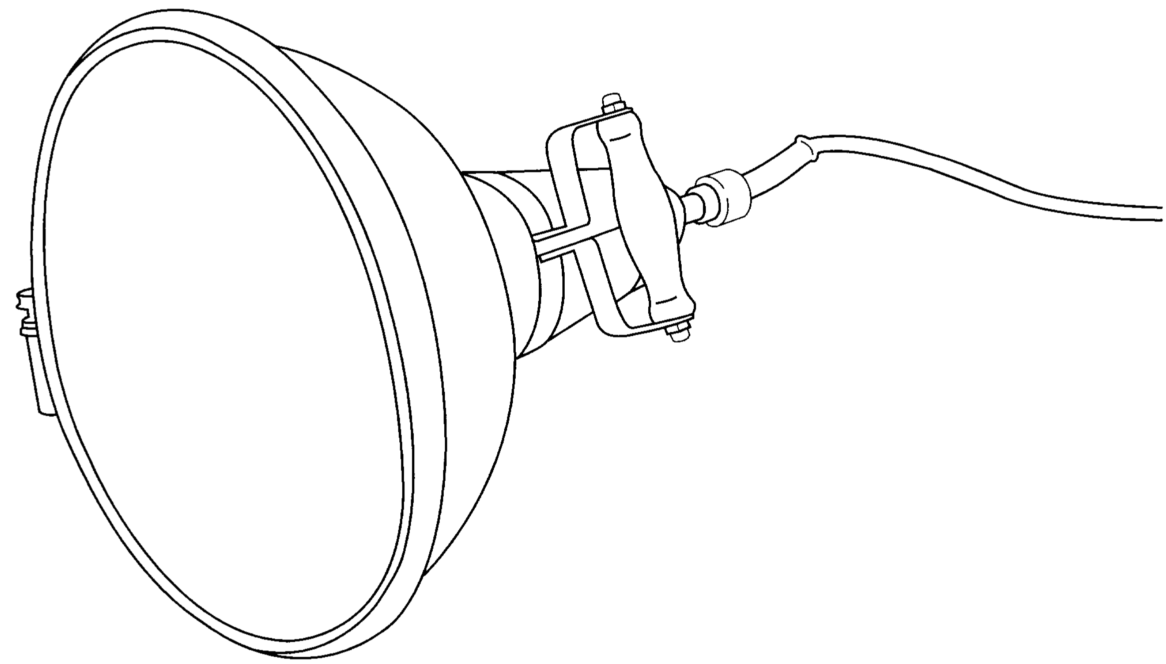

Fig 19-2. Damage Control Floodlight

1923. When emergency lighting is being rigged, care must be taken to ensure that watertight integrity is not breached by the cables. The closing of doors and hatches forming smoke or watertight boundaries should not be impeded by allowing cables to pass through them.

1924. Emergency Supply Arrangements

Emergency supplies are distributed in two ways. Either via portable, flexible, cables, normally run along the communications deck, thus giving relatively free fore-and-aft access for repair parties, or by a hard wired system supplied from an emergency (salvage) generator via an emergency switchboard to a number of ship's vital services eg HPSW pumps, steering gear and emergency portable pump sockets. In some classes of ships it can be a combination of these two methods. These cables are never to be rigged until required in an action/damage situation, unless ordered by HQ1 or their designate. In some ships, where there are passageways on both sides of the communication deck, facilities are provided for port and starboard systems.

1925. In some ships with a large number of decks, provision is made for emergency supply systems to be run on two deck levels; the communication deck and one other. Permanent cables are run to these decks from generators and switchboards. Where emergency cable runs are required to pass through watertight bulkheads, special through-bulkhead connection boxes are provided.

1926. Permanent Risers

Where it is necessary to transfer emergency power from one deck to another, two methods are used:

a. Short vertical lengths of cable are fitted permanently through watertight deck glands (where watertight or gastight integrity must be maintained). These permanent cables are called risers.

b. Deck tubes with removable caps are fitted for the passage of cables (where watertight or gastight integrity is not a prime consideration). The caps are painted white with a green cross.

1927. Emergency Supply to Fuse Panels

Some fuse panels suppling important services are fitted with normal/emergency changeover switches and emergency connections. In earlier ships the first fuse panels supplied from the switchboard breaker/switches were fitted with these arrangements. In later ships the panels fitted with emergency arrangements have been limited to those supplying important services. Only the necessary panels, which may not be the first after the switchboard breaker/switch, are so fitted.

1928. Emergency Connections

Facilities for obtaining emergency power are provided at all main switchboards or generator LCPs in the form of emergency socket connections fed from the bus-bars through switch and fuse units. All ends of permanent risers are terminated by emergency connection boxes (ECBs) and so, by means of flexible cables having suitable connectors at each end, the main emergency run can be energized from available power sources. Similarly, at all important services there are facilities for accepting emergency power. The facilities comprise either an emergency switch and connection box fitted in the supply to the service or emergency socket connections in a fuse panel supplying a group of important services. Each type of facility includes a changeover switch to enable changeover from 'normal' to 'emergency' supply. Distribution for these services is by portable emergency link boxes or portable fused distribution boxes, normally bolted to bulkheads at positions near the main emergency run. They can easily be made portable but when so used they must be earthed to the ship's structure by connection to the earthing terminal provided. Details of emergency connections and equipment are shown in Figs 19-3 to 19-12.

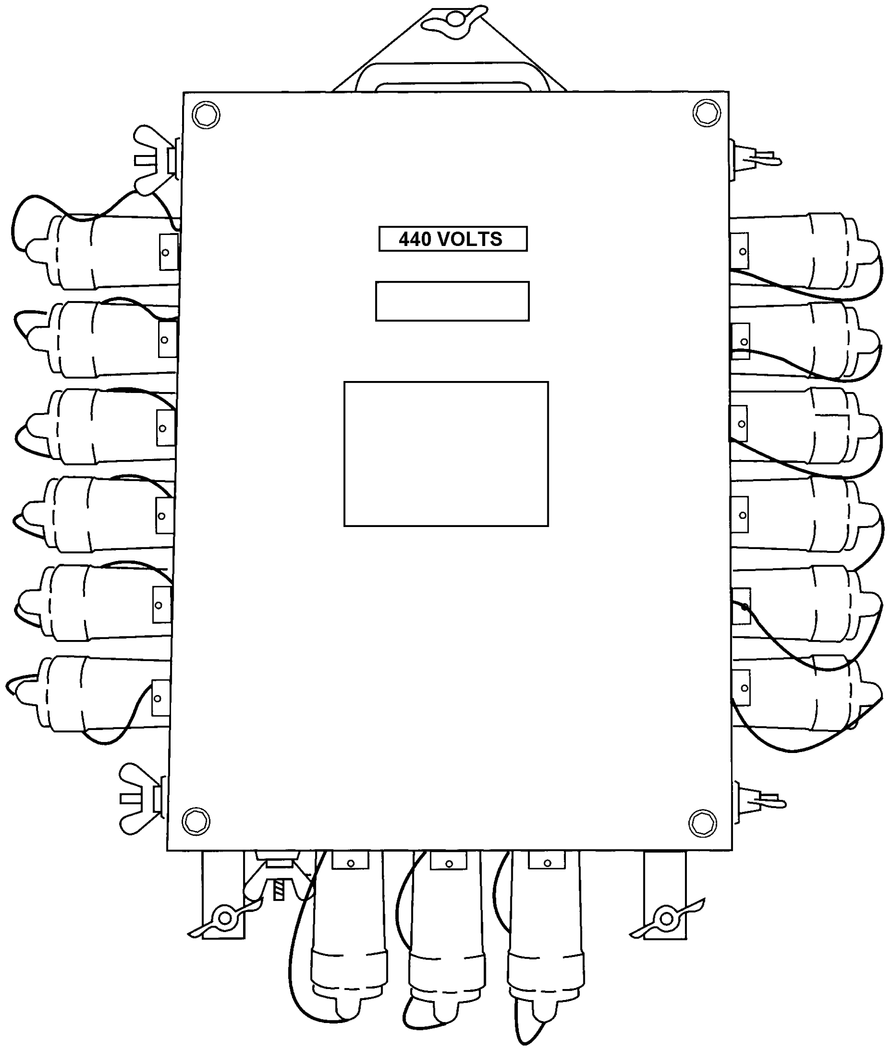

Fig 19-3. Emergency Distribution Box

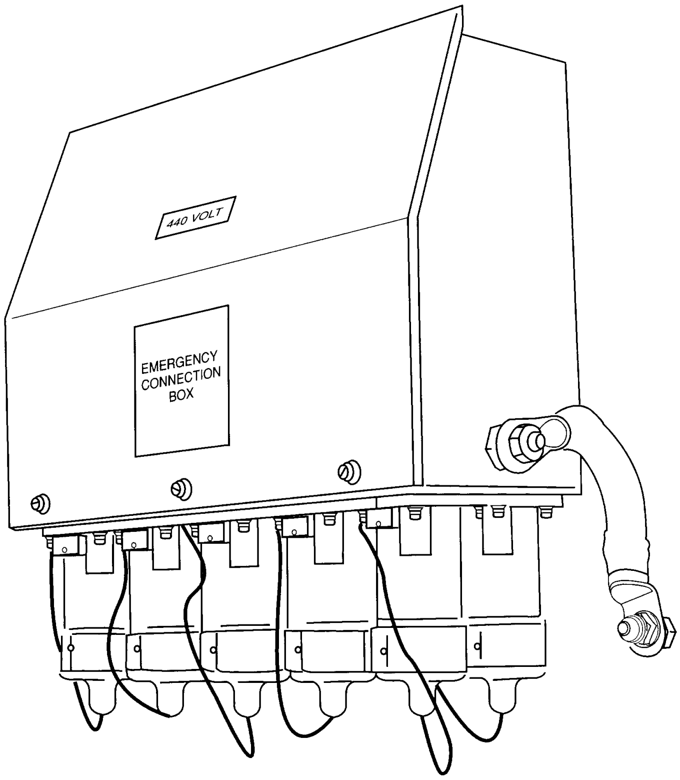

Fig 19-4. Emergency Connection Box

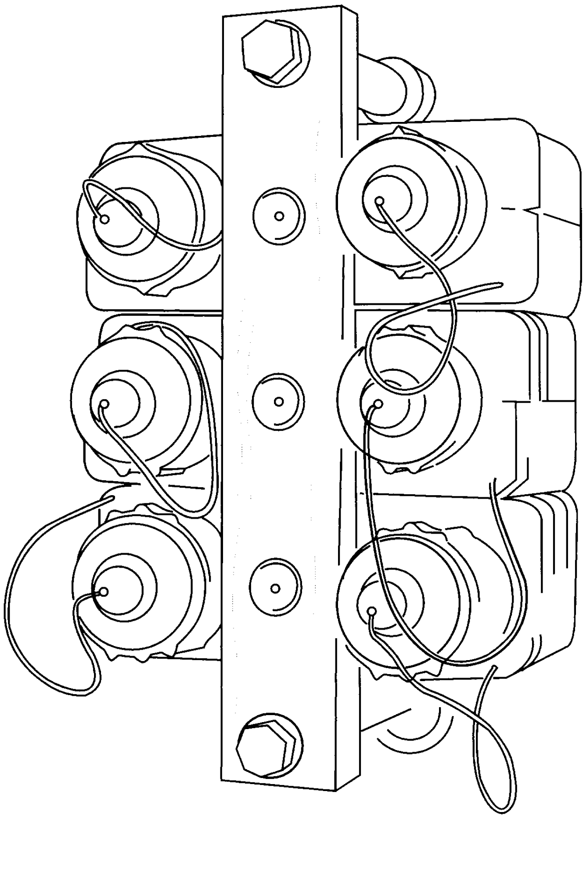

Fig 19-5. Emergency Through-Bulkhead Terminal

1929. Emergency 115 V AC Supplies

These are taken from portable fused distribution boxes through portable 440/115 V transformers (Fig 19-6) and distributed via portable fuse boards (Fig 19-7). Whenever portable equipment (eg lighting transformers, fuse boards, etc) is used, care should be taken to protect it from damage and, if possible, it should be kept out of the way of personnel and moving equipment. Earth connections, where applicable, must always be secured and warning notices placed before power is supplied. The stowage positions of all portable electrical equipment should be clean and dry. Portable fuse panels should carry the designated fuse links, and 115 V panels must have rubber sheets attached to guard exposed live terminals.

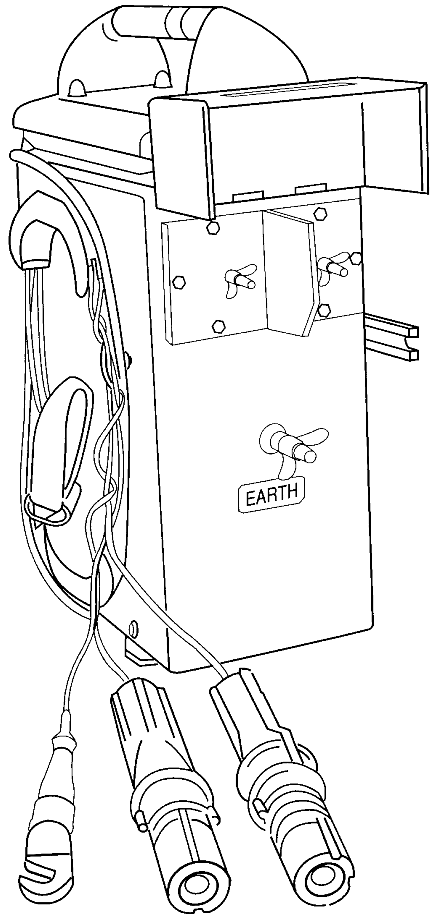

Fig 19-6. Portable 440/115 V Transformer

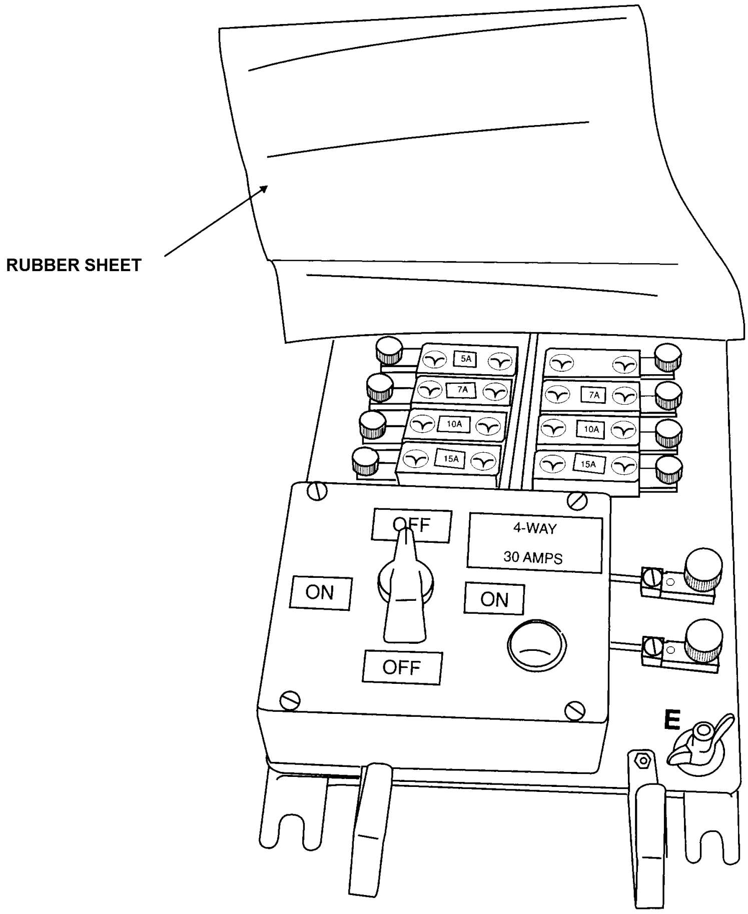

Fig 19-7. Portable 115 V Fuse Board

1930. Emergency 440 V Cables

In older ships, cables are pre-positioned, with fitted connectors. In newer ships (Type 23), cables are manufactured, as required, from rolls of colour coded cables (red, yellow and blue phases) and crimped onto tails which have connector plugs fitted. The crimped butt connectors should be insulated by wrapping insulating tape around them. The connectors and sockets have standard phase colouring and, to assist phase identification by touch, a number (one, two or three) of raised rings are moulded on the shroud of each cable connector and a corresponding number of raised lobes are on each socket. In addition, to make doubly sure, shrouds are moulded with one, two or three keyways to fit corresponding numbers of keys in the sockets. Cable connectors are shown in Fig 19-8. Emergency cables are stowed on special brackets or reels, where they make small targets for splinters. They should not be rigged in position until required. To enable certain important items of equipment to be connected to permanent risers, or to the main emergency run, they are provided with lengths of flexible cable which are stowed near the equipment. If long lengths of emergency cable are damaged and unusable, short lengths may be joined together by use of muff couplings (Fig 19-9). The cable tails used in Type 23 and later ships are shown in Fig 19-10 and the contents of the cable lockers are detailed in BR 4500(120) - Emergency and Converted Electrical Supply Systems Type 23 Frigates.

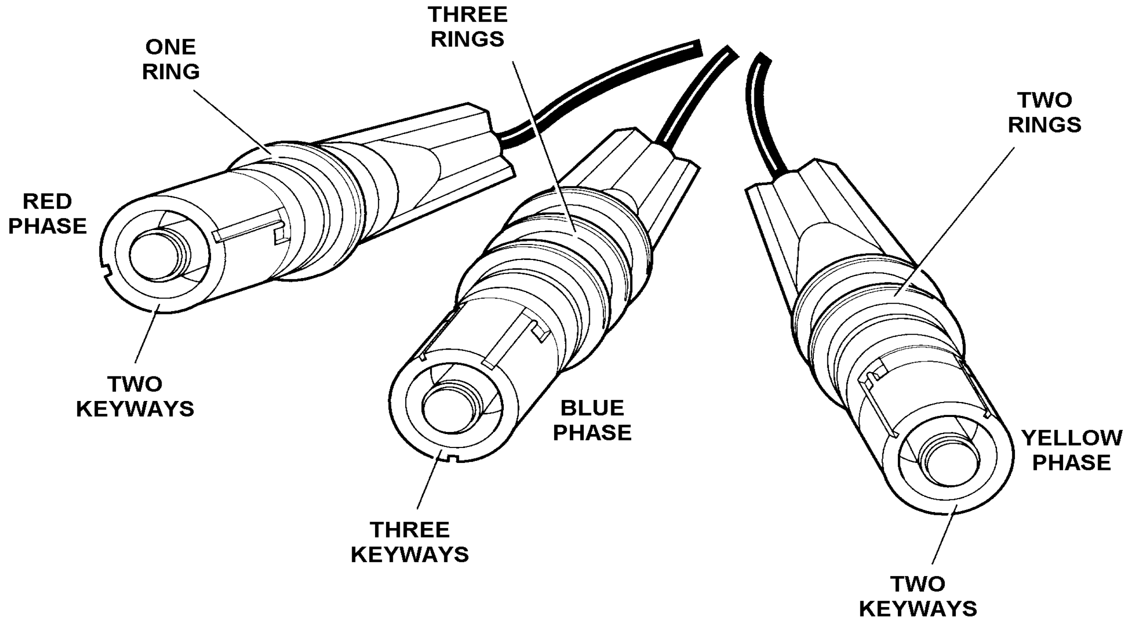

Fig 19-8. Emergency Cable Connectors

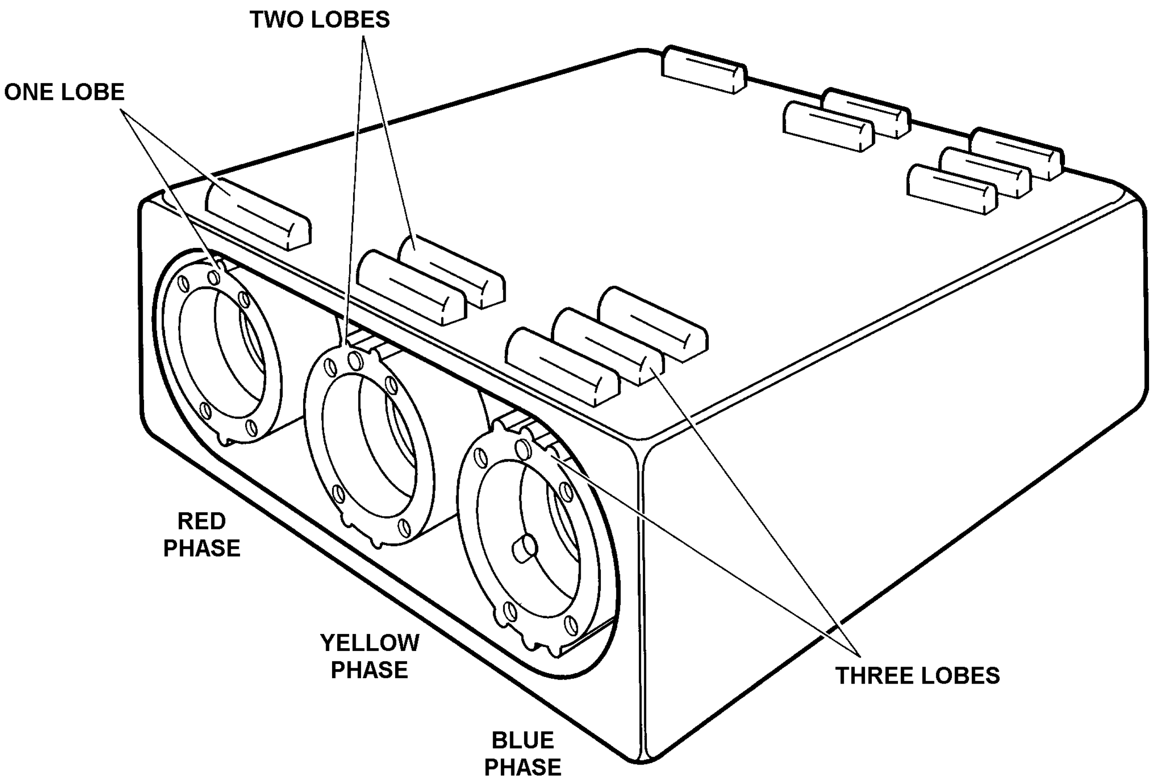

Fig 19-9. Muff Coupling

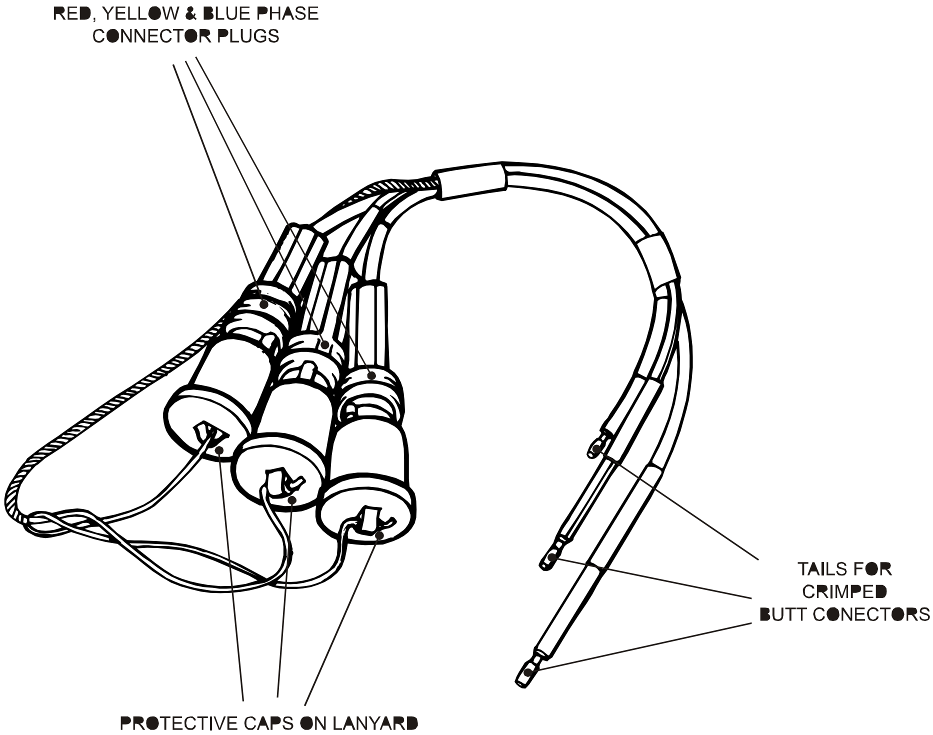

Fig 19-10. Cable Tails - T23 Frigates

1931. The stowages for all emergency cables are to be clearly marked, preferably with an embossed tally. Cables should be neatly stowed in their correct stowages with the connectors clear of the deck. The cables should be maintained strictly in accordance with the relevant MMS schedule.

1932. Electrical Supplies to Portable Pumps

Switched sockets are provided at strategic positions throughout ships, for normal 440 V 3 Ph supplies to portable pumps (see Fig 19-11). The socket boxes are painted yellow and numbered in black. For connection to an emergency supply, a special switched adaptor cable ('rats tail') is provided in ERP lockers (see Fig 19-12).

1933. Type 23 Frigates and later ships are fitted with electrical pump power sockets conforming to BS 4343. To enable pumps to be transferred between these ships and those fitted with the older design of socket (all pre T23 ships), one adaptor lead per pump is supplied. There are two types of adaptor leads:

a. Type A, for pre T23 ships.

b. Type B, for T23, LPH and later ships.

WARNING - 440 VOLTS

POWER MUST BE ISOLATED AT THE SUPPLY SOCKET BEFORE THE ADAPTOR LEADS ARE CONNECTED/DISCONNECTED. CONNECTORS MUST BE KEPT DRY.

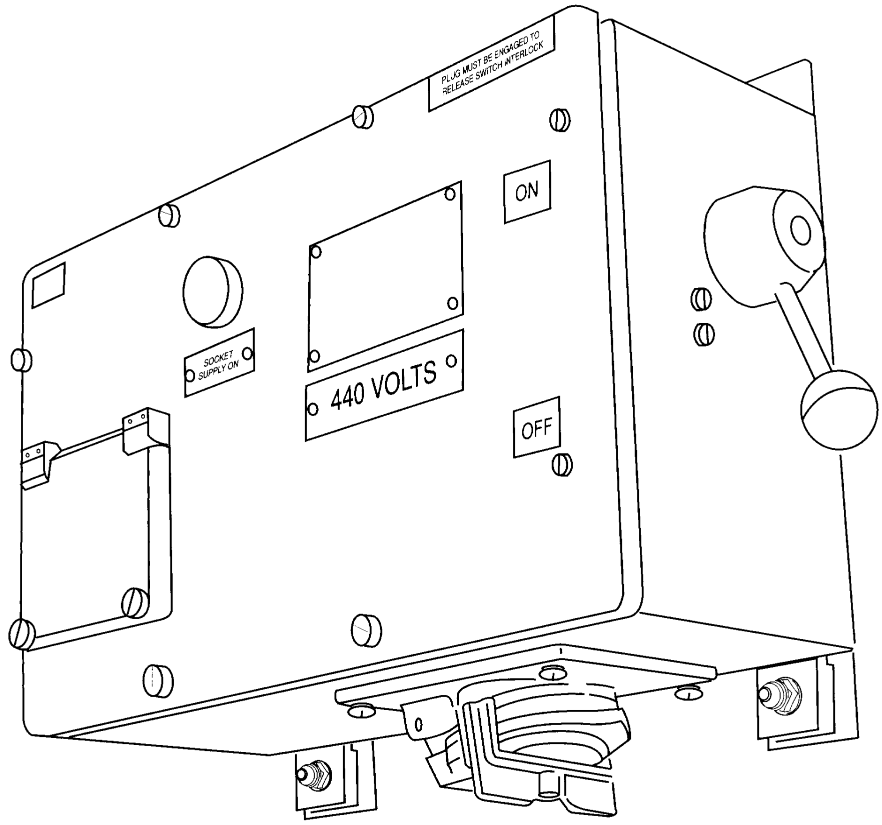

Fig 19-11. Switched Portable Pump Supply Socket

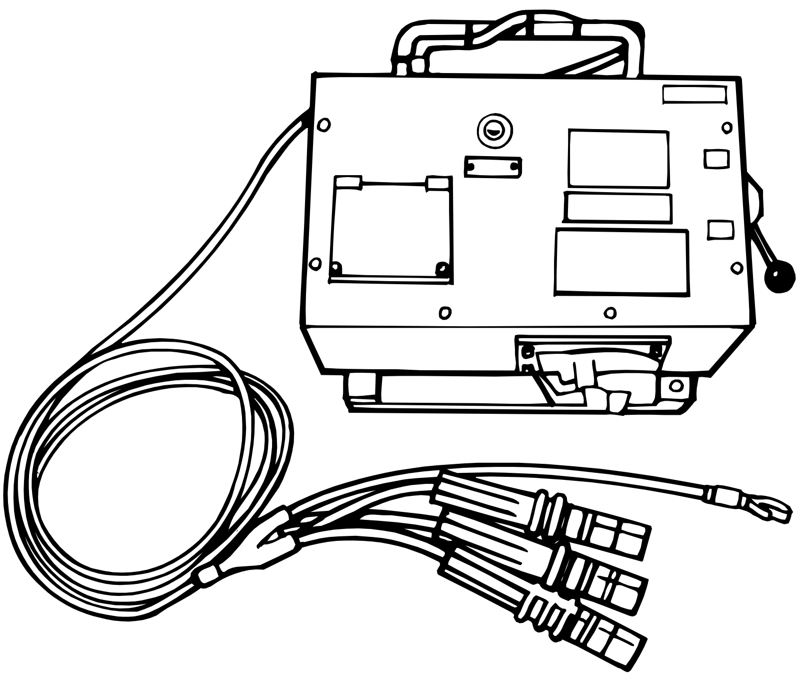

Fig 19-12. Switched Rat's Tail

1934. Battery Operated Lanterns

The allocation of battery operated lanterns (see Fig 19-13) is three to each FRPP, plus one each to sickbays, secondary medical positions and dental surgeries. Those allocated to these medical stations are to be clearly marked as such. They are to be held by the appropriate Marine Engineering section for issue when assuming NBCD State 1. Lantern maintenance is limited to replacement of the lamp or lens gasket, and recharging the two batteries using either the BC2 (2 way) or BC10 (10 way) charger. The charging system is self regulating and the lantern may be left on the charger until required for use. State of charge is indicated by lamps as follows:

a. Red lamp - charging.

b. Green or green and red - charged.

CAUTION

LANTERN END CASINGS OR BATTERIES MUST NOT BE REMOVED AND BATTERY SEALS ARE NOT TO BE REMOVED DURING RECHARGING.

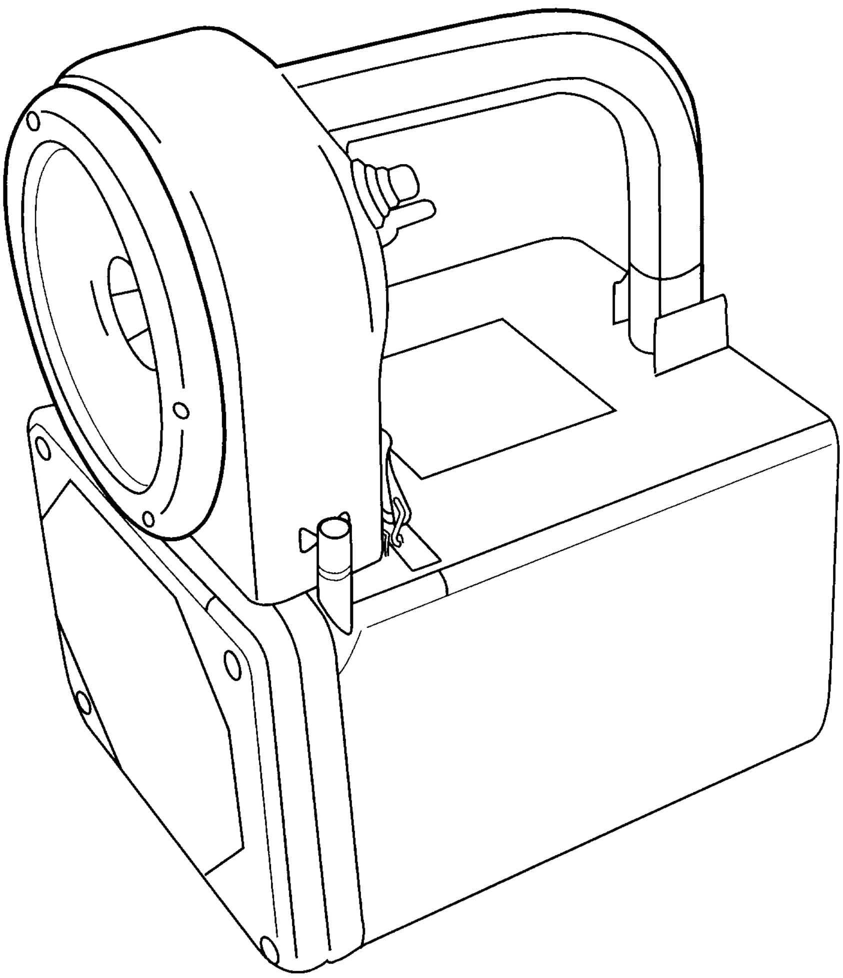

Fig 19-13. Battery Operated Lantern

1935. Battery Operated Headlamps (Caplamps)

The allocation of headlamps is nine per FRPP. Also one each to the Sickbay, SMP and dental space and three to each First Aid Party, to be stowed in the Sickbay. Headlamp maintenance is limited to:

a. Recharging of the battery using the BC10 and BC2 chargers (see Fig 19-14). The charging indications are as for the lanterns in Para 1934. Headlamp batteries are sealed during manufacture and are not to be topped up. Battery seals are not to be displaced or removed.

b. Replacement of defective lamp filaments.

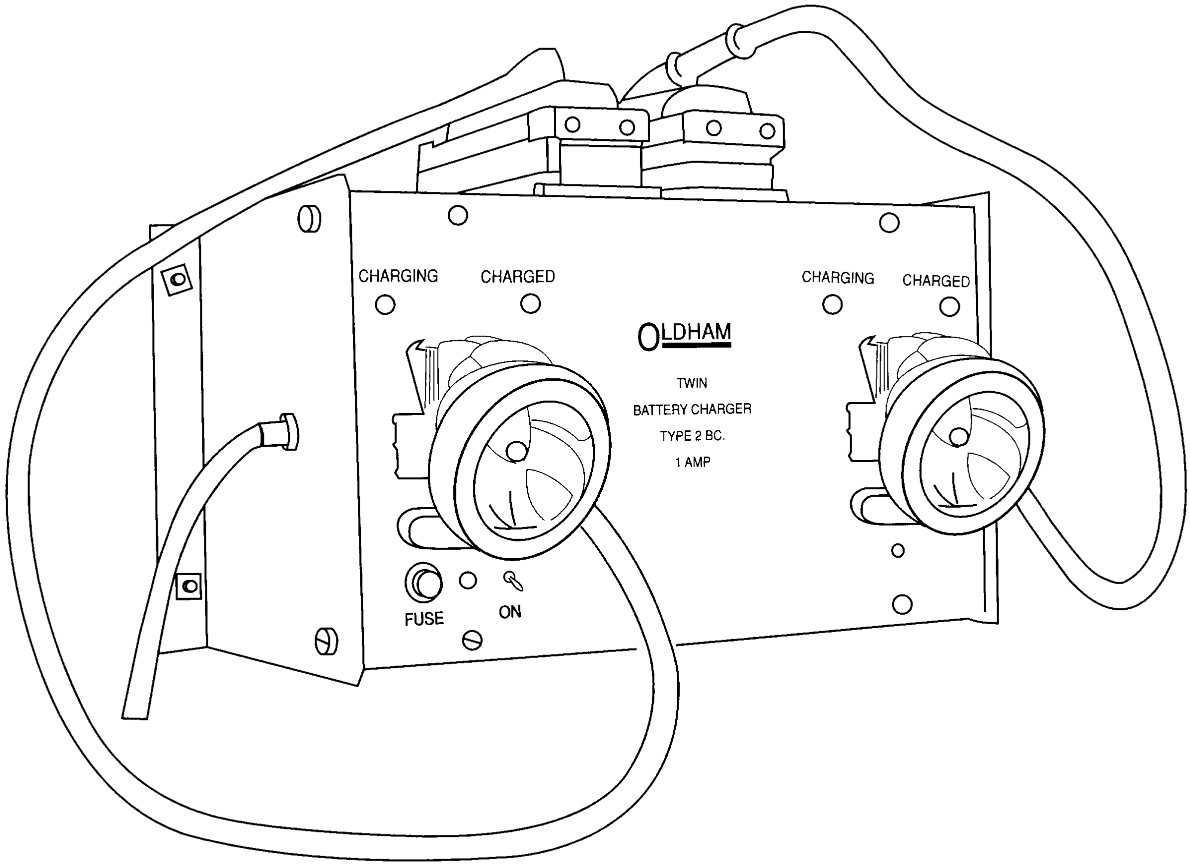

Fig 19-14. Headlamp Battery Charger

1936 to 1939. Spare.

SECTION 2 - ELECTRICAL DAMAGE CONTROL PRACTICE

1940. Electrical Damage Control Officer (DCO(L))

At NBCD State 1, the DCO(L), in HQ1, is responsible for the integrity of the main electrical supply system, including converted supplies. His detailed responsibilities are listed in Chapter 2.

1941. NBCD Electrical Information Board

To aid him in his duties, the DCO(L) has an Electrical Information Board. This board (or boards) comprises:

a. A simplified whole-ship incident board.

b. Emergency supply system diagram ('underground map') (see Fig 19-15).

c. Details of emergency cables (number, length and current carrying capacity).

d. Position and supply sources of portable pump connections.

e. Diagram and details of the main electrical supply system, incorporating the facility for logging generator and emergency supply outlet loadings.

f. Availability of sources of supply to important services.

g. 'Tote board', showing priority to be given to damage repair tasks.

1942. The electrical incident board should be sighted within view of the main NBCD incident board, and used to reflect the NBCD incidents indicated on the main board, eg fires, floods etc. It should be marked in the same manner and colours as those used on the main NBCD incident board. NBCD incidents are not to be erased from the board when successfully dealt with, but left as a reminder that electrical equipment in that area must be tested/inspected prior to use. Once equipment in the affected area has been tested and its condition determined and recorded, then the incident(s) may be removed. The board should be restrained but portable, so that in the event of HQ1 having to be evacuated, then the incident board can be taken at the same time. A duplicate of the electrical incident board should be maintained at each FRPP (and AHQ where manned at action).

1943. Emergency Cable Run Diagrams

The DCO(L) is responsible for the issue of cable run diagrams ('underground maps') to electrical repair teams. Initially information on individual cable runs is passed verbally over the 'green line'. This information is then backed up by a cable run diagram. Authorised cable runs issued to electrical repair teams are to be indicated on the cable run diagrams using continuous lines. (It should be noted that in LPD/CVS the issue of cable run diagrams is delegated to the FRPPs.) The following procedure is to be followed:

a. Cable run diagrams (Fig 19-15) are to be used as the primary method of authorising the running and powering-up of emergency cables.

b Cable run diagrams are to be dispatched from HQ1 to FRPPs enclosed in plastic envelopes.

c. The receipt of the cable run diagram is the normal authorisation to power-up, but in the absence of the diagram, and if the cable run is complete, then verbal confirmation from HQ1/SCC is an acceptable alternative authorisation.

d. Authorised cable runs are to be indicated on the NBCD electrical information board by broken lines until the run is complete, after which the line are made continuous.

e. Authorised cable runs are to be indicated on the cable run diagrams using continuous lines, together with the following information:

(1) Time of issue.

(2) Estimated time back on line (ETBOL). This should be in real time ie a four digit time.

(3) Priority.

(4) Services to be supplied.

f. The cable run must be indicated in total from the service to the source. Any connection point to an energised conductor must be clearly marked LIVE.

g. On completion of a cable run, the FRP is to ensure that the cable run diagram is returned to HQ1.

1944. Whilst cable run diagrams are the authority for cable running teams to run and apply power to an emergency cable run, no time should be wasted waiting for the cable run diagram to be delivered prior to commencing the cable run as it may never get delivered. The cable run diagram does not authorize starting of the equipment which may be operating in a reversionary mode.

1945. Electrical Repair Party

The electrical ('L') contingent at each FRPP normally consists of a senior rating as I/C and at least two ratings; they are identified by green surcoats. Each 'L' team is under the control of the DCO(L), but they may occasionally be employed on mechanical ('M') damage repair activities dependant on the damage scenario prevailing. Care must be taken to ensure that 'L' teams are not employed on tasks from which they cannot be easily recovered in the event of an 'L' incident taking priority. It should be noted that the 'L' teams usually operate from the switchboards in Type 23s with the switchboard operator as I/C of the team. 'L' teams are responsible for the following areas:

a. Emergency cable running.

b. Blanket searching.

c. Electrical damage repairs.

d. Electrical State 1 preparations.

1946. Blanket Searching

When a blanket search is ordered (see Chapter 8), the searches are to include inspections of EDCs, COSs and any action damage that may adversely effect the running of emergency cables (eg damage to through-bulkhead connectors or cables). The following is a general guide on items to be checked:

a. **Electrical Distribution Centre**

(1) Check that the busbar supply lamp is illuminated.

(2) Check that the earth percentage meter reads zero.

(3) Open the MCCB cubicle door and check the following:

(4) Check for unusual smells or burning.

(5) Check for breakers that have tripped (MCCB in the mid position), reset the MCCB by switching it to the 'OFF' position and then switching the breaker 'ON'. Should the MCCB again trip then annotate the EDC List.

(6) Check the MCCB fuzes are intact.

(7) Report any anomalies to the i/c DC 'L' team.

b. **Switchboard**

(1) Carry out a full earth check on all sections of the switchboard.

(2) Carry out a full lamp test.

(3) Check all running generator parameters are within tolerance. (Check AVRs T23 only).

(4) Check condition of all main breakers.

(5) Check 440 volt 3 Phase output of all Emergency Supply Units (ESUs).

(6) 'Rack In' and functionally test shore supply/ship alongside breaker.

c. **Conversion Machinery Room**

(1) Check that NORMAL supply is selected on Automatic Changeover Switches (ACOS).

(2) Check state and rotating electrical conversion machinery are operating correctly.

(3) Check Control and Communications switchboard parameters are correct and carry out a full earth check.

d. **General Equipment Checks**

(1) Check availability of NORMAL and ALTERNATIVE supplies.

(2) In the event of loss of NORMAL and ALTERNATIVE supplies a report on equipment serviceability should be rendered to DCO(L) at the earliest opportunity.

(3) Check all running and standby equipment for damage. This should include mechanical items such as shock mounts, associated pipework, bellows etc.

1947. Emergency Cable Runs

Personnel are in danger when live emergency cables are in use. Therefore competent ratings must properly supervise their use to ensure that all safety rules are followed. The rating I/C of the cable run must be in full possession of the facts relating to emergency cable running techniques and should carry a copy of the authorised cable run. Prior to commencing the cable run, the 'L' repair team should receive a comprehensive brief from the I/C of the 'L' party on the required cable run and any possible associated hazards.

1948. Procedure for Running Emergency Cables

The following rules are to be applied:

a. Wherever practical, personnel should work in pairs.

b. Personnel must wear electrically resistant rubber gloves (see BR 2170(3) for shelf life).

c. Before use, emergency facilities must be checked for earths and interphase short circuits if exposed to flood or fire damage.

d. Emergency cable ends must be kept clear of the deck at all time. Where possible the whole cable should be kept clear of the deck to prevent water contamination and abrasive damage.

e. Cables must be run from the service to be supplied to the source of the supply.

f. Care must be taken to ensure that watertight integrity is not breached by the running of emergency cables and the effectiveness of smoke curtains is not compromised. Operating mechanisms should not be obstructed by emergency cables.

g. Cables must not be hung from:

(1) Small bore pipework.

(2) Existing hard wired electric cabling.

(3) Any non-robust installation.

h. Whenever possible, before connecting into emergency changeover switches, the switches are to be set to the OFF position until the correct number of live phases have been proved.

i. Before changing the Emergency Supply Connection Box (ESCB) or fuse panel Normal/Emergency changeover switch to EMERGENCY, the absence of supply on the NORMAL side must first be verified.

j. Before the supply to the emergency cable run is energised, the installation must first be inspected by a competent rating.

k. 440 volts warning notices must be secured to all live connection points.

l. On completion of the emergency cable run and when power has been applied, the emergency supply is not to be interrupted without prior permission from HQ1 (unless there is a danger to personnel).

1949. Switchboard Operators

In State 1, the main distribution system is under the overall control of the DCO(L) and should be operated by qualified switchboard operators from the secondary switchboards. One of the secondary switchboards is designated the controlling switchboard. Having the secondary switchboards manned this way in State 1 serves several purposes. Firstly it reduces manning in the SCC/MCR and it ensures that any load transfers can be carried out using manual operation of breakers without the need to close up additional personnel. Where switchboards have control of ventilation supply breakers, these are to be opened at the order 'BRACE' and re-closed approximately 15 seconds later. HQ1 is to be informed of these actions. Mimic diagrams of the supply system are to be maintained and generator and emergency cable loadings (where applicable) are to be forwarded to the DCO(L) in HQ1 at regular intervals.

1950. NBCD State 1 Electrical Preparations

It is important that the initial material state of important electrical equipment is assessed on closing down to NBCD State One. The following aspects are a general guideline:

a. Muster all Damage Control Electrical Party personnel and report all manning to DCO(L) in HQ1.

b. Wibres, torches and dc electrical gloves (checked and serviceable) to be carried by all Damage Control Electrical Personnel.

c. Muster the electrical damage control locker contents and note any deficiencies for early rectification. (Reference BR 2170(3) Chapter 2)

d. All portable pump sockets are to be checked for 440 volt 3 phases available.

e. Check WEDA pumps for serviceability and check that the pump suction area is clear.

f. Check all Hand Changeover Switches (HCOS) are in NORMAL supply. Check that NORMAL and ALTERNATIVE supplies are available to the HCOS. Correct safety precautions are to be adhered to in accordance with BR 2000(52).

g. Check that NORMAL and ALTERNATIVE supplies are available to all automatic Changeover Switches (ACOS) and that NORMAL supply is selected.

h. Sight electrical damage control cables are in the correct stowage.

i. All generators are to be run up and put on load; interconnector breakers should be OPEN. CVS to start all generators, conduct running checks and assume state one configuration with 4 generators on load.

j. Check 440 volt 3 phase output from Emergency Supply Units.

k. All conversion machinery running with 'Main L.P. batteries floating'.

l. All HPSW Pump battle override switches are to be unlocked with the switch put to the override position. (Not to be done for exercise purposes).

m. Ensure the following CRETE is available in the relevant sections:

(1) BM80 - one per DC team.

(2) Clip on Ammeters - one per switchboard.

(3) Cable repair kit to be readily available.

(4) 'RATS' tool kits available and contents checked.

n. All equipment is to be re-secured for action on completion of Start One Preps.

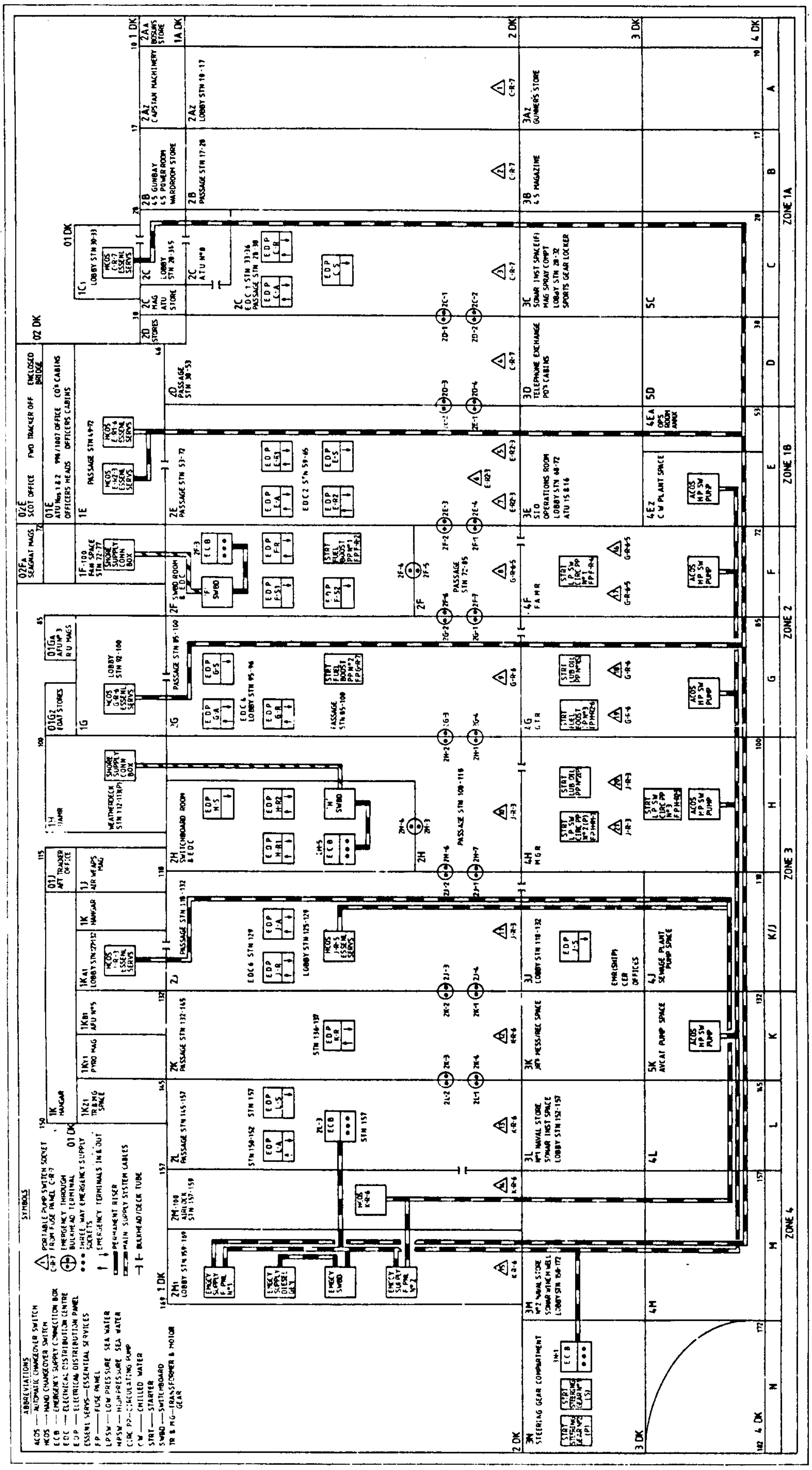

Fig 19-15. Emergency Supply System Diagram

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CHAPTER 20

FIREFIGHTING ORGANISATION

CONTENTS

CONTENTS (Continued)

CHAPTER 20

FIREFIGHTING ORGANISATION

2001. Terminology

Since the Harbour Fire and Emergency Party (HFEP) and the Standing Sea Emergency Party (SSEP) deal with a variety of incidents such as fire, flood and structural damage the terminology describing the control points for an incident are:

a. **Scene of the Incident (SOTI).** The actual location of the incident. This will be under the immediate control of the I/C Attack Party.

b. **Forward Control Point(FCP).** The elected control point of the I/C Main Group. By definition this will be the single entry control point for entry to the SOTI. It should be located at the established smoke boundary for a fire situation, ie a watertight door or hatch.

2002. The Duty Watch is the smallest unit capable of fighting, or at least containing, a major outbreak of fire. It must be organised to provide Specialist Personnel to maintain overall control of the incident and safety of the ship, a Main Group to locate, control and extinguish the fire as quickly as possible and a Containment Group to establish the boundaries of the fire and contain it.

2003. Duty Watch Organisations

Three duty watch organisations are available to ships in Fleet Time. They are:

a. **Full HFEP.** For use by ships outside of HM Naval Bases and for those ships recovering from a period of Upkeep. Lean manned ships should note Para 2032b.

b. **Reduced HFEP.** Details of the Reduced HFEP are at Para 2035. Commanding Officers may consider this the standard organisation for use in HM Naval Bases but should take into account the factors at Para 2034 in deciding whether it is appropriate to their ship's level of training and programme. It is expected that, in many cases where sufficient personnel are available, Commanding Officers will consider that a Full HFEP better meets their requirements for training and their Duty of Care commitments.

c. **Minimum HFEP.** Details of the Minimum HFEP are at Para 2037. The total manpower requirement is 18. It may be used in HM Naval Bases Portsmouth and Devonport to provide greater flexibility in manpower management and should take into account the factors at Para 2034.

2004. Ships intending to use a Reduced or Minimum HFEP should ensure that the MOD Area Fire Prevention Officer is informed.

SECTION 1 - FULL HARBOUR FIRE AND EMERGENCY PARTY ORGANISATION

2005. This section sets out a flexible organisation for the composition of the Full Fire and Emergency Party of all ships in harbour, whether at anchor or alongside outside a Fleet base. The number of hands forming each of the groups detailed in the following paragraphs are the recommended minimum (based on the capability of a fully manned frigate) and if they cannot be met, the risk of ineffective firefighting will be increased. However, it will be necessary in some ships to make some adjustments to the numbers, and under these circumstances it is important that the overall concept of the organisation is retained.

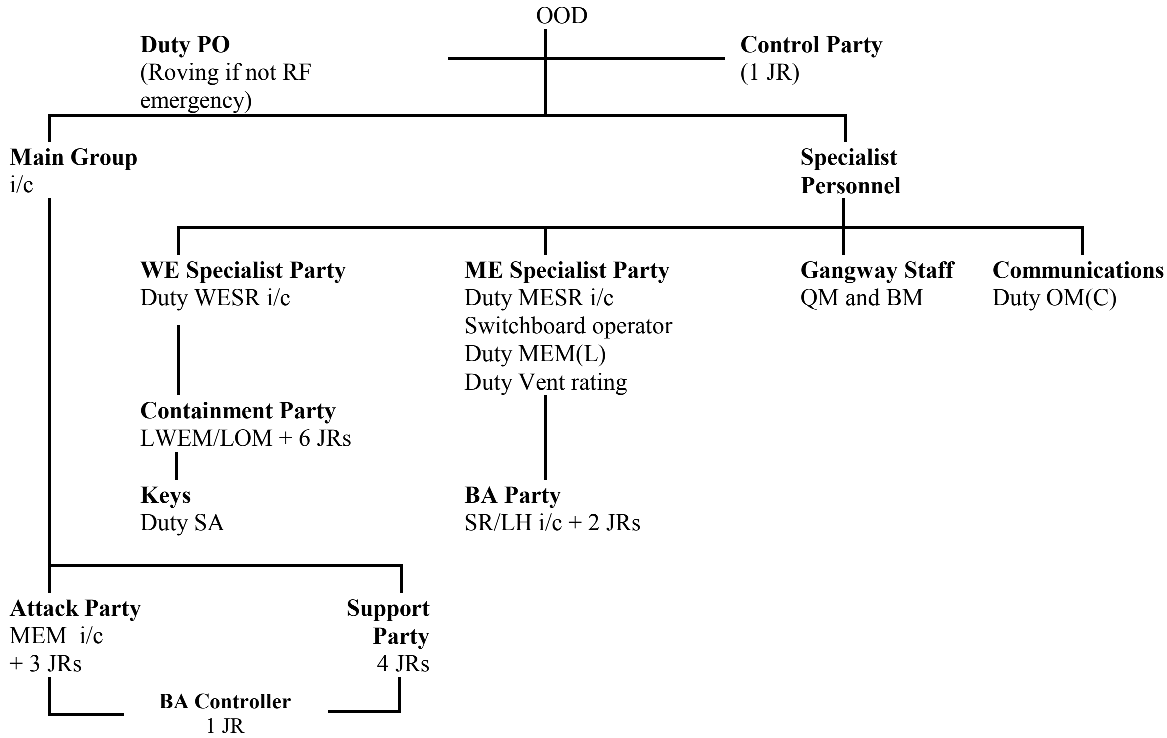


Fig 20-1. Full Harbour Fire and Emergency Party

Notes:

1. When wearing BA, men with beards experience up to 10 per cent reduction in the wear time due to the reduced efficiency of the face seal. Men with beards should not, wherever practicable, in peacetime, be allocated to duties which require them to wear breathing apparatus. (In war time all beards are removed as part of the preparations for war.)

2. The HFEP is to include a First Aid qualified rating (non-RF and not a Main Group member).

2006. Ship knowledge, teamwork, speed and effective use of firefighting techniques, and well maintained equipment are essential for successful firefighting. To further enhance the effectiveness of the HFEP the following actions are recommended:

a. At the forenoon muster of the HFEP, on taking over the duty, personnel are to be detailed for their specific firefighting duties and all junior ratings are to be fully briefed on their individual tasks and responsibilities by group leaders. (It is too late once an emergency has arisen, to attend to these arrangements.)

b. Daily Orders should include the names of all members of the HFEP and specify their individual roles within the organisation.

2007. First Aid Firefighters

These personnel are not necessarily duty or specifically detailed personnel. They are the person(s) discovering the fire and those in the vicinity who hear and respond to the loud vocal alarm of 'FIRE FIRE FIRE'. (It is most important that when a fire is discovered the alarm is also raised by informing the Quartermaster or HQ1/SCC). First aid firefighters must use equipment to hand in an attempt to extinguish or contain the fire. If unsuccessful in their attempt, the person who found the fire and who has vital information about the location, seat and type of fire etc, must remain at the scene of the incident (SOTI) and report to the person in charge of the Attack Party and of the Main Group as they arrive to take charge of the incident. The OOD and Officer in Charge of the Local Authority Fire Brigade (LAFB) may also require to debrief the person who found the fire. The name of the person finding the fire is to be reported to HQ1 by the I/C Main Group and the person is to be escorted to HQ1 for debrief as soon as he can be spared or when ordered by the OOD.

2008. Main Group

The precise function of the Main Group may alter, depending upon the situation and nature of the fire, but the basic philosophy remains the same - the Attack Party must always be prepared to attack a fire **immediately** it is reported and the remainder of the group then maintains this attack **continuously** and **aggressively**. The I/C Main Group is identified by wearing a red surcoat with a white stripe.

2009. I/C Main Group

a. The I/C Main Group should:

(1) Have a thorough knowledge of the ship's layout, which includes all routes of entry and exit from major compartments and those fitted with fixed firefighting installations.

(2) Have a thorough knowledge of the harbour fire organisation contained in this Chapter and be familiar with:

(a) Chapter 16 and 21.

(b) Ship's General Orders, Chapter 15	)	Individual ships may differ as to where the details of their fire-
	)	fighting orders and instructions
(c) Ship's NBCD Orders	)	are laid down.

(d) Harbour Fire Exercise Assessment Form (paying particular attention to Umpire 1 section).

b. On taking up the duty he is to brief the Main Group to ensure that they are aware of their tasks and responsibilities within the fire and emergency organisation.

c. On hearing the alarm he should proceed immediately to a safe position as close as possible to the scene of the incident, in order to appraise the situation and to ensure that an effective initial attack is being made on the fire. With this first hand knowledge, and after debriefing the person who found the fire, he will be able to decide where to position himself and where to establish, after consultation with the DWESR, the smoke boundary.

d. He must operate the fixed firefighting systems, when ordered by HQ1, and confirm their operation to HQ1.

e. He must also bear in mind that the attack BA personnel:

(1) Should be dressed in overalls/No 4 working dress with sleeves rolled down.

(2) Should carry out a BA face seal check before entering the fire zone.

(3) Will not necessarily be relieved by the firefighting team provided by the Support Party as they may have either put the fire out, run out of air or been beaten back by the fire.

(4) Will have been nominated at the Duty Watch muster so that the BA Controllers' boards can be made up in advance. (In making up the boards it is to be assumed that the pressure in each BA is 160 bar (EDBA), and the time started to breath is taken as time the incident was piped.)

(5) May be compelled, for any of a variety of reasons, to withdraw from their attack on the fire. Should this happen they must ensure that the compartment is sealed by shutting the hatch or door. Consideration may also be given to holding the hatch or door on a waterwall. In deciding which of these methods should be adopted consideration must be given to the problem of free surface water which can build up should the sealing hose be in prolonged use, compared to the flash over dangers involved in a full hatch/door re-entry procedure.

f. The I/C Main Group must ascertain if there are any personnel trapped in the fire zone and if there are any casualties who require assistance.

g. On the withdrawal of the Attack BA personnel, the I/C Main Group must ensure that the expended firefighting appliances are moved out of the area from which the next attack is to be mounted.

h. He must request, from HQ1, information on any specific hazards existing in the compartment on fire or in adjacent compartments. This information is included on compartment firefighting Kill Cards, which are held at HQ1.

i. He must supervise hose running, detailing the lengths of hoses required and the type of nozzles to be used, and should be guided by the following principles:

(1) Firefighting hoses must be run from separate hydrants, although it is acceptable to use a 'Y' piece to supply a boundary cooling hose and a firefighting hose from the same hydrant.

(2) Sufficient hose must be provided to allow the firefighters to reach all parts of the compartment.

(3) The firefighter nozzle has a considerably lower discharge rate than the waterwall nozzle and is therefore the preferred nozzle for firefighting between decks.

(4) Waterwall nozzles must always be used to provide the waterwall, and the firefighter nozzle is used for fighting carbonaceous fires.

j. He must establish the nature of the fire and if there is a possibility that it is a fuel/oil fire, must ensure:

(1) The firefighting medium is AFFF.

(2) An FB5X branchpipe is used, in conjunction with an inline inductor where appropriate.

(3) Sufficient quantities of replenishment AFFF are provided for the Support Party. (A 20 litre drum lasts approximately sixty seconds when supplying an FB5X branchpipe through a No 2 hose).

(4) The number of drums to adequately blanket a compartment is shown adjacent to the foam inlet tube. This number should not be exceeded. It must be remembered that the foam will not spread evenly throughout a compartment owing to obstructions such as machinery, lockers, consoles etc, or if the ship has a heel.

(5) If hatch or door re-entry is to be made, a third hose incorporating an inline inductor and fitted with a FB5X foam making branchpipe must be used to provide AFFF. Before the FB5X is directed at a fire it is essential that foam is being produced.

k. If it has not been necessary to shut the door or hatch on the fire and the Attack BA personnel are continuing to fight it, then the I/C Main Group may request, either directly to where the Support party are dressing, or preferably through HQ1/SCC, that the first two fully dressed Support Party members be called forward to the FCP. The I/C at the FCP then has the flexibility to use them in pursuing an aggressive attack, if circumstances dictate, or holding them to await the remainder of the Support Party if a full re-entry is to be made. The I/C at the FCP is to make every effort to inform HQ1/SCC and/or the Support Party dressing area whether the first two dressed are required or not.

l. If the Support party arrive as a team then the I/C at the FCP must brief them on the nature, location and size of the fire, together with any other information available. This can be taken from Kill Cards and should include positions of hazardous items such as gas bottles, batteries etc. This briefing should take place in a suitable clean air environment where the team need not use air from their sets. He must ensure that each team member is conversant with his task within the team.

m. The I/C Main Group must ensure that all personnel not involved with a re-entry procedure are kept well clear of the door or hatch to be used. He must ensure that all those remaining in this area are fully protected by fearnought suit and BA, and keep low to avoid any fireball.

n. As soon as the Support Party has been deployed to fight the fire (and if a second Support Party cannot be supplied from 'Emergency Clear Lower Deck' personnel), the I/C Main Group must ensure that the relieved Attack Party is being dressed and prepared to form a second Support Party to be ready for briefing well before the team tackling the fire is due out.

o. He will debrief all firefighting teams on their exit from the fire zone.

p. He must keep the control team informed on the current situation, especially when it is changing, for better or for worse. In the latter situation, requests for additional manpower should be made early.

q. The I/C Main Group must continue to direct the Main Group's attack on the fire until he is sure that the Local Authority Fire Brigade (LAFB) (which should arrive at the scene of the incident (SOTI) quickly in the UK, and probably less quickly in some other parts of the world) is ready in all respects to commence firefighting, and has been fully briefed on taking over the firefighting task. He remains at the SOTI and:

(1) Liaises with the LAFB.

(2) Maintains control over RN personnel who are assisting the LAFB in carrying out other firefighting tasks.

(3) Keeps the OOD informed of the current situation and so assist him in his overall ship safety function.

2010. Attack Party

The Attack Party, under the leadership of an MEM, should consist of two OMs (or equivalent) and one other JR. These are organised such that the MEM i/c plus one attack the fire and other two are BA wearers. They, and the BA Controller, are to be dressed in basic firefighting rig (No 4 working dress or cotton overalls, natural fibre socks, DMS boots and red surcoats) throughout the period of their duty. Their aim is to attack the fire as quickly as possible.

a. On the alarm being raised the MEM plus one other junior rate are to attack the fire, collecting SPE(AFFF) and CO_2 fire extinguishers en route. They should establish the seat and nature of the fire using the thermal imaging camera (TIC) if it has been delivered by the nominated rating.

b. The two persons detailed as BA wearers, on hearing the alarm, are to act independently of one another and everyone else on board. They are to collect a portable SPE (AFFF) and proceed to the nearest BA locker, don the BA (plus firefighters' hood and anti-flash gloves), conduct a face seal check and (remaining on air) proceed to the SOTI and attack the fire, whether or not the Attack BA Controller is present. The BA 'set number' tally should be left at the entrance to the SOTI to identify that the BA wearer is within. The men being relieved (first aid attack firefighters) who are not wearing BA must then withdraw (see sub para d); again the use of ELSA should be considered if personnel are showing signs of smoke inhalation or respiratory distress.

c. The BA Controller is to obtain his own BA control board and enter on it the time of the fire broadcast as the time of entry of the Attack BA team. He may not see the Attack BA men prior to them making their entry and must assume their initial BA pressure as entered on the control board to be 160 bar (EDBA). The BA Controller must search the access to the SOTI for BA tallies and report his findings to the I/C SSEP/Main Group.

d. When relieved, or beaten back and their attack on the fire has to cease, the Attack Party is to join up as the second Support Party and prepare for further firefighting. (If none is available from 'Emergency Clear Lower Deck' personnel).

Notes:

*1. **Thermal Imaging Camera (TIC).** The prime use of the TIC is to locate the seat of the fire through smoke. It is also useful in search and rescue, identifying fuel leaks feeding a fire, locating firefighting equipment and spotting unexpected hazards in smoke-logged areas. Until the arrival and involvement of the fearnought suitmen, the TIC is a valuable tool to the MEM of the Attack Party. Initially the TIC is to be given to the MEM i/c of the Attack party by a member of the Containment Party. Subsequently, its use will be controlled by the I/C Main Group. In most circumstances, where the TIC is needed, the user will be wearing BA. The user should be aware of the TIC limitations described in Chapter 23.*

*2. **Large Compartments with More than One Access Point.** There is a risk that when the alarm is raised, members of the Attack Party will proceed to differing access points and frustrate the aim of a coordinated attack. Provision is to be made in Ship's Orders for a standard muster point for each major space, so that these become well known and can also be piped when the initial alarm is raised. Simplicity is vital, therefore choice of port or starboard passage access to all compartments may be appropriate as standard operational procedures.*

*3. **Head and Hand Protection** Attack Party BA wearers should wear firefighter's hoods and anti-flash gloves. The non BA wearers are not required to do so.*

2011. Support Party

a. On the alarm being raised, the Support Party is to muster, with all speed, at the designated FRPP. This party has two main tasks:

(1) To provide personnel dressed in full firefighting rig, (see Chapter 26), with a BA Controller, to the scene of the incident as soon as possible.

(2) To coordinate, collect and provide to the SOTI all necessary equipment to sustain a continuous attack on the fire (hoses, nozzles, inline inductors, AFFF, etc). Manpower for the latter task is to be provided from members of the retiring Attack Party, from supplementary personnel onboard when the alarm is raised, or from Emergency Clear Lower Deck.

b. Support Party fearnought suit men are to be dressed in basic firefighting rig (see Chapter 26) throughout the period of their duty. Surcoats are to be worn (see Para 2028). The composition of the Support Party 4-man firefighting team is detailed in Para 2141.

c. To ensure a continuous and aggressive attack on a fire, the Support Party is to be deployed as follows:

(1) Alarm raised, initial attack made by Attack Party / Attack BA.

(2) Support party muster at the designated FRPP (BA Controller at the FCP).

(3) The first two members of the initial Support Party are to don FFHBC and proceed to the FCP 'on air'. They are not required to carry out the standard communications check, as this will delay their arrival at the FCP. If the helmets are functioning correctly, each team member will have communications with each-other and with the I/C FCP who will have a hand-held radio pre-set to Channel 1.

(4) Once the first two arrive at the FCP, the I/C then has the flexibility to use them, if needed, to maintain a continuous and aggressive attack or, if the door to the compartment has been shut, keep them there to prepare for a full re-entry whilst waiting for the remainder of the Support Party to arrive.

(5) The remainder of the Support Party are to carry out a communications check before reporting to the I/C FCP 'on air'. The Team Leader of the Support Party is to switch from FF to TL mode before donning the helmet.

(6) If no message or information is received at the Support Party dressing area, with regard to the state of the door/hatch to the compartment on fire, then it is to be assumed that the door/hatch is open.

(7) The second Support Party is to use Channel 2 on their FFHBC helmet radios, so that they do not interfere with communications at the SOTI. The I/C at the FCP is to change to Channel 2 once the second Support Party have taken over at the SOTI.

2012. BA Controller

When BA is used operationally a BA Controller must be detailed.

a. The BA Controller must be well trained in the use of the apparatus and understand the important part he plays in the safety arrangements for the firefighters in the fire zone.

b. He must always be in possession of a reliable timepiece and a marker pen for the control board.

c. He locates at the nominated FCP, on hearing the 'fire' pipe. He must remain outside the fire zone, near to the smoke boundary, and must on no account be detailed for any other duties.

d. He may act as the Controller for up to ten BA wearers (two 5 man teams), ie in the harbour fire situation he controls both the Attack and Support Party.

e. The duties of a (EDBA) BA Controller are as follows:

(1) Assist the wearer to don and adjust BA, and to carry out functional and face seal checks. Clip the set number tally to the control board.

(2) Mark up the BA control board (see Chapter 27).

(3) When used for search and rescue, ensure that the tail of the guide line is secured to an anchorage point at the incident entry point.

(4) Keep a sharp listening watch for any signals from distress alarms.

(5) Ensure that the I/C Main Group is kept informed of the time that a relief team should be committed to relieve the previous team ('time relief due in').

(6) Inform the Officer in Charge of firefighting if a BA wearer has not emerged by the 'time due out'.

(7) Replace the 'set number' tally back on the set when the wearer has completed the task.

2013. WE Specialist

On the alarm being raised, the Duty WE Senior Rate is to close up in HQ1/SCC. He is responsible for:

a. Ensuring firefighting teams have access to magazines in the vicinity of the fire.

b. Advising the OOD on the following:

(1) Magazine and explosive safety.

(2) Movement of ammunition.

(3) Magazine firefighting arrangements, spray systems and fitted pumping arrangements.

(4) Electronic and electrical equipment safety.

(5) Internal and external communications.

c. Coordinate containment, liaising between the 2 I/C of the Containment Party, specialist parties and the OOD, in order to establish priorities for the containment task and to ensure that the duties listed in Para 2014 are effectively executed.

2014. Containment Party
The containment Party, in harbour, should comprise the following personnel.

a. WE Senior Rate (OIC).

b. LWEM/LOM (2 I/C).

c. Normally 6 personnel, (but see Section 2 for Reduced and Minimum HFEP numbers)

d. Additional hands should be employed when available.

2015. When the alarm is raised, members of the Containment Party are to muster, as quickly as possible, as directed by the fire 'pipe', collecting their containment bags from the blue lockers. A rating is to be predesignated to provide a TIC at the SOTI. The OIC should work closely with HQ1 and regularly update HQ1 on the status of containment. In harbour, the 2 I/C's primary role is to brief boundary coolers on where they are required to cool and hazards in the vicinity of where they are cooling, and to confirm that boundary cooling has been established where directed. He should also check on the well-being of personnel, particularly on the upperdecks and rove regularly to ensure boundary cooling efforts are proving effective. Containment details should not be marked on incident boards until they are confirmed. Guidance on boundary cooling and the temperature monitoring system (TMS) is at Annex B to Chapter 21.

2016. All personnel involved in containment should receive a detailed brief on their roles and responsibilities when assigned to boundary cool a compartment. The use of diagrams and containment Kill Cards, particularly in high risk areas such as magazines, will help considerably in ensuring boundary cooling is effectively conducted.

2017. The Duty LWEM/LOM
The Duty LWEM/LOM, as 2 I/C of the Containment Party, is to be briefed by the Duty WESR on the location of all the adjacent compartments and to be made aware of those compartments presenting the greatest hazard, eg magazines, gas bottle stowages, fuels, flammables etc. He should constantly check the boundaries to ensure that his team has contained the incident and is to keep the OOD informed through direct liaison with the DWESR. He is to provide first hand guidance on the safety of electronic and electrical equipment and personnel. Smoke control measures initiated by the Attack Party become the responsibility of the Containment Party once it has closed up. He may initiate local smoke control measures, using ventilation, as directed by HQ1/SCC, reporting back on their effectiveness and the location of smoke boundaries. He is to initiate action to remove or drain down free surface water.

2018. Keys Rating
Normally the Duty SA, the Duty Keys Rating musters at containment control on the alarm being raised, and is responsible for obtaining the keys to the duplicate keyboard from the OOD, and then providing to the ratings in charge of both Main Group and Containment Party the necessary keys to enable firefighters to gain access to all compartments in the vicinity of the fire.

2019. ME Specialist Party

This party is responsible for:

a. Maintaining the integrity of the ship's electrical power supplies and safeguarding those to electrical services, if necessary by shedding load and/or putting additional generators on load. Where possible, normal and alternative power supplies to the HPSW pumps should be established and maintained during firefighting operations.

b. Crash stopping ventilation if only operable from the switchboard, or ensuring it has been stopped. Shutting upper deck vent flaps on systems serving the compartment on fire, and subsequent operation of other vent systems for smoke clearance.

c. Checking all HPSW pumps and starting additional pumps to maintain the HPSW system pressure. If necessary, this is to be achieved by shutting off sea water to non essential services.

d. Isolating electrical power supplies in and around the area of the fire to minimise the danger to firefighters and equipments.

e. Checking and safeguarding those systems essential to the firefighting effort (saturated steam, HP air, etc) and isolating those systems containing hazardous fluids (fuel, lub oil, hydraulics, etc) to prevent them from feeding the fire.

f. Making contact and liaising with the shore electrical supply authority.

g. Advising the OOD on fixed firefighting installations for machinery spaces, paint shop, flammable store rooms, gas bottle stowages, hangars, etc.

h. Advising the OOD on the following:

(1) The technical aspects of firefighting.

(2) Pumping and salvage arrangements.

(3) Ventilation and smoke clearance.

(4) Ship stability.

(5) The presence of compressed gases or pressure vessels in the vicinity of the fire, including HP air, refrigerant gases, oxygen and acetylene gases, beer kegs and associated CO_2 bottles. The discharging of the contents of HP air bottles, where possible.

(6) The nature of the ship's structure, ie aluminium or steel on the area of the fire.

Note. *In the Full HFEP organisation, all ships should employ a Duty ME Senior Rate and a separate qualified Switchboard Operator.*

2020. Breathing Apparatus Party

The Breathing Apparatus Party is led by the BA Coordinator who must be specifically trained in this task. All members of this party must be familiar with BA control as well as recharging techniques. On the alarm being raised the BA Coordinator organises his party to collect BA and spare cylinders (excluding the 4 designated for the upper deck re-entry locker) to form a dump in a position allowing room to work and being free from smoke. This location is to be broadcast. Once the necessary BA has been collected, the BA Coordinator is responsible for:

a. The BA Tote Board. This provides a method of accounting for all BA and associated equipment and shows the quantity, identity number and location of all BA sets and spare bottles held onboard.

b. Provision of BA to required user locations.

c. Recharging used BA cylinders.

d. Informing the OOD of the BA availability state.

e. Coordinating optimum use of BA procured from outside sources (other ships etc).

f. Briefing all BA Controllers in their duties at the start of their period of duty, noting that BA Controllers in the Main Group are not members of the BA party.

g. Provision and briefing of BA Controllers, other than BA Controllers pre-designated as members of the Main Groups.

2021. Breathing Apparatus Dump

a. **Forming The Dump.** The location of the BA dump should take into consideration:

(1) Location of the fire.

(2) Proximity to the Flight Deck (flying ops), weapons, sensors and areas where guard rails have been 'struck'.

(3) Access to charging facilities.

(4) Weather conditions (rain, etc).

(5) Location of gangway(s) and potential Local Authority Fire Brigade BA Dump/ Forward Control Point.

(6) Availability of communications with HQ1/SCC/OOD.

Note. *If, after the initial location of the BA dump has been piped, the BA Coordinator considers that a move to another, more suitable, location is appropriate he should inform HQ1/OOD and re-locate the dump.*

b. **Setting Up The Dump**

(1) In forming the dump, all BA and associated equipment must be collected where possible.

(2) The collection of BA and associated equipment should start in areas adjacent to the scene of the fire to minimise possible loss of equipment should the fire escalate.

(3) When sets are collected from lockers all associated items should be removed and taken to the dump, ie control boards, board markers, hoods and gloves, etc.

(4) As BA and other items arrive at the dump they should be placed in separate areas as designated by the BA Coordinator, ie useable sets, spare bottles (full), spare bottles (empty), extension sets.

(5) All sets should be checked on arrival at the dump to ensure that they:

(a) Are not defective.

(b) Are fully charged.

(c) Have all straps fully extended.

(d) Are recorded, along with all associated items on the Tote Board.

2022. Gangway Staff

On receipt of the fire alarm, from whatever source, a pipe is to be made by the Gangway Staff or HQ1/SCC Watchkeeper, as appropriate, informing the Ship's Company of the existence of a fire, its location and where various members of the Fire and Emergency Party are to muster. This pipe is to be repeated. When available, the main broadcast alarm is to be used prior to making this initial emergency broadcast. Thereafter, the Gangway Staff or the HQ1 Watchkeeper (depending on access to shore telephone) are to carry out the following:

a. Inform the Local Authority Fire Brigade (LAFB), and maintain a 7.5 m clear area at the foot of the brow for LAFB access.

b. Inform shore authorities.

c. Inform adjacent ships.

d. If the LAFB has arrived, then once the appropriate route to the SOTI from the 'on' brow has been agreed between the officer responsible for ship safety and the LAFB officer, the BM can be instructed to leave the gangway to identify the route by running a combined guide and sound powered telephone line.

e. Control entry to and exit from the ship, and account for personnel using the 'peg board'.

f. Prepare to meet the LAFB Officers and escort them to HQ1/OOD.

g. Keep a red flag in daytime, or a red light at night at the foot on the 'on' brow.

2023. Communications Rating

On the alarm being raised, a Duty OM(C) is to carry out the following tasks:

a. Rig a sound powered telephone between HQ1 (or other control position) and the FCP.

b. Man emergency communications nets to outside authorities.

Notes:

1. Task a. above should be undertaken by the HQ1 Incident Board Operator/ Communications Number when in the Reduced Harbour Fire Party organisation.

2. Task b. is only to be undertaken when the Full Harbour Fire Party organisation is in force and there are two duty OM(C)s in the Duty Watch.

2024. Control Party

On the alarm being raised, the Control Rating is to close up in HQ1 (or another suitable position with adequate communications should it not be possible to occupy HQ1) and man the incident board and internal communication lines. He is to make a chronological record of events during the incident. The OOD, also in HQ1, must not become too involved in the details which are the responsibility of the ratings in charge of the various groups and parties, but he must consider the following:

a. The possible hazards from explosives and flammables.

b. The availability of equipment, power supplies, fire and salvage pumps.

c. The hazards of smoke and smoke clearance (see Chapter 21).

d. Safety of personnel, including any civilians, who may be onboard.

e. Ship stability.

f. Control and allocation of additional manpower.

g. Liaison with adjacent ships and outside authorities.

2025. Medical First Aid

A certificated first aider, qualified to Level 2, is to be included in the Harbour Duty Watch. He is not to be part of the Reaction Force or Main Group. The role of the Duty First Aider (DFA) and the response expected from a Ship's Company when dealing with a fire involving casualties is as follows:

a. Ships with reduced manning/harbour duty watches may use the DFA to deliver the TIC or keys to the I/C at the SOTI but he must be relieved of those responsibilities to deal with any immediate casualties. If there are no immediate casualties he is to close up at HQ1, with adequate equipment, draw the keys to the Sickbay and prepare for casualties. (This allows direct communication between SOTI/OOD/HQ1/SCC).

b. On assuming the duty, the DFA is to draw a specific first aid bag from the Medical Branch Rating or previous DFA, be re-briefed and perform equipment checks on Entonox and oxygen.

c. A loud vocal alarm on finding a fire should include the presence of casualties. Priorities for attacking the fire should not change, although casualties should be moved if hindering firefighting efforts. On being beaten back, the casualty should then be rescued by the retreating firefighters or as directed by the OOD or I/C at the SOTI.

d. The casualty is to be moved to clear air, beyond the smoke boundary and clear of any traffic, and passed into the care of the DFA who should receive the following information about the casualty:

(1) Nature of injuries, if known.

(2) Whether or not exposed to inhalation of smoke, any loss of consciousness.

(3) Whether or not a key member of the firefighting organisation.

(4) Location/compartment rescued from, and whether or not any other casualties exist, so that search and rescue is not implemented unnecessarily.

e. All information is to be passed immediately to the OOD/HQ1. The DFA is then to liaise with the QM and await arrival of professional medical assistance.

f. The DFA must be afforded assistance when dealing with isolated injured personnel.

g. On completion of the duty, the DFA is to return the first aid bag and debrief the Medical Branch Rating/incoming DFA as required.

2026. Emergencies

As soon as it is apparent that a fire is more than a minor incident, the OOD should declare a full scale emergency as detailed in Section 2 of Chapter 7. This will ensure that all uninvolved personnel are brought out of the ship, clear of danger, and provides a ready pool of spare hands for extra firefighting and containment tasks.

2027. Spare.

2028. Identification of FF Personnel

In order to facilitate the easy recognition of Fire and Emergency Party personnel, coloured surcoats should be worn as follows:

a.	Red, with a white stripe	I/C Main Group.
b.	Red	Main Group with the exception of the BA Controller.
c.	Yellow	Breathing Apparatus Party plus Attack and Support Parties' BA Controllers.
d.	Green	Duty Vent.
e.	Blue	Containment Party.
f.	Brown	Nominated Key Personnel.

2029 Firefighters' Communications

The Support Party are equipped with the Firefighter's Helmet with Built-in Communications (FFHBC) to enable them to communicate with the I/C Main Group. The helmet is described in Chapter 26 and the radio procedures are detailed in Chapter 9.

2030 -2031. Spare.

SECTION 2 - REDUCED AND MINIMUM HARBOUR FIRE AND EMERGENCY PARTY ORGANISATIONS

2032. It is mandatory to maintain a harbour Duty Watch roster of not less than 1 in 4 in HM Naval Bases outside of leave periods. Whilst some ships are able to achieve this without undue problems, others (particularly Type 23s) have difficulty. Therefore, the composition of Harbour Fire and Emergency Parties (HFEP) may be reviewed in order to provide Commanding Officers with greater flexibility in manpower management. The following paragraphs provide Commanding Officers with guidance on the options of HFEP size required and mandates the minimum organisation which can be operated, in specific circumstances, in Fleet Time. It does not include the arrangements for:

a. Ships in Upkeep.

b. Ships outside HM Naval Bases, which should maintain a Full HFEP. (Lean-manned ships which are unable to achieve this level may reduce towards the Reduced HFEP organisation at Para 2035 and Fig 20-2, taking into account the associated risk).

2033. Risk

Commanding Officers retain Care and Protection of their personnel in all circumstances and a prime role of the Duty Watch is to safeguard those personnel living on board. In HM Naval Bases, where a degree of support can be guaranteed, there is potential to reduce the numbers of HFEP personnel commensurate with the level of potential support and the degree of risk of a major fire/flood occurring. The decision regarding the size of HFEP required should only be made after careful assessment of the relevant risks, balanced against the need to maintain 1 in 4 or better alongside in support of Personal Functional Standards. Fleet Waterfront Staff should be consulted before reducing to the Minimum HFEP.

2034. Risk assessment involves several areas, most particularly the management of fires and other such emergencies. The following key areas will require evaluation before deciding on the level of HFEP to be employed:

a. **Level of Experience.** Ships that have not achieved a formally recognised level of training in the past year ('Satisfactory' or better assessment in OST) would normally need to operate a full Duty Watch although, in the intervening periods (and after additional training if a 'Satisfactory' assessment was not achieved at OST) assessment can be conducted by Fleet Waterfront Staff. Commanding Officers will need to pay close attention to the impact of the turnover of large numbers of personnel, or key personnel such as OODs, on standards previously achieved.

b. **Prior Training.** Ships planning to change from one size of HFEP to another should ensure that all Duty Watches are fully briefed and exercised prior to undertaking a duty in the new organisation.

c. **Local Authority Fire Brigade (LAFB).** The LAFB serving HM Naval Bases Portsmouth and Devonport can be expected to arrive in about 5 minutes. However, Commanding Officers should be aware that a further significant period of time (perhaps 10-15 minutes) may elapse before LAFB firefighters are able to commence tackling the fire. Industrial action by LAFB (either actual or forecast) would normally preclude use of the Minimum HFEP.

d. **Ship's Status.** Is the ship fuelled/ammunitioned/stored? What machinery and electrical equipment is operating? What nature of work is being undertaken onboard? The amount of burning/welding taking place during an AMP significantly increases the risk of fire. Commanding Officers may wish to consider utilising a larger Duty Watch during the day until such work has completed and then revert to a smaller HFEP, noting that thorough re-briefing of personnel would be required at the transition. An enhanced rounds routine could also be considered.

e. **Mutual Support from Other Units.** When a ship is berthed in close proximity to other RN warships it can normally be assumed that adjacent ships will be able to provide additional manpower and equipment, should an emergency occur. However, if they too are working a Minimum HFEP the numbers of personnel they will be able to provide will be significantly reduced. Ships should also consider what support they themselves can safely provide to an adjacent ship if it requests assistance to deal with an emergency.

f. **Age of Ship.** Older ships do not have the benefit of modern integrated fire detection systems. However, the same ships also tend to have larger numbers of personnel from which to draw the HFEP.

g. **Security State.** The Duty Watch will need to be enhanced when the security state dictates.

h. **Risk Assessment.** Commanding Officers considering reducing to the Minimum HFEP will need to balance the above factors against their manpower constraints and their knowledge of the experience and competence of their personnel. In some situations it may be necessary to review the composition of certain duty rosters to ensure that the required experience and competence is available. Squadron advice should be taken into account.

2035. Reduced HFEP

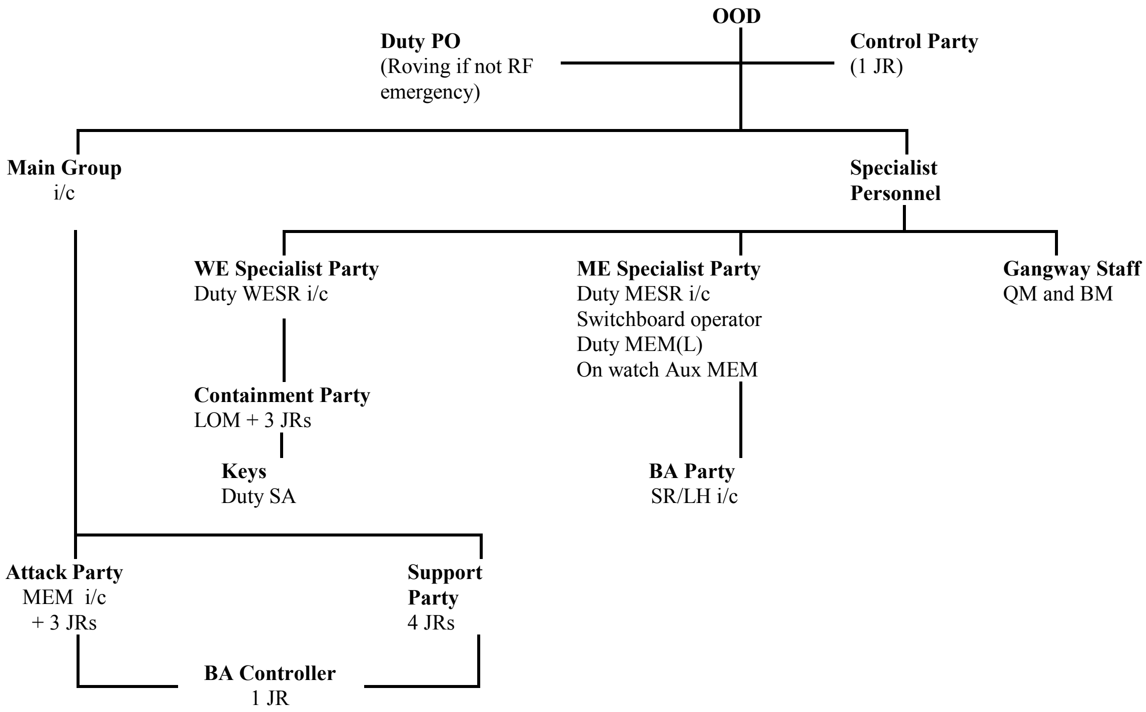


Fig 20-2. Reduced Harbour Fire and Emergency Party

2036. The Reduced HFEP, shown in Fig 20-2, includes of the following personnel:

a. The Main Group should be under the overall charge of the I/C Main Group who must have a good knowledge of the ship and firefighting techniques.

b. The Attack Party, under the leadership of an MEM, should contain one WEM and one Operations Department junior rating (or two OMs) and one other JR.

c. The four members of the Support Party are to dress in Full Firefighting Rig before reporting to the I/C Main Group. The Attack party BA Controller is to act as Controller for all members of the Main Group.

d. Attack and Support Parties share the BA Controller.

e. In addition to taking charge of the Containment Party, the LOM should also provide a guidance on electronic and electrical safety.

f. The Containment Party should contain all other duty personnel who have not been detailed for other specific fire and emergency party tasks, plus all available non-specified Duty Watch and non-duty personnel.

g. The On-Watch Bosun's Mate is to act as one of the members of the Containment Party, after running out the guideline from the gangway to the FCP. (This can only be carried out if he is not carrying a weapon.)

h. The duty SA is to act as a member of the containment group once he has obtained keys for all the compartments in the fire area.

i. Provided he is suitably qualified, the duty ME Senior Rate may, in ships where the main switchboard and HQ1 are co-located, also undertake the duties of the Switchboard Operator.

j. All non-specified Duty Watch and non-duty personnel are available for use.

2037. Minimum HFEP

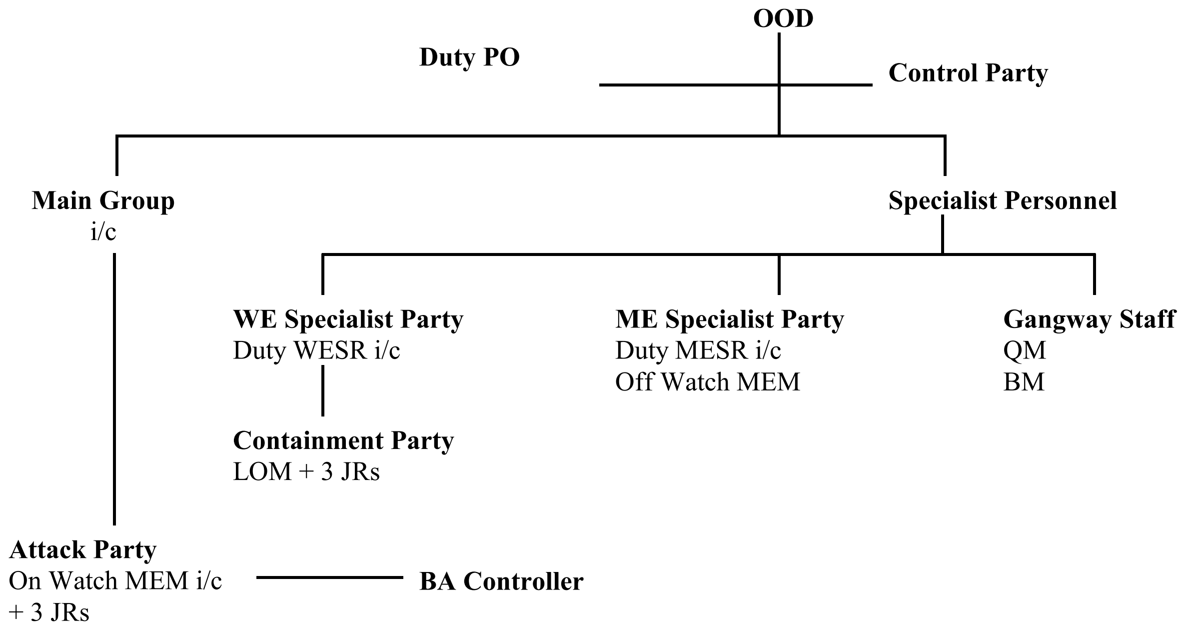


Fig 20-3. Minimum Harbour Fire and Emergency Party

2038. The Minimum HFEP, shown in Fig 20-3, consists of the following personnel:

a. **Officer of the Day (OOD).** The experience and competence of the OOD will be pivotal to the Minimum HFEP's ability to deal with a significant incident such as a fire which is not extinguished by the Attack Party. The OOD will need to have a complete understanding of the tasks being undertaken by the various personnel and will need to direct them positively and with forethought. In particular the OOD will need to control the transition of the HFEP from an immediate reaction posture to the core of a larger team concerned with combatting a more serious incident.

b. **Duty Petty Officer (DPO).** The DPO's initial response to an alarm is to obtain first hand information from the Scene of the Incident (SOTI) and surrounding compartments in order to provide a verbal brief to the OOD in HQ1 of the situation. The brief should include, but is not limited to, details of the fire/flood, the compartments affected, the extent of smoke within the ship, the positions of the I/C Main Group and Attack Party, casualties and any perceived problems. If possible, the DPO should give the OOD an indication of whether he considers that the Attack Party will be able to deal with the emergency. On completion of the brief, the DPO should act as directed by the OOD, either repeating the tour of the affected area to provide a further brief to the OOD, or establishing the progress with the mustering of non-duty personnel. If available information indicates that the fire is not within the capabilities of the Attack Party, the OOD should direct the DPO to switch role to BA Coordinator in preparation for controlled attack on the fire utilising non-duty personnel, personnel from adjacent ships or the LAFB.

c. **Control Party.** The Control Party will be the on-watch HQ1 Watchkeeper. On the alarm being raised he is to make the standard pipe and then immediately pipe 'Emergency Clear Lower Deck'. Either the HQ1 Watchkeeper or the QM is to inform adjacent ships and call the LAFB in accordance with the ship's standard procedures. The HQ1 Watchkeeper then mans the incident board and internal communications.

d. **On-Watch Quartermaster (QM).** The QM's initial reactions are as laid down in Para 2022. In addition, the QM should ensure that a senior person from the non-duty personnel is mustering them. Presuming the non-duty personnel are adjacent to the brow or on the jetty, the QM should act as the communications link to and from the OOD. The QM should also ensure that the second brow is opened, utilising one of the non-duty personnel (or if none are onboard then one from an adjacent ship) if possible.

e. **On-Watch Boatswain's Mate (BM).** The BM should immediately take the Thermal Imaging Camera (TIC) (which is to be held adjacent to the brow) to the SOTI then provide the communications from HQ1 to the SOTI. He is then to return to the brow to await the arrival of the LAFB and lead the LAFB Senior Officer to HQ1. Once the route to the Forward Control Point (FCP) from the 'on' brow has been agreed the BM is to run the combined guide and telephone line. On completion he is to return to the brow but may be required to form the core of the BA Party under the leadership of the DPO if the fire has not been extinguished by the Attack Party. He will need to be trained in BA re-charging.

f. **Duty ME Senior Rate (DMESR).** The DMESR must be Switchboard Operating Certificate (SOC) qualified. He is to direct the off-watch MEM and is to undertake the function at Para 2019.

g. **On-Watch MEM.** Immediately the alarm is raised the on-watch MEM is to assume the role of I/C of the Attack Party.

h. **Off-Watch MEM.** The off-watch MEM is to muster in HQ1 for tasking by the DMESR, primarily to carry out ME isolations and vent duties.

i. **Duty WE Senior Rate (DWESR).** After his initial briefing to the OOD on the WE aspects, the DWESR is to act as the Containment Coordinator in accordance with Para 2013.

j. **Containment Party.** The Initial Containment Party will comprise the duty LOM plus the off-watch QM, BM and HQ1 Watchkeeper. Their duties are as laid down in Para 2014 excluding provision of the TIC to the SOTI. In addition the LOM is to act as the Keys Rating, noting that the priority compartments will always be those adjacent to the scene of the fire rather than the locked/closed compartment containing the fire which would require a full controlled re-entry in slower time. The LOM is to liaise with the Containment Coordinator ensuring that he has a full picture of the extent of the fire/smoke and requirements for additional personnel. The Containment Party may be supplemented later by the on-watch BM, by non-duty personnel, personnel from other ships or re-deployed Attack Party personnel.

k. **I/C Main Group.** When a Minimum HFEP is being used the I/C Main Group must ensure that he provides the OOD with the earliest possible assessment of the scale of the emergency supplementing the information later as necessary. The OOD must be informed early whether the door to the compartment is open/shut. He must ensure his plan for dealing with the emergency takes account of the availability of manpower. In particular, the availability of personnel to form a Support Party will influence whether the door to the compartment will need to be closed on withdrawal of the Attack BA or whether the I/C Main Group consider calling forward individual members of a forming Support Party to relieve the Attack BA.

l. **Attack Party.** The Attack Party will be formed by the on-watch MEM plus 3 other junior ratings. The Attack Party duties are as laid down in para 2010 except that when relieved/beaten back they are immediately to work as directed by the I/C Main Group to prepare the necessary equipment for a Support Party/LAFB attack on the fire or to be re-deployed for containment effort. Information obtained by use of the TIC must be passed to the I/C Main Group to assist in planning the next attack and for optimising containment effort in the interim.

m. **BA Controller.** Duties are in accordance with Para 2012.

2039. No dedicated First Aid Party is available in this organisation. Ships should ensure that one non-Main Group member of the HFEP is suitably trained or that adequate cover can be provided by an adjacent ship.

2040. Spare.

SECTION 3 - HARBOUR FIRE AND EMERGENCY PARTY IN MM/PP

2041. HFEP Manning

MM/PPs have significantly fewer personnel than DD/FFs, but they have sufficient people to form a competent and effective HFEP to successfully tackle a harbour emergency until assistance arrives. There are two levels of HFEP in operational MM/PP:

a. **Full HFEP** (Team of 8)

OOD:	I/C Gangway Position
DSR:	I/C at Scene of Incident/BA Controller
DLH:	Attack BA
DTECH:	Technical duties/provide OOD with technical advice
QM:	(Longest off watch) First Aid Attack
QM:	(Off watch) First Aid Attack
QM:	(On watch) Flag, inform other ships and Emergency Services and Incident Board Marker
S&S:	Attack BA, I/C keys and First Aider

b. **Reduced HFEP** (Team of 7)

OOD:	I/C Gangway position and Incident Board
DSR	I/C at Scene of Incident/BA Controller
DTECH:	Technical duties/provide OOD with technical advice
QM:	(Off watch) First Aid Attack
QM:	(Off watch) First Aid Attack
QM:	(On watch) Initial duties flag, inform other ships and Emergency Services then Attack BA
S&S:	Attack BA, I/C keys and First Aider

2042. Outside of Naval Bases, all MM/PPs are to maintain a minimum number of eight personnel in their HFEP. When berthed in Naval Bases, this may be relaxed to seven if a 1:4 roster cannot be maintained, keeping Squadron Commanders informed. This relaxation is not to apply to ships undergoing OST where the SPO organisation is implemented. The guidance in FLAGOs regarding the sharing of some elements of the Duty Watch between two similar ships berthed alongside on another, or in adjacent berths, may still be followed. Approval is not required, but Squadron Commanders should be kept informed of the intent to follow this routine.

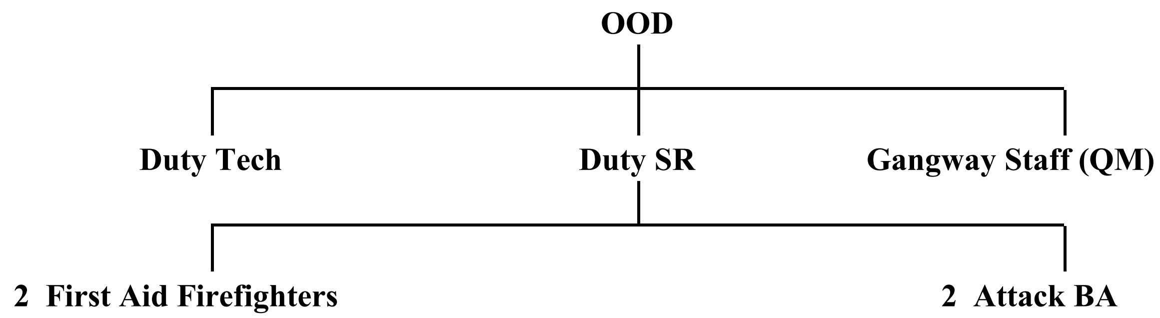


Fig 20-4. HFEP Structure in MM/PPs

2043. Gangway Staff

On receipt of the fire alarm, from whatever source, a pipe is to be made by the gangway staff (or SCC if manned) informing the Ships Company of the existence of a fire and its location. The pipe is to be repeated. The main broadcast General Alarm should be used prior to the making the initial 'Fire' broadcast. Thereafter the gangway staff are to carry out the following tasks:

a. Inform the LAFB and other shore authorities (iaw local instruction, ie 2222/999).

b. Inform adjacent ships (Telephone numbers to be recorded in Gangway Log).

c. Position a red flag in daytime, or red light a night at the foot of the 'on' brow.

d. Control entry to and exit from the ship.

e. Switch on the portable communications and ensure the correct pre-designated channel is selected.

f. Commence marking-up the emergency on the NBCD Incident Board.

g. Break out the Kill Card log; identify relevant card(s).

2044. Officer of the Day

On the alarm being raised, the OOD is to close up at the gangway and establish HQ1 at the QMs harbour position.

a. The OOD must not become too involved in the details of fighting the fire, but must have an accurate and clear picture of the incident, which will allow him to properly assess the situation and therefore deploy his limited resources accordingly.

b. As soon as it becomes apparent that a fire is more than a minor incident, the OOD should not hesitate to declare a full scale emergency and order an 'Emergency Clear Lower Deck'. This will ensure that all non-duty personnel and visitors are brought out of the ship and clear of danger. It will also provide a ready pool of manpower for additional firefighting and containment tasks.

2045. First Aid Firefighters

A minimum of two hands must be detailed as first aid attack firefighters. On hearing the emergency broadcast they should:

a. Pick up the nearest SPE(AFFF) and proceed directly to the SOTI, (additional extinguishers can be collected on the way to the SOTI, including either dry powder or CO_2 extinguishers if appropriate).

b. Before entering, re-acquaint themselves with the compartment orientation, location of specific hazards, and additional firefighting, lifesaving apparatus and alternative escape routes within the compartment by using the Kill Card diagram at the compartment access.

c. Relieve the person(s) who discover the fire and direct them to withdraw from the compartment to de-brief the Duty Senior Rating (DSR). The use of ELSA should be considered when personnel are showing the signs of smoke inhalation or respiratory distress.

d. Commence a continuous and aggressive attack on the fire using their SPE, whilst assessing the situation in preparation for briefing the DSR, eg size and type of fire, likely source/cause, etc. The priority is to maintain the initial aggressive attack on the fire, however, efforts must be made to brief the DSR so that the correct preparations can be made to support the initial efforts.

Notes:

1. The provision of additional SPE(AFFF) will ensure that a continuous and aggressive attack may be maintained on the fire and will additionally equip the attack BA firefighters when they arrive to fight the fire.

2. All initial firefighting efforts must be made using SPEs. The use of lay-flat hoses and firefighter nozzles could:

a. Result in personal injury from electric shocks (power isolations are unlikely to have been completed).

b. Divert efforts, while the hoses are run out and charged, from maintaining the initial, aggressive attack on the fire.

c. Foul SOTI access and hinder personnel evacuating or closing down the compartment should the fire escalate out of control.

d. Pump unwanted water into the ship causing a free surface problem in addition to the fire.

3. The transfer from shore supply to ships generators may require the use of 'dead-board' routines. This will cause the momentary loss of supplies to fire pumps and could jeopardise the safety of personnel if lay-flat hoses are used during the initial aggressive attack on the fire.

2046. Attack BA Firefighters

A minimum of two hands must be detailed as Attack BA firefighters. On hearing the alarm they act independently of one another and everyone else on board. They are to collect a SPE(AFFF) and proceed to the nearest BA locker, don the BA, firefighter's hood and anti-flash gloves, conduct a face seal check and (remaining on air), proceed to the SOTI and attack the fire, whether or not the DSR (Attack BA Controller) is present. The BA 'set number' tally should be left at the access to the SOTI to identify that the BA wearer is within. The men being relieved (First Aid Firefighters) who are not wearing BA must then withdraw; again the use of ELSA should be considered if personnel are showing the signs of smoke inhalation or respiratory distress.

Note. *There is no provision in the HFEP for a Support 'fearnought' Party to relieve the Attack BA firefighters. If the initiative to fight the fire is lost, either because the firefighters run out of SPE or the fire escalates out of control, the firefighters should evacuate and the compartment should be closed down and contained until a full re-entry, using a fully dress and briefed re-entry team can be made.*

2047. Duty Senior Rating (DSR)

a. On hearing the emergency broadcast, the DSR has two immediate responsibilities:

(1) Record the time of the initial 'FIRE' pipe, to enable completion of the Attack BA control board.

(2) Ensure the portable communications is switched on and the correct channel pre-designated is selected.

b. The DSR should then proceed to a safe position immediately adjacent to the SOTI and establish an FCP, picking up an additional SPE en route. The Attack BA firefighters act independently of all other personnel and proceed to attack the fire whether or not the BA Controller is present. The BA Controller may not see the attack BA men prior to them making their entry to the SOTI and assumes:

(1) Initial BA pressure, entered in column 'B' on the BA (EDBA) control board to be 160 bar.

(2) The 'Time started to breathe' as entered in column 'C' to be the time of the initial 'Fire' pipe.

(3) EDBA control tallies found adjacent to the SOTI access indicate that BA wearers have already entered the SOTI.

c. The responsibilities as detailed above can be competently and be safely undertaken by the DSR. However, this interpretation of guidance must only be used for the first 'on air', entry made by the nominated attack BA firefighters into the SOTI. He should have the partially marked-up 2-man Attack BA control board marked with nominated names, altogether with a chinagraph pencil with him at all times (see Chapter 27 for details of the 2-man Attack BA control board).

Notes:

1. Should either or both BA wearers withdraw from the SOTI and remove their mask or breach the face seal, they are forbidden to proceed back into the SOTI unless another BA Controller is nominated and normal BA control procedures applied.

2. The Duty Senior Rating (DSR) must not enter the Scene of the Incident (SOTI) or become too involved in actual firefighting. He must maintain a safe Forward Control Point (FCP) and control access of manpower and material resources into the SOTI, compile his BA control board and monitor the endurance of the Attack BA firefighters and make regular reports to the OOD.

2048. Duty Technical Rating

The Duty Technical Rating is to be fully conversant with the operation of ME, 'L' and basic WE equipment. On hearing the emergency broadcast he is to proceed to the SCC/MCR and carry out the following tasks:

a. Crash-stop ventilation by opening all ventilation breakers at the switchboard or SCC/MCR central crash-stop panel. After a pause for five seconds reclose the breakers to restore the electrical supply to local fan starters, (see Note).

Note. *Hunt Class MMs have in-line switches fitted to 5" general ventilation fans and require these switches to be locally opened before their respective breakers are reclosed otherwise these fans will restart automatically. Therefore, in Hunt Class, the general ventilation breakers must not be reclosed until all 5", fan starters have been visually sighted as 'open' at the local position.*

b. Start the stand-by generator, transfer the load from shore-side power and isolate the shore supply breaker. It may be necessary to conduct this operation via a 'dead-board' routine which results in the loss of all lighting and supplies to fire pumps. Therefore, the transfer to ship's power must be quickly undertaken and every effort must be taken to minimise the disruption to the firefighting effort.

c. Start additional fire pumps and positively confirm the pressure in the HPSW main.

d. Implement (referring to Kill Cards) primary and secondary power isolations as ordered by the OOD.

e. Additionally, he is to advise the OOD on:

(1) Fuel and HP air isolations required.

(2) Compartment fixed firefighting/drench systems to be operated or made ready.

(3) Any pumping/salvage arrangements to be considered.

2049. Duty First Aider (DFA)

Due to the size of ships companies, MM/PPs may find it difficult to include a dedicated first aider within the Harbour Duty Watch. However, it is possible for the responsibilities of a DFA to be undertaken as a secondary task by an appropriately qualified member of the HFEP. During emergencies, early consideration must be given to 'Emergency Clear Lower Deck' of all personnel not involved in the incident. This will provide a ready pool of spare hands to release the DFA from his primary function to concentrate on casualty handling, or, to identify qualified non-duty personnel to assist with first aid treatment. The role of the Duty First Aider (DFA) and the response expected from a ship's company when dealing with casualties is as follows:

a. **MM/PPs in Base Naval Port.** Medical support and cover is provided from the Duty Medical Officer of the Guard (Medical Guard). Nevertheless, a member of the HFEP is to be nominated DFA as a secondary task. Naval Base facilities, adjacent ships and non-duty personnel onboard the ship can be called upon to assist. The level of cover during working hours is to be increased by nominating the Duty Cook as the DFA.

b. **MM/PPs Away from Base Naval Port.** Consideration must be given to nominating a DFA from within the Duty Watch to provide 24 hour cover, restructuring as necessary to ensure the tasks expected of a DFA can be undertaken without detriment to the firefighting effort.

c. On assuming the duty (including if detailed as a secondary task), the nominated rating is to draw a specific First Aid bag from the Coxswain or previous DFA, receive a brief and perform checks on Entonox and other first aid equipment. The first aid bag is to be readily available at all times and must be carried when closing up on hearing an emergency pipe.

d. The DFA and/or personnel evacuating casualties are to ascertain:

(1) Nature of injuries.

(2) Possible inhalation of smoke, any loss of consciousness.

(3) Whether or not a key member of the firefighting organisation.

(4) Location/compartment rescued from.

(5) Whether other casualties were in the vicinity, to avoid unnecessary search and rescue effort.

e. All information is to be passed to the OOD on the gangway immediately. On completion, the DFA is to monitor the casualties and await the arrival of professional medical assistance.

f. The DFA must be given assistance to cope with injured personnel at isolated locations. The use of non-duty personnel should be considered.

g. On completion of the period of duty, the DFA is to return the First Aid bag and brief the Coxswain, or oncoming DFA as required.

2050. Personnel Safety and Control

In the event of the OOD ordering an 'Emergency Clear Lower Deck', it is important that every person onboard (including civilian personnel where appropriate) can be accounted for as quickly as possible. In the event of a fire onboard an MM/PP whilst in harbour, the safest location to muster personnel is on the jetty. The ship's gangway peg board, visitors book, ashore on duty log, 'T-card' rack, etc, should all be used to positively account for personnel. The first member of the Ships Company over the brow (once Emergency Clear Lower Deck is piped) should be detailed by the gangway staff to coordinate the muster of personnel and report back to the OOD, until relieved by the 'Jetty Marshall' (an officer or senior rating nominated by the OOD to coordinate resources, manpower and arriving emergency services, ie LAFB, Medical Guard, Police, personnel from adjacent ships, etc on the jetty).

2051. Responsibilities of Non-Duty Personnel

The HFEP in a MM/PP can only provide an initial aggressive attack on the fire. Should the incident escalate out of control and require full containment and a re-entry, the assistance of non-duty personnel onboard at the time, together with the emergency services and adjacent ships will be vital in successfully dealing with this major incident. If the OOD orders an 'Emergency Clear Lower Deck' in response to an escalating fire, non-duty personnel should evacuate the ship by the quickest possible route, whilst keeping clear of the SOTI and its associated smoke boundaries. Personnel must not return to their messdeck to collect belongings, although whenever possible they should try to dress in sufficient clothing to prevent exposure and enable their employment in support of the emergency. Doors and hatches should be closed behind them to reduce the spread of smoke.

2052. Equipment Requirements

The following initial preparations are required to ensure that the HFEP are adequately prepared and supported to effectively deal with a major fire in harbour:

a. AHQ incident board (including portable illumination), Kill Card Log, full range of chinagraph pencils and portable communications to be immediately available at the QM's harbour gangway position.

b. TIC to be readily available and accessible from the upper deck.

c. A yellow surcoat, BA control board, and chinagraph pencil to be available at the QMs harbour position.

2053. Once the OOD orders 'Emergency Clear Lower Deck' the following equipment should be taken by evacuating non-duty personnel to the jetty:

a. A minimum of four sets of fearnought suits, gloves, firefighters' hoods, boots and socks, (these are usually stowed rolled together, in bundles, in the FRP locker).

b. TIC to be collected and taken to the jetty.

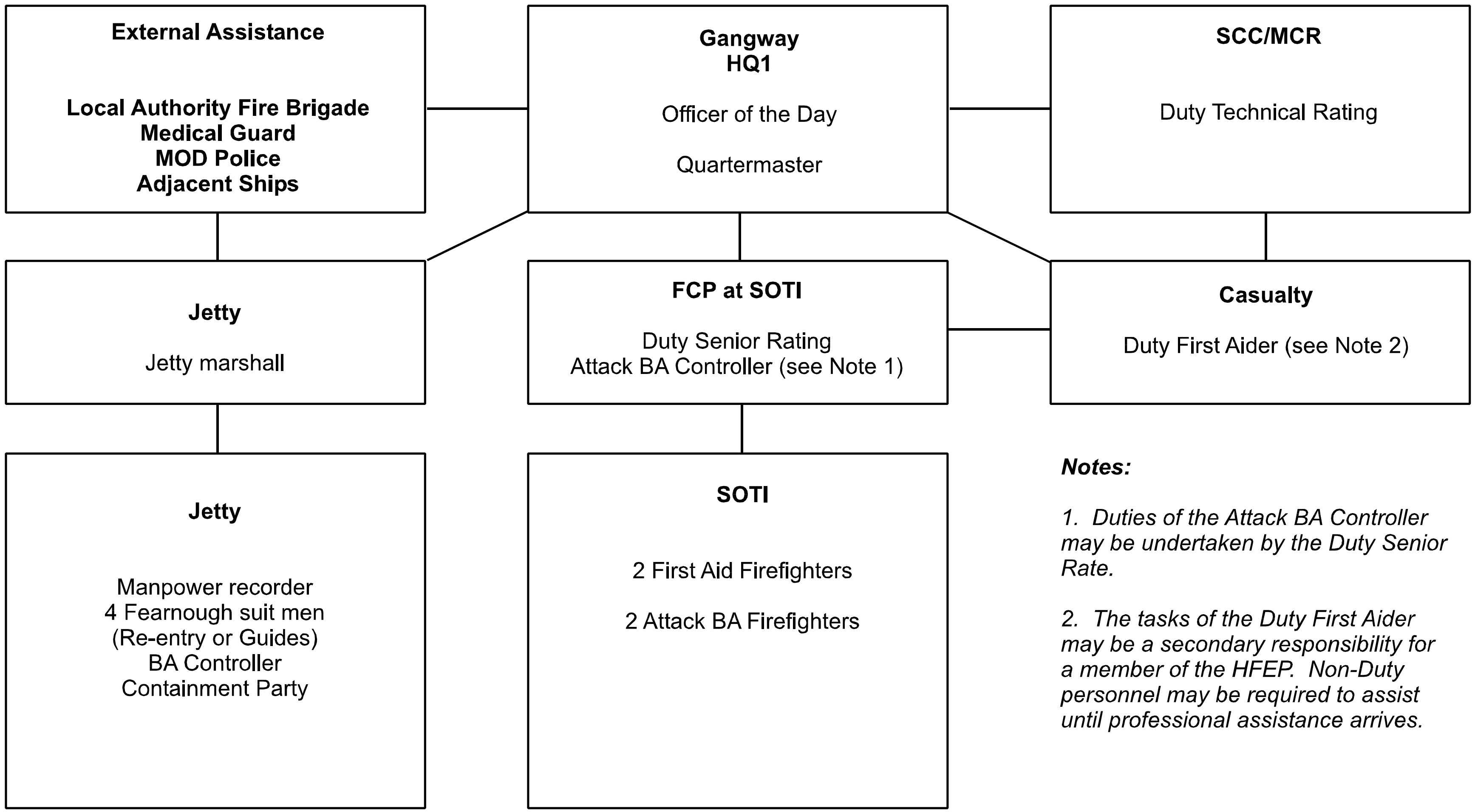
c. A minimum of four sets of BA.

This will enable spare hands to dress and equip a four-man fearnought suit team together with a BA Controller, who can either be briefed and detailed to conduct a re-entry, or act as guides for a LAFB firefighting team.

2054. Jetty Space

Whenever physical conditions permit, a clear space (7.5m radius) should always be kept clear near the foot of the brow; LAFB appliances require a space 10.5m x 5m for parking and operation although certain special appliances may require a larger area. The area is to be conspicuously marked 'Fire Brigade - Keep Clear', and gangway staffs should enforce no parking or waiting in that zone during an emergency. Care must be taken not to foul the immediate area at the bottom of the gangway. The 'Jetty Marshall' must ensure that spare hands and equipment dumps are to the side, and liaise with the arriving emergency services and adjacent ships teams to prioritise space and access. Fig 20-5 shows the structure and interaction between the groups during an emergency.

2055. Spare.



Notes:

1. Duties of the Attack BA Controller may be undertaken by the Duty Senior Rate.

2. The tasks of the Duty First Aider may be a secondary responsibility for a member of the HFEP. Non-Duty personnel may be required to assist until professional assistance arrives.

Fig 20-5. MM/PP HFEP - Structure and Interaction Between Groups

SECTION 4 - FIREFIGHTING IN CONJUNCTION WITH LOCAL AUTHORITY FIRE BRIGADES

2056. Liaison with Local Authority Fire Brigades (LAFB)

A good liaison with LAFBs is essential if efficient use is to be made of their service in the event of fire. This liaison is vital when a ship is in harbour for any length of time and/or the Ship's Company is depleted (eg by leave or training).

a. All RN and RFA vessels are to contact the LAFB on arrival at a port away from their home base, either in the UK or abroad, to arrange for a ship acquaint visit. The objective of this visit is for the LAFB Officers to familiarise themselves with the ship's layout, firefighting practices, firefighting organisation and installed firefighting equipment.

b. Exceptionally, for security reasons or assessed lack of capability in some foreign ports, the Commanding Officer may exercise his discretion in not making local contact.

c. Contact with the LAFB in Portsmouth, Plymouth and Clyde Naval Bases should be made, in the first instance, through the Ministry of Defence Area Fire Prevention Officer (AFPO). The AFPO should be kept up-to-date with any significant changes that might affect the ship's firefighting capability, eg docking, leave period, supply of additional pumps etc.

d. The AFPO or one of his officers will attend ship fires during normal working hours, but this attendance may be delayed during silent hours.

e. For ships in Upkeep Periods it is essential that the LAFB and AFPO are kept fully informed by the Commanding Officer or Senior Naval Officer of the circumstances applicable to a ship. (See Chapter 24).

2057. LAFB Priorities

The firefighting priorities of the LAFB are as follows:

a. To save life.

b. To save property.

c. To extinguish the fire.

2058. LAFB/DLC/OOD Liaison

Ship's General Orders are to contain instructions for calling the LAFB as an automatic response to the discovery of a suspected or known fire when a ship or submarine is berthed in a Naval Base, commercial port or shipyard. During exercises the LAFB emergency call is to be a touch drill only. At anchor or at a buoy, due regard must be given to the LAFB problem of getting out to the ship.

2059. Upon arrival of the LAFB the Senior Fire Officer attending the incident is to be met at the brow and escorted directly to the Ship's Officer responsible for the safety of the ship. At this stage in Portsmouth, Plymouth and Faslane the LAFB may establish their own Control Point (CP), Forward Control Point (FCP), and Breathing Apparatus (BA) and firefighting equipment dump in the most appropriate locations. Should the LAFB subsequently become involved in the incident, communications are to be established between the Officer responsible for ship safety and the LAFB CP. Whenever possible a Liaison Officer or Senior Rating should be stationed at the LAFB CP.

2060. The Ship's Officer responsible for the safety of the ship is to fully brief the Senior Fire Officer on the situation, and then, after consultation with him, decide whether to ask the LAFB to standby or carry out firefighting actions. The Ship's Officer responsible for the safety of the ship may request the LAFB to undertake some, or indeed all, aspects of the operation. The appropriate strategy will be dependent on the nature of the incident and the ship's manpower and equipment available. Any request for assistance should be clearly recorded. If LAFB assistance is accepted, control of the firefighting aspects of the incident is to be given to the Senior Fire Brigade Officer. A main broadcast pipe advising personnel that the LAFB are assuming control of firefighting is to be made.

2061. The level of involvement of the LAFB will be determined by the operational state of the vessel and the ship's complement. As a general rule, frigates and above that are operational may require less assistance than MM/PP or submarines. Due to the limited manpower resources, RFAs and ships in refit or repair will generally require major assistance from the LAFB. The initial level of attendance is predetermined by individual local authorities and is usually in the order of two appliances with others later.

2062. Ship Safety

Notwithstanding the involvement of the LAFB in some or all aspects of the operation, the officer responsible for ship safety retains full overall responsibility and safety of the ship, but not the control of the LAFB personnel if they are committed to the firefighting task. It is imperative that no matter what firefighting strategy is adopted, until such time that a fire is extinguished, a continuous attack on the fire is maintained.

2063. Jetty Space

Wherever physical conditions permit, a 7.5m radius space is to be kept clear at the foot of each brow. In addition the LAFB will require a space 10.5m by 5.0m for parking and operation, although certain special appliances may require a larger area. The area is to be conspicuously marked 'FIRE BRIGADE ACCESS - KEEP CLEAR'.

2064. Brows

When a ship has more than one brow, a clear indication is to be given as to which one should be used by the LAFB to come aboard. A red flag, or a red lamp by night, should be placed in a prominent position to mark the 'on' brow.

2065. Probable Questions

The following are among the questions likely to be asked by the LAFB Officer on arrival:

a. Is anyone missing and/or injured?

b. Where is the fire?

c. What is burning?

d. Have electrical supplies to the ship/fire zone been isolated?

e. How long has the fire(s) been burning?

f. How did the fire start?

g. What action is being taken by the Ship's Staff?

h. What is the state of the ship's HPSW system?

i. Are there any dangerous compartments adjacent?

j. What is the composition of the ship's Fire and Emergency Party?

k. How critical is the ship's stability?

l. How much water has been pumped in?

m. Are timber docking shores affected (in dry dock only)?

n. Has a smoke boundary been set up? If so, where?

2066. Missing Personnel

The LAFB may arrive before an accurate check of personnel has been made. During the initial consultations between the LAFB and the officer responsible for ship safety, a decision whether search and rescue operations by the LAFB are required in preference to firefighting assistance may have to be made.

2067. Electrical Supplies

The LAFB normally expect all electrical supplies to an installation on fire to be isolated. This is seldom practicable in a warship fire. However, when there is a risk of voltages in excess of 440 volts, the equipment should be isolated. It must be noted that attempts at maintaining a 'keep alive' policy may be counter-productive when compared with the savings in damage through quick extinction of the fire.

2068. Route to Fire

Once the appropriate safe route to the Forward Control Point (FCP) from the 'on' brow has been agreed between the officer responsible for ship safety and LAFB Officer, the Ship's Staff are to identify that route by running a combined guide and sound powered telephone line.

2069. Control of Personnel

a. Strict control over the combined numbers of personnel involved in the firefighting operation will need to be exercised, and the LAFB will normally require all RN/RFA personnel not directly involved to clear the ship. This will be achieved by sounding the main broadcast alarm and making a pipe to clear lower deck (see Chapter 7 Section 2).

b. Entry to and egress from the ship is to be controlled by the gangway staff at the brow(s).

c. LAFB personnel will at all times act under the direction of Fire Officers. RN/RFA personnel will act under the direction of the OOD or his representative.

2070. Employment of RN/RFA Personnel

Ship's firefighters, working in pairs and wearing BA, will normally be required to act as guides. Close collaboration between the rating in charge of the ship's Main Group and the LAFB Officer at the FCP is essential. The rating in charge of the ship's Main Group, once relieved by the LAFB at the FCP, is to remain there. His duties will be:

a. To liaise with the LAFB Officer in charge at that position.

b. To keep HQ1 informed of all actions being taken.

c. To maintain control of all the RN/RFA personnel actively engaged in firefighting.

2071. Evacuation of HQ1

Should HQ1 and AHQ need to be evacuated for any reason, it is recommended that the ship's control team moves to the brow. If this is not practicable, any other location in clear air with good ship's internal communications should be selected.

2072. Communications

The ship is to provide a communication link from HQ1 or AHQ to the FCP, and from the brow to the FCP, manned by Ship's Staff at both ends. LAFB officers will normally use their own communications system, but these may prove inadequate in a warship environment and, in some cases, the associated RADHAZ prohibits their use. Regulations in place preclude the use of any portable communications equipment in RFAs unless the equipment is designated intrinsically safe.

2073. Disposition of RN/LAFB Personnel

LAFB firefighters normally 'mask up' within the ship at their FCP. The rating i/c of the Main Group will operate from the agreed FCP.

HQ1 (Gangway in RFA)	FCP	CONTROL POINT (Jetty/Brow)
OOD	Junior Fire Officer	2FO
Senior Fire Officer	I/C Main Group	2nd OOD
Specialist Personnel	LAFB BA	Quartermaster
	Ship's BA Controller	Bosun's Mate

2074. Ship's Staff BA Controllers should continue to control ship's personnel using BA at the same time maintaining the closest possible liaison with the LAFB Controllers. Should firefighting measures be assigned to the LAFB, overall coordination of all BA wearers is to be exercised by the LAFB officer in charge of the firefighting operations. The endorsement of the combined RN/LAFB FCP adjacent to the scene of the incident depends on the Fire Officer classifying the area 'clean air'. The rating i/c of the Main Group and the RN BA Controller will be required to relocate to the LAFB FCP if control of firefighting operations passes to the LAFB.

2075. Spare.

SECTION 5 - FIREFIGHTING AT SEA

2076. Standing Sea Emergency Party (SSEP)

In all ships at sea there must be a party of specifically detailed firefighters under the charge of a suitable senior rating, which is available at all times and ready for an immediate response to a fire. In NBCD State 1 this requirement is met by the Fire and Repair Parties. For States 2 and 3 a Standing Sea Emergency Party (SSEP) is to be formed. The SSEP should be made up from daywork personnel for the State 3 situation and 'on call' personnel for State 2. The SSEP members are to be briefed on their duties prior to the ship sailing.

2077. If the SSEP is unable to cope with a fire, either due to lack of personnel or shortage of material resources, it is important that the ship be piped to Emergency Stations in good time. This will get the right people to the right places quickly and bring the ship's Fire and Repair Parties to State 1. It will also clear the area of unnecessary personnel, allow off-watch watchkeepers to be accounted for and provide back-up where necessary. The actual stage at which the ship should be piped to Emergency Stations will vary depending upon the size of the SSEP and the rate of escalation of the incident.

2078. In order to facilitate the identification of SSEP personnel, coloured surcoats should be worn as detailed at Para 2028.

2079. SSEP Organisation in DD/FF and Larger Ships

In DD/FF and larger ships, the SSEP comprises all the firefighting groups and parties detailed in the previous paragraphs (main, containment and specialist), since manpower is readily available.

a. **SSEP Team.** All the ratings should be daywork/on-call personnel and the aim should be to achieve continuity and a well trained, worked-up team. The most suitable Attack Party senior rating is probably the CMEM(M), the junior ratings should be drawn from all departments and one should be from the Ventilation Party. They should not be detailed as Special Sea Dutymen.

b. **Procedure.** In DD/FF and larger ships, where the SSEP comprises all the firefighting groups and parties of the full harbour organisation, the procedure to be followed is much the same as when the ship is in harbour:

(1) When the alarm is raised the Attack Party should proceed directly to the SOTI. They are to collect portable first-aid firefighting appliances and TIC *en route*, and join up with such firefighters as there may be. Having established the seat and nature of the fire, they are to fight it with the appropriate appliances. Two ratings (previously detailed) should arrive at the SOTI wearing BA, and carrying portable firefighting appliances. The sixth member, the BA Controller, proceeds directly to the FCP, ready to prepare the ratings wearing BA for entry as quickly as possible. The BA Attack Party, using portable appliances or hoses as appropriate, is to commence firefighting immediately. All members of the Attack Party are to be fully experienced in dressing and wearing BA as well as being capable of using a BA control board.

(2) In those ships with numbers other than six junior ratings in the Attack Party, the firefighting procedure should be adjusted to suit the numbers involved.

(3) As soon as the initial alarm is raised, HQ1 should be manned by the Action NBCD Officer, the DCO, an incident board operator, a communications number and the DWEO to advise on WE aspects; switchboards should be manned by qualified switchboard operators to crash-stop ventilation and to safeguard electrical supplies; SCC/MCR/ER watchkeepers should put all available HPSW pumps on to the HPSW system. The first task of the communications number is to rig a sound powered telephone between HQ1 and the FCP.

(4) The Executive Officer should briefly visit the FCP and HQ1 in the early stages, in order to gain and up-to-the-minute appreciation of the situation so that he will be able to give advice to the Command on whether there is a need for the ship to go to Emergency Stations.

c. **First-Aid Firefighting During Silent Hours.** It is recommended that the following on-watch ratings be detailed to undertake first-aid firefighting until relieved by the SSEP: a MEM, an OM(C), a Bosun's Mate and an Operations Department rating either from the Operations Room or Watch on Deck.

2080. Containment Party

To contain primary boundaries quickly, it is important that a Containment Party is provided immediately following the emergency pipe. These personnel are an integral part of the SSEP and are identified by the wearing of blue surcoats. It is advantageous to have a WE senior rating as I/C Containment Party, so that he can advise Deck Managers on electrical equipment and magazine hazards at the boundaries. Should the ship subsequently go to Emergency Stations, then personnel nominated from spare hands would augment the Party. In capital ships, there is normally sufficient manpower available to deal with all primary boundaries, adding extra personnel from Section Bases when at Emergency Stations. The minimum containment organisation for a typical DD/FF at sea is normally as follows:

a. DWEO/WSO - Technical advice to the DCO.

b. CCPO/CPO/PO - I/C Containment Party.

c. CPO/PO/LH - 2I/C Containment.

d. Four CPO/PO - Deck Managers (from any department).

e. All Officers of Quarters (OOQ).

2081. The I/C Containment Party has a roving role, visiting HQ1, WSB, the Containment HQ and containment operations as necessary. He is responsible to, and briefs, the DWEO/WSO in HQ1. He ensures consistency between the respective incident boards.

2082. The 2I/C Containment is normally stationed at the nominated Containment HQ and is responsible to the I/C Containment Party. He details and controls the Deck Managers and Boundary Coolers, and coordinates TMS data from the Deck Managers (see Annex 21B).

2083. Deck Managers are each allocated a deck as their area of responsibility. They are particularly valuable for MMS fires, which require boundary monitoring/cooling on several decks and in a large number of compartments. They are responsible to the 2I/C Containment for ensuring that Boundary Monitors/Coolers are in the correct location with the correct equipment to monitor/cool the designated areas of the boundary. The use of diagrams and Kill Cards, particularly in high risk areas, will help to ensure that boundary cooling is effective. They are to report to the 2I/C Containment when the Monitors/Coolers are in position and undertaking their tasks. Deck Managers are then to constantly monitor their areas, briefing the 2I/C on progress, including TMS data.

2084. OOQs are to report to the 2I/C Containment with their magazine keys. Should a fire be adjacent to a magazine or ready-use locker, the relevant OOQ should then report to the FCP to take charge of the Boundary Monitors/Coolers in the vicinity of his quarter.

2085. Boundary Monitors Coolers are to carry out their duties as detailed by their Deck Manager. They are to cool designated areas, if they are hot to the touch, and carry out temperature monitoring in accordance with the procedures in Annex 21B.

2086. SSEP Organisation in MM/PPs

In all MM/PPs at sea an SSEP is to be nominated and available at all times for immediate response to fire and other emergencies.

a. **SSEP Team.** The SSEP team in MM/PPs is generally very small, and in the case of fire can only form an Attack Party. Should the firefighting initiative be lost or the indications from the SOTI are that the SSEP will be unable to extinguish the fire, the ANBCDO should immediately bring the ship up to Emergency Stations. The SSEP should be made up of non-watchkeepers on the following lines:

(1) *Control Party in HQ1.* XO (ANBCDO), MEO (Technical advisor) and an NBC Incident Board Operator.

(2) *Attack Party.* I/C at the Forward Control Point (FCP) with 5 hands. Provisionally allocated duties of two for First Aid Firefighters, two for Attack BA firefighters and one as Standing Sea First Aider.

b. **Procedure.** On either a smoke or fire alarm being raised, the following procedure is to be followed:

(1) *Command and Control.* As soon as the initial alarm is raised:

(a) The Control Party should man HQ1.

(b) ANBCDO establishes portable communications with I/C SSEP.

(c) ANBCDO breaks out the Kill Card log to identify the compartment and any associated internal or external hazards.

(d) Incident Board Operator identifies compartment on the Incident Board together with suitable positions for establishing smoke boundaries, ready to brief ANBCDO.

Note. *Once the ANBCDO is satisfied that HQ1 is established, he should make the broadcast 'HQ1 IS MANNED, MAKE ALL REPORTS TO HQ1'. This has two functions:*

a. It tests and confirms that the operation of the main broadcast system from the HQ1 position, ie the ability to make pipes.

b. Informs the OOW that the ANBCDO has closed up in HQ1 and is ready to assume responsibility for controlling the emergency. This allows the OOW to concentrate on bridge and navigation aspects and ship safety. Until the ANBCDO makes this pipe all reports should be made to the bridge.

c. **Attack Party.** When the alarm is raised, the I/C SSEP, First Aid Firefighters and Standing Sea first Aider should proceed directly to the SOTI, collecting SPEs on route. The I/C SSEP should establish a safe FCP immediately adjacent to the SOTI and communications to the ANBCDO via his portable communications. The I/C should complete his partially marked 2-man BA control board using the time of the emergency pipe as the 'time started to breathe'. Nominated Attack BA firefighters are to collect a portable SPE(AFFF) and proceed to the nearest BA locker, don the BA, conduct a face seal check and (remaining on air) proceed directly to the SOTI and attack the fire, whether or not the I/C is present. The BA control tally should be left at the access to the SOTI to indicate the BA wearer within. The men being relieved (First Aid Attack Firefighters) who are not wearing BA must then withdraw. The use of ELSA should be considered if personnel are showing signs of smoke inhalation or respiratory distress.

d. **Containment Party.** Despite the lack of manpower in MM/PP, once Emergency Stations has been ordered, the principles of containment for larger ships should be followed.

e. **Remainder of the Ships Company.** Initially the remainder of the Ship's Company should stay clear of main passageways to enable clear access for the SSEP, although if in the immediate vicinity to the SOTI they should supply additional SPEs to prolong the initial aggressive attack on the fire. However, should the ANBCDO pipe the ship to 'Emergency Stations' they must close up at their pre-determined station, ie FRPP, FAP, Bridge, etc or muster with the spare hands.

CHAPTER 21

FIREFIGHTING PROCEDURES

CONTENTS

CONTENTS (Continued)

ANNEXES

CHAPTER 21

FIREFIGHTING PROCEDURES

2101. Preparations

Serious damage through fire can generally be attributed to late discovery, faulty technique (including misuse of appliances), or the rapid growth of fire following explosion:

a. Early discovery of a fire can be helped by conscientious regard of all automatic warnings and by the use of diligent patrols/rounds personnel who frequently visit all compartments, including storerooms.

b. Faulty technique can be eliminated by good training, which starts at the firefighting schools and must continue in the ship. Every opportunity must be taken to carry out realistic and imaginative exercises and all personnel should know where to find and how to use all firefighting appliances/equipment and breathing apparatus with confidence.

c. The possibility of rapid growth of fire (from any cause) calls for a carefully prepared organisation, the strategic stowage of appliances and the ability to concentrate appliances and firefighters rapidly in adequate but not excessive numbers. Complex situations may arise when more than one compartment and/or a variety of materials are involved or threatened. Explosives, combustibles, gas cylinders, etc, are possible complications. Structural damage, which might include jammed doors and hatches, will make the firefighting task more difficult. These situations can be met with confidence if the officers and key ratings likely to be called upon to direct operations have used imagination in assessing the risks before the fire occurs and if they have a thorough knowledge of their ship and the firefighting procedures.

2102. Management of Firefighting Equipment and Personnel

The limited amount of firefighting equipment and personnel in a ship necessitate careful management of resources. In particular:

a. When firefighting, positive efforts are required to salvage firefighting appliances from teams being relieved. Personnel must be trained to ensure that all equipment is kept under control and not needlessly lost.

b. With the possibility of firefighters in EDBA working for nearly an hour, the signs and symptoms of heat stress and physical exhaustion must be understood. An organised system of feeding/watering firefighting teams is essential. Supplies of drinking water must be easily available to all manpower containing the incident and those working in spaces where temperature has risen due to the fire.

c. Accurate identification of compartments can save wasted effort. A combination of location markings and compartment name should be used.

d. Running portable diesel or gas turbine pumps for long periods requires good fuel supply management.

2103. Sources of Compartment Information
Detailed information about compartments can be made available to firefighting teams from the following sources:

a. S.3021 - Firefighting Kill Cards (see Annex 21G).

b. In Type 23 frigates, the Damage Control Data Retrieval System (DCDRS).

c. Personally, from departmental specialists.

2104. Smoke Alarm - Reaction
Guidance on the reaction of personnel, in the event of a smoke alarm sounding, is given at Annex 21F.

2105. First Report and Action
The person discovering a fire is not necessarily on duty or a member of the ship's firefighting team. He is known as a first aid firefighter and his immediate action must be to shout a loud vocal alarm 'FIRE, FIRE, FIRE' and, together with those personnel in the vicinity who respond to his alarm, use the equipment at hand to extinguish or contain the fire. If the attempt is unsuccessful, the first aid firefighter with the vital information about location, seat of fire, type of fire, etc, must report to the person who arrives to take charge of the incident and remain with him until ordered otherwise. After debriefing, he is to be escorted to HQ1 for further debriefing and, if necessary, to the Sickbay for medical examination.

2106. Correct and prompt action by the person discovering a fire can make the difference between the fire causing minor damage and becoming a major conflagration. The action depends on whether the fire is in an open or closed compartment.

a. **If Smoke is Seen to be Issuing from Beneath a Closed Door.** Suspect fire but do not open the door because, if the door is opened, the fire might flare up fiercely and spread rapidly. Raise the alarm by shouting 'FIRE, FIRE, FIRE' and inform the Command by the quickest method, ie 999 call on the ship's automatic exchange, or NBCD telephone to HQ1/SCC/Quartermaster, or bridge, depending on the state of readiness. Pass a clear accurate message stating the location of the fire, return to the scene of the incident (SOTI) and rig hoses for containment/re-entry.

b. **If the Door is Open or the Fire is not Behind a Door.** If a fire is discovered in an open compartment, raise a loud vocal alarm by shouting 'FIRE, FIRE, FIRE' and try to extinguish it with the equipment to hand. The command must be informed by the quickest method (if a second person is present he must attend to this). If the finder is doubtful of his ability to extinguish the fire, he should shut all openings to the compartment, rig hoses for containment/re-entry, ensure the Command is informed and report to the person who arrives to take charge of the incident. If the retreating personnel have time, it may be possible to remove the blanking cap from a through-bulkhead HPSW connector. This would aid subsequent survey of the closed compartment.

2107. Continuous and Aggressive Attack

Fires will usually spread quickly if the firefighting effort is interrupted, so it is essential that a continuous and aggressive attack is maintained from the moment of discovery. If First Aid Firefighters are unable to extinguish a fire, they should attempt to maintain a continuous attack until the Attack Party take over. If the compartment becomes untenable, the First Aid Firefighters may have to retreat to the door or hatch to fight the fire, but they should attempt to limit smoke and flame to the compartment without shutting the door or hatch (the use of a waterwall nozzle or a fixed hatch waterwall should be considered). This will obviate the need for a compartment full re-entry. The same applies to the Support Party relieving the Attack Party. The standard time within which the Attack BA should arrive at the Scene Of The Incident (SOTI), is 2 minutes. The Support Party should report to the I/C FCP within 8 minutes of the alarm being raised. These times are for during normal working hours and it is accepted that during silent hours it may take longer for personnel to arrive.

2108. The continuous and aggressive attack must not be allowed to endanger the ship or personnel. If firefighters are inadequately protected or equipped, they may be beaten back. (eg while waiting for a waterwall nozzle). If this happens, the compartment door or hatch should be closed and preparations made for a full re-entry. The decision to shut the door or hatch must be taken by the person at the scene of the incident.

2109. Important Questions at a Fire

a. The initial concerns of the person taking charge at the Forward Control Point (FCP) must be to find out:

(1) Where is the fire? The scene of the incident (SOTI).

(2) What is burning?

(3) When did it start?

(4) How did it start?

(5) Is there anybody fighting the fire? Has a continuous and aggressive attack been maintained?

(6) Are there any casualties present?

(7) Have the boundaries of the fire been established and is monitoring/cooling under way.

(8) What are the immediate dangers? (eg fuel tanks/magazines, structural damage).

(9) Has communication been established to HQ1/SCC?

Note. *These initial questions must be asked, within the first two minutes. The discoverer of the fire, if there is one, may well be able to answer most of these.*

b. From these broad considerations, more detailed questions arise:

(1) Have all the Attack Party arrived and are they using the right equipment?

(2) Has effective control over smoke been achieved, with smoke boundaries identified? (see Annex K)

(3) Has ventilation been crash stopped?

(4) Has the FCP been established in the right area, affording the best entry into the scene of the incident?

(5) Has the Command Aim been given? (In NBCD States 1 and 2).

(6) Are any more appliances required from other parts of the ship? Will more personnel be required?

(7) Is smoke present in such a manner as to give false impression of the seat of the fire?

(8) Are Support Party personnel available and getting dressed?

(9) Have all relevant isolations been made?

(10) Are HQ1/SCC aware of the water levels?

c. When the fire appears to be out, the following questions remain:

(1) Is it really out? Have charred solids been broken up and wetted? Is any insulation still smouldering?

(2) Is there any danger of spontaneous re-ignition? Can the danger be prevented? Has a sentry been posted?

(3) What damage is there to electrical apparatus? Has HQ1/SCC been consulted about the precautions that might be necessary?

(4) Are all personnel accounted for?

(5) How are smoke and water clearance going to be achieved?

2110. Control of Firefighting Operations

A serious fire cannot be effectively controlled unless there is well coordinated control of the firefighters (see Chapter 20). The direction of all firefighters in a single fire zone must be unified and remain so. Take-over of control by a senior person, if necessary, must be carried out with the greatest of care and only after he has assessed the situation. Inopportune taking over, contradictory orders from different sources and overcrowding of a FCP constitute serious hindrances to firefighting. While the first actions at a fire are with the person who discovers it, hands should not join in the fighting of an established fire except as directed by the person in charge at the FCP. Spare hands should be mustered, (Emergency Stations at sea or Emergency Clear Lower Deck in harbour) clear of the fire zone, where they will be immediately available when needed. Sentries, if possible, should be posted to keep the fire zone clear.

2111. Except in very small ships (and then only in emergency), the person in charge of the FCP should not actively operate a firefighting appliance. It is his duty to ensure the fire is being aggressively attacked and that the fire is not spreading beyond the established boundaries, to appreciate any possible complications and take anticipatory action, and to keep in touch with HQ1/SCC and in particular, be responsible for the safety of personnel. The person in charge should position the FCP as close as possible to the SOTI outside the danger area and smoke boundary. Whenever possible, he should try to utilise fixed communication systems to HQ1/SCC.

2112. Choice of Firefighting Method

Having discovered the fire situation, the person in charge at the FCP must choose the most suitable technique and call for appliances, some of which may have to come from other parts of the ship. Speed is essential in the first attack, but should the first measure fail to contain the fire, a careful assessment of the situation is as important as speed. The right action in good time is better than the wrong action too quickly. Since fire depends upon a reaction between two substances and is sustained by self-generated heat, there are three ways of extinguishing a fire:

a. Take away the heat faster than it is generated.

b. Separate the substances.

c. Interfere with the chemical reaction that takes place between the fuel and the oxygen.

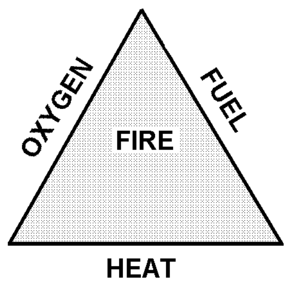


Fig 21-1. The Fire Triangle

Note. *The fire triangle is explained in simple terms in BR 4007 - Guide to Ship Firefighting.*

2113. Principle of Extinction

Assuming that a fuel is burning in oxygen drawn from the air, two methods of separating the substances may be possible. Either air or fuel may be prevented from reaching the fire. Consequently, the firefighter has three aims:

a. To starve the fire by removing solid combustibles or by cutting off the supply of fuel either in its liquid or gaseous state.

b. To cool the fire and its surroundings to a temperature at which it dies through lack of heat.

c. To smother the fuel by preventing air from reaching it, or by diluting the air with some form of inert gas.

These aims are the principles of firefighting and self-descriptive names can be given to them: STARVING, COOLING and SMOTHERING.

2114. Application of the Principles

Firefighters should keep all three principles in mind when attacking a fire. They should use the structure of the ship itself and the various installations, to assist the fire appliances they are using. The closing of watertight doors and hatches or the shutting down of appropriate valves on fuel supply lines and ventilation systems may prove as important as the use of any fire appliance. In fighting major fires, a change in the course of the ship may be warranted to prevent fires from being fanned and to assist in smoke clearance.

2115. More than one principle is brought into effect from most firefighting appliances even though a single principle dominates the extinguishing process. If this is understood, firefighters may safely classify their appliances according to their major function.

2116. Starving

There are certain obvious ways of starving a fire. Take combustibles away from a fire and the fire will not burn so long. With uncontrolled fires, removing combustible solids from the immediate vicinity will limit the spread of the fire. If a fire is fed by liquid fuel flowing from a burst pipe, isolation by the appropriate control valve is an essential precaution. If a fire can be completely isolated it will eventually die from lack of fuel. Allowing a fire to burn-out in this way is justifiable in some cases when the burning substance contains or produces oxygen, however this means of extinguishing a fire is hazardous and slow.

2117. Cooling

Heat is a form of energy, and cannot be destroyed. Cooling is the alteration of this energy from a destructive force into innocuous energy. Water is an excellent cooling agent. Projected on to a fire it takes a certain amount of heat to bring it to boiling point and about six times as much to turn it to steam. The firefighter must initially seek to remove the heat energy by cooling the flame and not the fuel. In an open area, steam carries the heat away. In a partially closed compartment, both the heat and the steam may fail to escape entirely, but the heat will be distributed and the temperature of the fuel will be reduced. The steam will also produce a smothering effect.

2118. The absence of flame does not necessarily mean that the fire has been extinguished. Transfer of heat within the fuel may lead to the renewal of flame. (This may occur hours or even days afterward.) Therefore, when the flames disappear, solids must be separated and broken up so that the insides, as well as the outside, are cooled. A metal compartment in which a fire has been burning may have parts hot enough to re-ignite the contents. Hence, the whole fire zone must be cooled to a temperature well below that at which flames disappear. The decrease in temperature of hot substances, and the prevention of cool substances from getting hotter, are closely related in the processes of fire extinction. Both ideas are inherent in the principle of cooling.

2119. Water is available in a plentiful supply from the sea, so there is a temptation to be extravagant with its use and this can be almost as dangerous as the fire itself. Water should therefore always be used as a spray except when it is necessary to break up and drench masses after the flames are extinguished. The following facts about water must always be remembered:

a. It is heavy. One litre of water weights one kilogram. Water partially filling any compartment, has a free surface which will hamper the stability of the ship. The higher in the ship or the further from the centre line, the greater the problem.

b. Most liquid fuels are lighter than water so they will float and may continue to burn while doing so. This may become a serious hazard in bilges, tanks etc. If water is introduced to a burning liquid that is at such a temperature, the water will boil and turn to steam. The expansion will cast the burning liquid out violently.

c. Sea water is liable to cause permanent damage to electrical equipment and temporary damage to most machinery. It may cause lethal shock when used as a jet on live electrical equipment. The use of fresh water does little permanent damage to machinery and the dangers of shock are not so high as with sea water.

d. Application of water will prevent the transfer of heat from bulkheads, etc or from one explosive charge to another, and thus prevent ignition. It will not necessarily stop an explosive charge from burning once it has become ignited. Oxygen continues to be evolved by the explosive even when it is drowned in water.

e. Water, a very stable compound, is composed of oxygen and the flammable gas hydrogen, it can react chemically with some substances:

(1) Even when cold, it reacts violently with some substances to produce flamable gas. Potassium, sodium and calcium, which are found in some medical stores, react producing hydrogen.

(2) When very hot, certain light metals used in the construction of aircraft react with water. These metals are able to burn in air. If water is applied at a slow rate, the generation of hydrogen may cause an intensification of the fire but, providing that the metals are not present in great quantities and the rate of water applied is high, the cooling effect outweighs any danger from hydrogen generation.

(3) Iron will not burn in air, but at 700°C it can burn in the presence of steam with the generation of hydrogen.

(4) When limited quantities of either water or steam come into contact with hot carbon, a result is ‘water gas’, a flammable mixture of both hydrogen and carbon monoxide.

2120. With these facts in mind, the most efficient use of water must be made to extinguish fires. For most situations a spray will be used. Water broken up into the fine particles that form a spray has a larger surface area than the same volume of water projected in the form of a continuous jet. In contact with a large hot surface, the transfer of heat to the water particles is very rapid. Hence, the cooling effect is very rapid and spray is particularly suitable for cooling large surfaces. The jet is most effective in dealing with structural fires and other fires involving metals.

2121. Smothering

Smothering is the process of preventing oxygen from reaching a fire. Applying a wetted, or even dry cloth over a chip pan on fire, can smother it. Shutting all doors and hatches to a compartment and crash-stopping ventilation is another way to smother a fire. But, because many combustibles contain oxygen, the process can be slow. As mentioned earlier, the discoverer of a fire must raise the alarm to summon help. If the fire is obviously beyond the capabilities of the discoverer to extinguish or even control, he must contain it by shutting all openings to the compartment, to prevent air (oxygen) from getting to the fire.

2122. AFFF is the most effective and readily available smothering agent, especially against burning hydrocarbon liquid fuels that are not miscible. It rapidly produces an air (oxygen) excluding film of water over the surface of the burning liquid and even when that film is disturbed, it will quickly reform. AFFF is also effective against paper, wood rags, etc, because it improves the penetration of water to extinguish deep-seated fires.

2123. Dry powder is a quick and effective smothering agent but the extinction is often only temporary. Its most effective use is against low flash point liquid fuel fires. Its swift 'knock down' effect on the flames is very effective in preventing further fire spread, allowing firefighters access to burning aircraft etc. However, dry powder does not form a permanent seal or remove heat, so AFFF must be used immediately as back up.

2124. Carbon dioxide (CO_2) is an inert gas and will neither burn nor support combustion. It is heavier than air and displaces oxygen by forming a temporary blanket. It is mainly used for electrical fires but some ships have CO_2 drench (smothering) systems fitted to machinery spaces. It must be remembered that CO_2 will not support life in concentrations over 17% in the atmosphere.

2125. HALON 1301 (BTM) has some minimal smothering qualities but its main extinguishing method is by chemically interfering with the reaction that takes place between the fuel and the oxygen. It is normally used in machinery spaces.

2126. Steam is an inert vapour but it is lighter than air and must be blown into the compartment. Steam drench systems are fitted in LPDs and nuclear submarines. It is very effective in a compartment properly closed down but has no cooling effect.

2127. Precautions and Limitations of Smothering

Ships' staffs are to ensure that relevant closing down and evacuation procedures appertaining to them are clearly laid down in Ship's NBCD Orders and understood. The following points must be considered:

a. Trying to smother a fire where all the oxygen required to complete the combustion process is mixed with the fuel, as with explosives, would be ineffective. Such an attempt would interfere with the venting of the products of combustion and increase the rate of flame generation and pressure. Consequently, explosives burning comparatively slowly might explode.

b. Smothering methods are slow and unpredictable if some of the oxygen required for combustion is held within the body of the combustibles (eg textiles, wood and other organic substances).

c. Hydrocarbon liquid fuels do not liberate oxygen so require an independent source of oxygen if they are to burn.

2128. Flashover

A Flashover occurs in fires when there is no shortage of oxygen. In any compartment fire there may be a stage where the radiated heat from fire and hot gases at deckhead level are sufficient to ignite much of the remaining combustible material in the compartment. This transition from a localised fire to total compartment fire can be very rapid.

2129. Backdraught

A backdraught can only occur in fires where there has been a period of oxygen starvation. (ie a compartment closed down). The heat in a compartment will still decompose the materials within, producing flammable gases but due to the lack of oxygen they will not ignite. The introduction of new fresh air results in these gases igniting, possibly explosively. This backdraught can take place immediately or when a new source of ignition is introduced, such as firefighters exposing smouldering material. Gases produced in a fire may well escape the compartment via cable runs, vent trunking, etc and build up in another compartment away from the initial fire source. These gases in turn could ignite with the introduction of a separate ignition source such as sparking from electrical equipment.

2130. Firefighting - Ventilation Control - Standard Procedure

The aim of this procedure is to reduce the flow of air to a compartment and limit the spread of smoke, in the shortest possible time, after the discovery of a fire. It is easily understood and can be applied in all NBCD states, and conditions, at sea and in harbour, namely by:

a. Crash stopping all ventilation fans as soon as the alarm is raised. This action contributes significantly towards the aim and also produces a known state of ventilation, which is essential for subsequent control procedures. (The various minor disadvantages, which will result from a complete crash stop of ventilation in some ships, must be identified and overcome by good training, and discipline, in the standard procedure.)

b. Closing smoke curtains in the ship section containing the fire and in adjacent sections.

c. Restoring power to all ventilation systems so that they may be restarted (under the control of HQ1/SCC or OOD) in order to:

(1) Supply ventilation to essential systems.

(2) Supply ventilation to areas of the ship not affected by the fire.

(3) Contain the smoke within the desired boundary.

(4) Reduce the supply of air to the fire.

(5) Remove smoke from areas adjacent to the fire.

(6) Remove all smoke and fumes after extinction.

2131. The NBCD Orders concerning firefighting in DD/FF and MM/PP are to reflect the following paragraphs concerning ventilation control. Larger ships are to adapt these instructions to suit their particular ventilation design features, possibly on an NBCD Section basis. In all ships the Officer in Charge of firefighting operations must have the authority to modify the instructions if exceptional circumstances warrant it. A generic example of a Smoke Clearance Plan is at Fig 21G-3.

2132. Stage 1 - Crash-stop Ventilation

Immediately the fire alarm is raised the following actions are to be taken:

a. Open all main machinery and general ventilation breakers at the switchboard or SCC/MCR central crash-stop panel. After a pause for five seconds, re-close the breakers to restore the electrical supply to local fan starters. However, those ships with in-line switches fitted to some general ventilation fans (ie 6 inch fans in MMs) must ensure that these switches are opened before their respective breakers are re-closed, otherwise these fans will restart automatically.

b. Trip the local starters of general ventilation fans, which are not controlled, from the ventilation breaker (see Note 1 below).

c. Re-set ventilation moulded case circuit breakers (MCCBs) tripped when breakers were opened (ships fitted with Electrical Distribution Centres (EDCs) only).

Notes:

1. The following fans should not be stopped because they will not spread smoke to other areas, and their continuous operation is required. If affected by fire, the electrical supplies to the system or unit should be isolated in conjunction with other equipment in the compartment.

a. ACUs fitted in individual compartments to re-circulate cooled air in that compartment only.

b. Full re-circulation ATU systems serving only unmanned spaces for equipment cooling purposes.

c. Closed-circuit equipment cooling systems which are independent on the ship's ventilation system.

2. The effectiveness of this procedure depends on regular and thorough briefing of the personnel nominated for the various tasks, and their practice in the drill.

2133. Stage 2 - Restart Selected Ventilation Systems

Electrical supplies must be made available to all ventilation systems as soon as possible after crash stopping so that systems essential to the ship's function and which do not interfere with the firefighting operations, or the establishment of a smoke boundary etc, can be restarted. The following guidelines are to be used by personnel tasked with using the ventilation systems to control contain or remove smoke during and after a fire:

a. The spread of smoke is a major factor in preventing a clear appreciation of the source and extent of a fire and in preventing the adoption of effective firefighting measures. Regular practice, using smoke generators and Ramfans and detailed ship knowledge are essential, always bearing in mind that cold smoke does not always behave in exactly the same manner as hot smoke.

b. It is vital that, in the earliest stages of a fire, efforts are made to isolate the smoke into the smallest area that is consistent with the need to gain access to the fire (see Annex K).

c. Early consideration must also be given to the removal of smoke in order to assist with containment. In almost all cases this can be done effectively by selective use of the ventilation systems, (the Ramfan can assist in this removal but consideration must be given to the effects on the HPSW main) but this requires great care since forced smoke removal may encourage the fire. When planning smoke clearance routes, the effect of smoke in previously uncontaminated spaces must be taken into account.

d. In general, ventilation systems should not be used to remove smoke from a compartment in which a fire is burning, and care is necessary in removing smoke from a compartment adjacent to the fire and through which the firefighting team will have to pass in order to reach the fire. Withdrawing smoke by means of an exhaust fan which is sited at some distance from the scene of the fire may fill previously clear compartments with toxic smoke and become a hazard to unprotected members of the firefighting and containment teams.

e. The most effective fans for the clearance of smoke are those in the main machinery spaces and the galley, and dedicated smoke clearance fans.

f. Care must be taken that smoke is not picked up by the suctions of the HP air compressors, or systems supplying habitable compartments.

g. When using main exhaust fans a route to atmosphere must be opened up to allow make-up air into the ship.

h. Should the ship suffer major structural damage above the waterline, the use of the newly created opening should be considered for blowing smoke through to the atmosphere.

i. Smoke may be removed by blowing or sucking. Except in the simplest cases, eg where the fire area is adjacent to an upper deck opening or, in action, a hole in the ship's structure, sucking is to be preferred because it gives much better control of the smoke. It is not possible to predict where smoke will go when it is blown.

j. Consideration should be given to altering the ship's course relative to the wind in order to blow exhausted smoke away from ventilation inlets or areas in use on the upper deck.

k. In Condition Alfa, a balance must be struck between the need to clear smoke and the risk of contaminating the citadel. In this event the use of the AFU air supply to blow the smoke out through a machinery space can be effective.

2134. Stage 3 - Prepare to Shut Down Machinery Space

(If the fire is in a machinery space.) Immediately following the crash stop, all supply and exhaust ventilation flaps are to be closed to seal a main machinery space on fire, in case the first aid firefighting measures fail and the fixed firefighting installation has to be used at short notice.

Notes:

1. When using steam drench or CO_2 fixed firefighting systems, one pre-designated exhaust ventilation flap is to be left closed but unclipped to prevent over pressurisation when the system is used. When the system has been discharged, and the pressure relieved, this flap is to be clipped shut. This ruling does not apply to compartments fitted with BCF or BTM gaseous fixed firefighting systems where all ventilation flaps should be shut and clipped before use.

2. Detailed procedures for Main Machinery Space fires are at Annex 21C.

2135. Stage 4 - Restore Essential Ventilation

As soon as possible after the crash stop, the Officer in Charge of the firefighting operation must assess the fire situation, and with the aid of reports from the scene of the incident, and the ventilation information held in HQ1/SCC, ensure that smoke boundaries to the affected areas have been established. He should then issue the necessary instructions to restore essential ventilation, in accordance with the Command Aim (having ensured that smoke will not be drawn back into the ship from the weather deck terminals of any exhaust fans used by the ship's firefighters). A record of the smoke boundary established, and subsequent restoration of essential ventilation, should be kept in HQ1/SCC. Thorough training and exercises are necessary to ensure that the time taken to restore ventilation is minimised, and that it is restored without further spread of smoke.

2136. Rigging of Hoses and Nozzles for Fire Incidents

Each fire incident must be individually assessed, but generic guidance for the rigging of hoses and nozzles is as follows:

a. During the initial attack phase for a carbonaceous fire, if the initial attack with extinguishers proves ineffective, the early deployment of a firefighter nozzle, used in ragged spray, may well extinguish the fire. All internal hose baskets are fitted with firefighter nozzles. They can be safely operated by one person and can also be used for boundary cooling and in personal protection mode should it be necessary to withdraw from the compartment.

b. If heat or smoke forces the initial attack personnel to withdraw to the compartment door/hatch, consideration should be given to rigging a waterwall nozzle or fixed hatch waterwall. This will allow the door/hatch to remain open for the Attack BA wearers or first two dressed Support Party members to continue the attack on the fire. Note however, that extinguishers do not have the force to effectively penetrate a waterwall. The Waterwall Operator must also be backed up when operating the nozzle through its full range.

WARNING

FIREFIGHTERS MUST BE AWARE OF THE HAZARD OF ELECTRIC SHOCK IF WATER IS SPRAYED ON LIVE EQUIPMENT DURING THE INITIAL ATTACK PHASE

c. When rigging for a 3-hose re-entry, the Ship Protector hose should be rigged first, underneath the firefighter and waterwall hoses. This will help to minimise the problems of hoses snagging against each other during the re-entry.

2137. Firefighting Techniques

Re-entry firefighting techniques are detailed in Annex 21A. They are also illustrated in BR 4007. The techniques are based on easily accessible doors and hatches, but in battle conditions the firefighting teams, in particular the Team Leader, may have to modify them. Very few hatches in a ship have enough space around them for the full team to get into ideal positions before re-entry.

2138. Flame, smoke, heat, darkness and structural damage may hinder access to the seat of a fire. With the aid of breathing apparatus and good ship-knowledge, smoke need not be an insurmountable barrier. Some protection from flame-lick can be gained by the use of a waterwall.

When fighting a fire without the aid of a BA, the firefighter should crouch on one knee, because at this level there is usually a layer of clear and cooler air. Once firefighters start to tackle the fire using first aid appliances, the steam produced may force the smoke layer down, rendering the compartment untenable.

2139. Before opening the door or hatch to a compartment containing a fire, the following preparations must be made:

a. Rig hoses of sufficient length to reach the furthest part of the compartment. Water supply to each hose should be from separate hydrants. A ‘Y’ piece should not be used to supply a team’s waterwall and firefighter hoses.

b. All hoses should be fitted with the correct nozzle (and fully charged where possible) prior to the Support Party ‘going on air’.

c. When using a FB5X foam making branchpipe, consideration should be given to use of an inline inductor adjacent to the hydrant. This can be outside the smoke boundary, allowing easier tending of the foam drums.

d. If the entry door opens away from the firefighters, a lanyard should be attached to the handle so that the door can be pulled shut if necessary.

e. If the re-entry is from below, a waterwall mounting pole will be required.

2140. If damage to the structure prevents a direct approach to the seat of a fire, it may be necessary to use portable cutting equipment, but only on the orders of HQ1. A hole just large enough to take a firefighter nozzle may be all that is necessary. Before cutting a hole, the following points should be considered:

a. If possible, the pressure in the compartment should be tested, using an indicator test plug.

b. Signs of blistering or charring may be useful in choosing the best location for a hole.

c. The effect on watertight or gastight integrity may not be acceptable.

d. The admission of air though the hole may increase the fire.

e. Damage to essential services on the other side of the bulkhead may be minimised if the hole is cut in a known clear area.

2141. 4-Man Firefighting Team

For a relatively simple re-entry into a compartment containing a fire, a 4-man team, such as the HFEP Support Party, can be used:

a. **Team Leader.** Leads the team, and carries a Thermal Imaging Camera (TIC) and opens hatches.

b. **Waterwall Operator.** Operates the waterwall nozzle.

c. **Firefighter.** Operates the firefighter nozzle or FB5X foam making branchpipe and opens doors.

d. **Hydrant Operator.** Operates the hydrants and tends the hoses (including the fixed hatch waterwall, if used).

2142. 5-Man Firefighting Team

For a more complicated re-entry, a 5-man team can be used:

a. **Team Leader.** Leads the team, carries the TIC and opens hatches.

b. **Waterwall Operator.** Operates the waterwall nozzle.

c. **Firefighter.** Operates the firefighter nozzle or FB5X foam making branchpipe and opens doors.

d. **Ship Protector.** Operates the containment waterwall nozzle.

e. **Hydrant Operator.** Operates the hydrants and tends the hoses.

Note. *Any number of additional Hose Tenders may be necessary.*

2143. Actions to be taken when a BA Whistle Sounds

The overriding principle upon a whistle sounding is a safe withdrawal of the team, consolidating their attack on the fire wherever possible. This should be accomplished by withdrawing the team to the door or hatch, shutting the door or hatch, leaving whichever member of the team has the highest pressure as a sentry with a controllable source of water and to withdraw the remainder of the team back to the FCP. Alternatively to maintain a continuous and aggressive attack, if only one team member's whistle is sounding (not the Team Leader's) the Team Leader may use his discretion to decide if the position of the person whose whistle is sounding can safely be taken by another member of the team. Depending upon the circumstances this may be conducted within the compartment or by withdrawing the team back to the door/hatch. If this action is taken the person who's whistle is sounding should be sent back to the FCP, with an escort if possible depending on the distance. The Team Leader will need to take into account the condition of the rest of his team, their time on air and the remaining EDBA pressures.

2144. Cyalumes for Firefighting Team Identification

In circumstances of low visibility, eg a smoke-logged compartment, the delay caused by firefighters trying to identify who they are to relieve may result in the initial re-entry team being relieved after their whistles have sounded. To alleviate this problem, personnel involved in firefighting management are to employ the following guidelines for identification of key firefighting re-entry team members:

a. A coloured cyalume, dependent on the re-entry team member's function is to be connected to the rear of the team member's BA belly band by a cable tie. Activation and fitting of the cyalumes should be completed just prior to the re-entry brief.

b. The following colour coding is to be used:

(1) Team Leader - Green.

(2) Firefighter - Red.

(3) Waterwall Operator - Blue.

(4) Hydrant Operator - Green (may wear 2 if considered necessary).

c. Cyalumes are only to be used by a re-entry team following the complete closure and containment of a compartment and their provision must not interfere with the efficiency of a continuous and aggressive attack on the fire.

d. A minimum of 6 green, 3 red, and 3 blue (see BR 2170(3) for stock numbers) are to be stored in each fire locker and upper deck re-entry locker.

2145. Boundary Monitoring and Cooling

Guidance on monitoring and cooling the boundaries of ship fires is at Annex 21B. Intact bulkheads and decks lined with fire barrier insulation (eg A60 bulkheads, described in Chapter 29) will effectively contain a fire for a limited period without cooling. In such situations, priority should be given to temperature monitoring, rather than cooling.

2146. Ship Stability and Firefighting

Ship stability is dealt with in Chapter 30. The officer/rating in charge of firefighting operations may not be in a position to judge the effect of firefighting water on ship stability, so guidance must be given by HQ1/SCC. It is advisable to remove water as quickly as it is introduced to a fire, by pumping out or draining down/out. In newer ships, drain plugs are fitted in some decks for this purpose. A ship could be in more danger from 'free surface' water than it is from the fire.

2147. Aluminium Structure and Fire

Unless aluminium structure is suitably protected by insulation (lagging) or by the cooling effect of water when involved in fire it will, in simple language, melt. Aluminium is non-combustible and will neither contribute fuel to, nor assist in, the spread of fire. However, at temperatures above about 250°C the load carrying capacity of aluminium is seriously reduced. It melts at about 650°C. Therefore, in that respect, if an aluminium structure is involved in a ship fire, it can materially assist in the spread of fire by no longer acting as a fire boundary. Fallen cables and other services that had been secured to the deckhead/bulkhead by aluminium hangers, which are destroyed in fire, may seriously hamper firefighting measures.

2148. Glass Reinforced Plastic (GRP) and Fire

Use of Glass Reinforced Plastic (GRP) for construction of ships poses two particular problems in respect of fire:

a. Dense smoke is evolved from burning of the surface resin.

b. There may be a marked reduction in strength of GRP with increase of temperature.

2149. The GRP beneath the layer of surface resin is very resistant to penetration by fire and the structure is an effective insulator. A fire in one compartment will not create a localised 'hot-spot' in an adjacent space. However, heat will be transferred laterally across the GRP laminate and can cause remote hot-spots in through-bulkhead pipework, cabling, securing bolts, etc. When the surface resin is heated it produces a strong pungent smell before ignition, thus providing an effective early warning of potential fire. Boundary coolers must be extremely vigilant and ensure that likely heat-soaks are regularly monitored and prompt action taken, should secondary fires occur. Notwithstanding the excellent insulation properties associated with GRP, the basic principles of boundary cooling still apply, ie a minimum of a CFHR or a charged hose with a firefighter nozzle (nozzle turned off until required).

2150. Fires Involving Hazardous Stores

Details of the chemical constituents of codified hazardous stores are available on the Hazardous Stores Information System (HSIS), which is held on CD by Naval Stores. As the hazard from such stores may be increased in a fire, it is important that this information is readily available. Chapter 25 contains specific information on materials used in aircraft, their associated hazards and the resultant firefighting procedures.

2151. Fuel and Lubricating Oil Tanks

Fuels and lubricating oils can present a considerable hazard in the vicinity of a fire. However, cold liquid fuel in a full tank is safer than fuel vapour in a partially filled tank. The following questions should be considered by the MEOOW/MEOOD when advising the MEO/OOD and by the Action NBCDO in State 1:

a. Is there associated action damage or is it solely a fire incident?

b. If there is action/heat damage, is a ready-use tank or associated pipe work ruptured, and therefore supplying fuel to the fire in that space?

c. Are emergency dump or rundown facilities fitted to the tank? (Compartment Kill Cards should state this information.) If this is so:

(1) Would dumping reduce the amount of fuel and so assist the extinction of the fire?

(2) Would pressing the fuel tank full cause further supplies of fuel to reach the fire via damaged fuel transfer pipes?

d. Where does the dumped fuel go to? If to an adjacent overflow tank or bilge, have they sufficient receiving capacity and would this promote further hazards?

e. Would vital power supplies still be available if the tank contents were dumped?

f. Is it possible to fill the tank 100 per cent full, ie does it have a float operated inlet valve and does it have an overflow? If it has an overflow, where does it overflow to?

2152. Bulk storage tanks pose additional questions:

a. Is the tank seawater compensated and therefore already full?

b. If the tank is structurally sound and the systems are intact, is fuel likely to escape from dip tubes or air escapes when it is pressed full? If so, take precautions to ensure that the fuel is not allowed to overflow via these openings.

2153. Machinery Space Fires

Guidance on fighting machinery space fires is given at Annex 21C.

2154. Galley Fires

Fire in a galley is usually the result of spillage and/or the overheating of trays and utensils in ovens or on hot plates, particularly when the equipment is left unattended. Deep fat fryers present a serious hazard because of the quantity of fat or oil they contain. In common with all other galley equipment, deep fryers should never be left unattended when they are switched on.

2155. If a galley fire breaks out, the immediate local action must be:

a. Switch off power to the equipment locally, stop the galley vent and raise the alarm.

b. Shut the fire baffle locally (see Chapter 18).

c. If the fire is in the deep fryer, shut the lid.

d. Attack the fire with a 9-litre SPE(AFFF).

2156. If the fire is not extinguished by the above immediate local action:

a. Switch off power at master switches sited outside the galley door.

b. If local closing of the fire baffle is not possible shut it by remote operation at the galley door, stop the galley vent and raise the alarm.

c. Shut the weather deck terminal to the galley exhaust trunking. Cooling the trunking with water spray may help to prevent the spread of fire.

2157. A fire that is beyond fighting with first aid measures should be attacked with a FB5X foam making branchpipe, used under close supervision because of the dangers inherent in a fat fire. Fire parties must be exercised regularly in the correct drill to deal with a galley fire. Water must never be used except for boundary cooling, and CO_2 is not recommended because it has insufficient cooling effect and re-ignition is most likely once the CO_2 has dispersed.

2158. Gas Cylinders

All cylinders containing compressed or liquefied gases are potentially dangerous in the presence of fire. As the cylinders get hot, the gas pressure increases and if it rises excessively the cylinders may explode. There is a double risk with highly combustible gases such as hydrogen and acetylene; the cylinders may explode and the gas, when released, may cause further explosions. This latter risk is greater between decks. If a flame is seen coming from the gas tubes of cutting/welding apparatus, the first need is to shut off the gas at the cylinder valve; the flame will then go out. If the flame is put out first, an explosive mixture might build up before the gas supply is shut off. Relevant personnel must ensure they have immediate access to all data and safety sheets of combustible gas cylinders. Gas cylinders should if possible, be removed from the fire zone. If this is not possible they must be kept cool with a continual spray, ie acetylene, if involved in a fire must be cooled for a minimum of one hour before it can safely be moved, and then placed in a bath of water for a further twelve hours.

2159. Danger from Oxygen Enrichment

Normal air contains 21 percent of oxygen. In air which contains more than that (oxygen-enriched), flammability, ie ease of ignition, combustion rates and combustion temperatures all increase. Materials such as clothing, which do not burn readily in air, burn much more actively in an atmosphere which is enriched with oxygen. An oxygen content increase of only four per cent gives rise to a particularly dangerous situation. A further hazard is that, under pressure, and in the presence of heat (such as can be generated by opening the valve of an oxygen cylinder too rapidly), oxygen will react to oil and grease with a violent explosive force. The utmost care must be exercised whenever oxygen is being used onboard ship, particularly if within a confined space. Oxygen cylinders must be turned off and the reducing valve removed whenever they are unattended.

2160. Electrical Equipment

Electrical fires are so called because, usually, some fault in a live electrical circuit has generated enough heat to ignite insulation, paint, or some other combustible substance close to it. Giving the name electrical to this type of fire serves to inform the firefighters of the precautions they must take and enables the correct firefighting technique to be employed. A fire which may start with solids or liquid fuels and subsequently involves live electrical equipment or circuits becomes, in effect, an electrical fire. It is important, therefore to switch off all electrical circuits in the vicinity of a fire, provided that it can be done without detriment to essential services, eg firefighting pumps. When power is off, what was an electrical fire is a straightforward fire of the combustibles present and should be attacked with the appropriate equipment. In the event of minor fire symptoms, eg a small smoke emission from within an electronic cabinet or switchboard, these may all disappear once all power supplies are removed. Some discretion is therefore necessary in the initial firefighting action.

2161. The actions, which should be taken, are:

a. **Fire in Low or Medium Voltage Equipment.** Isolate the power supply and attack the fire with CO_2. The use of CO_2 should not be delayed if power cannot be removed. However, re-ignition is likely until isolation is achieved. If this action does not extinguish the fire it should be treated as an ordinary fire and attacked with water. If the power cannot be switched off, it is possible, at voltages up to 440 V ac or 800 V dc to use water or AFFF in the form of a spray, provided that the nozzle is not nearer than 1.8m to any live equipment, irrespective of the type of water (fresh or sea) being used. The output from a 9-litre SPE(AFFF) is regarded as a spray.

b. **Fire in High Voltage (HV) Equipment.** Due to the energy inherent within a HV system (above 1000 V ac or 1500 V dc), high voltage electrical fires will not be extinguished until electrical power has been disconnected. Therefore, manual injection of CO_2 should only be undertaken once power has been disconnected; however, fixed CO_2 systems may be operated prior to disconnection. Although electrical disconnection is likely to occur either through the correct operation of the safety protection devices or due to high energy discharge through the fault region resulting in an open circuit, firefighting action must only be taken once disconnection has been confirmed. Water, even in the form of spray or AFFF foam, must not be used for firefighting on live HV equipment.

c. **Fire Within a Live HV Compartment.** Where all HV equipment within the compartment has ingress protection (IP) of IP56 or greater and the integrity of the HV equipment is not endangered by the fire, then manual firefighting is permitted using AFFF, dry powder and CO_2 extinguishers or CFHRs. Where any HV equipment within the compartment has an ingress protection of less than IP56, then manual firefighting is limited to CO_2 and dry powder extinguishers. For other than strictly controlled training serials, lay-flat hoses are not to be deployed and used within any HV compartment where the ingress protection of the HV equipment is less than IP57 (submersible) until such time that it has been confirmed that power to all HV equipment has been disconnected. Once disconnection has been confirmed, normal RN firefighting procedures are to be followed. Fixed water and AFFF spray systems may only be operated on live HV equipment in an extreme case and where the ingress protection of all the HV equipment is IP56 and all personnel have been evacuated from the compartment. Detailed Guidance is given in BR 2000(52)(1) - Operating Guidance for High Voltage Systems in HM Ships, Submarines and the Royal Fleet Auxiliary.

d. **Fire in Electronic Cabinets.** Isolate power if the local switch is accessible, and attack with CO_2 through the injection nozzle when fitted, or by opening doors/covers when not. Switch off and remove fuses from all power sources (including alternatives) to the equipment. If these actions do not extinguish the fire it should be treated as an ordinary fire and attacked with water, observing the precautions regarding voltages given above. When the fire has been apparently extinguished, all drawers or sections of complex equipment should be opened to confirm that the fire is extinguished.

e. **Stingray Torpedo Battery Fire.** This battery contains (amongst other substances) magnesium, and the fire is to be fought using copious amounts of water (see Annex 21D for fires in air weapons magazines). It is most important that the firefighters must wear BA and, should their clothing become contaminated with thallium effluent, it must be thoroughly washed after removal (see BR 8680(A)(2)(5(1))).

2162. Explosives and Pyrotechnics

Firefighting in magazines and the behaviour of explosives and pyrotechnics is discussed at Annex 21D. The effects of fire on aircraft armaments and pyrotechnics is covered in Chapter 25.

2163. Fires in Aircraft Hangars

Detailed information on aircraft firefighting is contained in Chapter 25. Large aircraft hangars, such as those in a CVS, are divided into sections that can be isolated from each other by closing fireproof curtains. The whole hangar is regarded as an NBCD section. The Hangar Control Position (HCP), from which the Hangar Control Officer (HCO) supervises safety arrangements and the movement of aircraft in the hangar, is equipped as an NBCD Section Base and has communications with fuelling positions and HQ1. The fire curtains can be operated from the HCP, inside the hangar on either side of each curtain and in the access lobbies. Each hangar section has one access lobby to port and starboard. If fire breaks out in the hangar, ventilation should be crash stopped, but it is recommended that the trunking is not closed because, if spraying is started, the sudden drop in pressure may damage the fire curtains. On the first instance the fire must be attacked with 9-litre foam (AFFF) extinguishers, CO_2 (if appropriate) and, possibly, main foam appliances. As soon as it becomes obvious that the first aid firefighting measures are having no effect, the Command should consider the use of fix installations (hangar sprays) and Command approval must be authorised prior to their use. Preparation to activate the fixed installation must be made from onset of the fire and very early action must be taken to drain back any aviation fuel from charged systems.

2164. The danger from composite fibre materials in a fire (see Chapter 25) will be compounded in an enclosed area such as a hangar, so early use of breathing apparatus will be essential. After a fire in a hanger, involving composite fibres, great caution must be exercised to contain contamination and to establish a safe working environment. Access is to be strictly controlled; protective clothing and BA will be necessary until it can be ascertained that no fibre dust is present. This may require the removal and cleaning of all equipment in the hangar.

2165. Floating Oil or Fuel

This hazard is sometimes met in harbours and basins. If ignited it could cause a ship fire. Alternatively, with a ship on fire, floating oil or gasoline in the basin, or discharged from the ship, might result in a ship-to-ship fire. Floating burning fuel should be attacked with AFFF, although high flash point fuel can usually be broken up with water jet and then isolated portions cooled and quenched with water spray. A patch of burning fuel can be prevented from spreading by using the wash from ships' boats.

2166. Firefighting in a Chemical Environment

The Citadel entry procedures after firefighting in a chemical environment are detailed in BR 2170(2). The protective clothing for these operations is detailed in Chapter 26 of this Volume. The BA procedures, including changes between EDBA and NBC respirator, are detailed at Annex 21H.

2167. Before committing firefighters to an incident where contamination is suspected, the following points should be considered to reduce the risk of contamination to personnel and equipment:

a. If fixed firefighting systems have been used and all indications are that the fire is extinguished, consider delaying re-entry to allow purging of the compartment to help disperse the contaminant. Once re-entry by minimum number of personnel has confirmed that the fire is extinguished, withdraw firefighters and carry out monitoring and then decontamination if required.

b. Consider all entry/exit routes to/from compartment, including escape routes. Machinery spaces may, for example, be entered via a pressurised airlock and exited via escape route to the upper deck. Contaminated personnel can then re-enter the citadel via normal cleansing stations. Equipment should be weathered for 24 hours before monitoring and cleansing routines to bring it back into service.

c. If liquid contamination is suspected, firefighters are to dress in full IPE. This gives minimal heat protection and they must therefore stay behind a waterwall until fire is confirmed extinguished.

d. Always have a relief team standing by, but consider minimising the number of personnel exposed by using only one team for the firefighting effort. The team maybe briefed to consolidate and withdraw to the airlock/entry for a rest and cylinder change at a pre-determined BA pressure.

2168. Search and Rescue

Search and Rescue operations in a fire environment are detailed at Annex 21E.

2169. Post Fire Precautions - Fire Sentry

In any firefighting situation, a sentry will need to be posted at the scene of the fire after it has been extinguished to report and attack any re-ignition. Initially, the Sentry may be provided by one of the withdrawing Support Party, if his BA has sufficient air remaining. The requirement for follow-on Fire Sentries are:

a. To be detailed from the pool of spare personnel, not from the Firefighting Team, who will need rest.

b. To be dressed in full firefighting rig and in communication, via FFHBC, with the FCP, the FRPP or HQ1. A BA controller will be required.

c. To be provided with a charged hose fitted with a firefighter nozzle, or centre feed hose reel of sufficient length to reach all areas of the compartment under surveillance.

d. To patrol a number of compartments, if they are on the same deck and it is practicable to do so. If there is requirement to patrol on different decks, then further sentries must be posed.

e. To remain closed up until relieved. A sentry will be required until the person in charge of firefighting is satisfied that there is no possibility of re-ignition.

2170. Welding and Burning Sentries

Instructions to Welding and Burning Sentries are contained in BR 2000(20) - Ship Engineering Practices: Safety Considerations and Precautions.

ANNEX A TO CHAPTER 21

RE-ENTRY TECHNIQUES

1. Hose Charging

Prior to the following re-entry techniques, which are illustrated in BR 4007, the hoses have to be charged, unless otherwise stated. The Team Leader must ensure that the Hydrant Operator has identified which hydrant supplies the Waterwall Operator and which supplies the Firefighter. He can then take up his position with the rest of the team. Both the firefighter and waterwall nozzles are to be shut initially. The Team Leader then gives the order 'HYDRANT OPERATOR, ON FIREFIGHTER AT THE HYDRANT'. The Hydrant Operator repeats the order, then carries it out. He then informs the Team Leader 'firefighter on at the hydrant'. The Team Leader then gives the order 'HYDRANT OPERATOR, ON WATERWALL AT THE HYDRANT'. The Hydrant Operator repeats the order, then carries it out. He then informs the Team Leader 'WATERWALL ON AT THE HYDRANT'.

2. Re-entry on the Same Level - Carbonaceous Fire

The Waterwall Operator crouches on one knee and positions himself, either in front or to the side of the door, depending on which way the door opens:

a. If the door opens towards the Team (hinges can be seen), then the Waterwall Operator positions himself on the opposite side of the door to the hinges, just to the side of the door so that he will not impede the opening of the door.

b. If the door opens away (hinges cannot be seen), he then positions himself on the side of the door opposite the hinges, with the nozzle in position against the door frame.

3. The Firefighter remains standing on the hinge side, at arm's length from the door.

4. The Team Leader positions himself behind the Waterwall Operator, and backs him up. The Team Leader then gives the order 'FIREFIGHTER, ON PERSONAL PROTECTION'. The Firefighter operates the nozzle one eighth of a turn to the right to produce a 2 metre flat disc of water for personal protection. The Team Leader first ensures that he is backing up the Waterwall Operator, then gives the order 'ON WATERWALL'. The Waterwall Operator rotates the nozzle swiftly through its full range to the left, to produce a 10 metre flat disc of water. If the door opens away from the Team, the Waterwall Operator now places the nozzle inside the door frame.

5. When both the firefighter and waterwall nozzles have been operated, the Team Leader orders the Firefighter to 'OPEN THE DOOR'.

a. If the door opens towards the Team, the Firefighter opens the last clip on the door (usually in the centre, opposite the hinges), and opens the door to 45 degrees. At the same time, the Waterwall Operator moves across to place his nozzle in the opening, against the door frame.

b. If the door opens away from the Team, then a chain or rope must be secured to the door and held by the Team Leader, to enable him to close the door if necessary. The Firefighter opens the last clip, turns his back and pushes the door open with his boot. The waterwall, already in position, has sealed the door.

6. Once the door is fully open, the Firefighter crouches on one knee, adjusts the nozzle a further one eighth of a turn to the right, to a ragged spray, and fights the fire if it can be seen. If the Firefighter cannot see the seat of the fire, he is to direct the ragged spray towards the deckhead to cool the combustible gasses.

7. The Team Leader uses the thermal imaging camera (TIC) to scan around the compartment, looking for the seat of the fire, and indicates its position to the Firefighter. When the Team Leader is ready, he orders the Team to 'STAND UP' and 'ADVANCE' into the compartment, cooling and breaking up the fires. The Hydrant Operator now acts as a Hose Handler, helping the Team to move forward.

8. Re-entry on the Same Level - Oil Fire

The Team position themselves by the door, as previously described for a carbonaceous fire. The Team Leader positions himself behind the Waterwall Operator, backing him up.

9. After ensuring that the Firefighter is aiming the FB5X away from the fire into safe corner, the Team Leader orders 'PROVE FOAM'. The Firefighter moves the switch on the FB5X to the *open* position and proves foam, using the finger-tip method. (Putting the tip of his firefighting glove into the flow of the foam, then wiping it on the extreme edge of his BA visor. Foam will stick to his visor; water will run off). Once the Firefighter has proved foam, he moves the switch on the FB5X to the *shut* position.

10. The Team Leader, backing up the Waterwall Operator, orders 'ON WATERWALL'. The Waterwall Operator rotates the nozzle swiftly through its full range to the left, to produce a 10 metre flat disc of water.

11. The Team Leader orders the Firefighter to 'Open the door' (as previously described). Once the door is fully open, the Firefighter gets into position, alongside the Team Leader, (behind the Waterwall Operator); he crouches on one knee, always keeping the FB5X pointing away from the fire into a safe corner. The Team Leader orders the Firefighter 'PROVE FOAM'. Once foam has been proved, the Team Leader orders the Firefighter to 'FIGHT THE FIRE'.

12. The Team Leader, using the TIC, directs the Firefighter to aim the foam towards the seat of the fire. Once the fire is extinguished, the Team Leader orders the Firefighter 'OUT FB5X'. The Firefighter directs the FB5(X) into a safe corner, then the Team Leader orders 'OFF FB5X'. The Team Leader confirms that all fires are extinguished, then orders the Waterwall Operator 'OFF WATERWALL'. The Waterwall Operator must ensure that the nozzle is not directed into the compartment while he is adjusting it to the *shut* position.

Note. *Consideration should be given to using a Ship Protector if the Team Waterwall leaves the access route unprotected. The three hose technique described in Para 20 may be adapted to achieve this.*

13. Re-entry From Above - Carbonaceous Fire

The Waterwall Operator and Firefighter each takes up position, crouched on one knee with the hose over the shoulder, one hand on the hose banding behind the coupling, and one hand on the nozzle. The hoses are positioned on the opposite side of the hatch to the hinges.

14. The Team Leader remains standing to back up the Waterwall Operator, holding the hose with one hand and backing him up with the other. The Team Leader then gives the order ‘FIREFIGHTER, ON PERSONAL PROTECTION’. The Firefighter turns the nozzle one eighth of a turn to the right to provide a 2 metre flat disc of personal protection waterwall. Then, backing up the Waterwall Operator, the Team Leader orders ‘ON WATERWALL’. The Waterwall Operator turns the nozzle swiftly through its full range to the left, to form a 10 metre flat disc of water for team protection.

15. The Team Leader moves to the end of the hatch and stands with his back to the hatch. He indicates to the Waterwall Operator and the Firefighter that he intends to open the hatch; both of them acknowledge this. The Team Leader reaches down, takes hold of the hatch and stands up, so that the hatch is at an angle of 45 degrees. The Waterwall Operator and Firefighter immediately position their nozzles with the release lugs of the hose couplings resting across the corners inside the hatch coaming. The Team Leader looks over his shoulder to check that both nozzles are in place and then opens the hatch, making sure that the retaining clip secures it in the fully open position. With the hatch fully open, the Waterwall Operator and Firefighter are now sealing the hatch, preventing the smoke and flame from escaping from the compartment.

16. The Team leader orders the Firefighter to lower the firefighter nozzle 2 metres into the compartment. With the nozzle still set to provide a 2 metre flat disc, the Firefighter aggressively swings the hose to gain maximum cooling coverage in the compartment. When the Team Leader is satisfied that adequate cooling has taken place, he orders the Firefighter to raise the nozzle out of the compartment. The firefighter raises the nozzle, assisted by the Hydrant Operator, checks that it is still set to personal protection, and then returns it to the corner of the hatch coaming to seal the opening.

17. The Team Leader takes over the waterwall from the Waterwall Operator, who makes his way down the ladder until his shoulder is level with the hatch coaming. The Waterwall Operator lifts his arm nearest to the waterwall nozzle and forms a clenched fist. The Team Leader lifts the nozzle from the hatch coaming and positions it underneath the arm of the Waterwall Operator, pulling it up so that it is tight under his arm, locking the nozzle in place. The nozzle protects the Waterwall Operator as he descends the ladder. On reaching the bottom of the ladder, the Waterwall Operator turns round, bringing the hose back under the right arm, then reports ‘LADDER CLEAR’.

18. The Waterwall Operator moves to a pre-determined position away from the ladder and crouches on one knee. The Firefighter uses the same procedure to descend the ladder. After reporting ‘LADDER CLEAR’, he turns around, grips the hose under his right arm and moves to a position behind the Waterwall Operator.

19. The Team Leader descends the ladder and positions himself behind the Waterwall Operator, alongside the Firefighter. He surveys the compartment, using the TIC, then directs the Firefighter to project a ragged spray towards the fire. If required, the Team Leader gives the order to advance on the fire, keeping control of the Team at all times.

20. Re-entry From Above - Oil Fire (Three Hose Technique)
An oil fire re-entry from above, using the three hose technique, requires a 5-man Support Party; the extra man being the Ship Protector. Both the Waterwall Operator and the Ship Protector position themselves, with waterwall nozzles, on the side of the hatch opposite to the hinges. The Firefighter has a FB5X to produce foam to fight the fire. When ready, the Team Leader orders the Firefighter 'PROVE FOAM'. The Firefighter proves foam (as detailed in para 9) and confirms this to the Team Leader.

21. The Team Leader, while backing up the Waterwall Operator, orders 'ON WATERWALL', then he backs up the Ship Protector and orders 'ON SHIP PROTECTOR'. The Team Leader then opens the hatch, making sure that it is firmly clipped open. Both the Waterwall Operator and the Ship Protector seal the hatch with their waterwalls.

22. The Team Leader orders the Firefighter to 'PROVE FOAM' again. When the Firefighter has proved foam, he directs the foam down into the compartment. After the contents of at least 2 drums of AFFF have been projected into the compartment, the Team Leader orders 'OFF FB5X'. The Firefighter moves the FB5X from the compartment and shuts it by pulling the switch to the *shut* position.

23. The Waterwall Operator descends into the compartment (as described in Para 17). The Firefighter moves onto the ladder until his shoulder is level with the hatch coaming, raises his arm nearest to the nozzle and makes a clenched fist. The Team Leader lowers the FB5X hose, parallel to the Firefighter's body, until the FB5X is at waist height. The Firefighter wraps his arm around the hose and descends into the compartment.

24. The Team Leader follows and takes up position, using the TIC to survey the compartment to find the seat of the fire. He directs the Firefighter away from the fire and orders 'PROVE FOAM AND FIGHT THE FIRE'. When the Firefighter has proved foam, he directs foam into the seat of the fire.

25. Re-entry From Above - Oil Fire (Fixed Hatch Waterwall)
This technique allows the use of a 4-man Support Party, yet still protects the ship. The use of FHWW is to be controlled by HQ1 due to the large amount of water (approximately 10 ton per hour) that it can put into a compartment.

26. The Team take up positions, with the Waterwall Operator crouching to the side of the hatch opposite to the hinges, and the Firefighter standing. After the Firefighter has proved foam, the Team Leader orders 'ON WATER AT THE HYDRANT, TO THE FIXED HATCH WATERWALL'. The Team Leader backs up the Waterwall Operator and orders 'ON WATERWALL'. The Team Leader opens the hatch to 45 degrees. The Waterwall Operator moves his nozzle into position inside the hatch coaming. When the Team Leader is satisfied that the Team Protection waterwall nozzle is in position, he opens the hatch fully, ensuring that the hatch retaining clip is engaged.

27. Once the hatch is fully opened, the Team Leader takes up position on his knees and orders the Waterwall Operator to 'LOWER YOUR WATERWALL TO JUST BELOW THE FIXED HATCH WATERWALL'. When the waterwall nozzle is in position below the fixed hatch waterwall, the Team Leader checks that the fixed hatch waterwall is still sealing the hatch opening. If it is, he orders the Waterwall Operator to move his nozzle back to the hatch coaming. The Team then carry on, as described for a 5-man team.

28. If the fixed hatch waterwall is not sealing the hatch opening correctly, then a controlled closure of the hatch must be made. The Team Leader orders the Waterwall Operator to move the waterwall nozzle back to the hatch coaming. The Team Leader releases the hatch retaining clip and lowers the hatch to 45 degrees, then orders the Waterwall Operator to remove the waterwall from within the coaming. Once the waterwall has been removed, the Team Leader lowers the hatch, backs up the Waterwall Operator, and orders 'OFF WATERWALL'. When the waterwall nozzle is shut, the Team Leader orders 'OFF WATER AT THE HYDRANT, TO THE FIXED HATCH WATERWALL'.

29. A 5-man team, using a ship protector must then be used for re-entry.

30. Re-entry From Below - Oil Based Fire
The Hydrant Operator is positioned at the hydrant. The Firefighter stands to one side of the ladder, holding the FB5X in a pistol grip fashion, right hand on the spill pick up connection, left hand on the ring guard, ensuring that the nozzle is shut.

31. The Waterwall Operator ensures that the waterwall nozzle is fully open, then inserts it in the mounting pole (see Chapter 22). The Waterwall Operator then waits at the base of the ladder.

32. The Team Leader gives the order 'HYDRANT OPERATOR, ON FIREFIGHTER AT THE HYDRANT'. The Hydrant Operator repeats and then carries out the order. Once he has carried out the order he will inform the Team Leader 'FIREFIGHTER ON AT THE HYDRANT'. The Team Leader then gives the order 'FIREFIGHTER PROVE FOAM'. The Firefighter then proves foam. Once he has proved foam he shuts off the FB5X.

33. The Waterwall Operator takes up position on the ladder with his nozzle in the mounting pole and positions it to seal the hatch. The Team Leader uses another pole to support the mounting pole. Once the Team Leader has confirmed that the waterwall is in the correct position he gives the order 'HYDRANT OPERATOR, ON WATERWALL AT THE HYDRANT'. The Hydrant Operator repeats and then carries out the order. Once he has carried out the order, he informs the Team Leader 'WATERWALL ON AT THE HYDRANT'. The Team Leader now opens the hatch.

34. The opening of the hatch is a coordinated effort between the Team Leader and the Waterwall Operator. The Team Leader removes his pole from the mounting pole and pushes open the hatch. Once he has opened the hatch, he returns his pole to the waterwall mounting pole. The Team Leader then assists the Waterwall Operator in manoeuvring the mounting pole to the hatch coaming.

35. The Team Leader gives the order 'FIREFIGHTER, PROVE FOAM' and 'PUT A LAYER OF FOAM IN THE COMPARTMENT ABOVE' (minimum 2 drums of foam). Once the firefighter has projected the layer of foam, the Team Leader gives the order 'FIREFIGHTER, OFF FB5X'. The Team Leader takes the FB5X from the Firefighter. The Firefighter then climbs the ladder. The Team leader passes up the FB5X to the Firefighter. The Firefighter positions himself behind the waterwall, proves foam in a safe direction away from the seat of the fire and, once he has proved foam, he brings the FB5X round in a sweeping motion and fights the fire.

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ANNEX B TO CHAPTER 21

BOUNDARY MONITORING AND COOLING

1. Fire Boundary

The fire must be contained within the smallest possible compass by forming a fire boundary, which is the bulkheads and decks surrounding the compartment or space on fire. The temperature of these bulkheads and decks must be monitored to establish the requirement for cooling with a water spray.

2. Fire Boundary Temperature Monitoring

The Temperature Monitoring System (TMS) is designed for use in Main Machinery Spaces and other high risk compartments to give the Action NBCDO, DCO and OOD the ability to assess conditions within a compartment prior to planning or committing a re-entry team. In an emergency the principles of TMS can be adapted to suit any compartment with a fire, however the inevitable delay in identifying, accessing and establishing suitable monitoring points may restrict its overall value and divert effort from the task of extinguishing the fire.

3. Material Preparations for TMS

The following are required:

a. **HQ1 Record Sheet**. A record sheet copied from the format at Fig 21B-1. This allows HQ1 to record temperatures from up to eight points, transferred from the Recorders' cards. By studying temperature trends and peaks, the HQ1 team can predict events and plan actions. The information contained on these cards should be retained for any subsequent investigation.

b. **Recorder's Card.** These are a 200mm x 125mm (to fit plastic JIC wallets) card matrix copied from the format at Fig 21B-2. Each card shows the location of pre-planned temperature monitoring points covering machinery spaces fitted with fixed firefighting systems and other high risk compartments. Cards are to be indexed and tagged together, and a marker pen attached. A blank Recorder's card is to be included for the ad-hoc use of TMS for any compartment without pre-planned temperature monitoring points. The cards are to be retained in HQ1 until required.

c. **Pre-planned Monitoring Points.** These are points on the outside of the perimeter bulkheads, decks and deckheads of the machinery space or high risk compartment being considered, which are suitable for monitoring temperatures of the space. These are to be identified by Ship's Staff taking into account:

(1) Access to the location, once smoke boundaries are established.

(2) The thermal conductivity of the bulkhead material allowing accurate measurement of temperature within the compartment. Thermal conductivity through bulkheads protected by fire barrier insulation will be considerably reduced. Monitoring points on these bulkheads should be at positions with a direct heat path from the other side, eg on metal door frames.

d. **'Doughnut' Signs.** Standard 'doughnut' signs, as illustrated at Fig 21B-3 are available from Naval Stores (see Volume 3). The blank centre of the circle should be cut out to improve conductivity and thus the recording of true boundary temperature. The line at the bottom of the sign is for identifying the monitoring point.

e. **Kill Cards.** HQ1 and AHQ/HQ2 copies of Kill Cards for compartments with pre-planned monitoring points are to be annotated to indicate that TMS could be activated if required.

f. **Temperature Monitoring Devices.** These are:

(1) Magnetic dial thermometers, held in HQ1/FRPP lockers, or

(2) Digital probe kit held in HQ1 of GRP vessels.

Note. *Difficulty may be experienced with cosmetically lined bulkheads, however, this can be overcome by installing hinged access points in bulkhead linings abutting Main Machinery Spaces and high risk compartments. The identifying 'doughnut' is to be on the hinged door.*

4. Personnel Requirements for TMS

TMS is administered by the Containment Coordinator and the rating i/c of the Containment Party. To ensure timely implementation, one rating should be nominated from the Containment Party to be responsible for recording temperatures from all the monitoring points. The nominated person should report to HQ1 after each set of readings and complete the HQ1 record sheet.

5. TMS Activation

TMS is activated when it is established that access into the compartment has been lost, ie Attack BA party beaten back and access closed, fixed firefighting systems have been used or no other means can be used to monitor the internal temperatures in a compartment prior to re-entry.

6. TMS Procedure

The procedure for activation and implementation is:

a. When activated from HQ1, the nominated TMS rating (the Monitor) collects the India tagged Recorder's Cards for the compartment on fire and the thermometers (or probe kit) from HQ1. The Monitor then proceeds to the locations identified on the Recorder's Cards and affixes the magnetic thermometers or takes a reading with the digital probe.

b. When all the magnetic thermometers are in place and have had time to settle, the Monitor takes a set of readings and records them on the Recorder's Card. When all possible locations have been covered, the Monitor returns to HQ1 and transcribes the individual temperatures and the reference time onto the HQ1 Record Sheet, briefing the ANBCDO, DCO or OOD on any specific points noted during the round.

c. When all the temperatures have been transcribed from the Recorders Card, it is wiped clean and the reference time for the next set of temperatures written in. Readings should be taken every 15 to 20 minutes depending size and complexity of the route. The monitoring cycle is repeated until ordered to cease by the ANBCDO/DCO/OOD.

Date:_____ Sheet __ of __

TEMPERATURE MONITORING SYSTEM - HQ1 RECORD SHEET

Compartment:____________ Fixed Firefighting System Used: Yes/No

Time of First shot:_____ Time of Second Shot: _______

Time										
Point	Location	Temp	Temp	Temp	Temp	Temp	Temp	Temp	Temp	Temp
1										
2										
3										
4										
5										
6										
7										
8										

Fig 21B-1. Temperature Monitoring System - HQ1 Record Sheet

TEMPERATURE MONITORING SYSTEM

RECORDERS CARD

Time: _________

Point	Location	Temp
1		
2		
3		
4		
5		
6		
7		
8		

Fig 21B-2. Temperature Monitoring System - Recorder's Card

7. Care must be taken not to breach established smoke boundaries. Any pre-determined monitoring point that is inaccessible because of a smoke boundary is to have a line drawn through the relevant column on the Recorder's Card and a note to that effect marked on the Record Sheet.

8. Although the Monitor will be entering compartments where boundary cooling is established he must not be employed on that task. The priority is to attach all thermometers and record temperatures. The Monitor may, however, relay messages from the Boundary Cooler to HQ1 and should take appropriate action on discovering secondary fires or casualties.

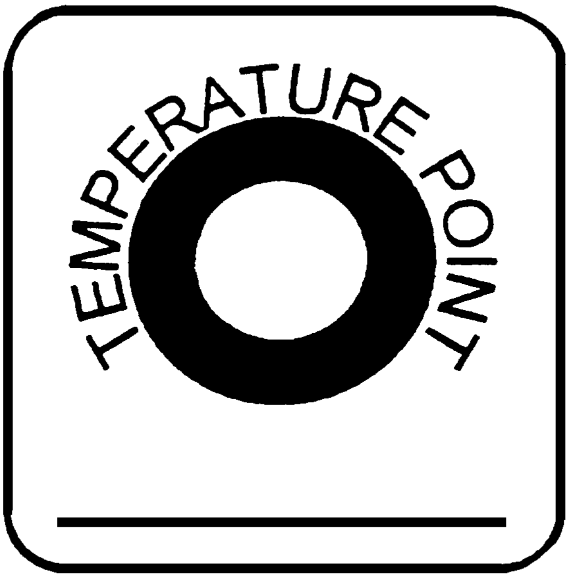

Fig 21B-3. The 'Doughnut' Sign

9. Boundary Cooling

The purpose of boundary cooling is to contain a fire within the smallest possible compass by keeping the adjoining decks and bulkheads cooled with water spray. Boundary cooling must be carefully controlled because indiscriminate spraying can sometimes cause unnecessary damage to electrical equipment, and create adverse conditions of ship stability. If a deck or bulkhead is cool enough to touch, it does not require the application of water spray. When the use of water does become necessary the amount used must be kept to the absolute minimum required. The Containment Group should make arrangements for boundary cooling in the very early stages of a fire. The following points will assist in the management of boundary cooling:

a. Assign a number to each Boundary Cooler; note it on the containment incident board with their name and mark on the board where they are cooling.

b. Mark on the containment board the positions of smoke boundaries and the FCP. Ensure HQ1 provides updates as boundaries move.

c. Consider the early provision of BA to those Boundary Coolers who will be inside a smoke boundary.

d. Brief Boundary Coolers on compartment hazards.

e. If re-entry is liable to affect the safety of a Boundary Cooler, the I/C of containment must ensure that the I/C at the FCP is aware of their position(s) and make plans for their removal/safety.

f. Electrical aspects:

(1) Electrical equipment ideally should be isolated (providing such action does not jeopardise the firefighting effort).

(2) Where possible whole units, or units within assembly racks are to be removed well clear of the area.

(3) Electrical equipment that cannot be isolated is to be covered with polyamide sheeting and securely taped (boundary coolers should then monitor equipment for sign of overheating).

(4) Avoid spraying directly onto any electrical equipment. Spray onto a deckhead or bulkhead and allow water to run down the surface.

g. Any obstructions, eg panelling, should be removed prior to cooling taking place. It may not be necessary to do so immediately, in which case the panelling/insulation should be monitored for signs of blistering paintwork/peeling/heat transfer. Ensure tools are available to remove the panelling/insulation.

h. Bathrooms, heads, sculleries and galley decks will not readily transfer heat, but brackets welded to the deck, deck drains and pipes passing through the deck will.

i. Remove flammable material, such as carpets, stores, bedding, etc from the fire boundary.

j. If the structure is cool enough to touch, it does not require cooling.

k. The minimum requirement for boundary cooling inside the ship is a CFHR/size 2 hose with a firefighter nozzle. Cloths, mops, extinguishers are unsuitable. Water from the deck can be applied by a bucket, but consideration must be given to how hot the structure is, and the amount of physical effort required. Nozzles should not be in the open position unattended.

l. Avoid the build up of free-surface by using the minimum amount of water.

m. Ensure Boundary Coolers know how to break up free-surface using materials to hand.

n. If the fire involves aluminium structure, it is most important that early boundary cooling is applied, as it may collapse or melt without warning.

o. Boundary Coolers should be briefed to contact HQ1 to report when cooling has started.

ANNEX C TO CHAPTER 21

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 per cent tank capacity - either continuous spraying or sporadic bursts. This holds 50 per cent in reserve for possible use at a later stage.

b. The decision to spray foam continuously or in burst rests with the ANBCDO/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

These systems which are single or multi-shot (Carbon dioxide (CO_2), Halon 1211 (BCF) or Halon 1301 (BTM)) are fitted in the main and auxiliary machinery spaces, and their use is authorized by the officer in charge of firefighting (ANBCDO/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. CO_2 drench systems require concentration of 35 per cent 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 CO_2 gas is released). This atmosphere is lethal if inhaled for even a short period.

b. BCF requires only about five per cent concentration by volume to effectively extinguish most fires. At these concentrations BCF is quite toxic and one-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 seven per cent 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 minimized by injecting the required five per cent concentration into the space in ten seconds 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 minutes 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 two-shot system is fitted, the operation of the first shot may be authorized by the MEOOW at sea. This will preclude a delay while waiting for the MEO's permission.

d. Compartments in which CO_2, 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.

WARNING

ALL PERSONNEL ASSOCIATED WITH FIREFIGHTING SHOULD BE MADE AWARE OF THE POTENTIALLY LETHAL PRODUCTS OF PYROLISED 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, ELSA BEING USED WHEN AVAILABLE.

e. Where available, fixed water/foam sprinkler systems may be used for up to 5 minutes, 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/CO_2 bottle stowage/compartment, there is a possibility of dangerously high concentrations of gas in the compartment. Therefore, EDBA is to be worn ‘on air’ by anyone entering the compartment/stowage. A BA Controller must be nominated. EDBA 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 firing 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/$C0_2$ Systems

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

(1) CO_2/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 Note 4 to 9(a) sub-para (26).

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 two-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. **CO_2/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). (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
(3) Has the correct pipe been made and repeated?	HQ1 WK
(a) Location of fire.	
(b) Muster points for:	
i. Attack Party.	
ii. Support Party.	
iii. Containment Party.	
iv. BA Party.	
(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 LAFB 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 . (Note 2)	DMESR OOD MEOOW

ACTIVITY	ACTION
(9) Establish containment priorities:	OOD/ ANBCDO
(a) Adjacent compartments.	I/C CONT
(b) Remote (any compartments to which the fire could spread by heat transfer through trunking or systems).	I/C CONT
(c) Magazines - sprays activated? Confirm weapons and ammunition ‘cook off times’.	DWESR
(d) Establish smoke boundaries and pipe locations.	I/C CONT
(e) Are all keys available for adjacent compartments?	DUTY SA
(f) Conduct full boundary search.	I/C CONT
(10) Debrief the person finding the fire:	I/C FCP/OOD/ ANBCDO
(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/POOD ANBCDO
(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 ships company.	OOD/ANBCDO
(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/ANBCDO

ACTIVITY	ACTION
(16) Authorise operation of gas drench to named compartment. (Note 3). Confirm gas cylinders have discharged their contents. BA to be worn.	OOD/ANBCDO
(17) Have the LAFB and assistance from adjacent ships arrived?	OOD/ANBCDO
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 LAFB 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?	I/C VENT
(f) Stability - remove water especially if high in the ship.	ANBCDO DMESR
For operation of single shot gas systems continue to para (25).	
(18) Monitor the compartment temperature in accordance with sub para (27).	I/C CONT
(19) Is the fire considered EXTINGUISHED? - NO - go to para (23).	OOD/ANBCDO
(20) Is the fire considered EXTINGUISHED? - YES. Clip remaining flap (CO_2 system only), operate water/AFFF sprays and monitor temperature (sub paras ((26)-(28)) refers). Crash stop ventilation carry out re-entry procedure using 3 hose/fixed hatch waterwall technique.	I/C FCP VENT OOD/ANBCDO
(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/ANBCDO

ACTIVITY	ACTION
(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 to be extinguished (sub para (19)), re-seal the compartment (for CO_2 system unclip nominated ventilation flap).	I/C FCP OOD/ANBCDO VENT
(24) When compartment confirmed closed down, verified against compartment Kill Cards - authorise second operation of gas drench to named compartment. (Note 2)	OOD/ANBCDO
(25) Allow 5 minutes to elapse for BCF chemicals/CO_2 to extinguish the fire. Re-clip nominated ventilation flap (CO_2 systems only).	OOD/ANBCDO
(26) After 5 minutes order ‘Operate high level water/AFFF sprays’. Spray compartment for 5 minutes to effect cooling. (Notes 4 and 5)	OOD/ANBCDO
(27) Monitor bulkhead temperatures using magnetic thermometers. Prior to making a re-entry confirm: (a) Three successive temperature drops have occurred, and (b) Compartment temperature is below 100 degrees Celsius. (Notes 5 and 6)	I/C CONT
(28) Consideration should be given to using the high level water/AFFF sprays for a further 5 minutes to cool the compartment before attempting to make a re-entry	OOD/ANBCDO
(29) Crash stop ventilation and authorise a re-entry using 3 hose/fixed hatch waterwall technique.	OOD/ANBCDO
(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/ANBCDO
(32) Retain all information which may be required for post fire investigation (Fire Report Alpha/Bravo).	OOD/ANBCDO

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 minutes but Secondary Isolations may take up to 30 minutes 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 authorization of the second shot. In 1 and 2 shot systems all Primary and Secondary Isolations should whenever possible be completed before authorizing 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 authorize operation of the gas drench system or make a re-entry.

3. Confirm all personnel have been evacuated from the compartment. On the order 'Operate CO_2/BCF Gas Drench', Cabinet doors are to be opened as a co-ordinated 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.

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.

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). (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: i. Attack Party. ii. Support Party. iii. Containment Party. iv. 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 LAFB 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. (Note 2)	DMESR MEOOW

	ACTIVITY	ACTION
(9)	Establish containment priorities:	OOD ANBCDO
	(a) Adjacent compartments.	I/C CONT
	(b) Remote (any compartment to which the fire could spread by heat transfer through trunking or systems).	I/C CONT
	(c) Magazines - sprays activated? Confirm weapon and ammunition ‘cook off times’.	DWESR
	(d) Establish smoke boundaries and pipe locations.	I/C CONT
	(e) Are all keys available for adjacent compartments?	SA
	(f) Conduct full boundary search.	I/C CONT
(10)	Debrief the person finding the fire:	I/C FCP OOD/ANBCDO
	(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 ANBCDO
	(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 ships company.	OOD ANBCDO
(13)	Continue to close down ventilation flaps	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.	I/C FCP
(16)	Authorise operation of gas drench to named compartment. Confirm gas cylinders have discharged their contents. BA to be worn. (Note 3).	OOD ANBCDO

ACTIVITY	ACTION
(17) have the LAFB and assistance from adjacent ships arrived? Assess outstanding tasks:	OOD ANBCDO
(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 LAFB 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?	I/C CONT
(f) Stability - remove water especially if high in the ship.	DMESR ANBCDO
(18) Allow **at least** 5 minutes for BTM to chemically extinguish the fire.	OOD ANBCDO
(19) After 5 minutes order 'Operate high level water/AFFF sprays'. Spray compartment for 5 minutes to effect cooling. (Note 4).	OOD ANBCDO
(20) Monitor bulkhead temperatures using magnetic thermometers. Prior to making a re-entry confirm:	I/C CONT
(a) Three successive temperature drops have occurred, and	
(b) Compartment temperature is below 100 degrees Celsius. (Notes 4 and 5).	
(21) Consideration should be given to using the high level water/AFFF sprays for a further 5 minutes to cool the compartment before attempting to make a re-entry.	OOD ANBCDO
(22) Crash stop ventilation and authorise a re-entry using the 3 hose/fixed hatch waterwall technique.	OOD ANBCDO
(23) Extinguish any remaining fire and secure the compartment.	I/C FCP

ACTIVITY	ACTION
(24) FIRE EXTINGUISHED! Post sentry, carry out smoke clearance and remove water.	I/C FCP OOD/ANBCDO
(25) Retain all information which may be required for post fire investigation (Fire Report Alpha/Bravo).	OOD ANBCDO

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 minutes but Secondary Isolation may take up to 30 minutes 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 authorizing 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 authorize a re-entry.

3. Confirm all personnel have been evacuated from the compartment. On the order "Operate CO_2/BCF Gas 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.

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.

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). (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: i. Attack Party. ii. Support Party. iii. Containment Party. iv. 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 ELSA if required. The first operation of BTM must not be delayed because personnel are not wearing respirator protection in the affected space. (Note 2). Confirm gas cylinders have discharged their contents. BA to be available.	OOD ANBCDO MEOOW
(6) Pipe SITREP over the main broadcast, including location of FCP.	OOD/ANBCDO

ACTIVITY	ACTION
(7) If fire is not extinguished by first aid action:	OOD/ANBCDO
(a) Emergency Clear Lower Deck/Emergency Stations.	
(b) Account for all personnel - service and civilian.	
(c) Control use of spare hands.	
(8) Introduce appropriate quantity of foam to bilge areas via foam tubes and replace foam tube caps.	I/C FCP
(9) Have LAFB 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. (Note 3).	DMESR OOD MEOOW
(12) Establish containment priorities:	OOD ANBCDO
(a) Adjacent compartments.	I/C CONT
(b) Remote (any compartment to which the fire could spread by heat transfer through trunking or systems).	I/C CONT
(c) Magazines - sprays activated? Confirm weapon and ammunition ‘cook off times’.	DWESR
(d) Establish smoke boundaries and pipe locations.	I/C CONT
(e) Are all keys available for adjacent compartments?	SA
(f) Conduct full boundary search.	I/C CONT
(13) Debrief the person finding the fire:	I/C FCP OOD/ANBCDO
(a) What is burning and the precise location?	
(b) Who is still in the compartment?	
(c) Are there any casualties?	

ACTIVITY	ACTION
(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 ANBCDO
(15) Personnel fighting the fire will confirm if the fire has been extinguished.	I/C FCP
(16) Pipe SITREP over main broadcast.	OOD/ANBCDO
(17) Account for all non BA wearers.	ODD/ANBCDO
(18) Have the LAFB and assistance from adjacent ships arrived? Assess outstanding tasks:	OOD/ANBCDO
(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 LAFB and assistance from adjacent ships.	
(d) Are firefighters in need of reliefs? (see 2660, Table 26-1).	
(e) Is the fire fully contained, smoke boundaries effective and TMS established?	I/C CONT
(f) Stability - remove water especially if high in the ship.	DMESR ANBCDO
(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 continue to attack the fire.	I/C FCP

ACTIVITY	ACTION
(21) Prepare for second operation of gas drench system:	OOD/ANBCDO
(a) Are all ventilation flaps confirmed shut and Primary Isolations completed where practicable? (Note 3)	VENT OOD/ANBCDO
(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/ANBCDO
(22) Allow **at least** 5 minutes for BTM to chemically extinguish the fire.	OOD/ANBCDO
(23) After 5 minutes order 'Operate high level water/AFFF Sprays'. Spray compartment to effect cooling. (Notes 4 and 5)	OOD/ANBCDO
(24) Monitor bulkhead temperatures using magnetic thermometers. Prior to making a re-entry confirm:	I/C CONT
(a) Three successive temperature drops have occurred, and	
(b) Compartment temperature is below 100 degrees Celsius. (Note 5)	
(25) Consideration should be given to using the high level water/AFFF sprays for a further 5 minutes to cool the compartment before making a re-entry	OOD/ANBCDO
(26) Crash stop ventilation and authorise a re-entry using the 3 hose/fixed hatch waterwall technique	OOD/ANBCDO
(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/ANBCDO I/C FCP
(29) Retain all information which may be required for the post fire investigation (Fire Report Alpha/Bravo).	OOD ANBCDO

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 minutes but Secondary Isolations may take up to 30 minutes 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 authorization of the second shot. All Primary and Secondary Isolations should whenever possible be completed before authorizing 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 authorize 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.

ANNEX D TO CHAPTER 21

EXPLOSIVES AND PYROTECHNICS

1. Definitions

A magazine is defined as a compartment or locker specially designed to be safe for the permanent or temporary stowage of explosives or explosive stores, ie all weapons, missiles or stores containing substances used to produce an explosive, incendiary or pyrotechnic effect.

2. Firefighting

A small fire in a magazine should be first tackled with the 9-litre foam (AFFF) extinguisher provided. A fire which has progressed beyond the use of portable equipment will normally be dealt with by the activation of a fitted spray system. Some spray systems are manually operated, but in most ships they are automatically operated at a specific rise in temperature (quartzoid bulb) (see Chapter 22). Flooding arrangements, as fitted to some magazine, RU magazine and pyrotechnic lockers are manually operated.

3. Floods and Sprays

With a manual system, the decision whether to spray and/or flood a magazine must be made in good time. The responsibility to do so rests with the Action NBCD Officer or OOD who, if time permits, must consult the Command. In cases of extreme emergency, the decision must be made by the officer/senior rating of the appropriate Fire and Repair Party or, in the case of RU magazines or lockers on the weather deck, by the officer or senior rating closed up in the vicinity. The Action NBCDO or OOD should be informed immediately.

4. Adjacent Compartments

To meet the hazard of fire in a compartment adjacent to a magazine, the bulkhead/deck/deckhead of the magazine should be sprayed with water (boundary cooled) from within the magazine, using either a firefighter nozzle supplied with water from the nearest hydrant or CFHR by running a hose through the door or hatch. The decision to boundary cool rests with the officer/senior rating in charge of the firefighting team or, in extreme emergency, with the officer/senior rating who may be stationed in the magazine.

5. Air Weapons Magazines

If the air weapons magazine smoke alarm activates (and if torpedoes are carried), the OOQ is to inhibit the sprays or, if the sprays are already activated, isolate the HPSW supply. Using both indicator test plug and 'fish eye' viewer, he is to attempt to ascertain the situation in the magazine:

a. If it can be seen that the cause of the smoke alarm is a non self sustaining torpedo battery fire, the sprays are not to be re-activated. Once all battery activity has ceased and the smoke has been cleared, a controlled re-entry into the magazine is to be made by the Support Party, backed up by the WE Hazard Team.

b. If the cause of the smoke alarm is confirmed as a self sustaining battery fire, a major magazine fire, or if there is any doubt, the sprays should be activated and/or the HPSW supply de-isolated. The magazine should then be sprayed for a minimum period of 30 minutes. On completion, provided all battery activity has ceased and other fires are extinguished, a full re-entry is to be made by the Support Party, backed up by the WE Hazard Team.

6. If no Stingray warshot torpedoes are held in the magazine, the policy for spraying remains the same as for any other magazine.

7. Boundary Cooling

If boundary cooling is being carried out in a magazine fitted with an automatic (quartzoid bulb) spray system and a high proportion of the spray heads are suddenly activated, the person(s) carrying out the boundary cooling, unless wearing breathing apparatus, should vacate the magazine immediately, as it is considered that the volume of fine spray water will make the compartment uninhabitable.

8. Regulations

The regulations applying in each ship should be contained in Ship's General Orders (SGOs).

9. Incendiary Weapons

These are generally thermite, or a similar substance, in a magnesium alloy casing. The filling produces its own oxygen and, once ignited, cannot be extinguished. While it is burning the outer case ignites and generally explodes, so that pieces of burning magnesium alloy can be thrown a distance of up to 15 metres. These weapons should be cooled with large quantities of water spray. Burning magnesium should be attacked with large quantities of water. Water on burning magnesium causes intense reaction and increases the burning rate, so vast quantities must be used. CO_2 should not be used because it increases the burning rate without producing any cooling effect. Firefighters must make full use of any available protective cover when tackling this type of fire.

10. Ammunition with Phosphorus Content

Phosphorus is air-reactive and, when on fire, should be fought with copious amounts of water. At about 250°C, encased white phosphorus changes its chemical form, with the resultant considerable release of heat, and is likely to explode.

11. Depleted Uranium Ammunition (DUA)

Fires involving DUA, in magazines, lockers or elsewhere, should be fought by personnel wearing BA, using copious amounts of water. Should uranium oxide aerosol be present precautions need to be taken with respect to the control of ventilation to prevent its spread and with the movement of personnel to prevent exposure. Care should be taken to ensure that the fire is completely extinguished and that the remaining ashes are cold and thoroughly soaked with water. It is recommended that all ashes and solid debris from such a fire should be collected up and disposed overboard, using copious amounts of water where necessary.

12. Risk Reduction Measures. The need for rapid and efficient firefighting is vital. The risk of explosion makes it necessary for the firefighters to wear protective helmets (if available) and to protect themselves as much as possible by shielding behind any structure or fitting which may be close to their required firefighting position. The possible loss of all or part of the firefighting team and their equipment as the result of an explosion must be considered, and back-up crews and their equipment must be available in a suitably sheltered position. Ship's Orders are to contain suitable plans for dealing with this situation. The requirement to ditch weapons, or loaded or crashed aircraft, must also form part of the contingency plan and detailed regulations are contained in BR 862, Naval Magazine and Explosive Regulations, Vol 1. Ditching must be considered immediately it is known that a fire involving explosives has developed; it may be the only way to avert a major disaster. Regular fire exercises are to be arranged so that ships' companies are thoroughly conversant with the requirements of these Orders.

13. The chance of explosives becoming involved in a fuel fire is greatest when the explosive is out of its normal stowage, for instance, on a flight deck. Every precaution must be taken, every order implicitly obeyed. The danger from explosives on flight decks arises from either those loaded on aircraft or from those held in weapon parks. BR 862, should be consulted for detailed regulations for handling and care of air weapons. The amount of explosive stores on flight decks must be carefully controlled and should never exceed that required for immediate operational requirements. Consideration should be given to the methods to be employed and the routes by which explosives can be ditched.

14. Cooking Off

The time factor for ammunition to 'cook off' (ie premature explosion due to excessive heat) in a fire situation depends on many variables, eg the nature of the explosive and the propellant, the thickness of the case, the temperature of the fire and the proximity of the explosive to the source of heat. BR 862 sets out in tabular form the hazard times and risk times of weapons when they are involved in fire, and officers who may be responsible for such firefighting operations are to familiarize themselves with the relevant articles.

15. When the flames surrounding a weapon have been extinguished, the internal temperature of the weapon may continue to rise and cause 'cook off' some considerable time later. The cooling of weapons exposed to fire must continue for at least thirty minutes after the fire is extinguished.

16. If a weapon is in danger of 'cooking off' the initial aim must be to separate other explosive stores in the following sequence:

a. Remove all explosives to a distance of at least 12 metres.

b. Following that, remove all explosives in fire divisions 1 and 2 to at least 18 metres.

c. Following that, remove all explosives in fire division 1 to at least 36 metres.

If circumstances permit, a, b and c should be carried out concurrently. Explosives within these radii which cannot be moved must be cooled.

17. Weapons and Pyrotechnics on Aircraft

Chapter 25 gives guidance on the effect of fire on weapons and pyrotechnics associated with embarked aircraft.

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ANNEX E TO CHAPTER 21

SEARCH AND RESCUE OPERATIONS

1. Implementing Search and Rescue (SAR) Operations
If personnel are known, or suspected of being in the smoke logged area and there is a high possibility that they are overcome or trapped, the person in charge of the incident must decide on whether a SAR operation is practicable. This should only be considered when all fires are under control or confirmed extinguished. This will then make available all SAR equipment and manpower. A SAR operation will take up all the resources of the HFEP or SSEP if it is to be carried out safely.

2. The decision is taken by HQ1/SCC, so the I/C Main Group should inform HQ1/SCC as soon as it is clear a SAR operation may be necessary, (Support Team overdue). When SAR operation is required, HQ1/SCC should immediately start to muster all equipment and prepare the teams.

3. It is always of benefit, if possible, to use personnel with knowledge of the area or compartment to make up the SAR teams. These personnel should at least be questioned for useful information on the area or compartment.

4. Consideration should be given to:

a. Location of area where personnel were last seen or known to be.

b. Details/locations of casualties (if known).

c. Dangerous areas, eg positions where guardrails, ladders or decks etc are missing in way of work or damage.

d. Difficult search areas and trap points (under machinery and small compartments).

e. Little-used exit points such as emergency exits, escape hatches etc.

5. Once members of the Ships Company are believed to be missing, all hands should be mustered so that a target number can be obtained for the SAR.

6. If a SAR operation is carried out during aid to another ship, passenger lists and crew check-off lists should be used.

7. Safety Precautions
The safety of the SAR teams is as important as the efforts to rescue trapped personnel. The person in charge of the incident should be guided by the following:

a. Make sure teams are well briefed on how to search a compartment and lay a guideline.

b. Make sure teams know how to use SAR equipment, especially breathing apparatus.

c. Have the area to be searched clearly defined and a clear route for the guideline to be laid if possible.

d. Always work in teams of at least two.

8. Equipment
The following equipment is available for SAR teams:

a. A 40 metre guideline in a pouch (see Fig 21E-1). The standing end is knotted to prevent it from being pulled out of the pouch. Four guidelines are supplied to each FRPP and UDRFPP. BA lockers containing guidlines are to be identified by a tally 'GUIDELINE WITHIN' applied beneath the EDBA tally.

b. A personal line with a knurled spring clip (8 per FRPP and UDRFPP). The spliced eye of the line is attached to the waist band of the EDBA harness. When the EDBA is not being used for SAR, the personal lines are to be stowed in FRPP lockers.

c. Breathing apparatus (EDBA).

d. FFHBC for the search team and a hand-held radio for the I/C at the FCP.

e. A 2 metre BA extension hose and rescue mask.

f. A 15 metre BA extension hose.

g. Lightweight stretcher.

h. ELSA, as escape BA for casualties.

i. Thermal imaging camera (TIC).

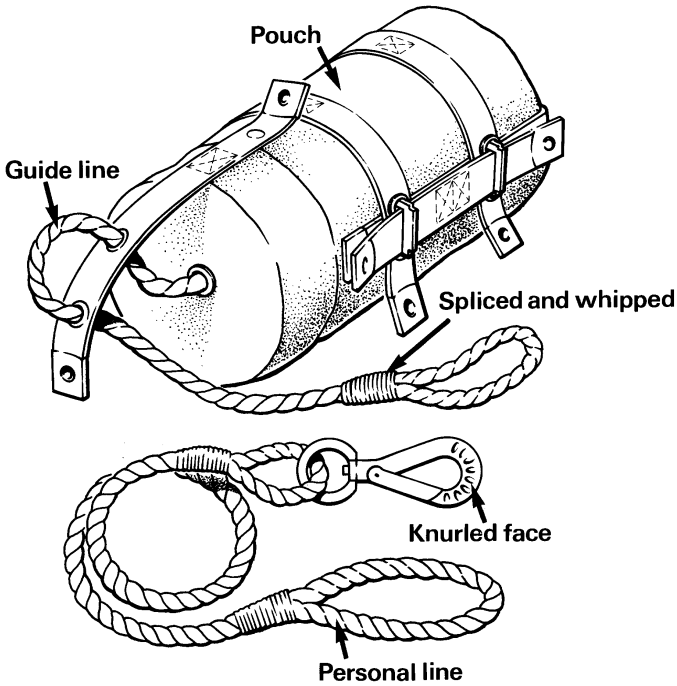

Fig 21E-1. Guide Line (Indicator Route Line)

9. SAR Technique

The search should begin at the nearest point to the scene of the incident and then work away from it towards fresh air and safety. This ensures that if a casualty is found before the team reaches the limit of their endurance they are as near to fresh air as possible. To this end, priority is given to a 2 man Pathfinder team who can lay the guideline to the scene of the incident (SOTI).

10. Pathfinders enter the smoke boundary making sure that the guideline is secured at the entry point, in fresh air, to a secure fitting. One ELSA is to be carried by each member of the team to help sustain any casualties found. A 2m BA extension hose is to be carried by one member of the team, ideally No 2.

11. The guideline should be laid by the most direct route, if possible at waist height, always to secure fittings. This will allow search teams to follow with ease. The guideline should, where possible, be laid above doorways to leave access for later search teams and indicate that the compartment has not yet been searched.

12. When the Pathfinders arrive at the SOTI the guideline should be secured to a fixed position.

13. When any team has been committed, a rescue team should always be ready, standing by, with all pre-wear checks done.

14. Once the guideline has been laid, SAR teams can be committed after being given a full brief on what areas they are to search, and search technique (boundary, quarter, diagonal). The SAR teams must clip onto the guideline in fresh air, at the entry point, with the knurled side of the personal line spring clip pointing towards the entry/exit point.

15. The search team should always follow the guideline to the search area. At the search point one member of the team remains on the guideline at all times to act as a datum for the search. At no time should both members of the team unhook themselves from the guideline.

16. The Team Leader should monitor air gauges and make a decision on when a return is necessary dependant on conditions, but the return should always take place by the time the BA whistle sounds.

17. Any moveable casualties should be sustained using the 2m BA extension and rescue mask or ELSA.

18. The benefits of the ELSA should always be taken into account, as the rescue mask greatly reduces the duration of the BA. Any casualties should be removed as soon as discovered, if possible. The 15m extension can be called for and used if a casualty is trapped or requires the lightweight stretcher.

19. In a smoke-logged compartment, casualties will be in immediate need of an air supply. The SAR team must supply this with ELSA or BA extension, keeping their own air supply for themselves.

20. If a lightweight stretcher is to be used, a four-man team should be considered. First aid should be given only when it is safe to do so.

21. Locating Missing Personnel

Personnel trapped by smoke or fire often retreat into unexpected places to protect themselves, so all areas of compartments must be methodically searched. Possible hiding places are:

a. In or behind bunks.

b. In or behind lockers.

c. Under tables or chairs.

d. Adjacent to compartment exits.

e. In bilges or under deck plates.

22. Casualties who are conscious will probably be suffering from shock and may present a danger to the search team. Teams must be prepared to restrain casualties and keep their own air supplies out of reach.

23. Dead Bodies

Bodies must not be moved until so directed by the officer in charge of the SAR. Whenever possible, dead bodies should be photographed in situ, or a sketch of the location made, to assist in the subsequent investigation or inquiry. Personnel must wear impermeable gloves (eg NBC outer gloves) when moving bodies, to protect against bacteriological infection.

24. Precautions when Searching

a. When negotiating a hatch and ladder:

(1) Ensure that the hatch retaining clip is secure.

(2) Test rungs/treads before committing full weight.

(3) Feel below for the next rung/tread. Never assume that deck level has been reached.

(4) Never jump from a ladder to a deck.

(5) One searcher at a time on a ladder, the other stood clear.

(6) Use the ‘clear ladder’ drill.

b. When passing through a doorway or access:

(1) Enter cautiously, as the door could lead to a ladder, a trunk or shaft, or an unsafe/damaged deck.

(2) If the access is restricted, do not remove BA.

(3) Ensure that there is sufficient room to turn around.

c. When moving through the ship:

(1) Tread gently and cautiously before committing weight to the lead foot, (shuffle, rather than walk).

(2) Never put weight on guardrails.

(3) Avoid touching metal items with bare hands as they may be hot from fire or electrically live.

(4) Continually test the area ahead by moving a hand ahead, with the palm towards the face.

25. Action if a Searcher Becomes Trapped

If a searcher becomes lost or trapped, he should sound his personal bulb horn or bang metal against metal. Both are recognised distress signals. Shouting should be avoided, as it wastes BA air and is not as effective as mechanically produced sound.

26. SAR Control at the Entry Point

The I/C of the Main Group will normally control SAR teams and is to keep HQ1/SCC informed of progress. The I/C is also to:

a. Establish a casualty handling area.

b. Ensure proper BA control.

c. Arrange for a Rescue Team to stand-by, with BA pre-wear checks completed.

d. Arrange for 15m BA extension equipment to be laid out and proved.

27. After Compartment Search

When a compartment has been searched and is believed to be clear, the door or hatch is to be closed to protect watertight integrity. A green cyalume light should be attached to a door/hatch clip to indicate a searched and clear compartment.

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ANNEX F TO CHAPTER 21

SMOKE ALARM - REACTION GUIDANCE

1. While it is impossible to provide rigid routines due to differing circumstances, (number of zones sounding, locations, sighted smoke, heat etc) the guidance in Fig 21F-1 should be reflected in ships NBCD Orders, adapted as necessary to suit the fitted smoke alarm systems.

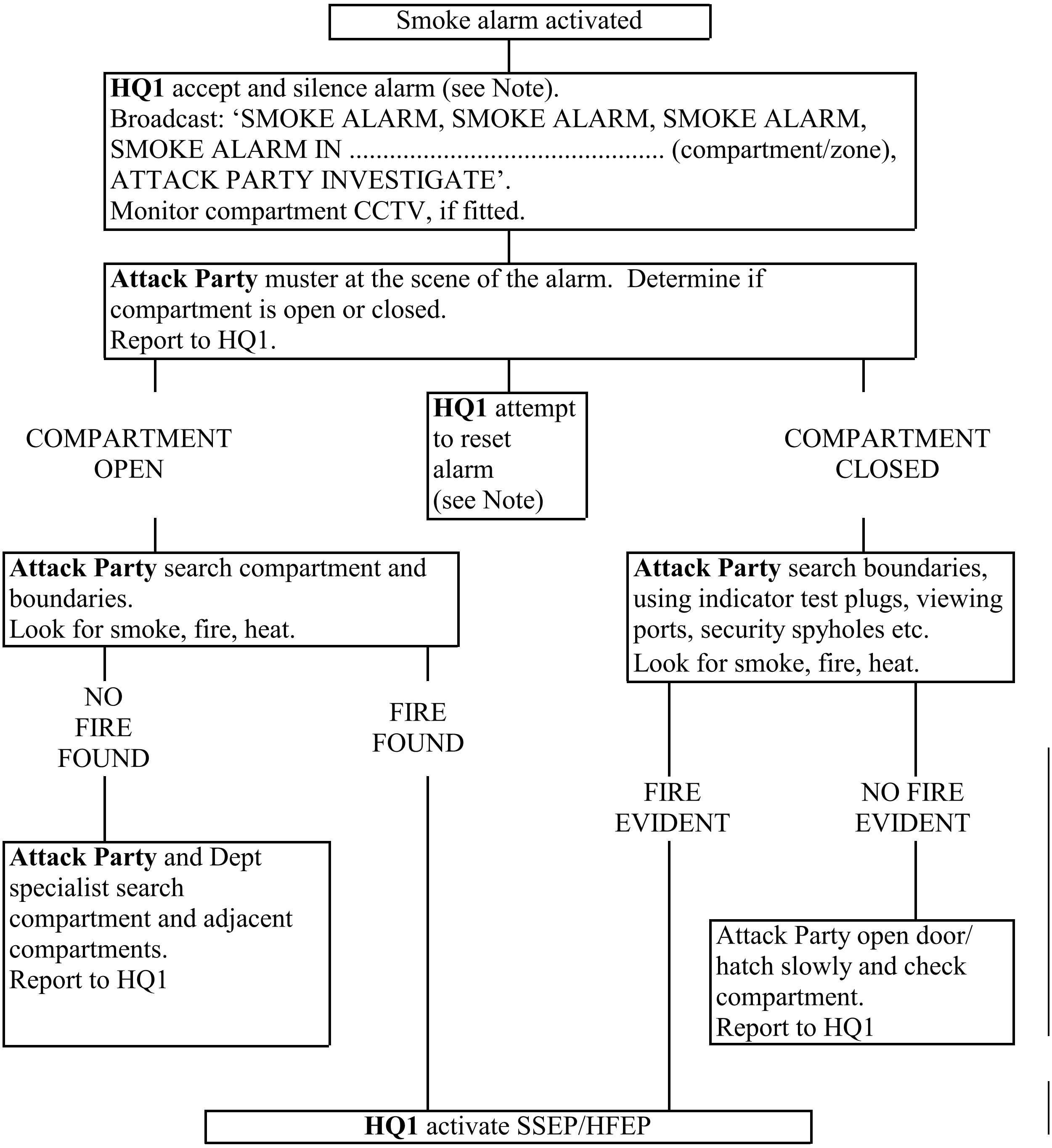

Fig 21F-1. Smoke Alarm Reaction Guide.

Note. *In older ships, with the high voltage smoke alarm system, the HQ1 alarm must be accepted and reset at the first stage of the procedure.*

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ANNEX G TO CHAPTER 21

FIREFIGHTING KILL CARDS

1. Application of Kill Cards

Ships are to raise Kill cards for all 'high fire risk', 'explosive risk' and the 'high value' compartments. Cards may be raised for other compartments at the discretion of ship's officers. Compartments and spaces should be classified according to the risk inherent in their function, ie:

a. **High Fire Risk.** Main and auxiliary machinery spaces, diesel-generator rooms, gas-turbine generator compartments, uptakes and downtakes, ventilation trunks from the machinery spaces up to the fire flaps, machinery removal and escape trunks to the above compartments, fuel pump spaces, hangars and galleys.

b. **Explosive Risk.** Magazines, lockers, RU stores and designated danger areas as defined in BR 862 - Naval Magazine and Explosive Regulations.

c. **Electronic and Operational Spaces of High Value.** Operations room, computer rooms, designated communications and weapon equipment compartments, ship control centres, navigation equipment compartments, switchboard rooms, electrical distribution centres, telephone exchanges, conversion equipment rooms, EW spaces, main cable and wiring spaces.

2. Disposition of Kill Cards

The Kill Cards are provided as Form S.3201 and are A4 size. They have holes punched, so that they can be bound together to form a loose-leaf book which can be indexed. They are to be indexed numerically. The completed cards are to be available as follows:

a. NBCD HQ1 (and HQ2) - full sets.

b. Section Bases/FRPPs - cards for compartments within the responsibility of the Section Base/FRPP.

c. An additional card is to be secured adjacent to the outside of the compartment door.

3. Information

Kill Cards must include the following information if applicable:

a. Recommended minimum time of operation of each steam/gas drench or foam/water-spray system.

b. Equipments, stores, services etc contained within the compartment with those items of extra high risk being so noted, and their position in the compartment stated. (A fuel line, hydraulic service pipe or air service pipe could add appreciably to the hazard of the fire if ruptured.)

c. Any other relevant information, displayed on a simple diagram of the compartment layout to assist firefighters entering the compartment. The diagram should also include positions of obstructions and passageways.

d. The presence of any structure other than mild steel, eg aluminium or melamine plastic laminate.

e. The presence and details of any Fire Barrier Insulation (FBI) fitted is to be indicated by a broken black line with the notation ‘Fire Barrier Insulation’, followed by the type of material in brackets ie (Type A90), (Type A60) or (Type A30).

f. Boundary temperature monitoring points.

4. A generic example of a completed Firefighting Kill Card is at Figs 21G-1 (front) and Fig 21G-2 (back).

5. Smoke Clearance Plans

A space is provided on the Kill Card for smoke clearance action. If this space is too small to contain the information, a separate Smoke Clearance Plan is to be made up, with an alphabetical cross-reference on the Kill Card. An example of a Smoke clearance Plan is at Fig 21G-3.

Firefighting Kill Card No. 209

RN Form S3021
(Revised 2/94)

Ventilation Control

	Fan	Starter at	Flaps/Slides at
Supply	ACU 17 3E 15 RECIRC FAN	3E STBD.	1E
Exhaust	01 F 19 EF 10	01F STBD.	01F HWTC

Natural Ventilation	
SUPPLY FROM No15&16 ACU 3E1	VALVE IN No 15 & 16 ACU 3E1

Danger Hazards

Within the Compartment	External to the Compartment
440V R22 GAS LUBOIL (IN CW PLANT)	HP&LP AIR (3/4F FAMR) DIESO FUEL (3/4F FAMR) LUBOIL (3/4F FAMR) 600 V (3/4F FAMR) 440 V (ALL COMPTS)

Compartment

CHILLED WATER PLANT RM.

Location Mark

4E

Frame Station Numbers

64 - 72 ZONE 1B

Nearest F & RP Post

FWD 2D

Firefighting Installations

Within the Compartment: Fixed	Within the Compartment: Portable	External to the Compartment: Fixed	External to the Compartment: Portable
SMOKE DETECTORS 2 HYDRANTS 2 DOUBLE HOSE BASKETS	1 AFFF EXT. 2 No 2 HOSE 6M 2 No 2 HOSE 12M 1 CO_2 EXT. 2 FF NOZZLES	1 HYDRANT 1 DOUBLE HOSE BASKET 1 No 2 HOSE 6M 1 No 2 HOSE 12M (3E LOBBY)	1 CFHR 1 INDUCTOR 1 AFFF EXT. (3E LOBBY)

Smoke Clearance Action

OPEN HWTC AT 01F STBD FOR EXHAUST FAN 01F19. OPEN 1E2 AIRLOCK DOORS FWD. OPEN 1/2 E HATCH FWD. OPEN 2/3 E HATCH AFT. OPEN 3/4E HATCH AFT. SHUT ALL OTHER DOORS/HATCHES IN E SECTION. RUN EXHAUST FAN 01F19. RUN ACU 17.
SMOKE COMMS: 3E ADJ GYRO ROOM

Pumping Out Arrangements

ONE 75 M^3/H SALVAGE EDUCTOR

NEAREST OVERBOARD DISCHARGE AT 2E2 SR PANTRY.

Electrical Supplies to be Isolated

ACP1: BKRS F-16 (N). H-16 (A)
ACP2: BKRS H-15 (N). F-15 (A)
HPSW PUMP: MCCB E-R1-07
ACP PUMPS: MCCB E-R2-6, E-R2-7

Hazardous Systems to be Isolated

SHUT LP AIR VALVE A1S 2007 IN 3/4F FAMR

Fig 21G-1. Example of a Kill Card (front)

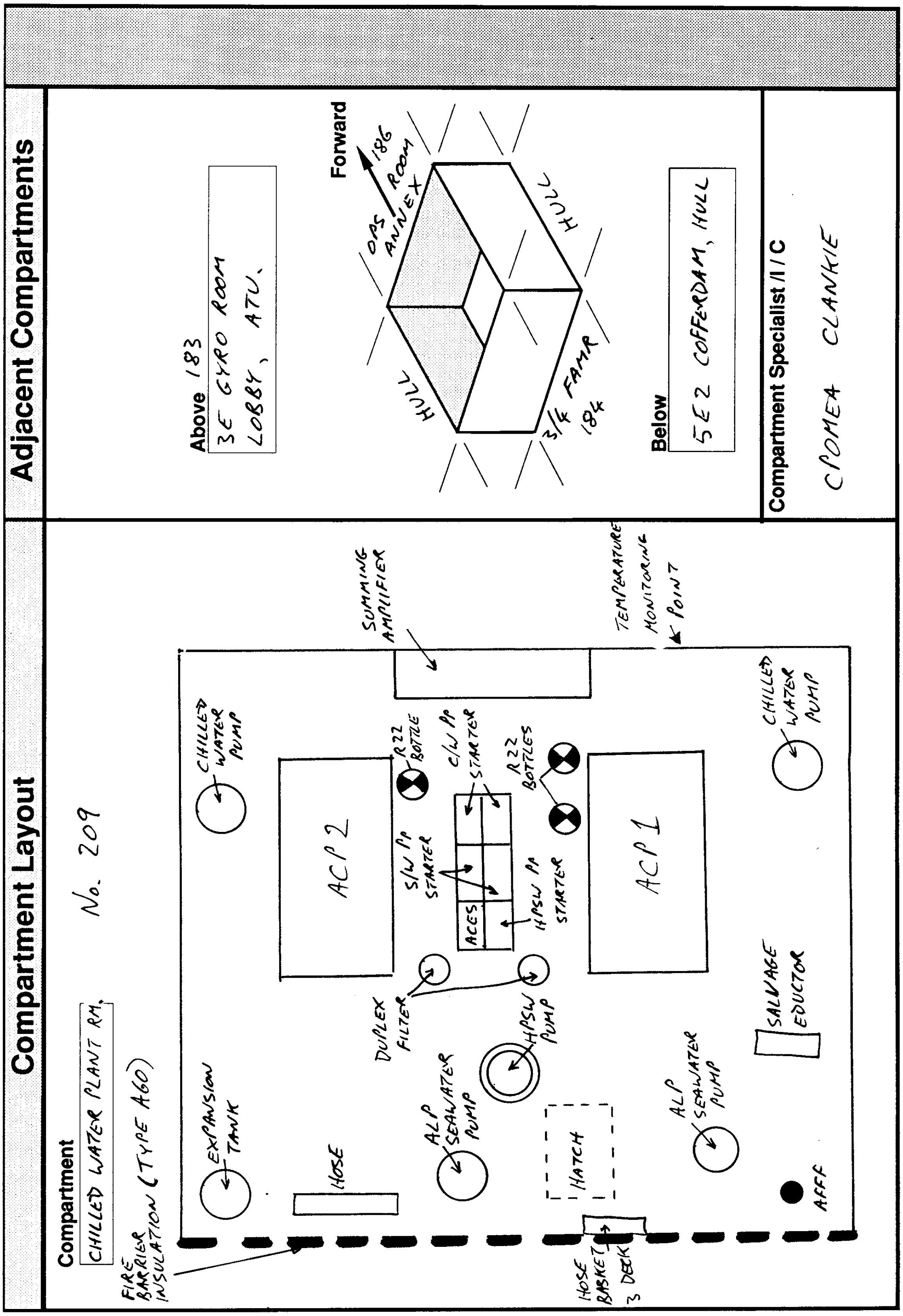

Fig 21G-2. Example of a Kill Card (back)

2P 2Q 2R Smoke logged compartment doors open Non-smoke logged closed	SMOKE CLEARANCE PLAN 1. Sentries to be placed on ALL open doors & hatches 2. Briefed to shut openings on ‘BRACE’ Command 3. HQ1 informed at end of smoke clearance 4. Do not start ATU’s unless fan is in smoke free area 5. Smoke Curtains to be tied back	**K**

OPEN DOORS AND HATCHES		CLOSED DOORS AND HATCHES		ADDITIONAL EXH FANS
DOORS	HATCHES	DOORS	HATCHES	Exh No 8 starter in AFU No 5
2K/M				Exh No 17 2R starter in laundry
2M/P		2J/K	2N	Exh No 18 2S starter in 2R lobby
2P/Q			2P	
2Q/R			2Q	
2R)			2S	
$2S_1$)Aft Airlock			1K	
			1M	
				ATU’s (See Note 4 Above)
If fire in JR’s Bathroom 2R1, NBCD store 2Rz1 of undress area 2Sz, open appropriate doors to atmosphere and close airlock 2R/2S		AER Hydraulic Hatch FER Hydraulic Hatch FAMR Hydraulic Hatch		ATU No 14 2R AFU No 5 IN

BLOW		SUPPLY FANS
MACHY VENT RUNNING	MACHY VENT STOPPED	Sup No 6 1P starter in Trans & MG Compt
FER Supply P&S	FER Exh P&S	Sup No 8 2R starter in laundry
AER Supply P&S	AER Exh P&S	Sup No 9 2R Starter in drying rm
AAMR Supply P&S	AAMR Exh P&S	

Fig 21G-3. Example of a Smoke Clearance Plan

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ANNEX H TO CHAPTER 21

FIREFIGHTING IN A CHEMICAL ENVIRONMENT - BA PROCEDURES

1. The protective clothing for firefighting in various NBC environments is detailed in Chapter 26. When a ship's firefighting team is required to leave the citadel to fight a fire in a chemical environment (liquid or vapour) the following BA procedures should be adopted.

2. Before Leaving the Citadel

a. The BA Controller is to carry the team's respirators (in their haversacks).

b. The Firefighting Team is to remain in the citadel, 'off air', until informed that all hoses are rigged.

c. The Team is to be briefed before they go 'on air'.

d. The Team and BA Controller are to exit the citadel under the control of HQ1.

3. If the ship is free from contamination within the citadel, then it may be possible for the team to exit the ship 'on air' (after undertaking the normal face seal check) and proceed directly to the fire (endurance of the BA set should be considered). However, if those inside the citadel are wearing respirators when the team is required to exit the citadel, then the following routines for changing from respirators to EDBA should be followed.

4. Changing from NBC Respirator to EDBA
The firefighter should change from respirator to EDBA in the following manner:

a. Select a sheltered position (if on the upper deck).

b. Put on the EDBA set, check the DV by-pass knob is *off* and open the bottle fully. To ease donning the facemask with the eyes shut, the straps should be folded around the front of the facemask and the facemask neck strap placed out of the way of the facemask. Firefighting gloves are placed, open end down, under the EDBA waist strap.

c. Decontaminate the EDBA facemask and straps using Fullers Earth (DKP1).

d. Remove headgear, antiflash hood in a vapour environment, IPE suit hood if in a liquid environment.

e. Using the 'buddy system', open the EDBA DV by-pass knob, take a deep breath and shut the eyes. The BA Controller then removes the Firefighter's respirator and the Firefighter, bending forward, dons the firefighter's hood and the EDBA facemask

f. Ease the top of the facemask away from the forehead momentarily to allow the air to purge out of the mask. Tighten the head harness straps, open the eyes and continue to breathe. Take a deep breath to operate the first-breath positive pressure mechanism, then turn off the by-pass.

g. Carry out a face seal check.

h. Pull up the firefighter's hood, don FFHBC and, if in a vapour environment, put on firefighting gloves. Using the 'buddy system' check each-other's dress.

i. The BA Controller, on completion of filling out the control board, decontaminates the respirators, placing them in their haversacks and keeps them available for future use.

5. Changing from EDBA to NBC Respirator

The four man Firefighting Team should change from EDBA to respirators in the following manner.

a. If dressed as required for a vapour hazard environment:

(1) Select a sheltered position on the upper deck.

(2) Remove FFHBC. The BA Controller then removes the firefighting gloves and rolls the firefighter's hood down around the Firefighter's neck.

(3) The BA Controller opens the Firefighter's haversack and presents the respirator and DKP1 to the firefighter, who removes these items.

(4) The Firefighters decontaminate their respirators and the BA Controller decontaminates his gloves with Fullers Earth (DKP1).

(5) The Firefighter takes a deep breath and shuts his eyes. The BA Controller removes the EDBA facemask and the Firefighter dons his respirator in the normal manner, breathing out hard to clear any contamination inside.

(6) When the BA Controller has removed the EDBA facemask from the firefighter, he presses the DV re-set button.

(7) If necessary, the Firefighter, using the 'buddy system' carries out the personal decontamination drill (see BR 2170(2)).

(8) The Firefighter replaces his firefighter's hood and takes his haversack from the BA Controller.

(9) The Firefighter collects all items of firefighting clothing and equipment and proceeds to the weathering point on the upperdeck.

(10) EDBAs and firefighters' helmets etc are then hung up to weather.

(11) Firefighters (wearing fearnought and respirator) then proceed to the Cleansing Station to enter the ship.

b. If dressed as required for a liquid environment:

(1) Select a sheltered position on the upper deck.

(2) Decontaminate NBC gloves using Fullers Earth (DKP1).

(3) Loosen and pull back the hood of the NBC suit.

(4) The BA Controller opens the Firefighter's haversack and presents the respirator and DKP1 to the Firefighter, who removes these items.

(5) The Firefighters decontaminate their respirators and the BA Controller decontaminates his gloves with Fullers Earth (DKP1).

(6) The Firefighter takes a deep breath and shuts his eyes. The BA Controller removes the EDBA facemask and the Firefighter dons his respirator in the normal manner, breathing out hard to clear any contamination inside.

(7) When the BA Controller has removed the EDBA facemask from the Firefighter, he presses the DV re-set button.

(8) Using the 'buddy system', the Firefighter carries out the personal decontamination drill (see BR 2170(2)).

(9) The Firefighter replaces his NBC hood and takes his haversack from the BA Controller.

(10) The Firefighter collects all items of firefighting clothing and equipment and proceed to the weathering point on the upperdeck.

(11) EDBAs, etc are then hung up to weather.

(12) Firefighters then proceed to the Cleansing Station to enter the ship.

6. The procedure for undressing and cleansing from a fearnought suit is detailed in BR 2170(2).

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ANNEX I TO CHAPTER 21

FIREFIGHTING ASSISTANCE TO OTHER SHIPS

1. Initial Assessment and Planning

The following points should be considered during the initial assessment of an incident in another ship at sea, before committing firefighting or search and rescue teams:

a. Accounting for personnel and casualties.

b. Establishing an incident boundary and checks of adjacent compartments.

c. Assessment of the hazards to firefighting or search and rescue (SAR) operations (eg hazardous cargo, fuel, live electrical systems, pressurised systems, smoke-logging, restricted access, sea state).

d. Informing shore authorities and other ships in the area.

e. Availability of ship's boats for transfer of personnel and stores.

f. The establishment of a stability datum and the effects of firefighting operations on stability.

g. The availability of ship systems (eg fire pumps, electrical supplies, ventilation, emergency lighting, fixed firefighting systems, portable equipment, BA).

h. Compatibility of hose connections. Availability of the International Shore Connection.

i. The hazards associated with cargoes containing Toxic Industrial Materials (see BR 2170(2) Chapter 5).

j. Prior agreement of the assistance to be provided.

k. Prioritisation of actions and agreement of the plan (SAR, CASEVAC, containment, firefighting).

2. Information Sources

The following information sources should be available to assist with the initial assessment and incident planning:

a. **Fire Control Plans.** These should be available in either English or French in all merchant ships conforming with IMO conventions. They should be kept, usually in a red container, either on the bridge or at gangway positions. They contain detailed information on ship firefighting equipment, fire lockers, fixed systems, ventilation plans, etc. They may be very complex, requiring assistance from the ship's crew to interpret them.

b. **Dangerous Goods Declaration.** Dangerous cargoes should be identified by IMDG Codes, which are detailed in Chapter 5 of BR 2170(2). In some ships these may not be very accurate, so all cargo should be treated as hazardous until confirmed otherwise.

c. **Cargo Plan/Manifest.** The Manifest gives details of cargo locations and the order in which it has been stowed for unloading. This may also be a complex document, requiring assistance to decode and interpret.

d. **Stability Data.** This may be difficult to find. Consideration should be given to nominating a Stability Officer to monitor and update stability information, using a portable stability board. If normal RN firefighting techniques are used in ships with large deck areas, free surface water could quickly pose a threat to stability.

3. Nomination of Responsible Officers

Personnel should be nominated as Responsible Officers for the following:

a. Stability.

b. Logistics.

c. Communications.

d. Safety.

e. BA Control.

f. BA Coordination.

g. Firefighting water supply.

h. Firefighting operations.

i. SAR operations.

j. Casualty handling.

ANNEX J TO CHAPTER 21

GAS TURBINE MODULE RE-ENTRY PROCEDURES

1. Introduction

The generic guidance provided in this Annex is to be adapted to suit individual ship machinery and equipment before being incorporated into local Standing Orders. These procedures concentrate on module re-entry after the initial watchkeepers' actions detailed in the respective Machinery Drills BRs. There are two procedures, one for peacetime operations and one for the Action State. The principles of maintaining module integrity while cooling, purging and then re-entering in the safest possible manner, (without re-ignition) are to take precedence in peacetime incidents. Purge times are not statutory; personnel in charge are to decide on safe and sensible periods, based on available information.

PART 1 - MODULE RECOVERY IN PEACETIME

2. Containment Stage

Unless the module has been breached, the operation of fire suppression systems should extinguish a fire within a module. Uptakes, downtakes, associated ventilation trunking and all sides of the module require monitoring and cooling. The most susceptible areas of modules are the flexible gussets between the engine raft, intake cascade bend and the acoustic enclosure. An engine fire will probably result in the module windows becoming blacked out or, at best, allow only a limited view of the interior. Continual checks using any visual indications through the module windows and all thermometers (fitted and portable) should confirm that temperatures are reducing and that no re-ignition has occurred. Empty fixed firefighting cylinders (single shot only) are to be replaced during this stage. If considered safe, machinery space ventilation may be used to clear fumes and provide fresh air for personnel within the compartment.

3. Firefighting Preparation Stage

Two hoses are required, one for a waterwall and one for foam. The waterwall should be by a standard hose with a firefighter nozzle or, if not fitted, a CFHR. Foam should be by a FB5X or, if not fitted, a CFHR. Where possible, these hoses are to be from within the machinery space, to allow the access to be closed during module re-entry. Boundary cooling hoses may be used once temperatures have reduced. A four-man Re-entry Team in Full Firefighting Rig is to be dressed and briefed.

4. Module Purge Stage

The aim of this stage is to clear the module of combustion products and gas, and reduce the temperature before re-entry. Before commencing the purge, consideration must be given to the exit location of the purge gases. If necessary, the weather deck in the area of the module ventilation outlet should be cleared and the ship's course relative to the wind may need alteration. After confirming that the module interior is safe to purge (temperature and observation via the module window), the ventilation flaps may be carefully opened. Immediately check the interior of the module for signs of re-ignition. If re-ignition has not occurred, module purging may now commence. If, at any stage, re-ignition occurs, immediately stop the purge, shut the purge valve and ventilation flaps, and operate the fixed firefighting system.

5. The method of purging is dependent on the design of the module:

a. **Module Enclosure Ventilation Fan** This is a fully contained method with the least risk to personnel in the machinery space. After opening the ventilation flaps, the enclosure fan is started and the module interior is purged. Personnel require no additional protection except Basic Firefighting Rig.

b. **Module Purge Valve** Module purging is achieved by the use of the machinery space ventilation fans. Supply fans are run and exhaust fans stopped, therefore pressurising the machinery space. Transit to/from the machinery space requires tight control to ensure that a positive machinery space pressure is maintained. Intermediate Firefighting Rig is worn but BA face masks need not be donned (except for the initial opening of the purge valve). Care is to be taken when initially opening the purge valve, to confirm the correct airflow direction and no re-ignition. A sentry with at least a portable extinguisher is to remain in the vicinity of the purge valve throughout the purging operation.

6. Module Re-entry Stage

When purging is complete and the module temperature has reduced to an acceptable level, all ventilation is to be stopped and the module ventilation flaps/purge valves shut. All personnel not wearing Full Firefighting Rig are to leave the machinery space. Close all machinery space accesses, where possible, and post sentries. Entry by the four-man team is to be authorised by the MEO and conducted with hoses charged and nozzles shut.

7. Recovery Stage

Once re-entry has been achieved, machinery space ventilation may be restarted to clear any products of combustion from the machinery space (the module door is left open). When the atmosphere is clear, the Re-entry Team may go ‘off air’, and personnel without BA may re-enter the machinery space. Damage to the engine and module is to be assessed and, if possible, rectified.

PART 2 - MODULE RECOVERY IN ACTION

8. Risk Management in Action

The principles of module recovery in the Action State are driven by the Command Aim at the time of the incident. Strong and effective management is essential. Some calculated risks and decisions may be needed to achieve speedy recovery of the engine. The drill reactions and module checks share much with the peacetime procedure. However, the imperatives of the Command Aim may necessitate more rapid module entry to assess serviceability, identify repair actions and arrange logistic/technical support requirements.

9. Containment Stage

Cooling should be concentrated on the areas most likely to breach, allowing loss of BCF/BTM from the module. The flexible gussets can be cooled by one person using a CFHR, releasing other manpower for blanket searching and other first aid actions. Should the Command veto tripping of the engine, consideration should be given to more robust cooling methods.

10. In the event of a module breach, initial leakstopping should be actioned and full containment instigated, with the aim of reducing the leakage of BCF/BTM and preventing the spread of fire to the machinery space. The use of breathing apparatus will be required in this instance.

11. An engine fire will probably result in the module windows becoming blacked out or, at best, allow a limited view of the interior. The use of fitted temperature gauges may be the only method of confirming that a fire is extinguished. Checking of thermometers in module windows should be included in State 1 preparations.

12. Firefighting Preparation Stage

Driven by the Command Aim, the urgency to recover the module will dictate the level of firefighting equipment deployed and whether the fixed gas drench cylinders should be changed. The potential exposure to higher than normal temperatures and the possibility of re-ignition must be considered. A size 2 hose with firefighter nozzle for personal protection and an FB5X must be used. In ships with no hydrants within the space CFHRs may be used one on water and one on foam. Personnel involved in other urgent tasks such as blanket searching, leak stopping, etc should carry an ELSA and continue until complete, and when available should assist in the recovery of the engine.

13. Purge and Recovery Stage

The initial communications between the local position and the SCC/MCR should determine the course of action. The Action crew should assess the local situation and request permission to purge and recover the module, taking account of the timescales involved. The order from HQ1 to conduct an Action Recovery should authorise the Action crew to start the machinery space ventilation, purge and enter the module without further reference to the SCC/MCR. It is therefore imperative that all factors are considered before ordering a recovery. The Action NBCDO is to authorise the re-entry.

14. The I/C of the space should risk assess actions in line with ship priorities, including the situation with regard to personnel remaining in the space, access to ELSA or breathing apparatus and an escape route. Any personnel remaining within the space are to be informed that the recovery is to be conducted. Action crews must then ensure that any personnel leaving the machinery space are aware of the proposed recovery, and order them to start the machinery space supply fans and act as sentries at the machinery space access door. External help may be needed to achieve these tasks.

15. The method of purging recommended in order to ensure that the quickest possible recovery can be achieved is as follows. Module vent flaps should be opened and module checked for re-ignition. If no re-ignition then the MMS supply fans should be started once permission has been granted. The purging time should be at the discretion of the I/C of the space, but approved by the PM, taking into account the circumstances that prevail and the priority placed on recovery. The Action crew with the necessary fire fighting equipment and BA being worn should then crack open the module door sufficiently to establish a purging air flow. Once purged the module door is to be fully opened and re-entry undertaken.

16. Engine Repair Stage

Specialist manpower should be activated while the Action Recovery is underway and every effort should be made to restore the engine to a serviceable condition as quickly as possible. Documentation and stores support should be primed as part of the initial actions, so that engine fault detection and repair can be started as soon as the module has been entered. Additional manpower may be required and this needs careful management by the Propulsion Manager/Action MEOOW.

ANNEX K TO CHAPTER 21

SMOKE BOUNDARY MANAGEMENT

1. During the initial attack on a fire the person discovering the fire, those in the immediate vicinity responding to the Loud Vocal Alarm and the Attack Party are expected to commence a continuous, aggressive attack on the fire, initially without the respiratory protection provided by Breathing Apparatus. There is clearly a risk to those personnel from the smoke inhalation and this must be balanced against the consequences of a small fire developing into a major incident.

2. To contain and prevent the spread of smoke through the ship, smoke boundaries should be established quickly by the person in control of the FCP. These should be at the periphery of the smoke-logged compartment(s) and the closest tenable area to the scene of the fire. Smoke boundaries must not fully enclose the fire until all non-BA wearing personnel known to be within the boundary have withdrawn. Only then should the final boundary be established; this will normally be directly between the FCP and the SOTI. 'Controlled Access' into the smoke boundary zone must be strictly enforced at the FCP. To this end, HQ1 must pipe the location of all smoke boundaries and the location of the FCP. All other doors and hatches forming part of the boundary should be manned to prevent unauthorised personnel entering the smoke affected area and jeopardising additional areas of the ship.

3. In major warships smoke boundaries must be established by shutting watertight doors, hatches and ventilation closures. Whilst non watertight doors, smoke curtains and water walls can be used to impede the spread of smoke, especially in the early attack on the fire, they are less effective and should not be considered physical boundaries.

4. In ships with limited watertight sub division, such as MM/PPs and those vessels built to commercial standards, it may not always be practicable, or desirable, to establish all smoke boundaries at the watertight closures. In certain cases, non-watertight doors, hatches or smoke curtains may need to be utilised. In this way, vital areas of the ship may remain more readily accessible and the FCP and key positions remain as close as practicable to the SOTI. In these circumstances personnel in charge of incidents must remain alert to their vulnerability and increased risks in the event of any sudden escalation of the fire.

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CHAPTER 22

HIGH PRESSURE SEA WATER SYSTEMS AND ASSOCIATED FIREFIGHTING EQUIPMENT

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CHAPTER 22

HIGH PRESSURE SEA WATER SYSTEMS AND ASSOCIATED FIREFIGHTING EQUIPMENT

2201. The high pressure sea water (HPSW) system supplies sea water throughout the ship, usually by means of a ring main, to supply the following services:

a. Firefighting installations including spray systems in machinery spaces, magazines, flammable stowages and other high risk areas.

b. Prewetting systems.

c. Domestic and sanitary services.

d. Ballasting and deballasting water-compensated fuel tanks and other tanks used for stability purposes.

e. Eductors for salvage and general drainage.

f. Hangar spraying systems in aircraft carriers.

g. Flight deck firefighting systems in aircraft carriers.

h. Cooling of essential machinery and equipment.

2202. Pumping, flooding and draining are dealt with in Chapter 28. Portable and mobile firefighting equipment, and fixed firefighting installations (other than those supplied from the HPSW system) are dealt with in Chapter 23. This chapter contains a general description of the HPSW installations and their associated firefighting equipment. For detailed information concerning specific ships, reference should be made to the appropriate NBCD Class Book.

2203. Intermediate Pressure and Low Pressure Sea Water Systems

Cooling for electrical and other equipment and emergency cooling for certain other items of machinery can be supplied by sea water, at reduced pressure, from the HPSW system.

2204. HPSW Pumps

The HP sea water main is supplied by electrically driven pumps of 72-200 m^3/h capacity according to the size of ship. They are designed to produce about 7 bar pressure in the system and are dispersed throughout the ship, inside and outside the machinery spaces. The number of pumps fitted in any ship is based on the water requirement for firefighting, deballasting or prewetting, whichever is the greatest, together with any essential service such as emergency cooling water for important equipment, plus allowance for breakdowns. The sole duty of these pumps is to supply the HPSW main. They normally take suction directly from the sea although one or more of the pumps can also take suction from the discharge side of the diesel generator heat exchanger, or some other hot discharge, so that warmed water can be delivered to the system in arctic conditions. This facility is not fitted in all ships.

2205. Domestic Services

If it is possible, domestic services such as supplies to bathroom eductors, sanitary services, garbage disposal, sewage plants, refrigerating plant and other similar services, are generally grouped together so that supplies can readily be isolated to enable adequate pressure to be maintained in the system in an emergency.

2206. HPSW Main

This can be a ring main, a single line of piping, or cross-connected double lines, running fore and aft with extensions and branches as necessary to carry sea water under pressure to all parts of the ship. It is identified by bands of green tape, marked 'SEA', around the piping. Branches for firefighting and spray systems are painted bright red throughout their length. The main usually runs fairly high in the ship above the waterline. It is intended to work at about 7 bar but damage (or other causes) may cause the pressure to drop below this and most appliances for use on the main are designed to work at pressures as low as 2.4 bar.

2207. The pumps discharge through vertical pipes called rising mains, which lead into the HPSW main. The numbering system for HPSW main valves is detailed in Chapter 2. To prevent flooding from, or loss of pressure in, a damaged main, isolating valves are fitted:

a. On each side of the junction of the rising main with the HP sea water main.

b. In the rising main below its junction with the HP sea water main.

c. On each side of branches leading to spraying installations.

d. At each watertight bulkhead (transverse or longitudinal) if there is no other isolating valve in that section.

e. On each side of a cross connection junction with the main.

2208. Pressure Gauges

Direct reading pressure gauges are fitted in the HPSW main adjacent to each riser. For single spot helicopter decks a direct reading gauge is fitted in the branch from the main immediately upstream of the monitors and hangar spray system. In ships with between-deck hangars pressure gauges are fitted in each hangar access lobby to indicate upper main pressure. The remote pressure information in each zone is displayed in the SCC/HQ1, HQ2 and/or AHQ and Section Bases. Where the main is fitted on port and starboard sides of the ship, as a ring main, they are treated as separate mains and each is fitted with pressure gauges.

2209. Shore Connections

Connections into the HPSW main are provided normally fore and aft port and starboard to enable shore-supply water to be used for firefighting purposes while the ship is in dock. These can also be used for rigging emergency fore-aft breeching hoses in the event of damage to the system. In ships with flooding systems, water can be supplied up to the sea inlet valves through flooding bonnets.

2210. Hydrants

These are fitted to the HPSW main throughout the ship, each consisting of a screw-down or single-action lever operated control valve controlling one or two outlets which should be blanked by caps when not fitted with ready-use hoses or required for use. The screw-down valve should be shut HAND TIGHT only, as overtightening will cause damage to the valve seat. The single action lever operated control valve should, when required to be operated, be opened slowly to avoid the possible displacement of the seal.

2211. Hoses

Impermeable lay-flat delivery hoses are supplied for use with the HPSW main, and they vary in length from 2 metres to 18 metres in the following two sizes:

a. **No 2 Size.** Of 50mm (2 inch) diameter for general use at all hydrants throughout the ship (except those fitted with No 3 hoses as sub-para b below).

b. **No 3 Size.** Of 70mm (2¾ inch) diameter and for use with FB10X foam branchpipes and fixed inline inductors on flightdecks and in hangar positions of some aircraft carriers. An allowance of No 3 hoses is also stowed at each Fire and Repair Party Post for use as a temporary HPSW main and as discharge hoses from portable pumps.

2212. Hose Couplings

Firefighting hoses are joined together and connected to the HPSW main by instantaneous couplings (Fig 22-1). Each coupling has a male and a female half. All hydrants have female connections so that when coupling a hose, THE MALE END MUST BE TAKEN TO THE HYDRANT AND THE FEMALE END TOWARDS THE FIRE. The marrying parts of the couplings are of one standard size but the tails are of size to suit the hoses concerned. The female half of each coupling has a rubber seal which should be inspected regularly and maintained in good order.

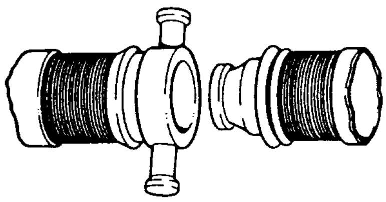


Fig 22-1. Instantaneous Coupling

2213. Stowage of Hoses

A hose should at all times be coupled to each hydrant and a nozzle connected to the hose so that water can be delivered immediately if it is needed (Fig 22-2). Although fairly robust, hoses need care if they are to be kept in good order, and the following instructions must be observed.

a. Hoses are to be faked down in their stowages ready for running out. Where double-hose baskets are fitted, the hose in the section of the basket closest to the bulkhead must be a faked 12m hose and that in the basket furthest from the bulkhead is to be a rolled 6m hose.

b. Hoses should not be left faked in their stowages for periods exceeding four months without being removed and run out for inspection. The position of the folds should be shifted when re-stowing.

c. Particularly when kinked, the hose should not be dragged over rough surfaces, especially when charged with water. To do so will subject it to severe local abrasion.

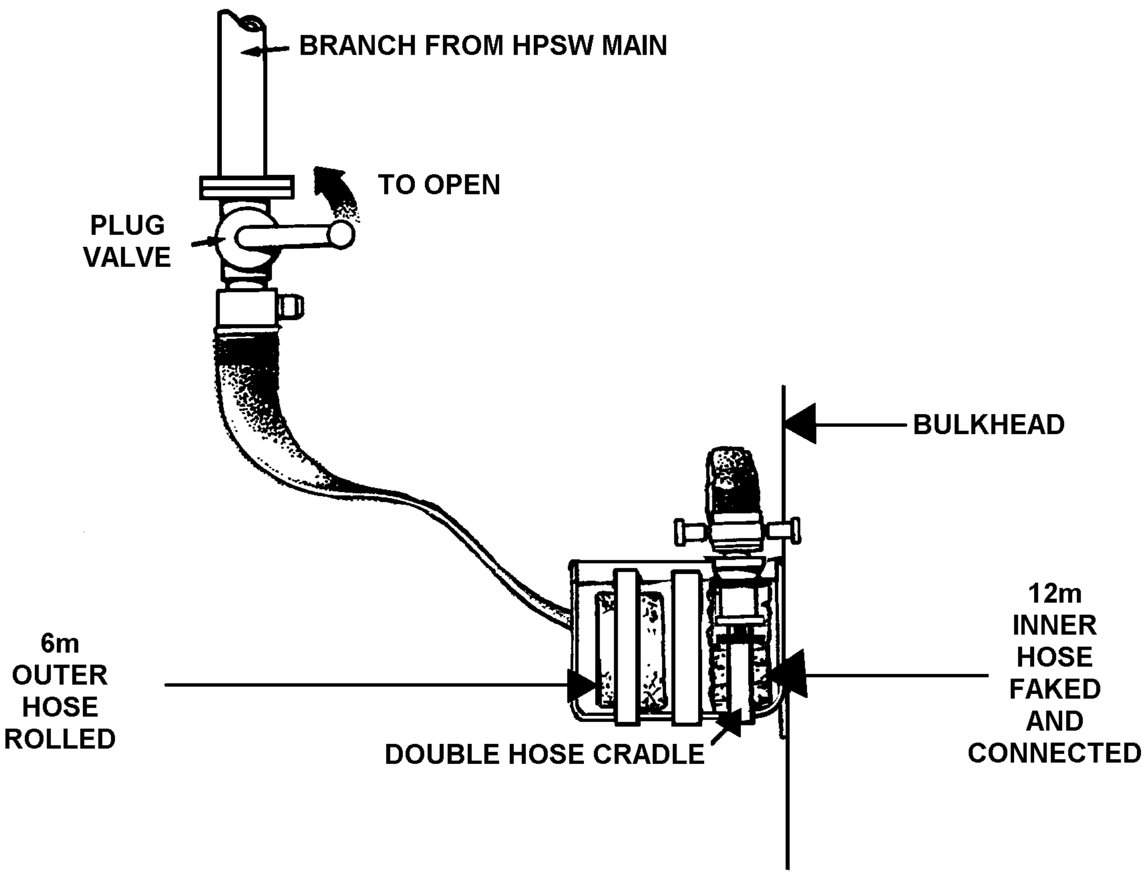


Fig 22-2. Stowage of Fire Hose

d. Because of pump vibration, a hose may chafe where it first touches the deck after leaving a portable pump outlet. This point of contact should be protected by wrapping rags around the hose. Similarly, protective padding should be used where the hose passes over sharp edges, such as door or hatch coamings.

e. To avoid subjecting the hose to sudden shock or strain, and to avoid possible displacement of the seal, hydrants and pump delivery valves should always be opened slowly, and sudden closure of the nozzle should be avoided.

f. Hoses must be drained and wiped down before being stowed. To expel water, hoses should not be walked along the deck but should be under-run at shoulder height.

g. Hoses and couplings must not be painted.

h. Hoses should be washed and flushed through after contamination with fuels, oils and greases, and after use with AFFF.

i. Hoses, which are not filled with water, catch fire or melt when in contact with excessive heat or fire and must be stowed away from hot pipes or structure.

j. Sea lashings may be fitted to upperdeck hose cradles in MM/PPs to prevent loss or damage to the rolled and faked hoses during rough weather and high sea states. However, they must not inhibit access to, and the operation of, the hoses during an emergency.

k. CVS/LPH hangar fire point basket carry two No 3 hoses. The inboard hose is Dutch rolled the outer hose is faked down in its stowage.

2214. Nozzles

Two types of hand-held nozzle are in service in HM ships:

a. **Firefighter Nozzle** (Fig 22-3). The Firefighter nozzle is provided at all between deck fire hydrants, already connected to a 12 metre faked hose. It is stowed in the shut position. To operate the nozzle turn it one eighth of a turn to the right to provide a 2 metre flat disc (personal protection) waterwall. A further turn of one eighth of a turn to the right produces a 60 degree ragged spray, which is used for fighting fires. The output from a firefighter nozzler ranges from 10 to 17 cubic metres per hour (see Table 22-1).

b. **Waterwall Nozzle** (Fig 22-4). These are provided at all weatherdeck hydrants and three are kept in each FRPP fire locker for use in providing waterwalls. They are stowed in the shut position, which is achieved by turning the rotating sleeve clockwise (looking from the operator) which takes the rotating sleeve away from the operator. Opening the nozzle by rotating the sleeve anti-clockwise produces, initially, a jet, but the nozzle must be opened fully to produce the desired waterwall. Water discharge capacities are given in Table 22-1.

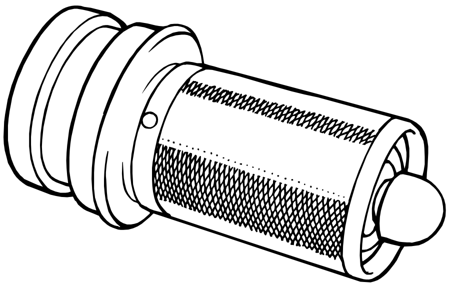


Fig 22-3. Firefighter Nozzle

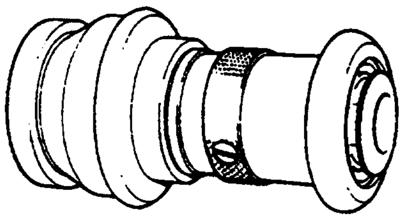


Fig 22-4. Waterwall Nozzle

Table 22-1. Water Capacities of Nozzles in m^3/h

Pressure	Waterwall			Firefighter			Hatch Waterwall
(bar)	Spray 110°	Spray 90°	Jet	Spray 45°	Spray 90°	Jet	
2.4	23.9	22.9	15.5	8.3	5.4	9.7	
3.5	28.7	27.4	18.3	10.2	6.4	11.5	
4.5	32.5	30.7	21.1	11.5	7.4	13.1	
5.5	36.4	34.0	23.9	12.7	8.1	14.7	
6.9	40.4	37.8	26.4	14.2	9.3	16.3	
7.0							10
8.3	44.3	42.2	28.7	15.7	10.2	17.8	

Note. *To convert m^3/h into litres/min (approximately) multiply m^3/h* by 17.

Table 22-2. Foam-Producing Characteristics of Branchpipes

	FB5X Mk 2	FB10/10
Water pressure in bar	5.5	not less than 4.1
AFFF consumption in litres/min	13.5	25
Foam delivery in litres/min	2,250	4,540

Table 22-3. Water Capacities of Branchpipes in m^3/h

Water Pressure in Bar	FB5X Mk 2	FB10/10
2.4	9.1	22.4
3.4	10.4	26.9
4.8	12.1	30.5
5.5	13.4	34.0
6.9	14.9	38.1
8.3	16.5	41.1

2215. Fixed Hatch Waterwall Nozzle

Fixed hatch waterwall nozzles are fitted primarily in the corners (their spray angle is approximately 120°) of all hatches leading to high fire risk compartments to facilitate re-entry when firefighting by providing a more effective sealing waterwall and possibly reducing the number of personnel in close proximity to the hatch. Where the fitting of these nozzles obstructs guardrail stanchions then the stanchions must be re-sited and their chains adjusted to length accordingly. The nozzle blanking cap is to bear the same watertight and gastight control marking as the hatch and is to be fitted when the nozzle is not in use.

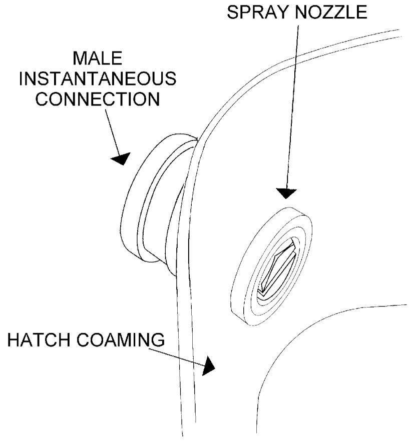


Fig 22-5. Fixed Hatch Waterwall Nozzle

2216. Waterwall Nozzle Mounting Pole

The procedure, detailed in Annex A to Chapter 21 and in BR 4007, for fighting surface ship fires from below requires an operating waterwall nozzle to be raised through a hatchway from below. This is achieved by mounting the nozzle on a special, one metre long, pole (See Fig 22-6). A separate, two metre long, support pole (See Fig 22-7) is used for pushing the hatch open from the deck below. The V shaped cradle on this pole is used to assist in positioning the waterwall nozzle mounting pole in the hatchway. A lug on the waterwall mounting pole allows it to be located on the hatch coaming.

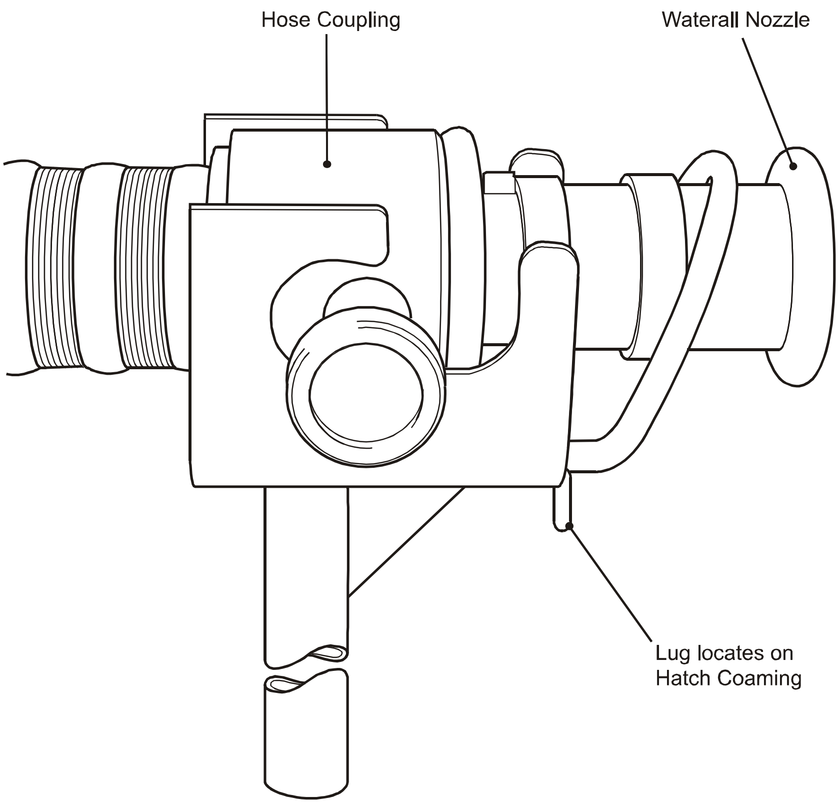


Fig 22-6. Waterwall Nozzle Mounting Pole

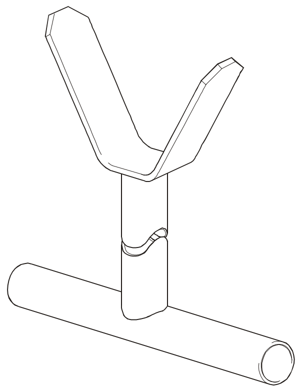


Fig 22-7. Support Pole

2217. Foam-making Branchpipes

The two types of foam-making branchpipe used in ships are the FB5X Mk 2 and the FB10/10.

2218. FB5X Mk 2 Foam-making Branchpipe

The FB5X Mk 2 is a lightweight branchpipe for general use against liquid fires in ships, except in the hangar or on the flight deck. It is only to be used with size 2 hoses. Using size 2 hoses, the consumption rate for a 20 litre container of AFFF is 70 seconds with a water pressure of 6.9 bar. A good backup supply of AFFF containers is therefore essential. The FB5X Mk 2 is fitted with an open/shut facility which enables the operator to control the foam discharge. It is also fitted with a foam mix selector which for RN application must always be pinned at the six per cent AFFF position. The pick-up assembly (suction hose and spill) are attached to the branchpipe by a quick-release coupling. The pick-up assembly is normally connected directly to the branchpipe but can be transferred to the associated portable inline inductor (see Para 2221). To induce AFFF, the cap of the AFFF container must be removed and the spill pickup inserted. The FB5X is also used to put foam into machinery spaces through foam inlet tubes.

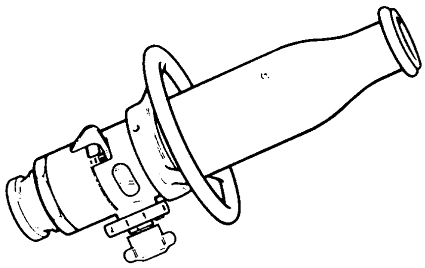


Fig 22-8. Foam Branchpipe FB5X Mk 2

2219. FB10/10 Foam-making Branchpipe

This is a high-output branchpipe used only on flight decks and Aircraft Carriers. Each of the hydrants in these positions has an FBU10 inline inductor bolted to the flange before the instantaneous coupling. The pick-up assembly is attached to the inductor and has a shut-off cock which is to remain in the open position.. The inductor passes a mixture of AFFF and water through a No 3 hose to the branchpipe which aerates and delivers the foam at the rate of about 4540 litres per minute. The branchpipe needs a HPSW main pressure of not less than 4.1 bar at the branchpipe to produce foam of good quality, and will consume about 25 litres of AFFF per minute. A handle at the output end of the branchpipe operates a swirl-vane selector which enables foam to be delivered to a distance like a jet or less forcibly as a spray. (A waterwall nozzle is stowed at each hydrant and can be attached to the hose in place of the branchpipe, with the pick-up shut off, to produce a waterwall spray protection.) The FB10/10 is a commercial variant of the FB10X and is similar in design and performance It replaces the FB10X only on a wastage basis.

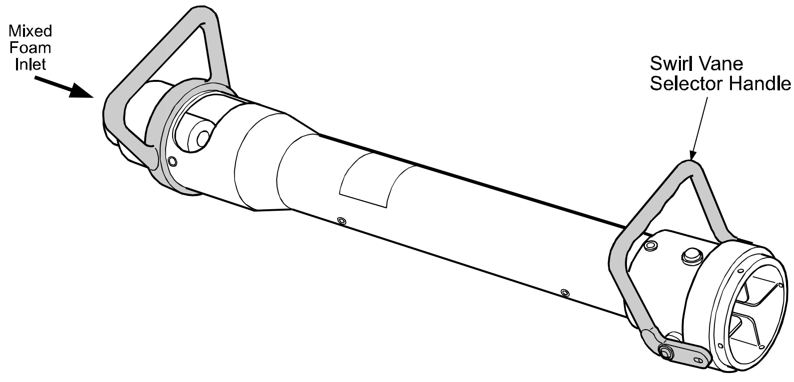


Fig 22-9. Foam Branchpipe FB10(X) or FB10/10

2220. Characteristics of Foam-making Branchpipes

The foam-producing characteristics of the branchpipes are given in Table 22-2 and the water capacities in m^3/h of the branchpipes are given in Table 22-3.

2221. Portable Inline Inductor FBU5

This inductor is designed for use with the FB5X and its purpose is to allow AFFF to be introduced into the hoseline at or near the hydrant position and not directly into the branchpipe. This allows the operator much greater mobility in that he is no longer encumbered by AFFF containers and the pickup assembly when passing through doorways, hatches and when using ladders. The inline inductor comes complete with stowage bracket and a 2m length of No 2 hose (for use between the hydrant and the inductor). The inline inductor is fitted with a quick release coupling which incorporates a non-return valve, this prevents the AFFF container being pressurised when the FB5X control valve is shut off. The pick-up spill for the inductor is taken from the branchpipe which no longer needs one when being used in conjunction with the inductor (the spill connecting point on the branchpipes need not be blanked off). The inline inductor should not be used when the FB5X is being used to introduce foam via inlet tubes. The number of inductors onboard are small and they are best kept for use with firefighting hoses which are being moved around by operators, as opposed to static hoses, eg those led to foam inlet tubes.

Note. *When using the FB5*X *with its spill pickup assembly, the portable inline inductor should not be connected into the hoseline, as this will induce air and prevent foam induction at the branchpipe.*

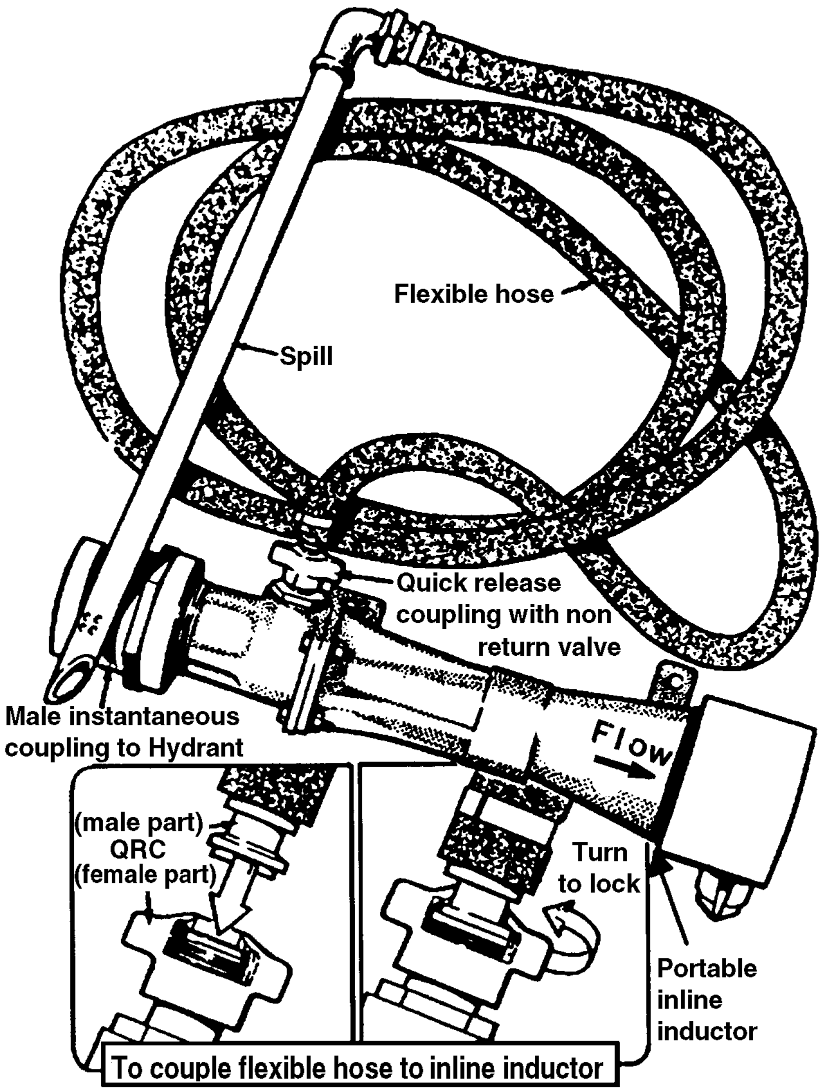


Fig 22-10. Portable Inline Inductor FBU5

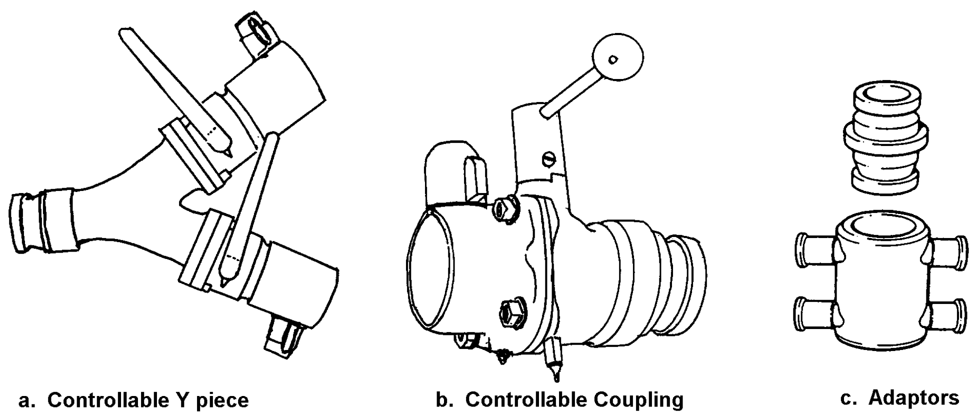


Fig 22-11. Couplings and Adaptors

2222. Controllable Y Piece

The controllable Y piece, shown in Fig 22-11a is manufactured from anodized aluminium and replaces the non controllable gunmetal version. It is carried in ships in order that two hoses may be run from a single hose or hydrant. It is particularly useful in:

a. Boundary cooling.

b. Allowing the extension of a hose in either leg.

c. Isolating burst hoses.

CAUTION

THESE ALUMINIUM Y PIECES ARE ONLY TO BE CONNECTED TO HYDRANTS USING THE 2 METRE LENGTH OF NO 3 HOSE PROVIDED. (CONNECTING DIRECTLY TO THE HYDRANT WILL CAUSE THE ALUMINIUM TO FRACTURE.)

WARNING

Y PIECES ARE NOT TO BE USED TO PROVIDE A WATERWALL AND A FIREFIGHTING HOSE TO THE SAME TEAM OF FIREFIGHTERS. THE WATERWALL AND FIREFIGHTING HOSE MUST COME FROM DIFFERENT HYDRANTS.

2223. Inline Controllable Coupling Piece

This coupling piece is shown in Fig 22-11b. It can be used:

a. To connect onto through-bulkhead connectors to facilitate zone isolation.

b. At clipped doors to enable closure in Condition Alfa.

c. On long hose runs to enable the hose handler to turn off and extend the run without going back to the hydrant.

2224. Double Ended Hose Adaptors

The double male and double female instantaneous adaptors, shown in Fig 22-11c, are provided to permit emergency runs of hoses between hydrants.

2225. Flange Adaptors

A range of flange adaptors are provided to allow the HPSW main or firefighting pumps to be connected to other NATO ships or merchant ships. The adaptors are detailed in Chapter 28 and ship allowances are listed in BR 2170(3).

2226. Spare.

2227. Emergency Bulkhead Hose Connections

The purpose of these connections is to allow a run of hoses, when the HP sea water main has been damaged, between adjoining watertight subdivisions without compromising watertight integrity by opening doors. They may also be used to help contain smoke when firefighting by allowing watertight doors on smoke boundaries to be kept closed. Connections are fitted in selected bulkheads, usually where the HPSW main is not duplicated and not adequately protected by structure, ie generally in the fore and after parts of the ship. Normally, the instantaneous coupling on the forward side of the bulkhead is female, and the after side is male. Where two connections are fitted in the same bulkhead, one will be male-aft and female-forward and one will be female-aft and male-forward. The blanking caps must always be kept fitted to bulkhead hose connections except when the connections are in use, to preserve watertight integrity, and they should bear the same WT and GT control marking as the adjacent door.

2228. Centre Feed Hose Reel

The Centre Feed Hose Reel (CFHR) is a first aid firefighting appliance, normally used in the FOAM mode, but with the facility to be used in the WATER mode for boundary cooling. (Some ships, fitted with the early model ¾ inch hose reel in the machinery spaces do not have a foam pick up capability.) The Mk 1 CFHR layout is shown at Fig 22-12 and the Mk 2 at Fig 22-13.

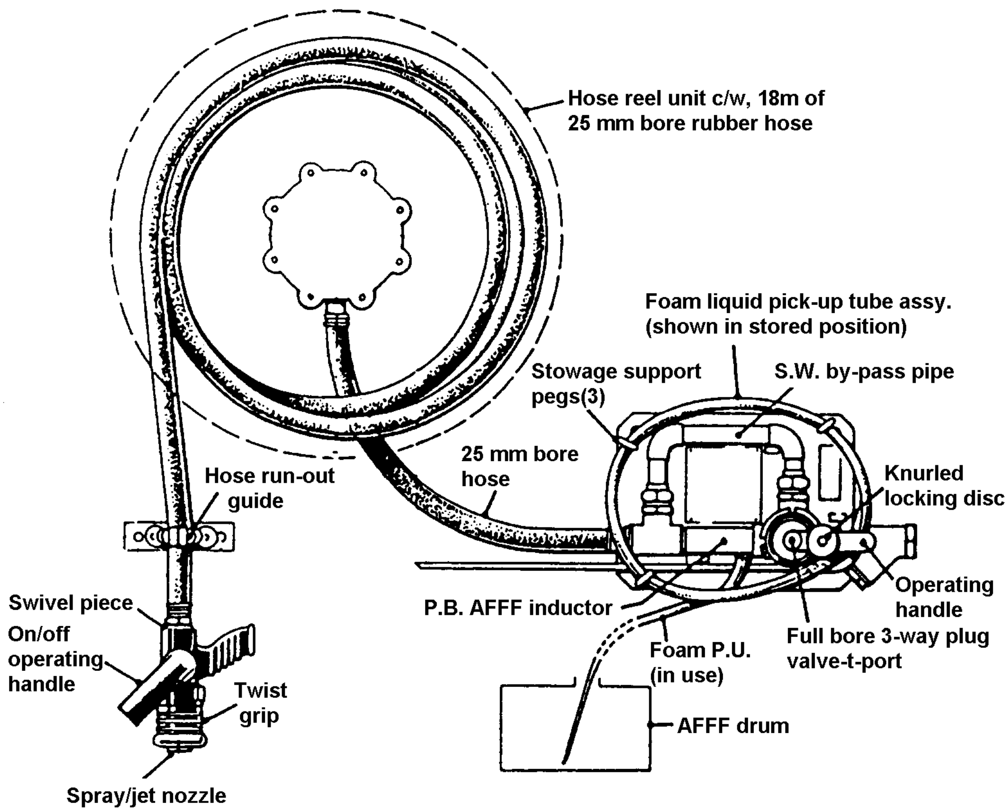


Fig 22-12. Centre Feed (Foam/Water) Hose Reel Unit (Mk 1)

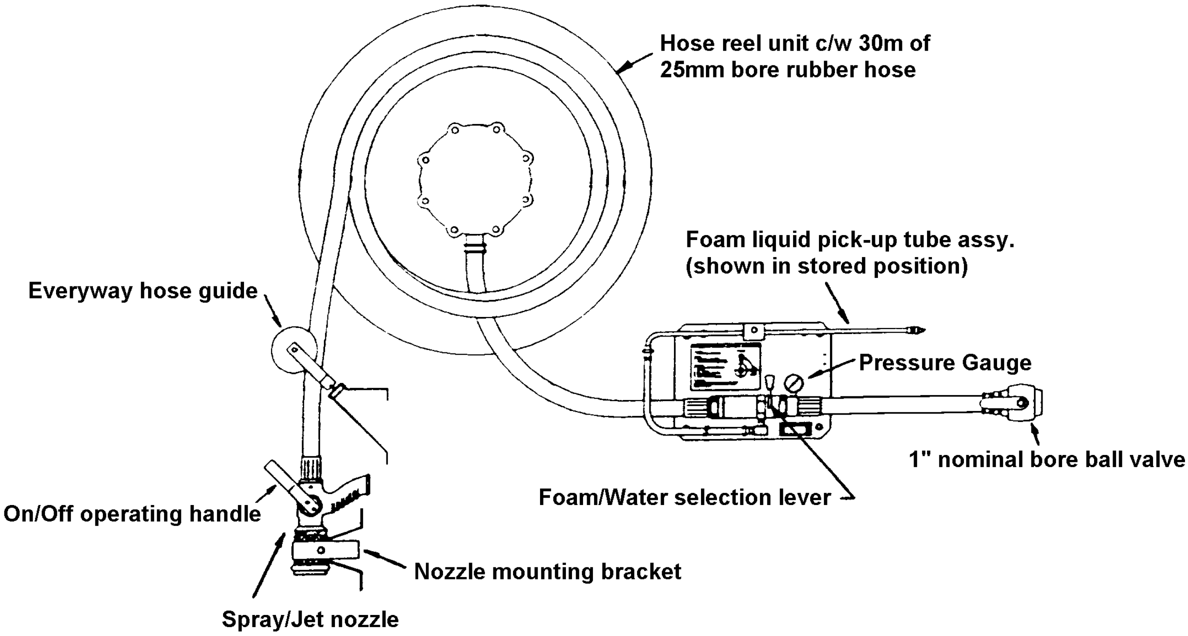


Fig 22-13. Centre Feed (Foam/Water) Hose Reel Unit (Mk 2)

2229. CFHR Standby condition

A number of ships with the Mk 1 CFHR are not fitted with an isolating valve adjacent to the inductor panel. These ships are to set the 3 position operating valve on the inductor to the OFF position. The normal STANDBY CONDITION for the 3 way selector valves is summarised as follows:

a. Two HPSW Isolating Valves Fitted:

(1) HPSW isolating valve PINNED OPEN.

(2) HPSW valve adjacent to the inductor panel SHUT.

(3) Three position selector valve set to FOAM (Mk 1) or Foam/Water selection lever set to FOAM (Mk 2).

(4) Nozzle valve SHUT.

b. One HPSW Isolating Valve Fitted Adjacent to the Inductor Panel:

(1) HPSW valve adjacent to the inductor panel SHUT.

(2) Three position selector valve set to FOAM (Mk 1) or Foam/Water selection lever set to FOAM (Mk 2).

(3) Nozzle valve SHUT.

c. One HPSW Isolating Valve NOT Adjacent to the Inductor Panel (not applicable to Mk 2):

(1) HPSW isolating valve PINNED OPEN.

(2) Three position selector valve SHUT.

(3) Nozzle valve SHUT.

2230. At NBCD State 1, centre feed hose reels are to be de-isolated and pressurised up to the nozzle control valve.

2231. CFHR Operating Instructions

Operating instructions and a deck plan showing compartments served are to be displayed adjacent to each CFHR. The CFHR is operated as follows:

a. **First Aid Firefighters**

(1) Remove the cap from the AFFF drum and insert the spill pick-up.

(2) Open the isolating valve adjacent to the inductor panel.

(3) Proceed to the location of the fire.

(4) Direct the nozzle away from the fire and open the nozzle valve.

(5) When foam is being produced attack the fire.

(6) The next person on the scene must re-supply AFFF.

b. **Boundary Cooling.** The WATER mode is to be used when boundary cooling.

(1) Select WATER position on the selector valve.

(2) Proceed to the location requiring boundary cooling.

(3) Open the nozzle and select ragged spray.

(4) Boundary cool using the minimum amount of water.

c. **After Use.** Following use the system is to be flushed with water, the isolating valve prior to the inductor panel is to be closed and the hose rewound with the nozzle open to allow the hose to drain, the nozzle is then closed. Care must be taken to rewind the hose in the right direction to avoid kinking at the exit from the drum.

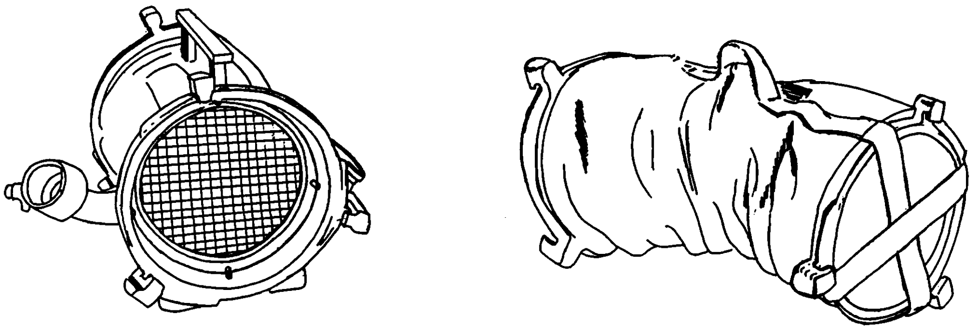
2232. CFHR Nozzle Mounting Pole

The procedure, detailed in BR 2170(4) and in BR 4007, for fighting submarine fires from below requires an operating CFHR nozzle (set to the spray/waterwall position) to be raised through a hatchway from below. This is achieved by mounting the CFHR nozzle on a special pole (different from the waterwall nozzle mounting pole). The standardised design and codification of this device is not yet completed. Pending codification, guidance on local manufacture and use of the pole may be obtained from Triumph NBCD School, HMS RALEIGH.

2233. Ramfan

The Ramfan (see Fig 22-14) is a water turbine driven, one-man portable, fan. Its purpose is smoke clearance or double bottom venting. It is driven from the HPSW main and will accept any pressure from 2.75 to 12.4 bar (40 to 180 psi) via a male instantaneous inlet coupling. Water discharge is from a female outlet coupling to be connected, via a Size 3 hose, to any discharge overboard. Air flow is through 5 metre lengths of 300mm diameter hose. This hose is rigid across its diameter but collapsible along its axis into half metre high bags, two of which can be carried by one person. A fan set comprises one fan and four lengths of hose. One set is kept at each FRPP.

2234. Where there is a requirement over and above the capability of the ship's ventilation system, to remove smoke from areas adjacent to a fire or remove smoke or fumes after the extinction of a fire, the Ramfan with its associated flexible ducting may be used in the Negative Pressure Ventilation (NPV) mode, ie fan suction, from the vented space. After use, the water turbine should be flushed through with fresh water to inhibit corrosion.



a. Ramfan   b. Ramfan Ducting

Fig 22-14. Ramfan

2235. Spare.

2236. Flooding and Spraying Systems

Flooding systems are no longer fitted in main magazines but they are fitted to some magazine lockers on the upper deck of ships. A variety of fixed water spray systems are fitted in ships, mainly in magazines, machinery spaces, flammable stowages and aircraft hangars. The following paragraphs give a brief description of the most common types. Full details are given in class-specific Books of Reference. BR 862 - Naval Magazine and Explosives Regulations gives generic instructions for magazine systems.

2237. Manually Operated Spray Systems

Each manually operated spray system is supplied with sea water from the HPSW system via an isolating valve, a strainer and a spray valve. The spray valve can be operated from two locations. Open ended sprinklers are normally fitted, although some explosive lockers have a perforated pipe instead. Some machinery space systems can also be used to spray foam.

2238. Automatic Spray Systems

Magazine automatic spray systems are permanently charged with fresh water, pressurised by the HPSW system. The spray valve and HPSW isolating valve are both locked open when a magazine contains ammunition. Each spray head incorporates a quartzoid bulb which bursts at a predetermined temperature to release the fresh water, followed by sea water from the HPSW system. A water flow alarm with remote indication is fitted to give warning when the system has operated automatically.

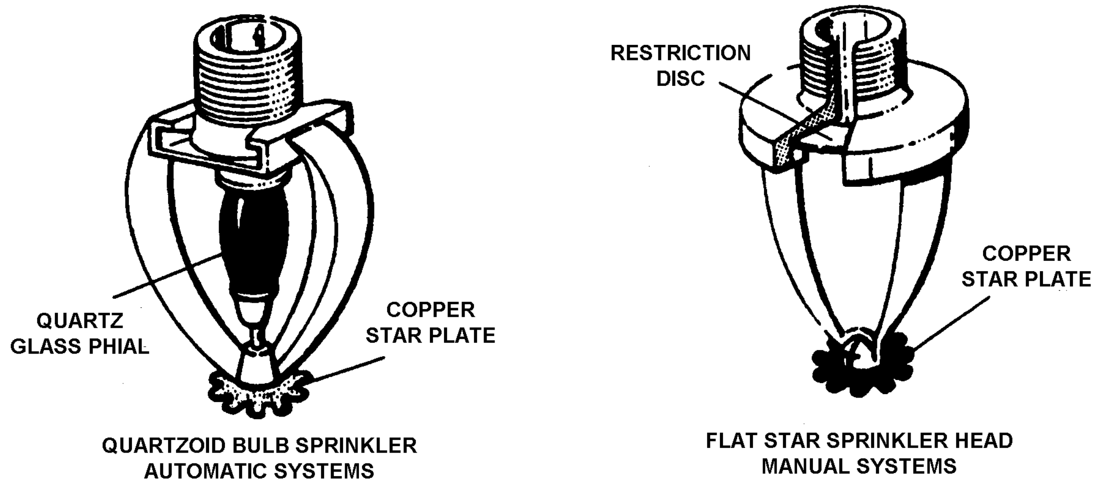


Fig 22-15. Sprinkler Heads

2239. Pressurised Reservoir Systems

Magazines which contain a large amount of propellant and high explosive require an automatic system with an instant high flow rate of water. A pressurised fresh water reservoir is therefore fitted to give the initial flow, allowing time for extra HPSW pumps to be started. When one or more of the quartzoid bulbs bursts, water is expelled from the fresh water reservoir by compressed air pressure acting on a rubber diaphragm bag in the reservoir.

2240. Rapid Reaction Spray Systems

The magazine rapid reaction spray system is a pressurised reservoir system, activated by smoke detection. The pneumatically operated spray valve is opened automatically by a control system. When the spray valve opens, the ship's HPSW pumps are automatically started sequentially to provide the required flow.

2241. Metron Activated Spray Systems

The metron activated spray system has quartzoid bulb spray heads in a pressurised system similar to that described in Para 2238. In addition to the normal activation by temperature, the quartzoid bulbs can also be burst by small charges, initiated by smoke detectors, via a control system. The control system can be switched to manual mode but it is normally left in automatic mode when ammunition is embarked.

2242. Spare

2243. Hangar Spray Systems

Manually operated HPSW spray systems are fitted to aircraft hangars in ships. In larger hangars, such as that in a CVS, the system is divided into separate grids, each with its own spray valve. Great care must be taken to prevent the accumulation of free surface water from hangar spray systems. Hangar scuppers must be kept clear at all times and they must be constantly checked when sprays are operated.

2244. Dry Risers

In some ships, minor compartments such as messdecks are fitted with dry HPSW or foam spray systems. Each system is terminated, outside the protected compartment, in a male instantaneous hose connection protected by a female blanking cap. If no isolating valve is fitted, the blanking cap is to bear the same watertight and gastight control marking as any adjacent door/hatch in the bulkhead/deck through which the system passes.

2245. Flight Decks

In aircraft carriers an independent sea water main is run under the flight deck supplied by its own pumps which produce about 7-9 bar pressure to the hydrants located on the flight deck and on the catwalks. At each hydrant (fire point) a metal locker provides a degree of protection for fire equipment against the weather and downwash from aircraft. Inside the locker, at the bottom, four 20 litre canisters of AFFF are stowed alongside a 9 litre SP AFFF and a 9 litre SP dry powder extinguisher. A No 3 hose is faked across the top of the AFFF containers and the female end connected to a Foam Making Branchpipe 10/10, the male end being routed outside the top of the locker and connected to the inductor. An additional No 3 hose is also stowed in the locker and is Dutch rolled. A waterwall nozzle stowed in the locker can replace the branchpipe, providing spray waterwall if necessary. Fig 22-16 shows a typical CVS flight deck arrangement.

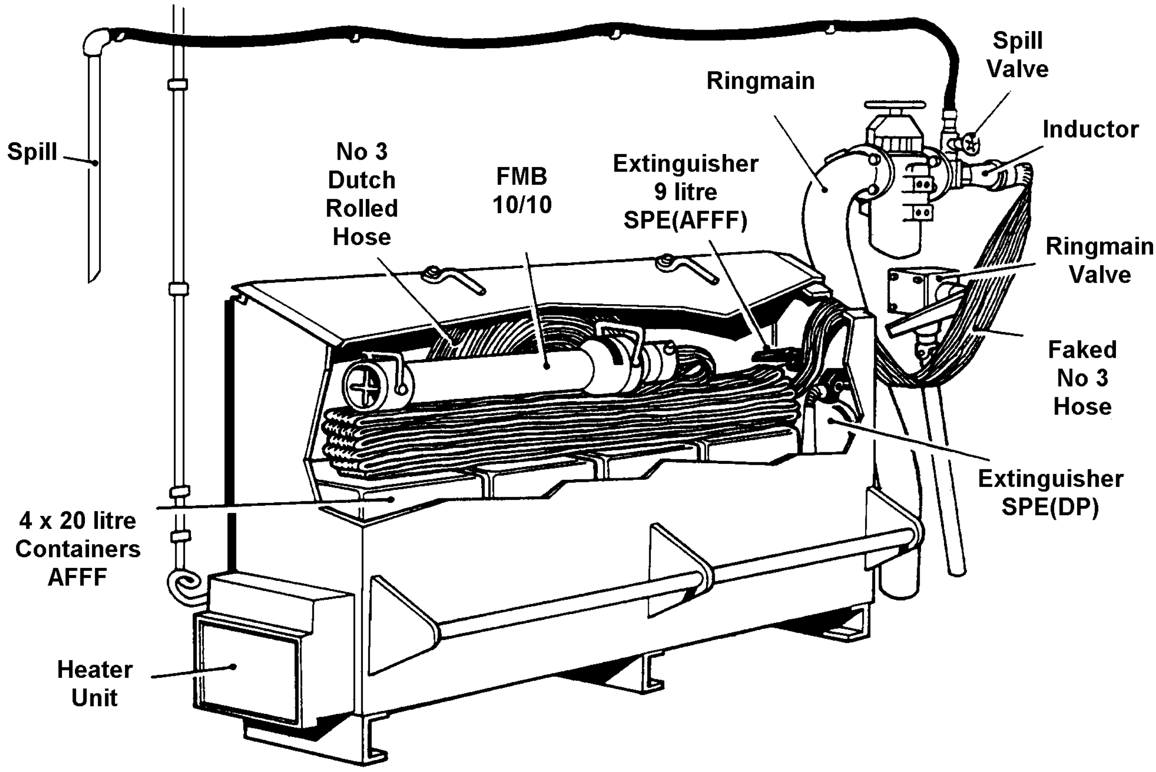


Fig 22-16. Typical Flight-deck Fire Hydrant Arrangement

2246. Dutch Rolling of Hoses

On flight decks manned by aircraft handlers, ie on multi-spot decks, spare fire hoses are stowed using the Dutch rolled method. Stowage and deployment of Dutch rolled hoses is achieved as follows:

a. **Stowing the Hose.** Lay the hose out flat. Draw the female coupling back along the hose length to 1 metre short of the male coupling. Once the upper layer has been aligned precisely over the lower layer the hose can be rolled up from the bight with the couplings coming together on the outside of the roll.

b. **Deploying the Hose.** To deploy the hose after removing it from its stowage, it should be held in front of the couplings with one hand supporting the roll of the hose. The hose is then rolled away so that it uncoils itself leaving a loop of hose on the deck. The male coupling can then be attached to the pump/hydrant/hose and the female coupling taken towards the fire.

c. **Stowing Dutch Rolled Hose.** The Dutch rolled hose will stow as shown in Fig 22-17.

Note. *The Dutch rolled hose method is only to be used on flight decks. Its use between decks, in any ship, is prohibited.*

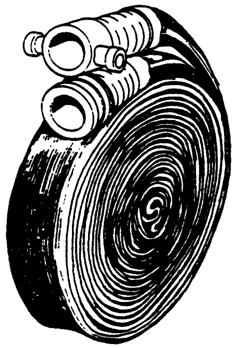


Fig 22-17. Dutch Rolled Hose

2247. Flight Deck Monitor

The flight deck monitor is used to project foam onto the area of an aircraft landing spot. The type of monitor varies between ship classes; the automatic oscillating type is illustrated at Fig 22-18. In this type, a Pelton wheel water motor, using a small amount of HPSW, provides the power for oscillation. The frequency of oscillation is dependent on HPSW supply pressure, but it is typically eight cycles per second at 7 bar. The range of oscillation and nozzle elevation are set during installation, but must be confirmed by a full functional check if adjusted during maintenance work. When not in use, the monitor is to be set in the automatic oscillating mode, with the nozzle centred. Monitors which do not have the automatic oscillating mode must be traversed and elevated manually. Monitors are supplied with 1% AFFF, the concentrate being stored in a dedicated tank.

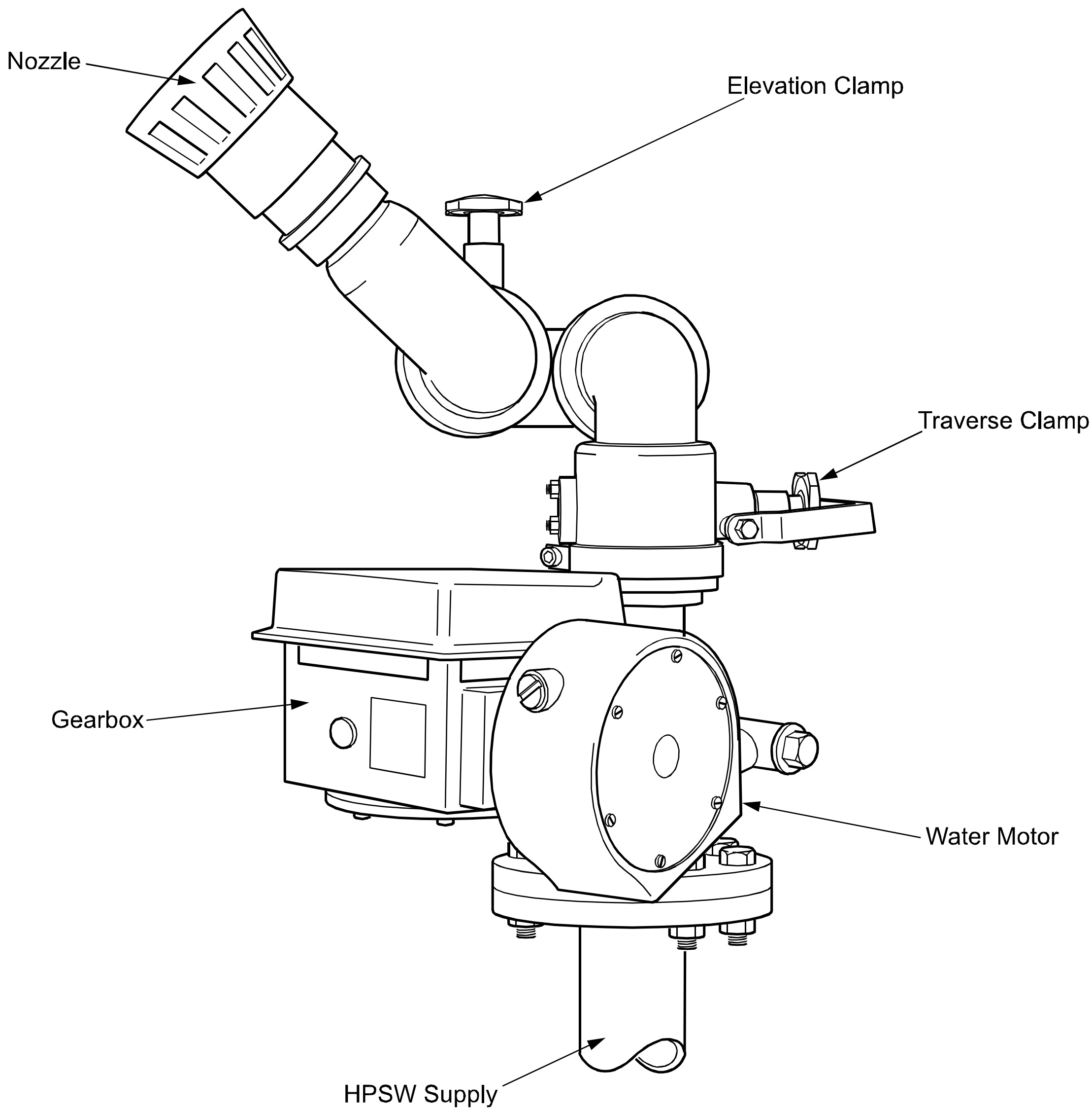


Fig 22-18. Automatic Oscillating Monitor

CHAPTER 23

FIREFIGHTING, APPLIANCES AND INSTALLATIONS

CONTENTS

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CHAPTER 23

FIREFIGHTING, APPLIANCES AND INSTALLATIONS

2301. Portable and Mobile Equipment

This Chapter deals with portable and mobile appliances and equipments, and fixed firefighting appliances and installations other than those associated with the HP sea water system. The latter are dealt with in Chapter 22.

2302. There are several types of portable (first aid) appliances for hand use, provided for attacking fire in its early stages. If tackled promptly, most fires can be extinguished by such appliances, but it is important to realize their limitations and to prepare adequate back-up should they fail. It should be noted that whenever a gas or solid (eg CO_2 or dry powder) is expelled under pressure from an extinguisher, electrostatic charges may be generated. The occasions when such charges assume the capability of causing electric shock to the user are rare; they vary according to circumstances and, in any case, are usually only of a minor nature.

EVERYONE MUST KNOW WHERE TO FIND AND HOW TO USE THE RIGHT TYPE OF EXTINGUISHER FOR ANY SORT OF FIRE.

2303. Stored Pressure Extinguisher (AFFF) (SPE(AFFF)) - Pre 2003 Model

The SPE(AFFF) is a first aid firefighting appliance, suitable for attacking all types of fire. It delivers a stream of AFFF by a simple ‘seize and squeeze’ controllable discharge which will last for a total of 50 seconds when charged to 10 bar. The pre 2003 model is readily identifiable by the polished finish of its stainless steel shell and red usage instructions.

a. **Instructions Regarding Use.** For more detailed information than is contained in these paragraphs, BR 6592(014) - Fire Extinguisher, Foam, Stored Pressure, Nine Litre Type, should be referred to.

(1) *Applicability.* This extinguisher is suitable for fighting all fires, both those involving solid materials (Class A fires) and those involving liquid fuels (Class B fires).

(2) *Method of Use.* It is brought into use by withdrawing the safety pin from the discharge head assembly and then depressing the operating handle whilst pointing the nozzle in the direction of the fire and playing foam over it, using a flat figure of eight motion to achieve complete coverage, as quickly as possible. Releasing the operating lever will stop the flow of foam and allow it to be redirected elsewhere, should it be needed, without wastage.

(3) *Use Against Electrical Fire.* This extinguisher is safe to use against low voltage fires providing the nozzle is at least 1.8 metres from the source of power. It must not be used on voltages above 400 V ac or 800 V dc.

(4) *Care After Use.* Carry out the recharging routine below.

(5) *Stowage.* These extinguishers are sited around the ship in accordance with the ship's firefighting arrangement drawing, and adjacent to FRPP lockers. A stowage suitable for the compressed air recharging bottle is provided adjacent to FRPP lockers.

CAUTION
INSTRUCTIONS ON THE SPE(AFFF) ARE IN RED: THOSE ON THE SPE(DP) ARE IN BLUE.

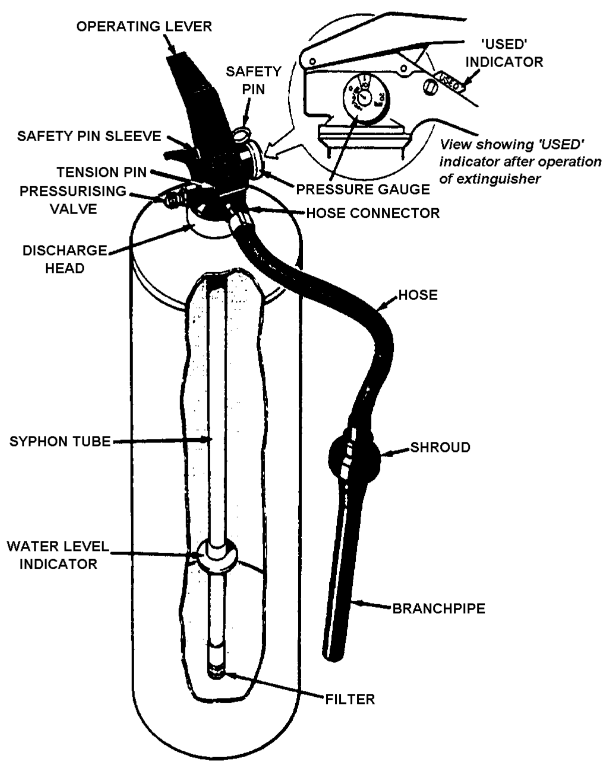

Fig 23-1. SPE(AFFF) - Pre 2003

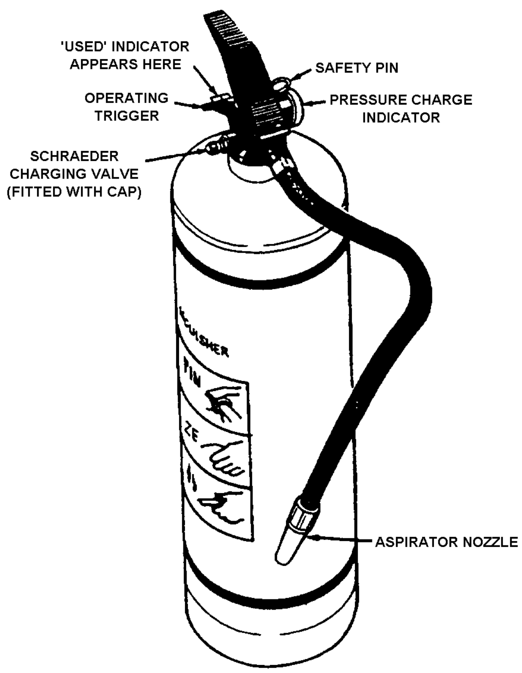

Fig 23-2. SPE(DP) - Pre 2003

b. **Recharging Arrangements.** The extinguisher is to be recharged with fresh water/AFFF solution as follows:

(1) Invert the extinguisher and squeeze the operating lever to vent any residual pressure.

(2) Unscrew the discharge head assembly, complete with the syphon tube, and withdraw it from the shell.

(3) Wash out the inside of the shell thoroughly with clean, fresh water.

(4) Pour 8.6 litres of clean, fresh water into the extinguisher using the syphon tube as a dipstick. (The correct amount of water is indicated when it reaches the end of the syphon tube and the measuring shoulder, which projects out from the side of the syphon tube, is resting on the lip at the top of the extinguisher.) Using a 500 ml graduated acrylic AFFF measuring cylinder, top up the extinguisher with 0.4 litres of 6% AFFF, making the contents 9 litres.

Notes:

1. In some extinguishers the measuring shoulder is replaced by a letter F.

2. Should sea water ever be used to fill the extinguisher in an emergency, the extinguisher is to be well rinsed out immediately after use with clean fresh water, otherwise corrosion of the extinguisher body will occur. Refill with clean, fresh water and AFFF solution as above.

(5) When the solution level is correct, replace the discharge head assembly and HAND tighten.

Note. *A thin film of petroleum grease is to be applied to the Head Seating 'O' Ring before replacing the head assembly.*

(6) Raise the operating lever to its non-operational position, insert the safety pin and retain it by fitting a Hellerman rubber sleeve to the end of the pin. Fit an anti-tamper tag through the pull end of the pin and around the operating lever.

(7) Reset the 'USED' indicator.

(8) Remove the air charging valve dust cap and connect the compressed air supply to the charging valve.

(9) Charge the extinguisher until 10 bar pressure is indicated on the gauge.

Notes:

(1) If a mix of pre/post 2003 extinguishers are held, care must be taken to avoid over-pressurisation to 15 bar.

(2) If a tyre inflator or a foot pump is used, pressure will not exceed 7 bar (see Para 2306.b and c).

(10) Disconnect the air supply and replace the air charging valve dust cap. Release air supply as described in the note to Para 2306.b.

(11) Check for signs of leakage around the discharge head with the extinguisher in an upright position.

(12) Stow and secure the extinguisher, and house the nozzle, using the arrangement provided.

2304. Spare.

2305. Stored Pressure Extinguisher (Dry Powder) (SPE(DP)) - Pre 2003 Model

The pre 2003 model can be identified by the polished stainless steel shell and blue usage instructions. This extinguisher is provided near to, or in, the accesses to some machinery spaces, in the flight deck area and in hangars for fighting liquid fuel fires. It is especially useful for fighting liquid fuelled pressure spray fires. The discharge from this appliance can be controlled by means of the operating lever which can be released whilst it is redirected, thus preventing wastage. The total discharge time is about 20 seconds when charged to 10 bar. The SPE(DP) should be recharged with dry powder in a dry compartment as follows:

a. Ensure the extinguisher is fully discharged.

b. Remove the discharge head assembly, clean off all powder residues with a soft brush.

c. Clean the Schraeder valve assembly, if necessary removing the valve core.

d. Clean out the cylinder using a soft brush, ensuring the inside of the cylinder is dry. Particular attention is to be paid to the threads and joint sealing faces.

e. Using a suitable chute as a funnel, pour the contents of one 11.2 kg (25lb) bag of powder into the cylinder.

WARNING

PROLONGED EXPOSURE TO THE POWDER MAY CAUSE IRRITATION TO SKIN OR EYES. WHEN HANDLING THE POWDER WEAR A DUST MASK AND GOGGLES

f. Check cleanliness and absence of powder from the screw threads and joint faces, then re-fit the head assembly.

g. Pressurise with DRY air to 10 bar from the portable charging assembly, via the Schraeder valve.

Note. *Do not use a foot pump or LP air in this (the SPE(DP)) application. The air must be dry.*

2306. SPE Pressurization Arrangements - Pre 2003 Models

Wherever possible the extinguishers are to be charged to 10 bar, the working pressure indicated within the black segment on the extinguisher pressure gauge. The performance of the extinguisher at 7 bar is, however, acceptable, being only marginally reduced from the performance at 10 bar. Therefore, when using the tyre inflator or foot pump, a 7 bar charge is acceptable, although the pressure gauge will not indicate a full charge. Pressurisation of the extinguisher may be carried out using:

a. **Portable Air Charging Assembly.** This assembly consists of a 1,240 litre free air capacity, steel, high pressure (BASCCA) air cylinder, fitted with a regulator valve, pressure gauges and discharge hose terminating in a connection which will mate with the air charging connection on the extinguisher (see Fig 23-3). The assembly is also fitted with a carrying handle and 'wind around' hose stowage. The air cylinder is charged to a maximum pressure of 207 bar and will charge the extinguisher to 10 bar.

WARNING

GOGGLES AND EAR DEFENDERS ARE TO BE WORN WHEN CHARGING SPE WITH COMPRESSED AIR.

CAUTION

THE REDUCING VALVE ON THE AIR CHARGE ASSEMBLY MUST BE SET AT 10 BAR FOR THE PRE 2003 SPE TO AVOID OVER-PRESSURSATION.

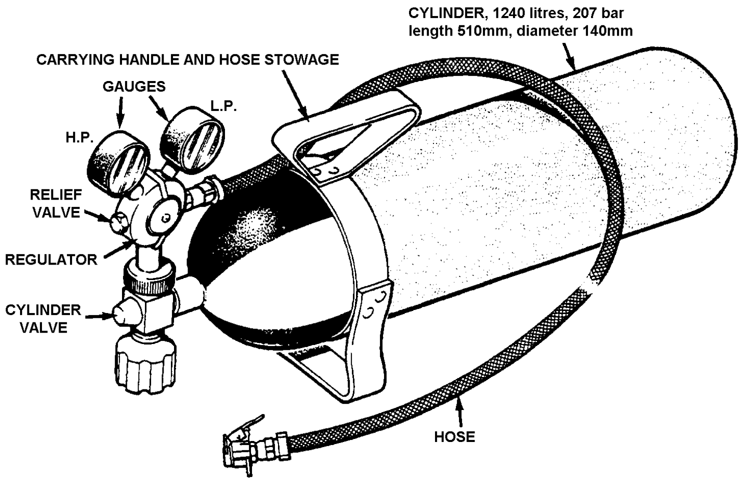

Fig 23-3. Portable Air Charging Assembly

b. **Low Pressure Air System.** When charging from the ship's low pressure air system using the tyre inflator, connect the inflator to a convenient low pressure air connection, eg tool point, by a suitable flexible hose and end connections. Position the extinguisher so that the air charging valve at the back of the discharge head is readily accessible. Holding the tyre inflator in one hand and the end charging connection in the other, place the end charging connection firmly against the air charging valve. Depress the lever sufficiently to allow the pressure on the tyre inflator to reach at least 7 bar. When this is reached remove the end charging connection from the air charging valve.

Note. *In order to prevent the possible discharge of the AFFF solution through the air charging valve when disconnecting the inflator, keep the operating trigger on the inflator depressed until disconnection of the charging connection is completed. This will keep the air charging valve pressurized so preventing the possible syphoning of the AFFF solution back through the valve.*

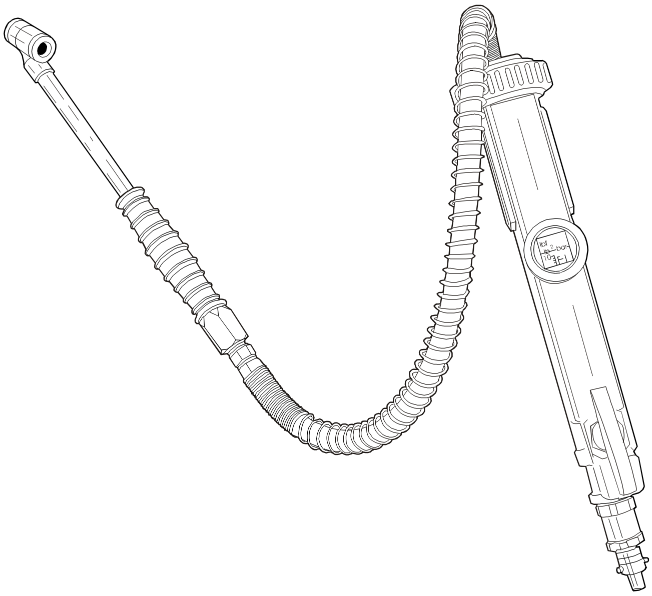

Fig 23-4. Tyre Inflator

c. **Foot Pump.** The method of charging the extinguisher using the foot pump is self evident in that the pump discharge hose is connected direct to the extinguisher charging connection. The pressure to be achieved in the extinguisher, using the foot pump is 7 bar. The foot pump is never to be used with the SPE(Dry Powder); dry air only may be used.

Note. Overpressurizing. *In the event that an extinguisher is accidentally overcharged, especially when using the method in Para 2306.a, the excess pressure should be released by standing the extinguisher upright and releasing the excess pressure by depressing the valve stem inside the air charging connection.*

2307. Recharging the SPE Portable Air Charging Assembly

The compressed air cylinder is to be recharged from a 207 bar air charging panel, if fitted, or from the ship's usual charging facilities ashore. To fill the compressed air cylinder from the BA panel the following procedure should be adopted:

a. Ensure that all valves on the charging panel are shut.

b. Open the charging panel pressure gauge stop valve on the 207 bar charging line to vent any pressure that might be remaining in the circuit.

c. Remove the blanking cap from the charging panel 207 bar outlet.

d. Open the main air supply valve and crack open the 207 bar outlet valve to blow any dirt out of the line.

e. Remove the regulator and hose assembly from the air charging cylinder, first ensuring that the cylinder valve is shut.

f. Connect the compressed air cylinder, through the charging hose and adaptor, to the charging panel 207 bar outlet.

WARNING

THE SPE AIR CHARGING ASSEMBLY USES A BASCCA CYLINDER WHICH MUST NOT BE CHARGED TO MORE THAN 207 BAR.

g. Open the cylinder valve and then open the charging panel 207 bar outlet valve enough to charge the cylinder to 207 bar at a comparatively slow rate. This avoids overheating the air passing into the cylinder.

h. When charging is complete, shut the cylinder valve, shut the charging outlet valve and shut the main supply valve.

i. Disconnect the cylinder, charging hose and adaptor from the charging panel.

j. Replace the blanking cap on the 207 bar outlet connection.

k. Replace the regulator and hose assembly on the air charging cylinder.

Note. *In ships without a 207 bar charging panel, the 205 bar SABA diving BA panel should be used.*

2308. 9 Litre Stored Pressure Extinguisher (AFFF) - Post 2003 Model

The model of 9 litre SPE(AFFF) introduced in 2003 can be recognised by a red painted shell and a cream coloured band to indicate the foam contents. It is used on solid or liquid fires. It has a working charge pressure of 15 bar, so it can only be charged by the portable air charging assembly or from the LP air system, not by a foot pump. When fully charged to 15 bar it has a throw of 6 metres and a discharge time of 38 seconds. There are two versions: standard and non-magnetic.

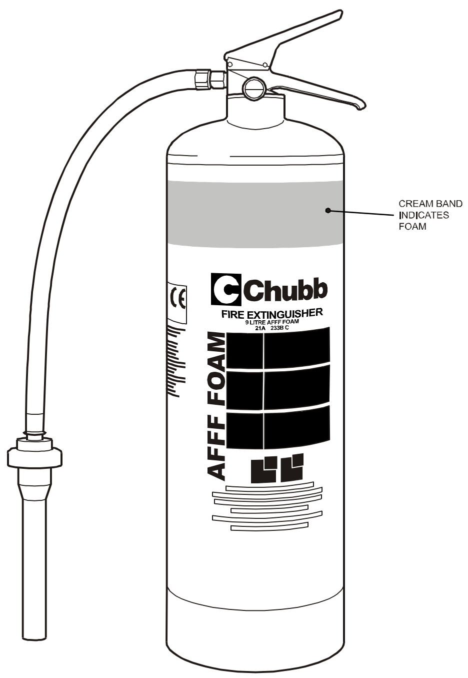

Fig 23-5. 9 Litre SPE(AFFF) - Post 2003

2309. To operate the post 2003 9 litre SPE(AFFF):

a. Hold the extinguisher upright.

b. Pull out the safety pin (the plastic dart will break).

c. Free the discharge hose and aim the nozzle to drop foam onto the fire from a minimum distance of one metre.

d. Squeeze the levers.

2310. To recharge the post 2003 9 litre SPE(AFFF):

a. Remove the safety pin, if fitted. Invert the extinguisher and squeeze the operating levers to vent any residual pressure.

b. Slacken the headcap by rotating it two complete turns and listen for any residual pressure. Do not use a hammer on the handle, lever or pressure gauge. Do not unscrew further until all residual pressure has dissipated.

c. Remove the head and syphon tube assembly.

d. Empty the residual contents and rinse out the extinguisher with fresh water.

e. Fill the extinguisher with fresh water to the 'F' line level indicator on the siphon tube.

f. Pour in a 560 ml charge of 6% AFFF concentrate. Do not overfill or mix with other foam types.

g. Check the actuation of all moving parts of the head and the condition of the neck ring. Check that the siphon tube is clear of obstruction.

h. Lightly grease the 'O' seals, moving parts and neck threads with petroleum jelly.

i. Screw on the head assembly and tighten it hand tight.

j. Fit the safety pin and insert a plastic dart through the end.

k. Pressurise the extinguisher with air to 15 bar (the white line on the gauge), using the portable air charging assembly or the LP air system and a tyre inflator. Replace the dust cap on the schrader valve.

2311. If the safety pin is missing, or the plastic dart is missing or broken, the extinguisher must be checked for the correct fill and recharged, if necessary. The post 2003 9 litre SPE(AFFF) must be returned and replaced if any of any of the following conditions occur:

a. Significant dents or damage to the shell.

b. Damage to the gauge or any extinguisher component, which renders it unserviceable.

c. Significant signs of corrosion.

d. Every fifth year after the date brought into service.

2312. 9 kg Stored Pressure Extinguisher (Dry Powder) - Post 2003 Model
The model of 9 kg SPE(DP) introduced in 2003 can be recognised by a red painted shell and a blue coloured band to indicate the powder contents. It is used on solid or liquid fires and is particularly effective for liquid fuel pressure spray fires. It may be used on low voltage electrical fires must not be used on live HV systems. It has a throw of 6 metres and a discharge time of 15 seconds. It is supplied with a 15 bar nitrogen charge and it is not to be recharged in ships/units. There are two versions: standard and non-magnetic.

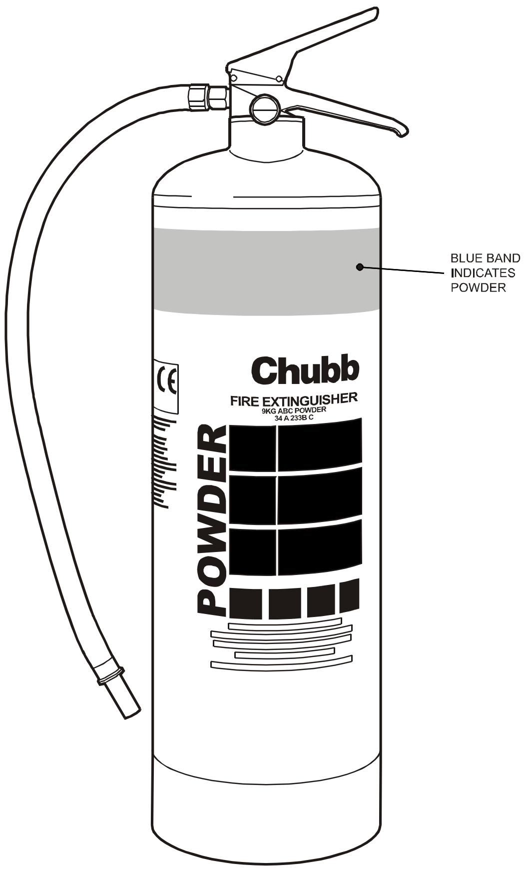

Fig 23-6. 9 kg SPE(DP) - Post 2003

2313. To operate the post 2003 9 kg SPE(DP):

a. Hold the extinguisher upright.

b. Pull out the safety pin (the plastic dart will break).

c. Free the discharge hose and aim at the base of the fire, from a minimum distance of one metre.

d. Squeeze the levers.

2314. If the safety pin is missing, or the plastic dart is missing or broken, the charge pressure and weight must be checked. The post 2003 9 kg SPE(DP) must be returned and replaced if any of the following conditions occur:

a. Partial or complete discharge.

b. Loss of pressure (ie when the gauge needle has moved out of the green sector).

c. Loss of weight (gross weight is approximately 12.8 kg).

d. Significant dents or damage to the shell.

e. Damage to the gauge or any extinguisher component, which renders it unserviceable.

f. Significant signs of corrosion.

g. Every fifth year after the date brought into service.

2315. SPE Maintenance

This equipment is to be maintained in accordance with the MMS. The list of spares which are required to keep the SPE in good working order will be found in BR 2170(3). They are considered to be minor items for which the extinguisher need not be returned to store for repair. These extinguishers are not to be painted.

2316. Misuse of Stored Pressure Extinguishers

Fire extinguishers are only provided to attack and extinguish fires and in no circumstances are they to be used for any other purpose.

2317. Marinised 2kg Dry Powder Extinguisher

The marinised 2 kg dry powder extinguisher (see Fig 23-7) is supplied for use in small craft using outboard motors. The extinguisher, which has a dedicated mounting bracket, has a 2kg charge of dry powder and is pressurised by nitrogen at 15 bar. This marinised version of the extinguisher is manufactured from corrosion-resistant materials, and should not be confused with the 2 kg dry powder extinguisher supplied for use ashore. To operate the extinguisher:

a. Hold upright. Pull out the pin.

b. Aim at the base of the fire, from a distance of at least 1 metre.

c. Squeeze the levers.

WARNING

ALTHOUGH THE DRY POWDER IS NON-TOXIC, THIS EXTINGUISHER IS NOT TO BE DIRECTED AT PERSONNEL

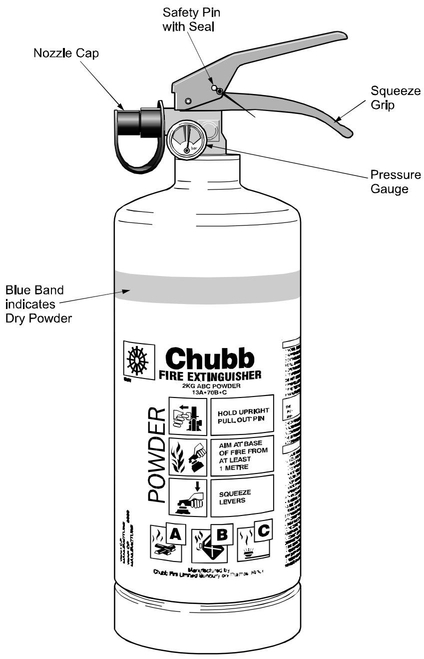

Fig 23-7. Marinised 2 kg Dry Powder Extinguisher

2318. On initial receipt, the pressure gauge is to be checked to ensure that it is reading in the green (charged) sector. The extinguisher should be weighed and the weight indelibly marked on the Inspection Record embossed on the rear. An extinguisher, excluding the mounting bracket, should weigh approximately 3.6 kg. The extinguishers are to be checked weekly for serviceabilty, ensuring that the seal on the safety pin is intact and no loss of pressure has occurred. At six monthly intervals they are to be shaken to prevent compaction of the powder, weighed and the nozzle checked clear. No attempt should be made to recharge these extinguishers onboard; they are to be returned and replaced if any of the following conditions occur:

a. Part or complete discharge.

b. Loss of pressure (ie gauge out of green sector).

c. Loss of weight.

d. Significant damage to the shell, damaged gauge, etc.

e. Significant corrosion.

f. Every fourth year after introduction into service (for refurbishment).

2319. 2 kg CO_2 Extinguisher

The 2kg CO_2 extinguishers is coloured red with a black identifying band around the cylinder. It consists of a cylinder containing 2 kg of liquified CO_2 at a pressure of 58 bar at 20°C and is normally fitted with a rigid discharge horn. There are two versions: normal and non-magnetic. To operate the extinguisher, remove the safety pin, (the plastic dart will break), hold the extinguisher by the squeeze-grip release valve and press the trigger of the grip very firmly to ensure a full discharge and to avoid the risk of freeze-up at the orifice. The discharge time is about eight seconds. The horn should be directed at the base of the fire from as near as possible.

WARNING

DO NOT GRIP THE HORN OR THE CYLINDER DURING USE IT WILL FREEZE THE HAND AND MAY CAUSE BURNS.

2320. CO_2 extinguishers provided in compartments containing electrical equipment eg radar cabinets, are fitted with a flexible hose and bayonet plug. The plug fits into inlet sockets on electronic cabinets. The socket has a breakable membrane which ruptures when the plug on the extinguisher hose is inserted. For use on open equipment and elsewhere in the compartment the hose is fitted with a detachable hand applicator, which fits over the plug, designed to prevent hand contact with the end of the hose. The extinguisher is normally stowed with the hand applicator fitted. A relatively cool stowage position is required for these extinguishers. No attempt must be made by any individual or ship/unit representative to remove the discharge valve from the extinguisher. If the safety pin is missing, or the plastic dart is missing or broken, the weight must be checked. The 2 kg CO_2 extinguisher must be returned and replaced if any of the following conditions occur:

a. Partial or complete discharge.

b. Damage to the gauge or any part of the extinguisher which renders it unserviceable.

c. Significant signs of corrosion.

d. Every fifth year after the date brought into service.

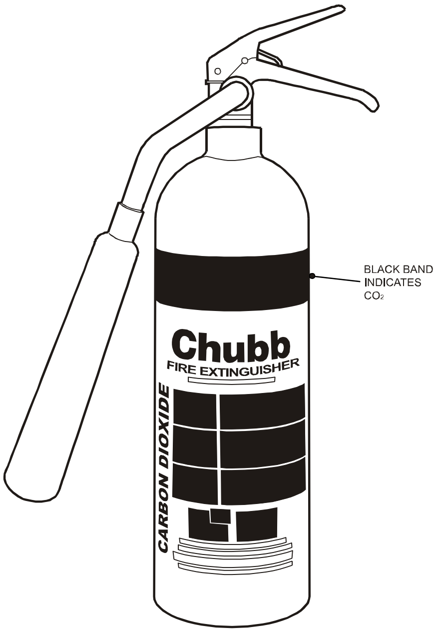

Fig 23-8a. 2kg CO_2 Extinguisher with Discharge Horn

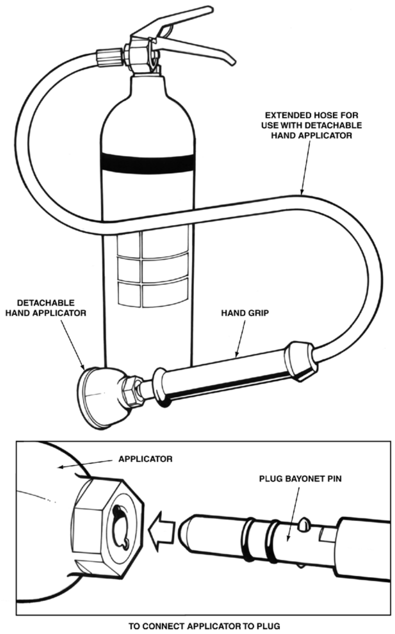

Fig 23-8b. 2kg CO_2 Extinguisher with Flexible Hose

2321. Marking of Portable Fire Extinguishers

a. **Extinguishers.** All extinguishers are to be marked with 25mm (1 inch) Black numbers using a permanent marker as shown below:

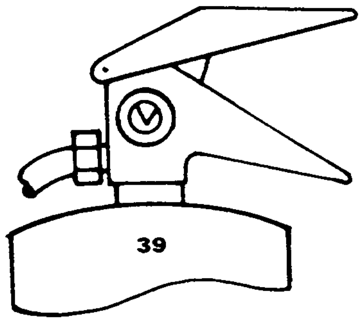

Fig 23-9a. Stored Pressure Extinguisher

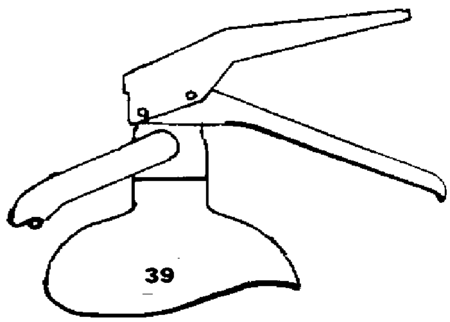

Fig 23-9b. 2 kg CO_2 Extinguisher

These markings can be removed, without causing abrasive damage, using Propanol Ampex, (see BR 2170(3)) applied with a soft cloth. ALL THESE POSITIONAL MARKINGS MUST BE REMOVED PRIOR TO THE EXTINGUISHER BEING RETURNED TO STORES.

b. **Stowages**

(1) All extinguisher stowages are to be identified by a red triangle on the structure directly above the stowage position. These can be painted or are available from Naval Stores (NSN listed in BR 2170(3)).

(2) The triangles should have outside dimensions of 115mm (4.5 inch) per side and a 7mm (0.25 inch) border. Corresponding type and number of the associated extinguisher is to be painted or marked in the triangle with 13mm (0.5 inch) Black lettering, as example below.

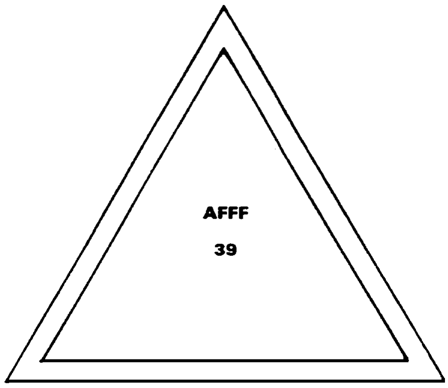

Fig 23-9c. Fire Extinguisher Stowage

2322. Mobile Foam Unit SF90

This is for use against flightdeck or hangar fuel fires in some ships. It is designed for rapid action to gain time while the main firefighting system is being brought into operation. The unit carries 90 litres of 6 per cent AFFF/fresh water solution, mounted on a trolley. It has a hose and a branchpipe with an on/off control valve. Discharge pressure is provided by an air cylinder mounted on the foam tank. The discharge hose is ‘dutch rolled’ in its stowage basket. The unit discharges in about 56 seconds and has a throw of 15 to 18 metres. To operate the unit:

a. Roll out the hose towards the fire

b. Open the valve on the air cylinder to pressurise the foam tank.

c. Open the nozzle-control valve and direct the jet to fall lightly on to the burning liquid.

Note. *A fixed version of this unit is fitted in the machinery spaces of some RFAs and submarines and in this application it is known as the SFU90 (see BR 2170(4)).*

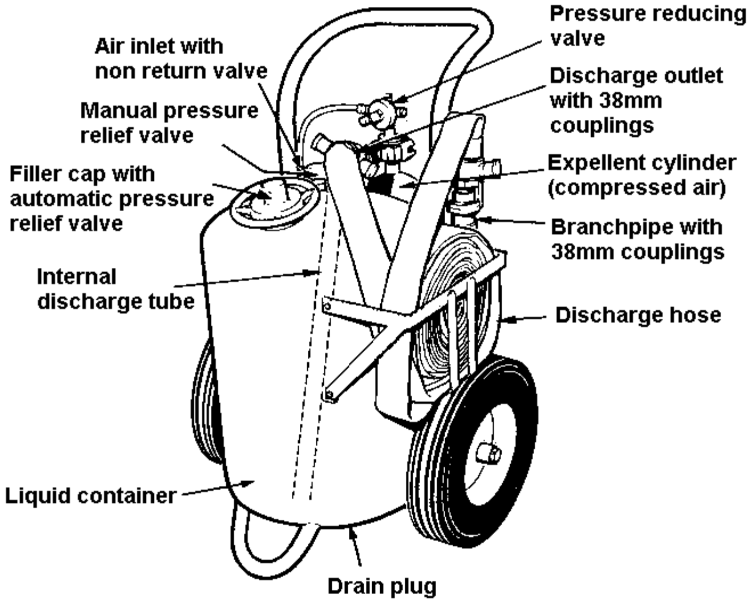

Fig 23-10. Mobile Foam Unit SF90

2323. The SF90 and SFU 90 extinguishers are re-charged after use as follows:

WARNINGS

1. DO NOT REMOVE ANY FITTINGS UNTIL ALL INTERNAL PRESSURE HAS BEEN RELEASED FROM THE STORAGE CONTAINER.

2. IF A DEDICATED 123 BAR CHARGING SUPPLY IS NOT AVAILABLE, GREAT CARE MUST BE TAKEN TO AVOID OVER PRESSURISATION OF THE AIR BOTTLE.

a. Ensure the air cylinder valve is shut.

b. De-pressurise the AFFF container tank via the pressure release valve.

c. Disconnect the foam discharge hose from the AFFF container and flush with fresh water.

d. Re-connect the foam discharge hose to the AFFF container.

e. Stow the foam discharge hose.

f. Unscrew the filler cap assembly and remove.

g. If completely discharged, fill the container with clean fresh water to within 150mm of the filling hole sealing face. Slowly add 5 litres of AFFF liquid concentrate and stir to ensure a constant mix. Top up to 100mm from the sealing face with fresh water.

h. If the unit has been partially discharged, top up with a prepared AFFF solution of 85 litres of clean fresh water and 5 litres of 6% AFFF liquid concentrate, to within 100mm of the filling hole sealing face.

i. Check the filler cap gasket is not damaged and in place and replace the filler cap hand tight.

j. Disconnect the air cylinder from the pressure regulator, release the cylinder retaining strap and remove the air cylinder.

k. Charge the air cylinder to 123 bar.

l. Replace the air cylinder, secure the retaining strap and re-connect the pressure regulator to the air cylinder.

m. Check all connections are tight.

Notes:

1. In an emergency, when fresh water is not available the unit can be recharged using sea water to enable it to be prepared for immediate use. At the earliest opportunity after being charged with sea water the unit is to be emptied and the storage container and hoses flushed with clean fresh water to prevent corrosion and salt deposit build up.

2. The unit is not to be left charged with sea water for long periods.

2324. 10 kg CO_2 Extinguisher

The trolley-mounted 10 kg CO_2 extinguisher (see Fig 23-11) is provided for dealing with fire during the starting of aircraft engines. The apparatus comprises a trolley-mounted cylinder, containing 10 kg of liquified CO_2, connected by flexible hose to a telescopic applicator. The applicator may be extended up to 3.6 metres and the length set by turning the knurled locking collar. A horn is normally fitted over the discharge nozzle for use in the open, but this is unscrewed and removed if the nozzle is to be inserted into an engine access panel. Discharge of a fully charged cylinder lasts between 30 and 40 seconds. Detailed instructions are contained in Air Publication 957.

2325. To operate the extinguisher:

a. Place the trolley in the upright position.

b. Open the cylinder discharge valve.

c. Remove the applicator from the trolley and extend to the required length. Lock the applicator adjustment to prevent it extending under gas pressure.

d. Position the discharge nozzle through an engine bay fire access panel, etc.

e. Squeeze the applicator control valve to release the gas. The operator should be prepared for jet reaction on discharge, especially if the applicator is fully extended.

WARNING

AFTER DISCHARGE, THE APPLICATOR EXTENSION TUBE WILL BE EXTREMELY COLD AND SHOULD NOT BE DIRECTLY HANDLED

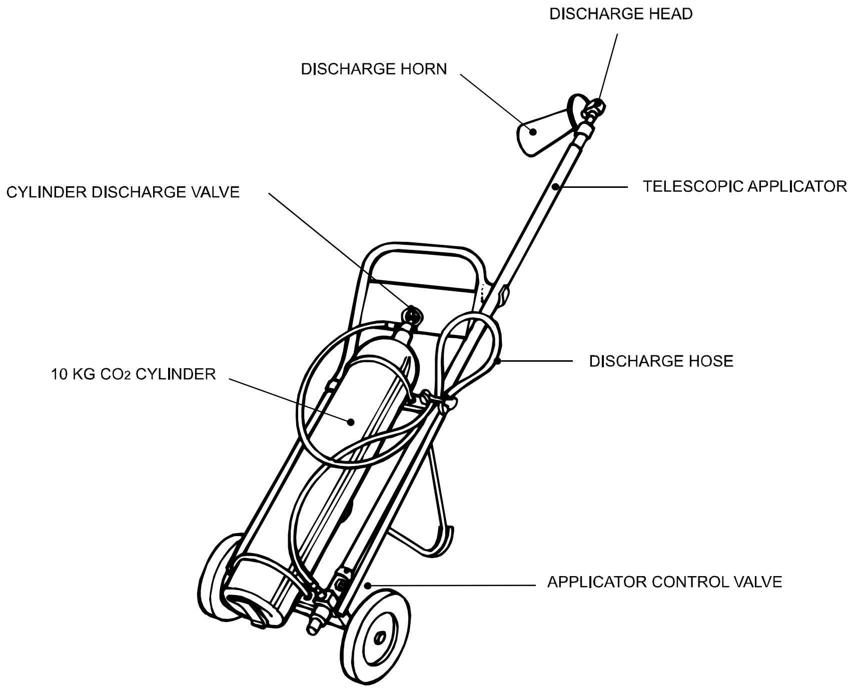

Fig 23-11. 10 kg CO_2 Extinguisher

2326. Aqueous Film Forming Foam (AFFF)

AFFF is a synthetic, non-toxic, foam-forming liquid based on flouro-chemical wetting agents designed for use with fresh or sea water. It produces an aqueous film to float out over the surface of a burning fuel, forming a vapour seal which extinguishes fire and prevents reflash. This sealing action will also take place on fuel spillages, thus securing them from ignition. AFFF can be used in conjunction with other firefighting agents used in HM ships, without impairment of its efficiency. It is as effective against solid fuel fires as it is against liquid fuel fires and, in each case, should be sprayed directly over the fire to achieve complete coverage as quickly as possible. Firefighting systems using AFFF should only be supplied with undiluted (neat) AFFF (except when freeze protection is added - see Para 2330).

2327. There are two types of AFFF used in HM ships, 6% and 1%. These figures indicate the percentage of AFFF concentrate that is mixed with water at the inductor. The 1% AFFF is therefore a stronger concentrate than the 6% AFFF. The two types are used as follows:

a. 6% AFFF is used in 9 litre stored pressure extinguishers, SF90 and SFU90 extinguishers, FBU5X and FB10/10 branchpipes. This is supplied in 20 litre drums.

b. 1% AFFF is used in flight deck monitors and in some hangar and vehicle deck spray systems (see specification for individual ships). This is also supplied in 20 litre drums.

2328. On receipt of the AFFF drums, the caps should be eased so that when required for use they may be opened by hand. Extreme care should be taken to prevent breaking of the sealing wire, so ensuring that the quality and nature of the contents is preserved. If necessary, the red plastic security seals, listed in BR 2170(3), may be used. Different batches of the same concentration may be mixed, but the shelf-life of the oldest batch must be assumed.

2329. Testing of AFFF

AFFF has a shelf-life of 20 years. If the quality of opened containers is suspected, details of testing procedures are available from WSA/MFFM5, who can be contacted on Foxhill extension 82386.

2330. Freeze Protection of 6% AFFF

6% AFFF concentrate is liable to temporary thickening when exposed to temperatures below 2°C. This could affect the pick-up of the concentrate by an inductor. AFFF stowed in exposed positions in cold climates, eg unheated stowage on jetties, on upper decks of ships or on submarine casings, may be freeze protected by the addition of 24% ethylene glycol, which will give protection down to -10°C. Drums of AFFF which have been thus treated must be clearly marked: '*Freeze protected by 24% ethylene glycol*' to avoid confusion with untreated AFFF, and are not to be put in between-deck stowages.

2331. Dilution by ethylene glycol will affect the performance of AFFF, so it is only to be added in exceptional climatic conditions, eg Upkeep Periods, when no heated stowages are available.

2332. Thermal Imaging Camera (TIC)

These are issued to HM Ships, Submarines and RFAs to the scale of allowances given in BR 2170 Volume 3 for surface ships and Volume 4 for submarines.

a. **Purpose.** The TIC is a battery operated, hand-held, device incorporating a miniature viewing screen, and is for use as a firefighting aid to give thermal pictures through dense smoke where normal vision is impossible. The TIC will provide:

(1) The operator with a clear vision through dense smoke and an indication of the source of the fire.

(2) Improve safety of the firefighters by making obstacles and other hazards visible.

(3) A possible reduction in search and rescue time.

b. **Description.** The TIC is illustrated in Fig 23-12. The latest type of TIC is smaller and lighter than the original model with a pistol grip handle and the battery pack and voltage stabilizer contained separate from the camera. The latter unit is hung around the neck of the operator or attached by means of snap hooks to his BA harness. Although the latest type of TIC has a different Naval Stores pattern number from the original, both types of camera may be issued against either pattern number. When a large TIC is returned to store for repair it will be replaced with a miniaturised TIC. therefore all large TICs will essentially become obsolete.

(1) For training purposes ten Ni Cad (Ever Ready AN 50) batteries are supplied which, when in good condition and fully charged, provide a camera operating time of about 45 minutes and must always be re-charged after use.

(2) For operational use, Duracell MN 1500 batteries are specified. These should be fitted to the TIC when in its stowage, bearing in mind that battery performance will be adversely affected if they are fitted incorrectly or for too long. When the TIC is used for training purposes the Ni Cad batteries should be used to replace the Duracells.

c. **Shortcomings.** Shortcomings in the operation of this equipment in realistic firefighting conditions include:

(1) *Discrimination.* In training scenarios, using synthetic smoke, objects and people are invariably clearly defined due to adequate temperature differentials. Real smoke will almost certainly be accompanied by varying degrees of heat which can create difficult conditions for TICs. Effects vary but include poor definition of objects, inability to 'see' people effectively and 'whiteout' where only relatively cool objects are seen as dark shadows.

(2) *Lock.* If a TIC is suddenly presented to a very high temperature flame, outside the protection of a waterwall, then the automatic iris control may have insufficient time to close. In this circumstance an over temperature exposure of the tube may occur and, in self protection, the TIC locks itself and leaves blurred, confusing images in the viewfinder. Recovery from this condition is made by switching the camera off and on again, thus effectively resetting the internal circuitry.

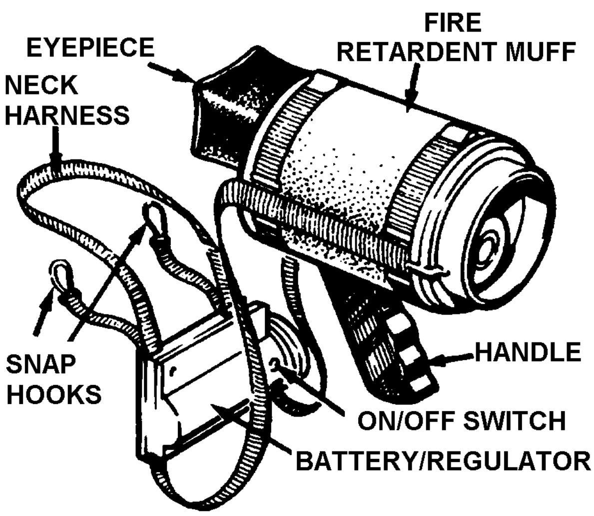

Fig 23-12. Thermal Imaging Camera

(3) The TICs are fitted with five light emitting diodes (LEDs) to the left of the camera viewing screen which indicates battery condition and use-time remaining. The time remaining as each LED is extinguished is, approximately:

LED	TIME		
1	30 mins	)	
2	15 mins	)	
3	10 mins	)	Duracell batteries only
4	5 mins	)	
5	2 mins	)	

c. **Instructions for Use.** The TIC is to be stowed (complete with 10 Duracell batteries fitted) at FRPPs for ships with, or less than, 1½ DC sections, and at the section bases of ships with more than 1½ DC sections.

(1) When TICs are used for training purposes the Duracell batteries are to be replaced by the Ni Cad Batteries. The latter batteries are to be re-charged immediately after use.

(2) The original TIC must be fitted with its visor, on receipt, using the retaining screws provided.

(3) The TIC can be connected to a TV monitor and used to provide a remote picture of the fire/damage scene, as seen by the operator, when used for training.

d. **Maintenance.** Onboard internal repairs or adjustments are not to be undertaken. Defective TICs are to be returned (having previously been tested with new batteries) to Stores, giving details of the fault.

e. **Special Precautions.** TICs are expensive and care must be taken when being transported and when in stowage. They should be stowed securely at a temperature between 15° and 35°C and not more than 70% humidity.

2333-2335. Spare.

2336. Foam Inlet Tubes

These are fitted in machinery spaces to enable AFFF foam to be delivered direct into the bilges, by means of an FB5X branchpipe, from positions outside the spaces. The tops of the tubes are to be fitted with blanking caps (identified) and these caps must be screwed down tightly when not in use to preserve watertight and gastight integrity. The upper portion of the tube protruding through the deck/bulkhead is to be painted signal red, the remainder being painted to suit the compartment decor and identified with red tape marked FOAM. Adjacent to the top of the inlet tube a notice is to be provided (white lettering on a red background) stating FOAM TUBE, compartment served and the maximum amount of AFFF solution necessary when fighting a fire via the foam tube. This may be calculated as follows: The water consumption of the FB5X, as indicated on the branch pipe, is 225 ltr/min at 5.5 bar, consumption of AFFF is therefore 13.5 ltr/min (225 x 6 per cent) and allowing an expansion factor of 10 the foam produces is 2,250 ltrs/min. From this it can be shown that to produce a layer of foam 100mm deep (experience has shown that an average depth of 100mm is required to produce a minimum depth of 50mm) in a compartment L metres long, W metres wide and having N foam inlets will require 0.03 LW/N 20 litre containers at each foam inlet. On current major warships this approximates to two 20 litre containers at each foam inlet.

2337 Spare.

2338. Gaseous Firefighting Systems
These are dealt with in Chapter 21.

2339-2340. Spare.

2341. Smoke Containment Curtains
Smoke curtains are fitted at main watertight doors to sub-divide passageways to enable smoke boundaries to be maintained in the event of distortion of doors/structure or for passage of personnel. They are manufactured from Columbus 300 flame retardant fabric. Canopy arrangements are provided at doors to form a mini airlock about 1 metre by 1 metre on the non door side of the bulkhead. Pelmet curtain rail, with well rounded corners to allow easy curtain movement, follows the form of the airlock. Curtains are fitted in two parts with an overlap. Reflective tape is fitted to the edges of the smoke curtains to allow the access to be rapidly identified, thus reducing the time taken to pass through. Curtains must be checked to ensure that:

a. Curtains have an overlap of between 600 and 700mm.

b. Pelmets fitted for the sub division of passageways hang both sides of the curtain to a depth of 225mm.

c. Curtains have a lead weight strips sewn in 50mm from the deck.

d. Curtains touch the deck to form a smoke tight seal.

e. Internal and external edges of curtains have reflective tape fitted.

2342. Smoke containment curtains are susceptible to considerable wear, chaffing and snagging from the passage of personnel and equipments when left in the rigged position. In order to retain the effectiveness and integrity of the curtains the following procedures are to be adopted:

a. **State 1.** Curtains are to be fully rigged and checked for defects, they are then to be restowed. Defects are to be rectified as soon as possible.

b. **States 2 and 3.** Curtains are to remain stowed.

c. In the event of a real fire or smoke generated for exercise purposes the curtains are to be rigged as soon as possible to establish the smoke boundary.

Note. *Columbus 300 flame retardant fabric is available from Naval Stores to allow curtain repair or the manufacture of ad-hoc smoke curtains (see BR 2170(3)).*

2343. Smoke Generating Training Devices

Two types of smoke generator are available as firefighting/search and rescue team training aids, smoke generating machines and 'generators, smoke training'. They allow realistic exercise of breathing apparatus, thermal imaging cameras and NBCD communications techniques and enhance training in smoke control and clearance.

2344. Smoke Generating Machine

This is a 115 V, 60 Hz electrically powered device known as the Minimist Turbo Smoke Generator. This operates on a 115V 60Hz electrical supply, producing smoke at 125 m^3/min. A pressurised cannister contains smoke fluid and a pressurising agent. An operating manual is supplied with each machine.

2345. Generators Smoke Training (GST) N5 and N6

These are pyrotechnic, cinnamic acid devices which will quickly fill compartments (50m^3 for the N5, 90m^3 for the N6) with a dense white smoke. They comprise 90 x 60mm light green aluminium canisters which are activated by unscrewing the end cap and removing the safety pin. There is then a delay of 2-4 seconds before smoke is emitted for 30-60 seconds. GSTs are designated SHIPCAT 3 and are to be handled and operated in accordance with the instructions in BR 862 Volume 4 - Ship Explosive Store Safety Instruction and BR 41 - Weapon Data Sheet.

2346. The Whole-ship NBCDQ is to be nominated as the Specialist User Officer for N5 and N6 Smoke Generators, which are to be handed over to him at the Explosive Delivery Point (EDP) of the magazine hatch. He is then to ensure that the smoke generators are handed to a responsible person, defined as someone who has been briefed by an NBCDQ on the purpose of use of the generators for a given exercise and in specified compartments, the mode of safe operation and the maximum numbers to be used. FOST Seariders and Squadron Staff may be considered responsible persons for the operation of smoke generators based on their experience and 'in house' training.

2347. 'Table Top' planning of exercises should include stipulation of the maximum number of smoke generators to be used in compartments and nominate the responsible person to activate them. It should be stressed that within the constraints of training realism, consideration should be given to minimum use within 'living' compartments such as messdecks and cabins.

2348. The following precautions are to be taken when using GSTs:

a. Operators must wear heavy duty (ie leather) gloves.

b. On initiation, the canister must be held at arms length and directed away from the face and other personnel. It should then be placed immediately on a flat surface, preferably in an open canister (eg metal waste bin). The built in 2-4 second delay allows this to be done.

c. An SPE(AFFF) extinguisher or independent water supply is to be available. Should the GST flare or should its canister bulge after initiation, it is to be extinguished immediately.

d. They are designed not to emit flames or hot particles and should not damage deck covering. However, once initiated the canister should be placed on a level surface and prevented from sliding against combustible materials. It can be extinguished by immersion in water.

e. The N6 generator must not be used in closed compartments smaller than $90m^3$. The N5 which contains half the charge of the N6, is not to be used in compartments of less than $50m^3$. At concentrations given by this constraint the smoke is safe to be breathed for up to 5 minutes, for longer periods BA should be worn.

f. These stores are not to be used in any compartment containing flammable liquids.

g. These smoke generators can release a heavy deposit of white powder that may affect the operation of electronic equipment and filters. Care should be taken to avoid use in unsuitable compartments whenever possible.

h. Severe respiratory distress may be caused by N5/N6 smoke generators to some personnel with a history of asthma. Those so affected should be given prompt medical attention and isolated from future exercises involving this smoke. The circumstances of these incidents are to be reported to NMOH (Fleet), DMEDOPS Portsmouth.

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CHAPTER 24

FIRE PREVENTION AND FIREFIGHTING IN UPKEEP PERIODS

CONTENTS

ANNEXES

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CHAPTER 24

FIRE PREVENTION AND FIREFIGHTING IN UPKEEP PERIODS

2401. Definition of Ships in Upkeep

Apart from the 'build' phase and disposal, a ship's life cycles between two main types of 'period':

a. **Fleet Time.** When CINCFLEET has Scheduling Authority (SA) for normal tasking of the vessel.

b. **Upkeep Time.** When SA passes to the Warship Support Agency (WSA) for a programmed Upkeep Period.

2402. Types of Upkeep

There are two main types of Upkeep Period, Repair Period (RP) and Docking Period (DP). RPs are reduced-manned, and Care and Protection is transferred to the Upkeep Contractor between Upkeep Period Start Date (UPSD) and Ship's Staff Move Onboard (SSMOB). DPs are generally fully-manned, with Care and Protection of the ship (including firefighting) remaining with the Commanding Officer throughout. However, there are certain occasions when it may become necessary for the majority of a ship's company in a DP to be withdrawn from the vessel, in which case Care and Protection will transfer to the Upkeep Contractor, as in a RP. The particular responsibilities for the Contractor and Ship's Staff are laid down in the associated Volume 0 of the Work Specification and the Safety Plan.

2403. Problems Peculiar to Ships in Upkeep

Ships are faced with a number of different problems associated with fire prevention and firefighting when undergoing an Upkeep Period. The introduction of tasks involving the use of open flames, eg burning, cutting, welding and grinding, together with the amount of arisings, combustible materials and flammable liquids necessary as part of the work increase the likelihood of fire. The risks associated with dealing with a fire incident are similarly increased due to the changes in the state of a ship's systems (eg with pipework and valves removed) and structure (eg with holes cut in tanks and superstructure, and doors removed). A further consideration is the presence of a large number of dockyard workers and 'outside' contractors who may be unfamiliar with the ship. For the above reasons, regulations require that in the event of a fire, no matter how small, the Local Authority Fire Brigade (LAFB) must be called. A number of criteria must be borne in mind in support of LAFB operation. Section 4 of Chapter 20, provides guidance in this area.

2404. Area Fire Prevention Officer - Defence Fire Service (Navy)

All Royal Dockyards and Naval Bases in the UK have an Area Fire Prevention Officer (AFPO) appointed who is responsible for providing advice to both his own establishment and Ship's Staff and provides the main link between the ship and the local fire authorities. Ship's Staff are to ensure that the AFPO, and thus the LAFB, are aware of the circumstances, particularly responsibility for firefighting, prevalent in a ship at different stages of the Upkeep Period.

2405. Although AFPOs are located in their particular Base Ports, they also have responsibility for providing 'cover' to ships that may be refitting in commercial yards, carrying out inspections appropriate to the Upkeep venue and type.

2406. BR 8647 - Navy Department Regulations for Fire Safety Management

BR 8647 is sponsored by the Command Fire Officer (Royal Navy) on the staff of the Chief Environment and Safety Officer (Navy), and deals with fire prevention in all MOD(N) establishments and bases. However, there is some overlap between BR 2170 and BR 8647 for HM Ships undergoing Upkeep and, if required, advice should be sought from AFPO on arrival at the Upkeep venue.

2407. Liaison with the LAFB

It is important that liaison with the LAFB is established through the AFPO at the start of an Upkeep Period and a good relationship fostered through visits and involvement in fire exercises as appropriate. The AFPO will organise attendance of the LAFB at exercises and will attend himself to help with conduct and debriefing.

2408. Fire Prevention in Ships in Upkeep

The risk of fire during an Upkeep Period can be reduced by application of good common sense, adherence to strict rounds routines and good practices coupled with a disciplined approach to fire safety and reduction of fire hazards. In ships where Care and Protection of the ship is held by a contractor, Ship’s Staff are to report any shortcomings in fire prevention measures to the Superintendent Ships representative and the Upkeep Contractor without delay.

2409. Fire Rounds

When Care and Protection responsibility is held by the Commanding Officer regular rounds, not necessarily at fixed times, must be carried out, by responsible officers and ratings, as follows:

a. **During Working Hours.** All spaces where work is underway to ensure that fire risks are minimised, that welding/burning is not being undertaken without proper authorisation, that welding/burning sentries are carrying out their duties correctly and that firefighting equipment is distributed correctly and is available.

b. **At the End of the Working Day.** All spaces affected by work to ensure that they have been left in a safe state and that flammable arisings; oily waste, paint tins, adhesives, aerosol sprays etc have not been allowed to accumulate. The rounds must be timed to occur at least one hour after the cessation of any hot work.

c. **Outside Working Hours.** Throughout the ship in order to detect any outbreak of fire, this activity may be conducted by company ship keepers if contracted to them and stated in the Safety Plan.

2410. Control Centre

The position of HQ1 is chosen to meet the requirements of damage control in the Action state and to be the control point to deal with normal peace time incidents when a ship is intact. During an Upkeep Period there may be times when, due to the amount and type of work being undertaken, an alternative position may be more suitable. If this is the case, reliable communications are to be provided and, if feasible, alarms and warnings remoted to this position. A portakabin adjacent to the ship or on the flight deck has proven to be a suitable alternative. For reduced-manned Upkeep Periods the contractor will provide the control position ashore adjacent to the main brow.

2411. Welding Control

Unless the control of welding operations is contracted out, eg in reduced-manned Upkeep Periods when the contractor will base his control functions alongside, the task of hot work control falls to Ship's Staff. Upkeep Periods are usually invasive and this task should not be underestimated. Commanding Officers should ensure they have a robust organisation capable of dealing with a significant hot work load. It is advisable to co-locate the control of hot work with the control centre as described above.

2412. Welding Sentries

The number of welding sentries that are to be provided will be detailed in the Work Specification and Safety Plan. The Welding Sentry control organisation must ensure that a competent sentry is detailed for each welding/burning operation and that the guidelines in BR 2000(20) are followed.

2413. Fire and Emergency Party Organisation

For ships where Care and Protection remains with the Commanding Officer the fire hazard is minimised by the use of the Duty Watch organisation. The size and composition of the Duty Watch and their responsibilities for fire and other emergency incidents will vary depending on the type of ship and prevailing circumstances. Annex 24A provides guidance for FF/DD undergoing fully-manned Upkeep. Annexes 24B and 24C describe the organisations that are to be used by MM/PP vessels of all types for Upkeep Period. For ships where Care and Protection transfers to the Upkeep Contractor, for the period between Upkeep Period Start Date and Ship's Staff Move Onboard Date, the Contractor will provide sufficient firefighting cover. Outside this period a ship is to provide a full Duty Watch in accordance with Chapter 20. If, due to manning constraints, this is not achievable, approval to employ a Reduced Duty Watch organisation is to be obtained via the Fleet Waterfront Staff (see FEOs).

2414. Proximity of Duty Watch Accommodation

For ships in which the Commanding Officer retains responsibility for Care and Protection, the Duty Watch must be accommodated as close to the ship as possible, to allow quick and easy access to the ship in an emergency. Therefore, the Duty Watch accommodation should ideally be situated adjacent to, but no more than 350 metres accessible distance from the ship, ie from the accommodation to the top of the ship's brow.

2415. Firefighting in Ships in Upkeep

When a fire is discovered and the alarm raised, all contractors and personnel not in the Emergency Party are to evacuate the ship and muster in a safe position. An early indication of any missing personnel is required in order to initiate rescue action, in conjunction with the LAFB.

2416. Smoke

Smoke, one of the greatest hazards in ship firefighting, is particularly so in a ship undergoing Upkeep as many doors/hatches and smoke curtains are likely to be unavailable to contain the spread of smoke. The Control Centre must be aware of those doors and hatches that cannot be used and the Incident Board must be marked accordingly. For ships responsible for firefighting it is essential that BA is correctly maintained and charging arrangements provided; alternative sources of safe breathing air may have to be considered.

2417. Ship Alongside or in Dry Dock

In some circumstances an approach from the jetty or dockside may provide the best and quickest means to deal with a fire.

2418. Ventilation

For the majority of an Upkeep Period ventilation will rarely be running in its normal state. The ship's Emergency Party must be aware of the actual state of the system at all times and in addition to crash stopping ventilation may have to take measures to minimise air flow to a fire.

2419. HP Sea Water Main

It is essential that an adequate number of points from which major firefighting equipment can be operated are maintained throughout the ship. If, due to the nature/scope of work being undertaken in an Upkeep Period, the ship's fitted main is unavailable a temporary main is to be established. The details of this alternative arrangement is to be described in the ship's Safety Plan.

2420. Hoses

Firefighting hoses can quickly deteriorate when exposed to the wear and tear on a dockside. Suitable protection and regular monitoring of their condition should be undertaken.

2421. Escape Routes

Escape routes for all positions within the ship must be clearly marked, ensuring that they are unambiguous to a work force that may be unfamiliar with the ship's layout. Escape routes must be regularly checked to ensure that work does not obstruct egress from the ship.

2422. Brows

Sufficient brows must be provided to ensure that evacuation from the ship is not impeded. As a minimum, brows should be provided forward and aft on each side whilst in dock, dependant on the size of vessel. To maintain security of the ship there should be one main brow, with the remainder locked but capable of being open from the inboard side without a key.

ANNEX A TO CHAPTER 24

DD/FF UPKEEP PERIOD DUTY WATCH

1. The Requirement

The Ship's Staff of a DD/FF will normally be accommodated ashore during a Docking Period for Health and Safety reasons. If a ship is docked down in a Naval Base port, de-ammunitioned and de-fuelled and the Ship's Staff live ashore, an Upkeep Duty Watch of an Officer of the Day plus 11 hands will allow a Commanding Officer to discharge his Care and Protection responsibilities within acceptable levels of risk. This Duty Watch may be utilised at the discretion of the Commanding Officer.

2. Upkeep Duty Watch

The Upkeep Duty Watch (UDW) is focussed on providing a rapid response to any detected fire, with the aim of dealing with an incident before it escalates. A table describing the duties of the 12 members of the UDW is shown at Table 24A-1. It should be noted that welding sentries are not to be drawn from this organisation and, unless provided under the Upkeep Period contract, other hands will have to be nominated for this task. In order to minimise risk it is essential that a Commanding Officer satisfies himself that an effective hot work sentry organisation and rigorous rounds regime is established. A minimum rounds requirement is shown at Table 24A-2.

3. The UDW can only provide a strong initial attack on a fire; it will require the early transfer of firefighting responsibility to the Local Authority Fire Brigade (LAFB) who will carry out the support phase firefighting activity if the fire escalates. For this to be successful the LAFB will need careful briefing on the fire incident and guides will be required. In order to provide suitably dressed guides in a timely fashion, personnel, once released from task, as shown in Table 24A-1, must return to the Officer of the Day's control position to be directed to further duties.

4. Implementation

The Upkeep Duty Watch requires Ship's Staff to take on significantly different roles from those undertaken in Fleet Time. Before implementing the Upkeep Duty Watch the Commanding Officer is to satisfy himself that they can effectively respond to ship emergencies. Ship's Staff should review a variety of fire incidents and prove their organisation by conducting a number of exercises. During the exercises and reviews the following points merit detailed consideration:

a. Positioning of potential sites for LAFB Forward Control Positions.

b. Provision of effective communications throughout the ship at different stages of the Upkeep Period.

c. The impact of the spread of smoke due to lack of doors/hatches or incomplete ventilation systems when establishing smoke boundaries.

d. Provision of effective evacuation routines and accounting procedures for personnel including contractors.

5. Material Changes

As the Upkeep Period progresses there will be changes to the ship's material state which may affect the ability of the UDW to respond to emergencies. In particular, the removal of ladders, soft patches and escapes can affect the access to and escape from incidents. Commanding Officers should ensure that a procedure for monitoring changes to the ship's material state is established and that all members of the UDW are briefed on the condition of the ship at the start of their duty period.

Table 24A-1. 12-Man UDW - Fire Incident Tasking

Duty Role	Rank/Rate	Attack Phase	Support Phase (with LAFB in Attendance)
OOD	Lt/CPO	I/C of Incident.	Liaison with LAFB I/C.
DPO	PO	Run field telephone to FCP. Report back to OOD with sitrep. Control Keys.	I/C Containment. Supervise personnel from other ships.
Duty Tech SR	CPO/PO	Provide HPSW from emergency dockside fire pump, Tech advice to OOD, check dockside BA charging facility if provided.	Liaise with Dockyard Control Engineer concerning power supplies and dockside firemain. I/C Guides and act as dresser.
I/C Attack Team	PO/LH	FCP I/C Attack Party.	FCP to liaise with LAFB Fire Officer.
SCC Watchkeeper	LH	Raise Alarm - make pipe, crash stop vent, TIC and comms to FCP/SOTI. I/C of initial attack until arrival of nominated I/C Attack.	Spare Hand: Assist OOD - Containment as required.
SCC Roundsman	AB	Collect 2 x CO_2 extinguishers. Initial Attack No 1.	Fearnought Suitman - LAFB Guide No 1.
Off-watch SCC Watchkeeper	LH	Attack BA No 1.	Fearnought Suitman - LAFB Guide No 4 if required, otherwise containment.
Off-watch SCC Roundsman	AB	Attack BA No 2.	Fearnought Suitman - LAFB Guide No 3 if required, otherwise containment.
QM	LH	Raise Alarm to Dockyard/ LAFB. Mark up Incident Board, assist OOD, monitor Kill Cards.	OOD Support-Incident Board Marker.
BM	AB	Collect 2 x SPE(AFFF). Initial Attack No 2.	Fearnought Suitman - LAFB Guide No 2.
Off-watch QM	LH	Attack BA Controller	BA Controller
Off-watch BM	AB	Place Gangway Flag, take 'T' Card Racks to muster point.	Dresser. Recharge used BA bottles

FCP = Forward Control Position
SOTI = Scene of the Incident

Table 24A-2. 12-Man UDW - Minimum Fire prevention Rounds Requirement

Duty	Rounds Areas	Rounds Conducted
OOD	Whole ship except machinery spaces, store rooms and magazines (concentrating on fire hazards).	Within one hour of completion of normal working day. Once every 4 hours between end of work and 2359. Once between 2359 and start of working day (combined with DPO rounds).
Duty Tech SR	ME/WE area (concentrating on areas where work has recently taken place).	Within one hour of completion of normal working day. Once per 4 hour watch until 2359. Once between 2359 and 0600.
DPO	Store rooms and magazines (concentrating on fire hazards).	With one hour of completion of normal working day. Once every 4 hours between end of work and 2359. Once between 2359 and start of working day (combined with OOD rounds).
SCC Roundsman	Whole ship.	Hourly 24 hours a day.
I/C Attack	FF equipment dumps.	On assuming duty. Every 4 hours until 2359. One hour before handing over duty.

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ANNEX B TO CHAPTER 24

MM/PP FIRE, EMERGENCY AND SECURITY PARTY DURING UPKEEP AT PORTSMOUTH

1. The Requirement

Commanding Officers of MM/PPs are responsible for the safety and security of their vessels throughout an Upkeep period. This annex describes the role of the Fire, Emergency and Security Party (FESP) of MM/PPs undergoing Upkeep by contract at Portsmouth.

2. For the periods in an Upkeep Period that the ship is docked or afloat in a non-tidal basin (2 Basin included) until one week before Ship's Staff move onboard (SSMOB), a Fire, Emergency and Security Party (FESP) is to be formed. However, if fuel is embarked during this period the FESP is to be augmented by a Senior Technical Rating (STR).

3. Role of the FESP

The role of the FESP is to:

a. Conduct security rounds and provide a fire/flood prevention organisation.

b. Raise the alarm in the event of discovering a fire/flood.

c. Provide a first aid firefighting/flood containment capability.

d. Provide a Ship's Staff Command and Control organisation to liaise with the LAFB and provide expertise and guides to assist LAFB firefighters.

4. Provision of welding/hot work sentries, if required, is to be made from non-FESP members.

5. Organisation

The manning requirement for the FESP will depend on where the ship is berthed and the Commanding Officer's ability to safely maintain an attack on a fire. As the composition and tasks of the FESP will alter throughout an Upkeep Period, each change is to be tested by carrying out a comprehensive programme of training and exercises. The minimum requirements are:

a. When docked in a graving dock.

(1) I/C FESP - Ship's Duty Officer (SDO) (Officer/Senior Rating).

(2) FESP - 4 Junior Ratings.

b. At a non-tidal berth before embarkation of fuel for set-to-work:

(1) I/C FESP - SDO as described above.

(2) FESP - 4 Junior Ratings, one of which is to be a technical rating conversant with power/system isolations.

c. At a non-tidal berth after embarkation of fuel for set-to-work:

(1) I/C FESP - SDO as described above.

(2) STR - to be fully conversant with power/system isolations.

(3) FESP - 4 Junior Ratings.

6. The FESP is to provide the following:

a. Fire, emergency and security cover for the duration of their duty.

b. Outside normal working hours, rounds as follows, to be recorded in a log at the gangway:

(1) Hourly, by a member of the FESP.

(2) At the end of the routine working day and/or on completion of all work, by SDO (and by the STR once inaugurated).

7. Whilst the ship is in Upkeep, the on-watch roundsman and quartermaster are to work from a portacabin adjacent to the gangway. However, if the ship's flood and fire warning systems are functional then the quartermaster is to be stationed onboard to monitor the alarm system.

8. Actions to be Taken by the Person Discovering a Fire
The person discovering a fire is to take the following actions:

a. Raise the alarm and operate the nearest contractor installed fire alarm. The quartermaster will call the LAFB and inform the Duty Watch in their accommodation.

b. Attack the fire using first aid firefighting equipment.

c. If forced to withdraw after the initial attack, report to the SDO at the gangway.

9. Actions to be Taken by the FESP

a. SDO is to:

(1) On receipt of the fire alarm, alert the FESP and proceed to the ship's gangway and assume command of the incident.

(2) Obtain a brief from the person discovering the fire, and mark up the incident board.

(3) Brief the LAFB, on their arrival, with respect to fire location and known hazards. If appropriate, hand over responsibility for firefighting to the LAFB but retain overall responsibility for the safety of the vessel.

(4) Dress the off-watch FESP ratings in full firefighting rig to act as guides for the LAFB.

b. FESP:

(1) On-watch FESP to fight the fire if possible. Proceed to the gangway and brief the SDO.

(2) Two off-watch FESP are to proceed to the gangway position, don BA and investigate/attack the fire.

(3) On completion of Attack BA duties, if able, dress in full firefighting rig in preparation for acting as LAFB guides.

(4) If fuel is embarked the STR is to proceed to the ship and make necessary system isolations. On completion he is to brief the SDO on actions taken, hazards and system configurations.

10. Equipment
A secure Ship's Staff fire locker (with frangible key container) is to be sited adjacent to the gangway. It is to contain the following equipment provided and be maintained by the Ships Staff:

6 SPE(AFFF)
2 CO_2 extinguishers
4 Fearnought suits, boots etc.
2 BA + 4 spare bottles with BA control boards and marker pens.
2 FFHBC and 1 hand-held radio
1 TIC with spare batteries
Guideline/sound powered (SP) telephone wire + 2 SP telephones
Incident board and marker pens
Kill Cards
Torches
1 Submersible pump
1 Portable eductor
Soft wood wedges

11. Ship's Staff are to provide radio communication between the SDO and roundsman and SDO and firefighters.

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ANNEX C TO CHAPTER 24

MM/PP FIRE, EMERGENCY AND SECURITY PARTY DURING UPKEEP AT ROSYTH

1. The Requirement

The Synchrolift Building at Rosyth is designated as a factory for firefighting purposes. This requires the building to be evacuated immediately in the event of a fire alarm and no persons are able to re-enter the building until given clearance by the LAFB.

2. Unless modified by the provisions of a ship's Upkeep contract, Commanding Officers of MM/PPs remain responsible for the safety and security of their vessels throughout an Upkeep Period. This annex defines the role of the Fire, Emergency and Security Party (FESP) of MM/PPs undergoing Upkeep in Rosyth, where Commanding Officers retain responsibility for Care and Protection. For the periods in an Upkeep Period that the ship is docked (graving dock or synchrolift) or afloat in a non-tidal basin until one week before Ship's Staff move onboard (SSMOB), a Fire, Emergency and Security Party (FESP) is to be formed. However, if fuel is embarked during this period the FESP is to be augmented by a Senior Technical Rating (STR).

3. Role of the FESP

The role of the FESP is to:

a. Conduct security rounds and provide a fire/flood prevention organisation.

b. Raise the alarm in the event of discovering a fire/flood.

c. Provide a first aid firefighting/flood containment capability.

d. Provide a Ship's Staff Command and Control organisation to liaise with the LAFB and provide expertise and guides to assist LAFB firefighters.

4. Provision of welding/hot work sentries, if required, is to be made from non-FESP members.

5. Organisation

The manning requirement for the FESP will depend on where the ship is berthed and the Commanding Officer's ability to safely maintain an attack on a fire. As the composition and tasks of the FESP will alter throughout an Upkeep Period, each change is to be tested by carrying out a comprehensive programme of training and exercises. The minimum requirements are:

a. When docked in a graving dock.

(1) I/C FESP - Ship's Duty Officer (SDO) (Officer/Senior Rating).

(2) FESP - 4 Junior Ratings (see note).

b. When docked in the Synchrolift building:

(1) I/C FESP - SDO as described above.

(2) FESP - 2 Junior Ratings.

c. At a non tidal berth before embarkation of fuel for set-to-work:

(1) I/C FESP - SDO as described above.

(2) FESP - 4 Junior Ratings, one of which is to be a technical rating conversant with power/system isolations (see note).

d. At a non tidal berth after embarkation of fuel for set-to-work:

(1) I/C FESP - SDO as described above.

(2) STR - to be fully conversant with power/system isolations.

(3) FESP - 4 Junior Ratings (see note).

Note. *If a contractor's shipkeeper (acting as a Quartermaster) is provided under the Upkeep contract then the number of junior ratings may be reduced by one.*

6. The FESP is to provide the following:

a. Fire, emergency and security cover for the duration of their duty.

b. Outside normal working hours, rounds as follows, to be recorded in a log at the gangway:

(1) Hourly, by a member of the FESP.

(2) At the end of the routine working day and/or on completion of all work, by the SDO (and by the STR once inaugurated).

7. Whilst the ship is docked in the Synchrolift the roundsman is to base himself in the ship's refit offices. He is to inform the contractor's Synchrolift watchkeeper of his whereabouts at all times and specifically on the start and completion of his rounds. All access to/from the ship/Synchrolift outside normal working hours is to be via the access to/from the ship/Synchrolift watchkeepers' controlled access at the north end of the building.

8. Once the ship is afloat at a non-tidal berth the on-watch roundsman is to work from a portacabin adjacent to the gangway. If a contractor's shipkeeper is provided in lieu of a quartermaster, the roundsman is to inform the shipkeeper of his whereabouts at all times.

9. Actions to be Taken by the Person Discovering a Fire
The person discovering a fire is to take the following actions:

a. Raise the alarm and operate the nearest contractor-installed fire alarm. The watchkeepers will call the LAFB and inform Lowden Building.

b. Attack the fire using first aid firefighting equipment.

c. If forced to withdraw after the initial attack, report to the SDO at the nominated control position:

(1) The gangway if afloat.

(2) The Emergency Control Centre (Synchrolift) if docked.

(3) The gangway if docked in a graving dock.

10. Actions to be Taken by the FESP

a. Docked in Synchrolift:

(1) SDO is to:

(a) On receipt of the fire alarm, alert the FESP and proceed to the Emergency Control Centre (ECC) and assume command of the incident.

(b) Obtain a brief from the person discovering the fire, and mark up the incident board.

(c) Brief the LAFB on their arrival with respect to fire location and known hazards and hand over responsibility for the incident to the LAFB senior officer.

(d) Dress the off-watch FESP ratings in full firefighting rig to act as guides for the LAFB.

(2) FESP:

(a) On-watch FESP to fight the fire if possible. Proceed to the ECC and brief the SDO as appropriate.

(b) Off-watch FESP are to proceed to the ECC and dress in full firefighting rig in preparation for acting as LAFB guide.

Note. *In the event of a fire alarm being raised in the Synchrolift, due to the design of the alarm system, all ship's FESP teams are to attend an incident, reporting to their respective SDO at the ECC. Once an incident is confirmed within a ship in the Synchrolift, then the SDO of that ship is to take command utilising all FESP teams as required. However, action is to be limited to the provision of advice to the LAFB and supplying guides in support of the LAFB firefighting activity. If the fire is in the Synchrolift building but not affecting a ship they are to take no part in the operation but should remain on call to advise the LAFB or provide guides in the event of a fire spreading.*

b. In a graving dock or afloat before embarking fuel:

(1) SDO is to:

(a) On receipt of the fire alarm - alert the FESP and proceed to the ship's gangway and assume command of the incident.

(b) Obtain a brief from the person discovering the fire, and mark up the incident board.

(c) Brief the LAFB on their arrival with respect to the fire location and known hazards. If appropriate, hand over responsibility for firefighting to the LAFB but retain overall responsibility for the safety of the vessel.

(d) Dress off-watch FESP ratings in full firefighting rig to act as guides for the LAFB.

(2) FESP:

(a) On-watch FESP to fight the fire is possible. Proceed to gangway and brief the SDO.

(b) Two off-watch FESP proceed to the gangway position, don BA and investigate/attack the fire.

(c) On completion of Attack BA duties, if able, dress in full firefighting rig in preparation for acting as LAFB guides.

c. Afloat after Embarking Fuel:

(1) *SDO*. As in 10b.(1) above.

(2) *STR*

(a) On receipt of the fire alarm proceed to the ship and make the necessary system isolations.

(b) On completion of system isolations proceed to ship's gangway and brief the SDO on actions taken, hazards and system configurations.

(3) *FESP*. As in 10b(2) above.

11. Equipment

A secure Ship's Staff fire locker (with frangible key container) is to be provided when docked, (Synchrolift or graving dock) and afloat (before SSMOB), to be sited adjacent to the designated incident control position. It is to contain the following equipment provided and maintained by ship:

6 SPE(AFFF)
2 CO_2 extinguishers
4 Fearnought suits, boots etc.
2 BA + 4 spare bottles with BA control boards and marker pens
2 FFHBC and 1 hand-held radio
1 TIC with spare batteries
Guideline/sound powered (SP) telephone wire + 2 SP telephones
Incident board and marker pens
Kill Cards
Torches
1 Submersible pump
1 Portable eductor
Soft wood wedges

One week before SSMOB, and in association with Duty Watch training, this equipment is to be properly secured onboard.

12. Ship's Staff are to provide radio communication between the SDO and roundsman and SDO and firefighters.

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CHAPTER 25

AIRCRAFT FIREFIGHTING

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CONTENTS
(Continued)

ANNEX

CHAPTER 25

AIRCRAFT FIREFIGHTING

2501. Aircraft Operations

This chapter provides information to Ships' Staffs on aircraft firefighting. It supplements the information in BR 766(C) - Aircraft Operating Handbook.

2502. The Behaviour of Aircraft Construction Materials in Fire

The following paragraphs give an introduction to the behaviour of aircraft construction materials in fire.

2503. Magnesium

Only magnesium alloys or aluminium alloys with a high magnesium content are likely to burn in an aircraft fire and those must be surrounded by flame for some time, usually a few minutes before they are ignited. When they are ignited they burn with a brilliant glare but this brilliance is rather misleading; although the metal itself attains an extremely high temperature, up to 3000°C, it gives off comparatively little heat and the mean flame length is no more than 50mm. Magnesium fires are not likely to be extinguished by mass discharge of foam normally used against aircraft fires. Burning magnesium is capable of breaking down water into its constituent elements, hydrogen and oxygen. The magnesium combines with some of the oxygen and the hydrogen may burn. The immediate result is intensification of the fire.

2504. Although the immediate result of applying water to burning magnesium alloy components is to intensify the fire, the quantity of water which magnesium is capable of breaking down is only three-quarters its own weight and, as the magnesium and the water are in contact only at their surfaces, the proportion of a continuous stream of water which is broken down is relatively small. If the stream of water is maintained, most of it is able to cool the magnesium until it solidifies and the fire is extinguished. It is therefore not advisable to use spray for cooling magnesium because of the low water application rate. It is better to use a jet at low pressure to achieve concentrated swamping and work progressively over the burning surfaces. The recommended method of application is by applying water at a pressure of two to three bar through the foam-making branchpipe over the burning magnesium. This method allows the quantity of water to allow swamping of the magnesium and gives the branch operator an on/off facility.

2505. Aluminium

Aluminium will ignite when heated to 800°C but the major airframe alloys (duralumin, alclad, etc) are not ignited in aircraft fires. A possible reason for this is that the melting point of aluminium is approximately 600°C, so it fuses and drips to the ground some time before it could be ignited. In doing so, it would often escape into an area where temperatures are significantly lower, and in this molten form it is easily covered and effectively sealed by a mass discharge of foam.

2506. Beryllium

Although occasionally used in aircraft construction, beryllium is more widely used in electrical or electronic equipment installed in aircraft. Beryllium/beryllia in solid form does not pose a hazard, but as a dust, powder or as an oxide it gives rise to serious health risk and extreme cases may lead to death. Various precautions may need to be taken, such as full protective clothing (aircraft crash) and BA should be worn. Breathing of dust or smoke from a component or equipment known to contain beryllium is to be avoided. When beryllium or its alloys are involved in an intense fire, there is an acute and immediate hazard. However, there is no need to adopt any special firefighting techniques or procedures because of the presence of beryllium.

2507. Composite Fibre Materials

Organic Compounds in the form of resins and epoxies are used in the manufacture of composite material products. Undisturbed in the final product, these substances are inert and harmless. When these substances are exposed to elevated temperatures and fires, as may occur in aircraft crashes, these compounds become unstable and decompose. They release smoke and fumes which are toxic. Personnel working in the immediate area following an aircraft crash / fire at sea should either don self-contained breathing apparatus or a full face negative pressure respirator fitted with the appropriate filter. The S10 respirators may be used by personnel involved in Post Crash management (PCM) in the general vicinity of, but not actively involved in aircraft crash fire fighting outside of an established cordon.

2508. In open, well ventilated spaces, the hazard area of composite materials smoke and fumes is generally limited to the visible smoke plume. Smoke and fumes dispersed in the open, through natural ventilation and dispersal do not constitute a hazard. In areas that are not well ventilated, composite materials smoke and fumes present a health hazard. The presence of smoke and fumes in such areas is usually easily detected by smell. Personnel should immediately evacuate such areas if they are not protected.

2509. Carbon Fibres

Pure carbon fibre is chemically inactive and non-toxic. However, carbon fibres have the capacity to absorb other substances. Carbon fibre released from burning composite material is not pure but carries with it absorbed combustion products. These products are toxic and thus pose a hazard.

2510. Carbon fibres are electronically conductive. Because they are also very light, they are airborne and can easily be carried to electrical installations or introduced into electronic equipment through cooling air drawn in by equipment. Sufficient concentration of free carbon fibres will interfere with the operation of electrical and electronic equipment.

2511. The following factors must be considered when responding to an incident involving an aircraft containing composite materials:

a. The upwind approach to the aircraft must be used.

b. Personnel must not enter the visible plume without BA and eye protection.

c. BA is to be worn by personnel who are imminently or actually exposed directly to the smoke, fumes and gases from burning composite materials.

d. Only in the gravest of situations may personnel enter the visible smoke plume without full skin protection.

e. Personnel exposed to the smoke, fumes or gases of composite materials and who are not wearing full skin protection should be withdrawn as soon as possible and be directed to thoroughly shower to remove any composite materials debris from the skin.

f. Flight deck vehicles, etc are to be kept clear of the area underneath the smoke plume as carbon fibres which have been released become airborne and drop from the smoke plume downwind. In windstill conditions they are dropped in the immediate vicinity of the fire site.

2512. The post-fire operations, salvage and recovery tasks are to be carefully controlled and monitored, and access to the aircraft crash site is to be restricted to those personnel who are suitably protected by full skin and respiratory clothing (see BR 766(C)(1) for more detailed instructions for dealing with fires involving man-made mineral fibres).

2513. Fuel Systems

Fuel is carried in a number of tanks, structurally separated but interconnected, in the wings, and in many instances, in the fuselage. The principle types of tanks are:

a. **Fuel Systems.** These are compartments formed by the airframe structure itself, which are sprayed internally with a synthetic rubber composition to seal their joints and make them fuel-tight.

b. **Bag-Type Tanks.** These are flexible plastic bags fitted into compartments in the wings or fuselage and secured by a pattern of press studs. They are sometimes known as collapsible tanks.

c. **Auxiliary Tanks.** These are carried externally under the wings or fuselage. They are aerodynamically-shaped and constructed from moulded fibreglass or a metal frame covered with stressed skin, depending on their size. In most instances, these tanks can be jettisoned in an emergency.

2514. Hydraulic Systems

Hydraulic fluid is carried in one or more reservoirs, usually installed in the fuselage. A reservoir may be a metal tank, which is not pressurised, or it may be a flexible bladder contained in a tank which is pressurised by air ducted from an engine compressor. The hydraulic fluid from the reservoirs is circulated through the system by one or more high pressure pumps. Accumulators are installed in the HP side of essential circuits.

2515. Electrical Systems

In most aircraft the electrical services are supplied by engine-driven alternators or generators providing ac and dc power. Additionally, the engine-drive generators charge the aircraft batteries which provide a small reserve of power. Both lead-acid and alkaline batteries are used.

2516. The method of disconnecting the supply from the aircraft's batteries are as follows:

a. **Ground/Flight Switch.** On a few types of aircraft there is a master electrical switch often called the ground/flight switch and the batteries are completely isolated when this is in the ‘ground’ position.

b. **Battery Isolation Switch.** Most types of aircraft have a battery isolating switch whether or not they have a ground/flight switch. This switch isolates the batteries from nearly all the electrical circuits but some emergency services (eg fire extinguishing systems, engine re-light circuits) remain connected.

2517. It should be noted that aircraft usually receive their electrical power from an external supply while they are on the ground, and that it is pointless to use the battery isolation switch while the aircraft remains connected to an external supply.

2518. Compressed Oxygen Systems

The system is supplied from a number of cylinders containing gaseous oxygen (GOX) at 1800 psi.

2519. Liquid Oxygen Systems

Liquid oxygen (LOX) systems are supplied from one or more LOX converters. These are spherical or cylindrical in shape, insulated and contain evaporating coils and valves to regulate the rate of evaporation of the liquid according to demand.

2520. Aircraft Systems in Fire Conditions

Many of the aircraft powered and pressurised systems depend to a very large extent on the running of the aircraft's engine(s) to provide their original power or pressure and it follows that many of them will become inoperative or lose their pressure in crash conditions.

2521. An aircraft's systems are likely to have more influence in the development of a fire when fire occurs in an aircraft on deck:

a. The systems are intact and there would have been no loss of pressure other than that from shutting off the engines.

b. An outbreak of fire in an aircraft deck may be localised at first, but the system may be influential because:

(1) Light alloy distribution piping may fuse at hot spots at an early stage, possibly releasing flammable substances.

(2) The distribution systems may be the means of spreading fire through the interior of the airframe.

(3) Electrical circuits are more likely to be 'live'.

(4) The distribution of the system may create misleading impressions of the extent of a fire, or the location of the seat of the fire, by conveying smoke to apertures some distance away.

2522. Other Combustible Materials

Many system components include materials which, although free-burning, may smoulder, often giving off disproportionally large quantities of smoke. Most of these are various forms of plastics used as linings or insulation and are often in well concealed positions. They may be resistant to extinction by foam or CO_2 and they may continue to glow for some time until they cool naturally or until they are cooled by the application of water.

2523. Aircraft Ejection Seats

Ejection seats are used in all jet fighters. Because of the potential dangers from ejection seats and their associated explosive canopies, red triangular warning signs are displayed on the fuselage adjacent to the ejection seats on either side of the aircraft. If advertently fired during a rescue or drill, the ejection seat can become lethal to both the pilot and the rescuer. In order that the safety of aircrew and rescuers is ensured, the fire/crash rescue teams must have a basic knowledge of how an ejection seat works and the whereabouts of certain units on the seat.

WARNING

DO NOT TOUCH AN EJECTION SEAT UNLESS IT IS FOR RESCUE OR DRILL PURPOSES

2524. Armament and Pyrotechnics

Detailed information will be found in BR 862 - Naval Magazine and Explosive Regulations, Volume 1. The following introductory information is for guidance only. There are four broad categories of armament and pyrotechnic stores in aircraft:

a. **Minor Pyrotechnic Stores.** This category covers the many uses of cartridges as an intrinsic part of the aircraft's system and survival equipment. The number and distribution of these varies with the type of aircraft.

b. **Major Pyrotechnic Stores.** These form part of the load carried by an aircraft, usually on carriers or in containers inside the aircraft or on external pylons. The stores which may be carried vary according to the role of the aircraft and the mission which is being flown.

c. **Weapons.** These may form part of the load carried by an aircraft in a bomb bay, on external pylons or recessed within the airframe. The weapons which may be carried vary according to the role of the aircraft and the mission which is being flown.

d. **Freight.** Considerable quantities of weapons and explosives may be carried in the cargo holds of aircraft and may consist of any or all of the armament and pyrotechnics mentioned above.

2525. The Effects of Heat on Rocket Motors

A rocket motor is a steel tube containing a shaped charge of cordite or other solid propellant designed for controlled burning to produce a flow of gases through a venturi exhaust for a number of seconds. The propellant charge is manufactured to a cross-sectional shape which allows circulation of air and escape of gases during burning (eg a cruciform cross-section is common). If this assembly is affected by external heat and the charge subsequently ignites, it is not likely to burn in the same controlled way. Taking cordite as an example, it deteriorates at temperatures above 50°C, and the charge would lose its shape, perhaps blocking the passages to the exhaust. Moreover, the higher the temperature, the faster the rate at which cordite burns, but the venturi exhaust is designed to pass the gas flow which cool cordite would produce. It is probable therefore that extreme pressure would develop within the motor tube, which itself would be weakened by heating, and that the motor tube would burst (perhaps blowing out the venturi assembly). Ignition of a rocket motor thus may result in a low order of detonation, like a warhead, rather than propulsion of the missile.

2526. The Effects of Heat on Cannon Shell

As cannon ammunition consists of two components, the cartridge and the shell, there are several possible effects of exposure to heat and the results would depend on which occurred first:

a. HE shells may burst, like any other warhead, before the cartridge is affected.

b. The cartridge case may expand more than the shell so that there is no longer a gas-tight fit.

c. The cartridge charge may burst the weakened cartridge case.

2527. Such effects as these would mean that the shells would not be projected and the following points should be borne in mind:

a. The shells are not in a gun breech and therefore would be projected at random in low velocity, tumbling, end-over-end flight.

b. If there is ammunition in the breech of a gun it would be well insulated from heat. Distortion of the gun mounting, barrel or other components is likely to occur before the ammunition in the gun would be effected.

2528. Behaviour of Pyrotechnics in Aircraft Fires

The points about weapons are also applicable to pyrotechnic stores. Generally, pyrotechnics stores have comparatively thin casing. If there is a burster charge to release the pyrotechnic filling, it may be initiated by heat, but it would probably be insulated at first by the filling which itself may create other hazards.

2529. Smoke and Flame Producing Compositions

The filling of these pyrotechnics may be ignited at an early stage during an aircraft crash fire and it is virtually impossible to extinguish these compositions when they are burning. A covering of foam would interfere with the liberation of gas and would subdue flaming. Whenever possible, it is better to allow the whole of the filling to burn away. The fumes from these compositions are in the form of clearly visible coloured smoke and the flames burn with high brilliance so it is possible to avoid them. Full protective clothing, with helmet visor down, is adequate protection against this hazard.

2530. Risk Reduction

It follows from the previous paragraphs that, if the fire/crash rescue teams can attack and suppress the fire rapidly, serious damage may be adverted. This is, of course, the normal objective and it is important therefore that the presence of weapons or pyrotechnics stores should not provoke what may be less effective firefighting by causing diffusion of the firefighting effort.

2531. It is an over-simplification to expect weapons or stores exposed to fire to behave as when they are fired or detonated in the ordinary way. It follows that precautions which are based on an expectation of ordinary behaviour (ie keeping out of the presumed line of fire of cannon, RP or guided weapons) are either inadequate or unnecessary. Such inhibited positioning (ie firefighting equipment and personnel outside the whole area in front of an aircraft, from one out-board pylon to the other) might prevent really effective firefighting especially where there is only a limited discharge of foam.

2532. The opening attack on an aircraft should not be varied because weapons or pyrotechnics are present; rapid suppression of major flame masses remains the starting point. In many instances, it may be necessary to achieve this before the weapons or stores can be located and it is probable that they would be in positions which are well shielded from jets. A weapon bay or ventral pack has the virtually complete shielding of the aircraft's centre section and it is likely that external weapons which have not been separated would be at least partly covered by the mainplane. In these circumstances, monitors should be used for no longer than is necessary to ensure that branchmen can close in to work their jets directly into such shielded zones.

2533. Crash Rescue Strategy

The fire/crash rescue teams, with regard to aircraft crash rescue firefighting, have the following primary responsibilities:

a. To save life.

b. To minimise damage to aircraft and its associated equipment.

c. To make safe any special risks.

2534. Passengers and aircrew cannot be expected to survive beyond three minutes if subject to fire. The equipment, organisation and training of the crash rescue and fire teams is, therefore, to be such that the fire can be extinguished or brought under control within three minutes from the start of firefighting operations and be kept suppressed for sufficient time to ensure the completion of rescue operations and final extinction of the fire.

2535. Critical Area

The critical area of an aircraft involved in a crash fire is deemed to be the area within the airframe which contains the crew and passengers. The critical area is the area that must be protected from fire in order to create the survivable conditions to allow personnel to live. The position and extent of the critical area depends on the type of aircraft involved, ie for fighter aircraft (Harrier) the critical area is the area around the cockpit. However, when passenger-carrying helicopters are involved, the critical area consists of the whole fuselage.

2536. Crash Firefighting Teams - State of Readiness

The standby requirements of the fire/crash rescue teams are as follows:

a. **Normal Standby (Multi-Spot Decks Only).** At all times the watch is on duty and the whole team is to be dressed in Crash Fire Fighting Assembly (CFFA), except helmet and gloves which should be kept in close proximity of firefighting equipment.

b. **Priority Landing.** When an aircraft is returning to the ship with a problem, the duty team is to be fully dressed in CFFA and closed up at a pre-determined point on the flight deck with appropriate firefighting equipment.

c. **Emergency Landing.** When an aircraft has to make a forced landing as soon as possible, the duty team is to close up at a pre-determined point on the flight deck and approach the incident, as directed by the pilot or marshall, with the appropriate firefighting equipment.

d. **Crash on Deck with Fire.** The fire/crash rescue teams suppress the fire in the critical area using the appropriate mobile extinguishers (SF90 or 10kg CO_2). The flight deck party operate fire hydrants in accordance with the flight deck watchbill. When the critical area is secured from fire, the fire/rescue teams will carry out a rescue. Hangar curtain to be lowered to 2 metres from the deck, aircraft lifts to be brought to flight deck level and lift drivers remain closed up for the duration of the incident to facilitate casualty evacuation.

e. **Crash on Deck without Fire.** This type of incident should in its initial phase be attacked in the same manner as a crash on deck with fire. There will be a very high risk that fuel will issue from ruptured tanks. All spilt fuel, especially in the critical area, must be covered with foam before an entry is made. Normal crash rescue procedures can then be carried out.

2537. Approach and Preparation of Fire/Crash Rescue Teams

When approaching the scene of an incident, the person in charge of fire/crash rescue teams will note several factors to help in deciding where to deploy teams:

a. Accessibility to the aircraft crash.

b. Wind speed and direction.

c. The state of the surrounding deck.

d. Dangers associated with aircraft.

e. The position of the aircraft and its condition.

2538. Opening the Attack
The first phase of a foam attack at an aircraft crash is governed by two general principles:

a. The maximum discharge rate should be applied, ie applicator (FB10/10) fully opened and operating at its optimum output.

b. Foam application should be started from the fuselage and working outwards. If there is a fire in or under the belly of the aircraft near the critical area, this must be the starting point, and:

(1) If the cockpit is occupied, foam should be spread outwards to increase the separation between cockpit and flame.

(2) If it is a passenger-carrying aircraft, again foam must be directed to achieve an increasing separation between fuselage and flame.

2539. Although there may be value in covering the fuselage skin with foam to insulate it from external fire, it is noted that separating the flame from the fuselage, by applying foam to the base of the flame alongside the fuselage, also reduces the radiant heat and is likely to be more effective. Branch operators must consider the following points:

a. Application of foam to the fuselage skin as an insulator has limited value when:

(1) Exits have been opened (or the skin has been ruptured).

(2) There is any internal fire.

b. Application of foam to establish a flame-free strip alongside the fuselage also reduces the total volume of flame.

c. It is difficult to control the results when applying a jet to a curved surface of the fuselage.

2540. Support of the Rescue/Evacuation
The initial foam attack should be mass discharge, aimed to establish survivable conditions for the occupants of the aircraft by reducing the effects of heat in the vicinity of the cockpit or passenger cabin. Securing survivable conditions around the cockpit or passenger cabin will also establish good working conditions for the rescue team and an exit route for survivors.

2541. When conditions for survival within the aircraft have been established, the branch operator task is to improve conditions outside, for movement of rescuers and/or survivors, usually by applying foam to extend the safe area progressively further from where movement is taking place.

2542. It may be that the entry used by the rescue team is not suitable for the evacuation of casualties. When branch operators are extending the blanketed area, therefore, an important objective is to make other possible exits usable. This, applies particularly to passenger-carrying aircraft since rapid evacuation of large numbers is possible only if most of the exists can be used. It follows that branch operators must observe the movements of rescuers and survivors. Where possible, they should try to work in positions between other personnel and adjacent flame areas. They should try to avoid being in positions where their jets are directed towards personnel, and if such a position is unavoidable, they must take care to avoid any driving of flames.

2543. The purpose of applying foam is to reduce the area of the fire progressively, starting where the flame appears to present the most direct threat to personnel. This is only a starting point and the speed with which the effects of the fire are diminished depends on the rate at which foam is spread over the base area of the fire.

2544. Means of Entrance into Aircraft

Once the deployment of the fire/crash rescue teams is completed and any fire around the critical area has been suppressed, an approach to the cockpit can be made. It is the fire/crash rescue team's responsibility to familiarise themselves with exit and entrances of aircraft operating on their flight decks. Full and current information on all NATO aircraft is available in NATO STANAG 3896 CFR (EDITION 4) AIRCRAFT EMERGENCY RESCUE INFORMATION (FIRE PROTECTION) which can be found on:

http://www.robins.af.mil/ti/tilta/documents/to00-105E-9.htm

Due to the number of multiple amendments being forwarded this publication is not available in hard copy or CD format. There are basically four methods of entering an aircraft:

a. **Normal 'Manual' Canopy or Entrance Operation.** This may not always operate due to airframe distortion or, if it operates, the canopy or entrance could hinder rescue work.

b. **Normal 'Electrical' Canopy or Entrance Operation.** This may not operate if the electrical supply has failed or the airframe is distorted. Again, the canopy or entrance could hinder rescue work.

c. **Emergency Canopy or Entrance Removal.** This is the quickest and recommended method to gain access. There may be possible hazard from an explosive canopy or Miniature Detonating Cord (MDC).

d. **Break-In Points.** If all else fails, either cut away the canopy or break-in point. This is a long and difficult method.

2545. Normal Entrances

The normal entrance to an aircraft is either a cockpit canopy or a door.

a. **Cockpit Canopy.** This is fitted to Harrier aircraft and may be operated manually or electrically. Aircraft fitted with canopies have no alternative means of entry; however, the canopy itself has separate provision for emergency opening.

b. **Doors.** These are fitted to all other aircraft and are manually operated. Aircraft fitted with doors normally have alternative emergency entrances.

2546. Marking of Normal Entrances

Instructions on how to open normal entrances are usually marked by:

a. Orange-yellow lettering near the handle, with direction arrow if necessary.

b. Instructions engraved on the handle.

2547. Emergency Entrances (Canopies)

The canopies of aircraft are designed to be emergency entrances as well as normal entrances and may be jettisoned or shattered in an emergency situation. When the MDC explodes, it shatters the perspex canopy to expose the occupants. A fragment hazard exists when the canopy shatters.

2548. Emergency Entrances (Doors)

Aircraft with a door or doors may have one or more of the following means of access for use in an emergency.

a. **Emergency Doors.** Ordinary doors, provided in addition to those normally used.

b. **Emergency Hatches.** Selected windows or panels which can be removed for emergency access.

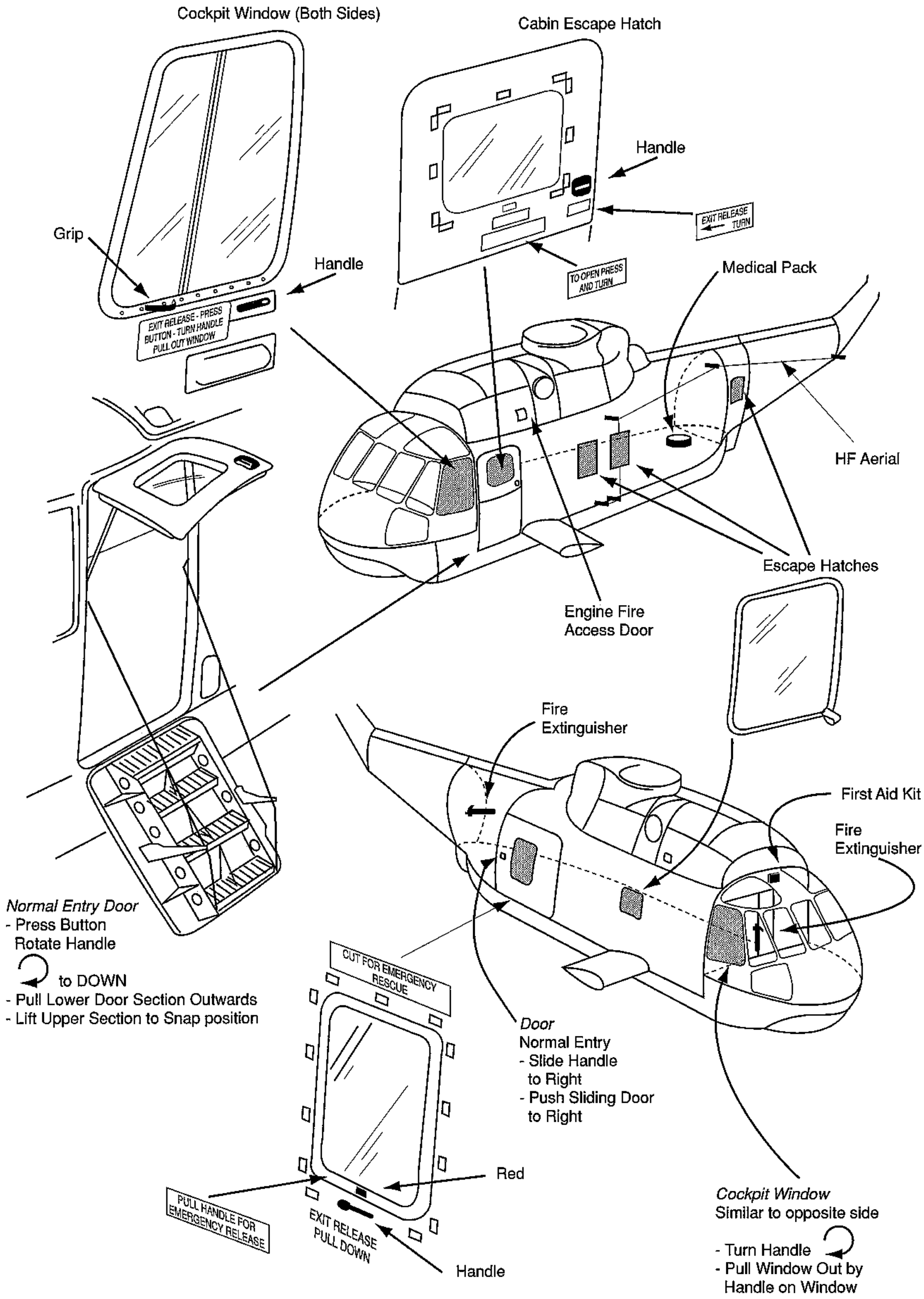

Fig 25-1. Marking of Emergency Entrances

2549. Marking of Emergency Entrances

Operating mechanisms and handles which are for use in an emergency are distinctly marked as follows:

a. Normally yellow and black diagonal stripes with operating instructions in orange-yellow lettering and arrows.

b. May be red or red in yellow and black diagonally striped frame.

c. Additionally, a large yellow arrow with the word 'RESCUE' in black letters, points to such handles.

2550. Miniature Detonation Cord (MDC)

The MDC is an explosive cord fitted to the canopies of aircraft (Harriers) to facilitate the escape of aircrew in an emergency, either in the air or on the ground. It is secured to the inside of the canopy and is designed to shatter the transparency outwards and away from the occupant(s).

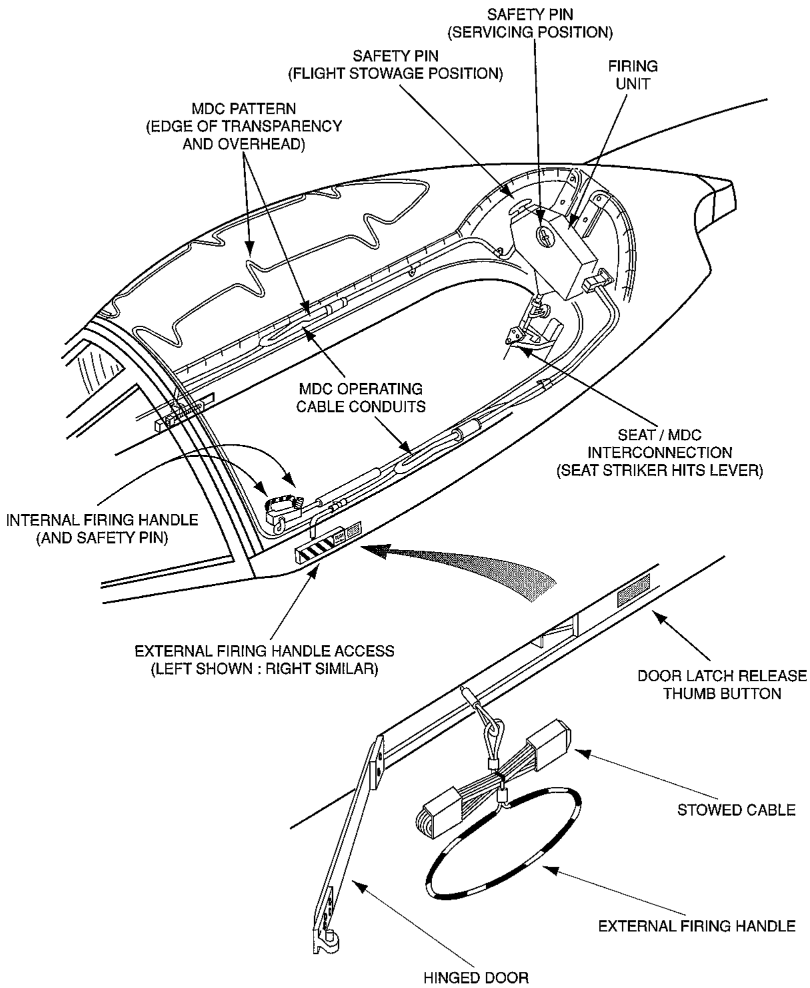

Fig 25-2. MDC System

Detonation of the MDC is by the normal ejection seat sequence, the internal canopy operating lever or the external emergency cable-operated device. When the MDC is detonated an initial cloud of fine particles and slivers of the canopy transparency, in line with the cord, are blasted outwards with the remainder of the canopy simultaneously breaking up into irregular size fragments. The travel distance of the canopy fragments varies from 2.8 metres to 20 metres, depending on the canopy shape. However, the majority of the canopy fragments are propelled upwards and sideways, the area in front of the cockpit remaining comparatively clear.

2551. Operation of the MDC External Emergency Cable

a. **Safety Precautions.** Fire/crash rescue teams, dressed in full protective clothing with helmet visor down, outside an area of 2.8 metres are adequately protected from canopy debris when the MDC is operated. It is therefore essential that:

(1) Fire/crash rescue teams responding to an incident involving aircraft fitted with a MDC are fully dressed in CFFA, with helmet visors down, when making their approach to the aircraft.

(2) The fully dressed state is not relaxed until it is clear that it is not necessary for the MDC to be operated, either internally by the occupant, or externally by the rescue team.

b. **Action by Fire/Crash Rescue Team.** On arrival at the incident involving an aircraft fitted with an MDC, the following procedures should be followed:

(1) Approach the cockpit, where possible, in full view of the aircrew.

(2) Be prepared to react to any signal from the aircrew indicating their intention to operate the MDC.

(3) On such a signal, the rescue crew should face away from the cockpit, withdraw at least 2.8 metres from, forward of, the cockpit area. If this is not possible, they should crouch down below the line of the cockpit.

c. Where it is necessary for the rescue crew to operate the MDC with the emergency cable, the operator should:

(1) Ensure that other personnel are clear of the cockpit and are aware of his intentions.

(2) Remove the cable from its stowage.

(3) Move to a position forward of the cockpit taking up slack of the cable.

(4) Then, facing away from the cockpit, lower his head and give the cable a sharp pull to detonate the explosive cord.

2552. Break-in Points

Break-in points are areas marked on the fuselage where it would be feasible to cut through the airframe to force an entry if necessary. As their locations are decided according to the arrangement of internal fittings, they are often awkwardly placed for rescue purposes, well above ground level on the outside and well above floor level on the inside. Break-in points are usually rectangular or follow the canopy frame colour. Their outline is marked by a broken line in contrast colouring (ie red on a white surface, yellow on a camouflage surface). On a number of military aircraft, the break-in points are marked in a contrasting colour keeping in tune with the aircraft's livery.

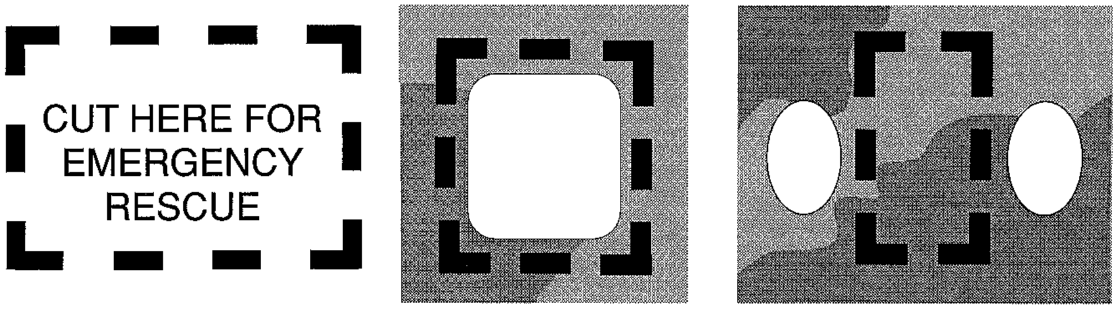

Fig 25-3. Break-in Point Marking

2553. Rescue of Aircrew and Passengers

Once entry to the aircraft has been gained, the first priority is to ensure that ejection seats, if fitted, are made safe by fitting the appropriate safety pins. The next priority is to ensure that the occupants who require rescuing are showing the basic signs of life (ie breathing and heartbeat) and preventing major bleeding. If necessary, basic first aid must be carried out in order to maintain the life of the aircrew and passengers whilst inside the aircraft.

Note. *Under no circumstances should an aircrewman's helmet be removed by fire/crash rescue teams as this could aggravate, or kill, a person suffering head or neck injuries.*

Once the two above important tasks have been completed, the necessary fire prevention tasks can be carried out to prevent outbreaks of fire and to neutralise potential hazards. These tasks involve, after consultation with aircraft ground support personnel:

a. Closing down engine throttles and/or HP fuel cocks.

b. Shutting down the Auxiliary Power Unit (APU), if fitted.

c. Opening the battery isolation switch(s).

d. Moving the armament safety switch(s) to OFF.

2554. In order to be able to neutralise the potential hazards listed above, it is necessary for fire/crash rescue teams to have a thorough knowledge of the means of isolating and making safe hazardous equipment that may be carried on aircraft. Fire/crash rescue teams and flight deck party continuation training programmes are to include the procedures for dealing with their particular based aircraft. It is emphasised, that fire/crash rescue teams should work only within the limits of their knowledge of the aircraft concerned. If they are not familiar with the appropriate controls they should await the arrival of qualified personnel. Once the crew and passengers have escaped or been rescued, if a fire subsequently breaks out, fire/crash rescue teams should not take unnecessary risks to enter an aircraft which becomes seriously involved in fire.

2555. Locating the Fire

It is essential to find out exactly where the fire is. Smoke and flame emerging from openings in the airframe are not a wholly reliable indication; their emergence is governed by internal air currents and they may have travelled some distance internally from any direction. As the airframe fills with smoke, it may emerge anywhere, perhaps giving a false impression of the magnitude of the fire. Other features may help to locate the fire more accurately. For example:

a. Metal expanding in the heat of the fire makes cracking sounds. This occurs all along the exit route of the flames but it is usually possible to establish the area of origin.

b. The aircraft skin becomes heated. Again this happens all along the exit route of the flames but the pattern of blistering of the aircraft finish usually reveals the area of origin.

2556. Engine Fires

Aircraft engines are complex structures and it is the most common area where fire may occur because of the presence of HP fuel and hot areas. Fires will affect one of two areas of the engine:

a. **Internal.** The internal areas of gas turbine engines can be broadly broken down into three areas:

(1) *The Compressor Section.* There is no real hazard associated with this area. FOD damage to a compressor blade may cause friction and heat by ‘compressor rub’ with the possibility of titanium powder being drawn into the combustion chambers.

(2) *Combustion Region.* The fire hazards associated with this region is small. Instruct the pilot to turn the engine over with the fuel off, apply CO_2 down the intake. If unsuccessful, prepare to cool the region with water on the advice and assistance from an airframe tradesman.

(3) *The Turbine Region.* The most common hazard in the turbine region is a ‘wet start’. Check the fuel supply is off and apply CO_2 up the exhaust tailpipe. If cooling is required with water, gain advice from the AEO. Cover spilt fuel on the deck with foam.

b. **External.** The area surrounding the internal areas of the engine contains all the services which the engine requires to operate. This region is termed the accessory region. This is the most common area for fires to originate and is usually served with an internal suppression system (BCF). Access to this region may be in the form of fire access panels or by removing airframe panels. The correct fire access panel must be found and CO_2 applied through this access.

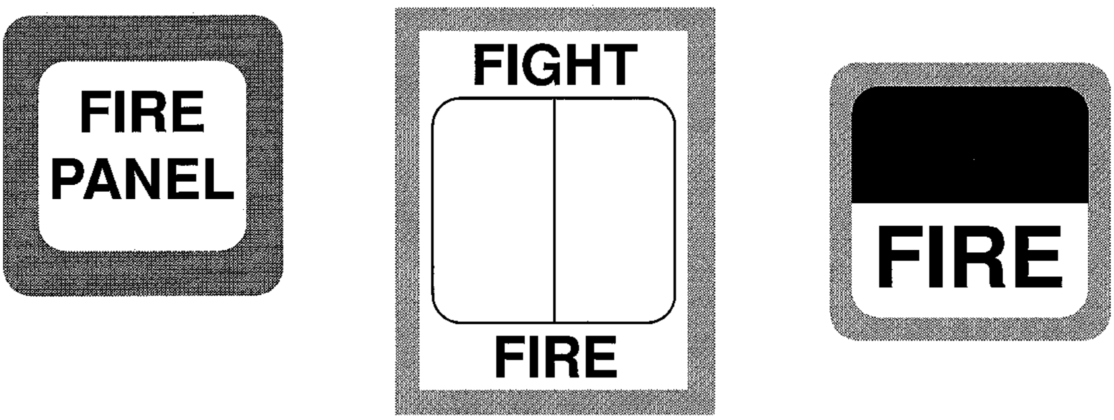

Fig 25-4. Various Types of Fire Access Panels

2557. Post-Crash Management

Royal Navy regulations for post crash management organisation are contained within JSP 318 - Military Flying Regulations and contain specific actions to be taken regarding aircraft with major components manufactured from Man Made Mineral Fibres (MMMF), ie Composites.

2558. Hangar Fires

Instructions for dealing with hangar fires are contained in Chapter 21 and in BR 766(C)(1).

2559. Detailed Ship-Type Information

Reactions within ships will vary according to the emergency and will be affected by many factors, eg the range of the aircraft from the ship, the time available before recovery, possible aircraft navigation difficulties, aircraft overdue action, priority of other evolutions within the ship, airspace reservations etc. It is for the Command to decide upon the correct course of action needed to recover the aircraft.

2560. Crash on Deck - Immediate Ship Actions

The whole-ship actions for a crash on deck are detailed in BR 766(C)(1). A generic guide to reactions by the NBCD organisation is at Annex A to this Chapter.

2561. Helicopter Operations in MM/PPs - Firefighting Preparations

The minimum firefighting preparations required by a MM/PP for helicopter operations are:

a. At ‘Prepare for Flying’:

(1) Rig two foam producing appliances (FB5X) plus portable inline inductors supplied from separate hydrants to transfer position (preferably from separate sides of the ship).

(2) Once rigged and foam production has been proved, the lever on the FB5X is to be turned to the *shut* position. This will allow the hoses to be fully charged but have the flow shut off at the nozzle. The hoses should be pulled back from the immediate area of transfer.

(3) Two waterwall nozzles may also be rigged (but turned off) ready to provide additional protection to exposed firefighters.

(4) Four sets of fearnought suits, boots, gloves and anti-flash should be broken out from the FRPP nearest to transfer position, checked and placed in a dry covered position ready for immediate use. There is no requirement to dress firefighters at this stage.

(5) Nominate and brief four personnel for duties as helicopter firefighters.

(6) HPSW main pressure is to be confirmed above 5 bar (80 psi) and pressure maintained throughout the duration of flying operations.

(7) On completion, report initial preparations complete to the OOW.

b. At the first indication of a possible incident involving the helicopter and the ship, the level of preparations should be increased.

(1) Dress fearnought suitmen; station them in a sheltered position ready for immediate deployment.

(2) Consider an increase in ship’s watertight integrity and restrictions to movement of personnel about the ship.

c. In the unlikely event of the helicopter crashing on the ship, the ship must immediately go to Emergency Stations. The nominated firefighters should endeavour to extinguish the fire, supported by the activated Emergency Stations NBCD organisation, based on the guidance at Annex A.

d. **Unless the ship has qualified AIR 233 trained personnel, no ad-hoc provision should be made to nominate personnel or equipment for an air-crew rescue party.** Once the fire is out, or access to helicopter established, casualty rescue should be attempted.

e. Ships officers should ‘table top’ and exercise the organisation and procedures most suitable for their ship’s manpower and equipment capabilities.

f. Detailed guidance and advice on helicopter operations and requirements can be sought from COMNA.

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ANNEX A TO CHAPTER 25

NBCD REACTIONS TO A FLIGHT DECK EMERGENCY

1. Introduction

This generic guide is based on a DD/FF and must be adapted to suit individual ships. It is imperative that all personnel onboard understand the procedures to be followed in the event of an aircraft emergency. Correct initial reactions are vital. The OOW is likely to initiate the onboard response to an incident. The ship's embarked flight and AIR 233 trained ratings will be first at the scene of the incident (SOTI) but may not have time to complete all necessary actions prior to a Crash on Deck. The SSEP and other key personnel must be prepared to take over the Damage Control and Firefighting effort and safeguard the ship.

2. Initial Response

The initial indication of an aviation emergency may result in a PRIORITY LANDING order over the flight deck intercom:

'*Stand by for Priority Landing, Stand by for Priority Landing*'

Flight personnel will close up and the ship will prepare for flying, if not already at Flying Stations. No reaction is required from the SSEP.

3. If the indications from the aircraft are that the problem is serious, then the General Alarm will be sounded and an EMERGENCY LANDING pipe will be made over main broadcast:

'Stand by for Emergency Landing, Stand by for Emergency landing. Forward and Aft FRPPs close up.
Clear all personnel from Aft of................ Section
Crash Boat Crew and Swimmer of the Watch close up
Attack Party muster at.........................
Support Party muster at the Forward FRPP.
First Aid Party muster at.......................
The aircraft has ....persons onboard and is armed with ....(Repeat pipe)'

4. If at the point of landing an aircraft crashes and/or catches fire, (this may happen without prior warning) the CRASH ON DECK pipe will he made:

'Crash on Deck, Crash on Deck
Crash stop ventilation. No smoking or naked lights throughout the ship.
Hands to Emergency Stations, Hands to Emergency Stations
Clear all personnel from aft of Section.................
Crash Boat crew and Swimmer of the Watch close up.
Attack Party muster at............................
Support Party muster at..........................
Containment Party muster at...........................
First Aid Party muster at.....................
The aircraft has............ persons onboard and it is armed with.......(Repeat pipe)'

5. If not already on an emergency course, the OOW will turn the ship so as to achieve a relative wind over the flight deck from the port side forward to clear the smoke and heat away from the ship. Consider turning on upper deck lighting to assist the SSEP actions.

6. SSEP Attack/Support Actions
The SSEP Attack Party muster as piped. If time and ship safety allows then the SSEP may prepare hoses on the upper deck and man the foam monitors if fitted, prior to taking cover. The i/c of the SSEP will establish the FCP and report its position to HQ1. The SSEP Attack Party members are to support the Flight's firefighting teams efforts. A member of the Flight/AIR 233 firefighting team (normally the SMR) will brief the i/c SSEP on the status of the aircraft, crew and firefighting actions. The FB10/10 may require re-supply of AFFF to maintain the continuous attack on the fire.

7. The SSEP Support Party muster at the Forward FRPP and commence dressing at 'Emergency Landing'. They will dress in accordance with standard practice for a continuous rolling attack. If Crash on Deck is not piped they are to come 'off air' after a face seal check and await further instruction from HQ1. If 'Crash on Deck' is piped they are to proceed to the FCP 'on air'. The i/c of the SSEP will direct the Support Party as required.

8. SCC Actions
SCC personnel are to carry out the following actions:

a. Crash stop vent.

b. Crash stop HP air compressors.

c. Start all available fire pumps.

d. Confirm Avcat transfer pump shut down.

d. Consider starting additional generators and moving load to forward generators.

9. Aft FRP Actions
The Aft FRP close up when the 'Emergency Landing' or 'Crash on Deck' pipe is made. The first priority is carry out a blanket search of the aft section of the ship to ensure personnel are clear and identify the boundary of the incident. The second priority is containment. SSEP Containment Party personnel will be dispatched to the Aft FRPP to assist. The third priority is to prepare a fully dressed Support Team ready to relieve the SSEP, or to fight any secondary fires. Additional hands from the Forward FRP are to be requested, via HQ1, if needed to augment the Aft FRP actions. It may be necessary for the Aft FRP to conduct re-entry onto the quarterdeck using a fully dressed Support Team. Re-entry to the quarterdeck will only be approved by HQ1 when the flight deck fire has been confirmed extinguished. The seaboat may be used to view the quarterdeck if the weather is good. However, the precautionary full re-entry procedure will still be required. The Aft FRP is to nominate one hand to close up at the hangar spray position in case their operation is ordered by HQ1.

10. Forward FRP Actions

Forward FRP personnel are to close up and assist the SSEP Support Party with dressing. Those not involved with dressing the Support Party act as a pool of manpower to assist the Aft FRP.

11. Manpower Control

Muster spare manpower and consider dispatching four hands immediately to the i/c at the FCP to assist with rigging hoses and collecting foam. Manpower will also be required to assist with containment (if the Watch on Deck are nominated as Containment Party, they will be required to launch the seaboat). Allocation of any spare hands must be coordinated via HQ1.

12. SSEP Containment Actions

The SSEP Containment Party will be utilised primarily to provide boundary cooling on the deckhead underneath the flight deck and hangar. Their activities will be coordinated via HQ1 and in liaison with the i/c Aft FRP. They may also be required in the vicinity of the hangar magazines should this be deemed necessary by HQ1.

13. The Weapons Section Officer (WSO) is to provide specialist WE advice including the implications of air weapons on the aircraft, in the hangar or magazines. WSO is to ensure that the hangar magazine OOQ and the Thallium Incident Reaction Team muster on hearing the 'Crash on Deck' pipe with keys to access the hangar magazines if required. Should the Attack BA find weapon damage, the Thallium team will be dressed and called forward immediately.

14. Flight Deck Crew

Flight/Air 233 trained personnel are the ship's primary Crash on Deck response team. They are to deploy and man the FB10/10s, fight the fire and rescue the aircrew under the direction of the FDO in accordance with BR766(1). The Flight SMR will liaise directly with the i/c of the SSEP.

15. Medical

The SSEP First Aid Party is to close up at the 'Crash on Deck' pipe. The i/c of the SSEP Attack Party will control the movement of casualties from the flight deck and will call for First Aid Party members as required once the casualties are safely clear of the SOTI. First Aid personnel are to keep clear whilst firefighting equipment is being rigged by the SSEP and are to transport casualties to the designated casualty handling point once they have been assessed and stabilised.

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CHAPTER 26

PERSONAL PROTECTION

CONTENTS

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CHAPTER 26

PERSONAL PROTECTION

2601. This chapter covers personal protective clothing for action, damage control and firefighting. Breathing apparatus is covered in Chapter 27 and individual protective equipment (IPE) for NBC hazards is covered in BR 2170(2).

2602. Action Dress

At Action and Defence Stations all personnel are to wear Action Dress. The basic Action Dress is as follows:

a. Cotton Underwear. Personnel are advised to avoid wearing undergarments made from nylon, thermoplastics and polyester, even in peacetime. The most practical material for undergarments is plain cotton although wool and materials derived from cellulose (eg rayon) are also melt hazard free.

b. Thick wool-rich black socks.

c. DMS boots.

d. Flame retardant action coverall.

e. Flame retardant anti-flash gloves and hood. (Gloves are to be worn over the coverall sleeve. The hood bib is to be tucked into the neck of the coverall. At Defence Stations the hood may be worn around the neck.)

f. In temperate or cold climates flame retardant (FR) No 4 shirt and trousers or FR overalls (blue or white) may be worn under the FR action coverall. This measure provides an additional insulating layer for personnel in positions where cold is a problem and aids survival prospects in the event of abandonment in cold conditions. It must however be balanced against the fact that no significant additional protection from burns is provided and that it can increase the risk of heat illness in warner climates, or if personnel undertake heavy or prolonged physical work.

2603. Selected items from the following list may be worn/carried in addition to Action Dress, when appropriate:

a. Rank/rate shoulder badges.

b. Lifejacket.

c. Survival suit.

d. NBC respirator in haversack with contents in accordance with BR 2170(2). (Only required if an N, B or C threat exists.)

e. Brassard, for identification.

f. ELSA. (Only if ordered for a specific function, eg patrols.)

g. Identity discs (stainless steel). Only when ordered.

h. NBC protective suit, gloves and overboots (IPE).

i. NBC decontamination suit.

j. Foul weather clothing.

k. Flight deck clothing.

l. Immersion coverall.

m. Protective helmet.

2604. Substitute Clothing
When dressed in full firefighting rig the following clothing substitution is authorized:

a. Firefighters' boots for DMS boots.

b. Firefighters' gloves for anti-flash gloves.

Note. *Firefighters standing by at Action stations should wear the anti-flash hood, as it gives better facial protection than the firefighter's hood, when BA is not being worn.*

c. Fearnought suit for action coverall if No 4s or overalls are being worn in accordance with Para 2602.

2605. Keyboard Operator Anti-Flash Gloves
Kid leather anti-flash gloves are provided for selected keyboard operators in areas such as the Operations Room. The flame retardant (FR) treatment will last for the serviceable life of the gloves. Gloves must not, however, become badly soiled or permanently stained since such deposits/defects reduce the FR properties and decrease the protection afforded.

2606. The gloves may be cleaned by careful hand washing as follows:

a. Synthetic detergents of known suitability are to be used. This can be determined from the instructions on the labels of proprietary products. Either they say clearly that the product is suitable for FR garments or suitability is indicated by saying how to wash FR garments or garments with FR finishes.

b. Do not use soap or washing products containing soap. The use of soap is to be avoided because it can cause an accumulation of flammable deposits on garments.

c. Do not boil.

d. Do not bleach.

e. Do not use fabric conditioner.

f. Do not leave gloves to soak.

g. Use warm water (maximum temperature 50°C).

h. Don the gloves and wet them thoroughly.

i. Carefully lather the leather portion of the gloves as if washing the hands; cotton sections may be rubbed together or with a separate piece of wet cloth.

j. Remove the gloves and thoroughly rinse in several changes of clean lukewarm water. It is important to continue rinsing until the water is clear.

k. Remove excess water by squeezing it out; never wring it out.

l. Pull the gloves into shape carefully; blow into them to separate the surfaces.

m. Hang the gloves away from direct heat, or sunlight, to dry.

n. When nearly dry, restore their softness, shape and size, by working them on the hands, then re-hang until completely dry.

2607. Chemical Threat - Wearing of Anti-Flash

When the Chemical Safety Rule is in force, upper deck guns crews are to wear IPE at a dress state appropriate to the threat. In Dress States Zero, One, Two and Three anti-flash is to be worn. (NBC Dress States are defined in BR 2170(2)). Personnel within the Citadel, whether wearing IPE or not are to wear anti-flash. For those in the Citadel and dressed in IPE the anti-flash hood is to be worn instead of the IPE hood and anti-flash gloves are to be donned instead of the IPE outer gloves. In the event of a citadel breach and a chemical hazard the anti-flash hood is to be removed, the NBC respirator donned and the IPE hood pulled up. When personnel wearing IPE with anti-flash are about to leave the citadel, they are to remove the anti-flash and don the remaining IPE protection (gloves and respirator with hood up).

2608. Action Coverall

The action coverall is a double-layered flame retardant garment which is to be worn during hostilities and firefighting only. The coverall may be mared in felt tip, for the identification of personnel, on the left breast pocket flap only. Air maintenance rating action coveralls, which do not have breast pockets, are not to be marked. For exercise purposes blue or white FR overalls over No 4 trousers and shirt are to be worn to stimulate the two FR layers of the action coverall.

2609. Personnel employed on duties in support of 4/5 man firefighting teams may be dressed in an action coverall ensemble (see below) at the discretion of the Firefighting Supervising Officer, although any person required to transit the ship protector waterwall to gain access to a compartment/scene of the fire must be in full firefighting rig. The action coverall firefighting ensemble includes the following additional items:

a. Cotton underwear.

b. Woollen socks.

c. Firefighter's hood.

d. Firefighting gloves.

e. Firefighter's helmet.

f. Leather firefighting boots.

g. Breathing apparatus.

h. No 4s, if worn in accordance with Para 2602.

2610. Due to the limited space available in FRPP lockers and the requirement that only clean oil-free action coveralls are used for firefighting, they are to be drawn from Naval Stores at the discretion of the Firefighting Supervising Officer. To facilitate this it is recommended that a selection of action coveralls in various sizes are dispersed within the ship's storerooms for immediate use. Action coveralls are also to be stored in the upper deck re-entry locker.

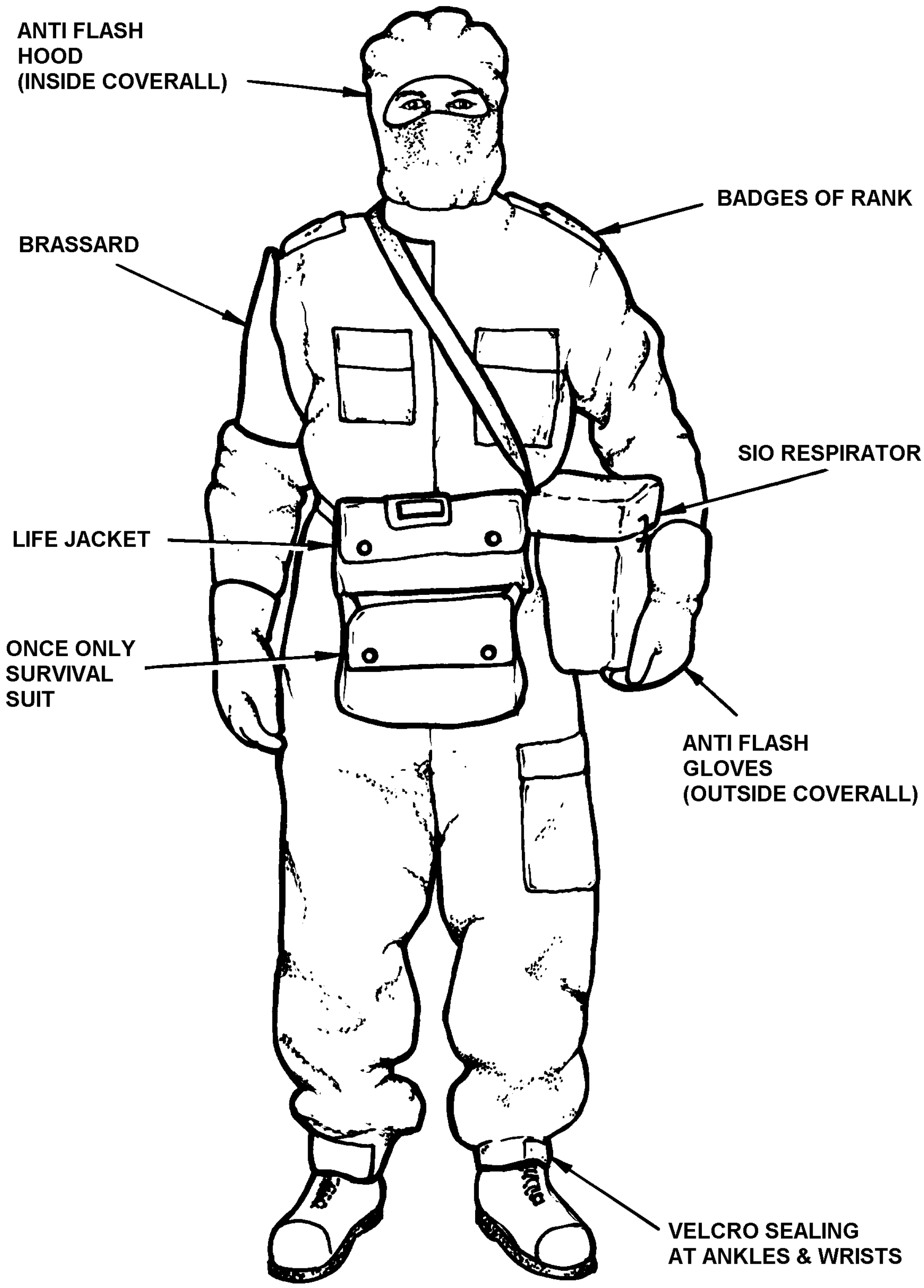

Fig 26-1. Action Coverall in Action Dress

2611. Brassards

Brassards are to be worn on the right upper arm, over action coveralls, to denote the following functions:

a. **Red.** Damage control personnel (except heavy 'L').

b. **Green.** Heavy 'L' personnel.

c. **Orange.** BA Controllers (Yellow brassards are not codified).

d. **Pink.** Weapon Repair Teams.

e. **Red Cross on White.** First Aid Teams.

f. **White.** Marked to indicate key personnel.

2612. 'Proban' Treated Flame Retardant Garments
The following garments have 'Proban' flame retardant (FR) treatment:

a. No 4 shirt and trousers.

b. Anti-flash hood and gloves.

c. Ratings' blue overalls.

d. Officers' white overalls.

e. Action coveralls.

2613. The effectiveness of this FR treatment depends on garment cleanliness, so correct laundering in accordance with the garment care label is therefore essential. BR 1277 - Laundry Manual provides guidance for laundry processes. Heavy duty detergent powder is to be used in the laundering process (maximum wash temperature 60°). General purpose detergent powder contains a bleaching agent, so should be avoided if possible. Soap or washing products containing soap are not to be used. It is especially important to avoid soiling by oils and greases, which impair the flame-retardant qualities of the fabric. Severely soiled garments are to be returned to stores.

2614. Action Dress for Embarked Military Forces

1. Combat Soldier 95 (CS95) worn by Embarked Military Forces14
2. (EMF) is not Fire Retardant (FR) and may increase the risk of burn injury if exposed to flame. To provide protection appropriate to risks when in the Action State, and to correspond with the protection provided afforded to RN personnel, all EMF personnel are to be issued with one Action Coverall, one anti-flash hood and one pair of anti-flash gloves as soon as practicable to cover any contingencies which may arise. These are to be worn when prescribed by the Command in accordance with the guideline below. The action coveralls are environmentally sealed and the packages should not be broached until required in accordance with the guidelines:

a. Action Dress and anti-flash is to be worn during the following ship states:

Risk	Ship State	Dress
Low	STATE 3 (Cruising Watches)	CS 95
Medium 1	STATE 2 (Defence Watches)	CS 95 (anti-flash hood and gloves carried)
Medium 2	STATE 2 (Defence Watches) and a credible risk to the ship exists	Action coverall, anti-flash worn (hood down)
High	STATE 1 (Action Stations) and a credible risk to the ship exists	Action coverall, anti-flash worn (hood up)

b. It is acceptable to wear items of CS 95 under the coverall but additional clothing (other than underwear) should only be necessary in extreme cold weather. Underwear and other garments worn under coveralls should, ideally, be made from natural fibres (eg cotton). However, there is no evidence that man made fibres (such as polyester) are hazardous when worn next to the skin since these are protected by the two layers of the action coverall.

c. It is recognised that EMF personnel will have to change back into CS 95 perhaps many hours before disembarkation (when the ship might be at greatest risk). However, personnel should try to delay changing until as late as possible and wear anti-flash hood and gloves, if possible, with CS 95 until disembarked. Ships will need to exercise the wearing of different levels of protection at Assault Stations and develop SOPs to minimise the impact any changes in dress states will have upon operations.

d. The wearing of CS 95 when there is no risk to the ship is considered safe. However, irrespective of the readiness state of the ship, other items of FR clothing such as Action Working Dress, should be worn by EMF if working for significant periods in machinery spaces or fuelled aircraft. In these areas the risk from fire is greater than in other areas of the ship and EMF personnel should be dressed appropriately to minimise burn injury.

2615. Immersion Coverall

Orange immersion coveralls are provided for damage repair personnel working in partially flooded compartments. The three sizes are generously cut, to be worn over action dress, including DMS boots. Extended wearing of the coveralls should be avoided due to the risk of heat stress. The wearing of action coveralls is not necessary when immersion coveralls are worn, although the double layer could provide additional insulation in exceptionally cold conditions.

2616. Brief instructions for care in use and for repair of immersion coveralls are printed on each garment. More comprehensive information is given below:

a. As necessary after each occasion of wear, the coveralls should be sponged or washed in water at a temperature not exceeding 50°C and placed on hangers to dry. Soap or detergent may be used and, if necessary, the whole garment may be hand or machine washed, the zip being closed prior to washing. Bleach must not be applied and garments should not be ironed or dry cleaned.

b. To avoid damage from creasing, coveralls should if possible be stowed on hangers when not in use. Alternatively they may be stowed lightly folded provided they are clean and have been thoroughly dried.

c. Zips should be kept lubricated with paraffin wax. If a zip becomes defective the coverall should be returned to Naval Stores.

d. Damaged coveralls can be repaired with orange fabric (see BR 2170(3)) and impact adhesive.

2617-2620. Spare.

2621. Ship Firefighting Clothing

Firefighting protective clothing is designed to give the wearer protection against radiant heat and flame, but only for limited periods. It will not protect from the effects of exposure to great heat for long periods. The protective clothing also reduces heat loss from the body and, as a consequence, heat stress increases, possibly leading to heat exhaustion and collapse. The safety of personnel working in heat depends on the correct approach to the problem, good training, discipline and careful supervision. Personnel who are to wear protective clothing must be regularly practised in its use. Protective clothing must be examined regularly and maintained in good order. There are three levels of ship firefighting rig:

a. **Basic Firefighting Rig.** This consists of Proban treated cotton No 4s or cotton overalls, DMS boots, cotton underwear and cotton/woollen socks (see Fig 26-2). When engaged in firefighting operations, collars should be buttoned up and the sleeves rolled down with cuffs buttoned. Man-made materials should not be worn by firefighters, (eg Nylon, Polyester or Lycra). During hostilities, the action coverall is substituted for No 4s or FR overalls in the Basic Firefighting Rig.

b. **Intermediate Firefighting Rig.** The intermediate firefighting rig consists of the basic firefighting rig, plus BA, firefighter's hood and anti-flash goves (see Fig 26-3). It is used by the Attack Party BA wearers. (A set of firefighter's hood and anti-flash gloves is to be stowed in each BA locker to facilitate the change from basic firefighting rig).

c. **Full Firefighting Rig.** This consists of basic firefighting rig, plus firefighter's hood, fearnought suit, firefighter's gloves, firefighter's stockings, firefighting boots, BA and FFHBC (see Fig 26-4). The Team Leader also carries a TIC.

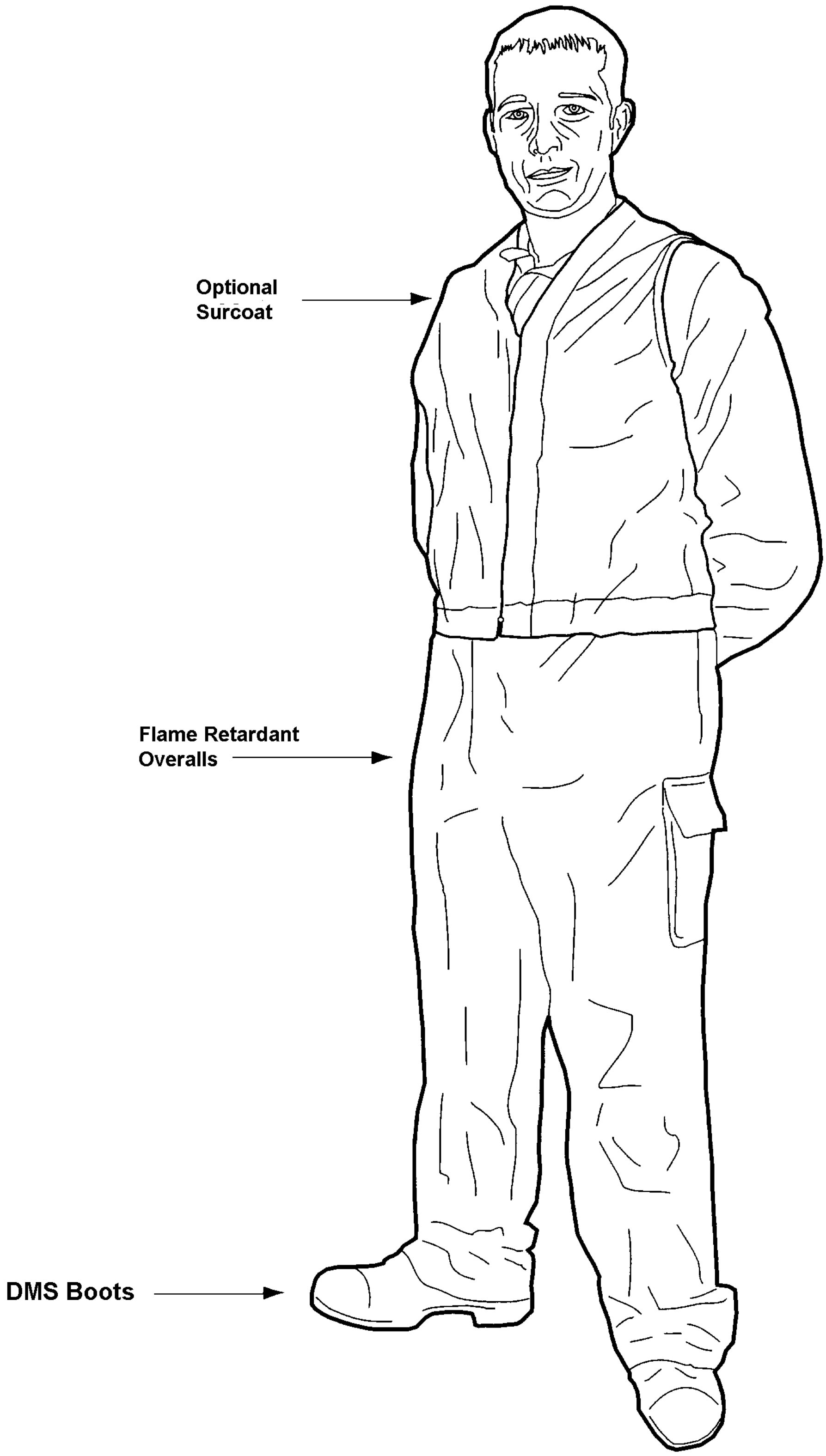

Fig 26-2. Basic Firefighting Rig

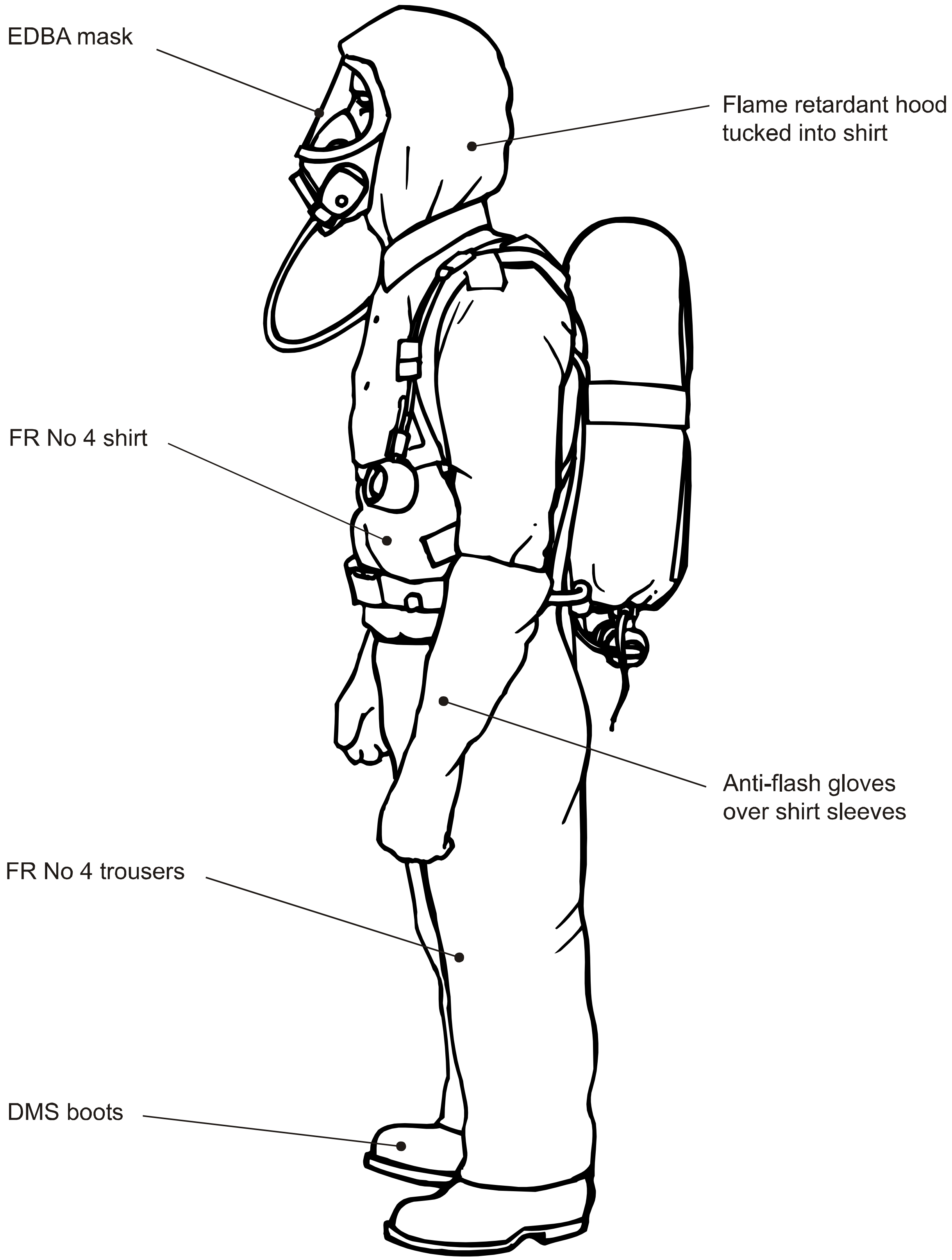

Fig 26-3. Intermediate Firefighting Rig

Fig 26-4. Full Firefighting Rig

2622. Fearnought Suit

Fearnought provides a large measure of protection against radiated heat but is not fireproof and will scorch if subjected to intense heat. The suits are treated with 'Zirpro' to make them flame retardant (FR), and they are unlikely to catch fire when in contact with flame.

2623. The 'Zirpro' FR treatment is designed to last the life of the garment, provided the washing instructions on the garment are followed. BR 1277 provides guidance for laundry processes. It is not possible to re-treat made up garments by the 'Zirpro' process. The garment should be washed as required for reasons of hygiene, and at intervals not exceeding 2 years. It is especially important to avoid soiling by oils and greases, which impair the flame-retardant qualities of the fabric. Soap or washing products containing soap are not to be used. Severely soiled garments are to be returned to stores.

2624. Firefighting Boots

Leather firefighting boots are provided in a range of sizes for ship firefighting teams. The boots should be carefully dried after contact with water, and cleaned with 'G Wax'. Insoles should be removed from boots occasionally so that they, and the boots, can be aired separately. The insoles should be cleaned by washing in warm soapy water (boiling water must not be used). They should be shaken, not wrung out, and then allowed to dry. When worn out they must not be destroyed by burning as this will produce toxic fumes.

2625. Ship Firefighter's Hood

The firefighter's hood is compatible with EDBA and FFHBC, and also with the S10 respirator. It has a yoke which is tucked inside the shirt/overalls/fearnought suit. The hood is made from an inherently flame-retardant (FR) material and may be washed, as for synthetics, on a medium wash cycle; it is not to be bleached.

2626. Firefighter's Helmet with Build-in Communications (FFHBC)

Head protection for firefighters is provided by the FFHBC, which is worn over the firefighter's hood and EDBA head harness. Guidance on the use of the helmet-mounted radio and associated hand-held radio is contained in Chapter 9 and use of the FFHBC by the Support Party is covered in Chapter 20. Full details of the helmet and associated radios are contained in BR 9215. Helmets are to be stowed in the top left hand corner of nominated BA lockers, facing towards the locker hinges. Care must be taken when stowing helmets, to minimise compression of fittings. Radios in stowed helmets are to be set to the FF mode, switched off and set to Channel 1. Lockers containing FFHBC are to be identified by a 50mm wide horizontal yellow band around all visible external surfaces, 50mm from the top. In ships where it is not convenient to stow FFHBCs in BA lockers, they may be stowed in a suitable alternative location (eg adjacent to FRPPs).

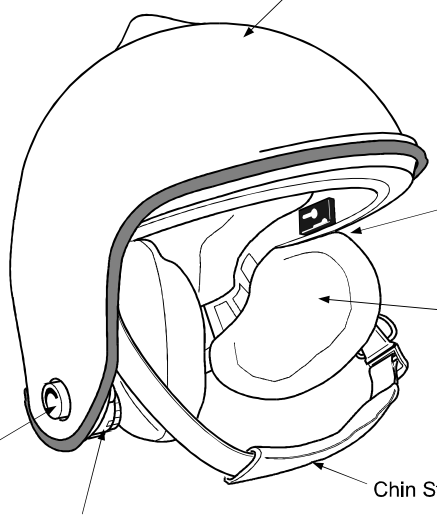

Fig 26-5. FFHBC

2627. Firefighting Protection in an NBC Environment

Protection for firefighters in an NBC environment varies according to the hazard:

a. **Firefighting Between Decks in an NBC Environment.** Firefighters should wear normal action working dress with/without fearnought. IPE clothing (suit and rubber gloves) is not required to be worn under the fearnought suit and firefighter's gloves. All fearnought suit personnel must, however, have access to BA and NBC respirator, and be well practised in the procedures for changing over from one to the other, as detailed in Annex 21H.

b. **Firefighting on the Upper Deck in an NBC Environment (Vapour Hazard).** If the NBC hazard is from vapour alone, then firefighters dressed as in para a. above and wearing BA will have adequate short term protection for the duration of their firefighting task. As for between decks, the respirator must be readily available (with the BA Controller) and firefighters must be practised in the procedures for changing to and from BA, as detailed in Annex 21H.

c. **Firefighting on the Upper Deck in an NBC Environment (Liquid Hazard).** In the unlikely event of having to fight a serious fire on the upper deck, in an NBC liquid environment, then all firefighting is to be conducted from behind a waterwall using the following personal protection:

(1) No 4s/overalls.

(2) Action Coverall.

(3) BA.

(4) IPE with the hood pulled up around the BA mask (flammable, but protects against liquid hards).

d. **Firefighting in a Nuclear Particulate Hazard Environment.** The clothing regimes used for firefighting in NBC vapour hazard apply equally well when firefighting in the presence of nuclear fallout hazard. The same clothing regimes used with respirators or BA will provide personal protection against particles which may emit Alpha and Beta radiation. The Protection Officer will however need to consider stay-times for personnel exposed to Gamma radiation.

2628. The procedures for undressing and cleansing after firefighting in an NBC environment are detailed in the Annexes to Chapter 14 of BR 2170(2).

2629. Spare.

2630. Aircraft Firefighting Clothing

Naval aircraft firefighters are provided with different protective clothing from ship firefighters, due to the different conditions encountered at the scene of an aircraft fire. Crash firefighting ensemble (CFFE) can protect the wearer from radiant heat and flame licks, but is not designed to allow deliberate entry into a flame mass. The clothing is not gas-tight, and the wearer inhales the surrounding air, so he must remain in a position where he is clear of superheated gases and toxic fumes. The clothing is designed as a composite outfit, and the complete outfit must be worn correctly to gain the maximum protection. (There is, however, no objection to the wearing of an additional cotton-based T-shirt or No 4s over the underwear. Man-made fibres should not be worn.) The protection from heat given by this clothing is subject to a time limit in severe conditions because the heat is conducted (although slowly) through the layers of fabric.

2631. Crash Firefighting Ensemble (CFFE)

The stock numbers and allowances for CFFE items are listed in BR 2170(3). The full ensemble is shown at Fig 26-6. It comprises the following items:

a. Tunic.

b. Trousers.

c. Boots.

d. Hood.

e. Helmet.

f. T Shirt.

g. Crop-top (females only).

h. Trunks.

i. Gloves.

j. Aircrew fire-retardant socks.

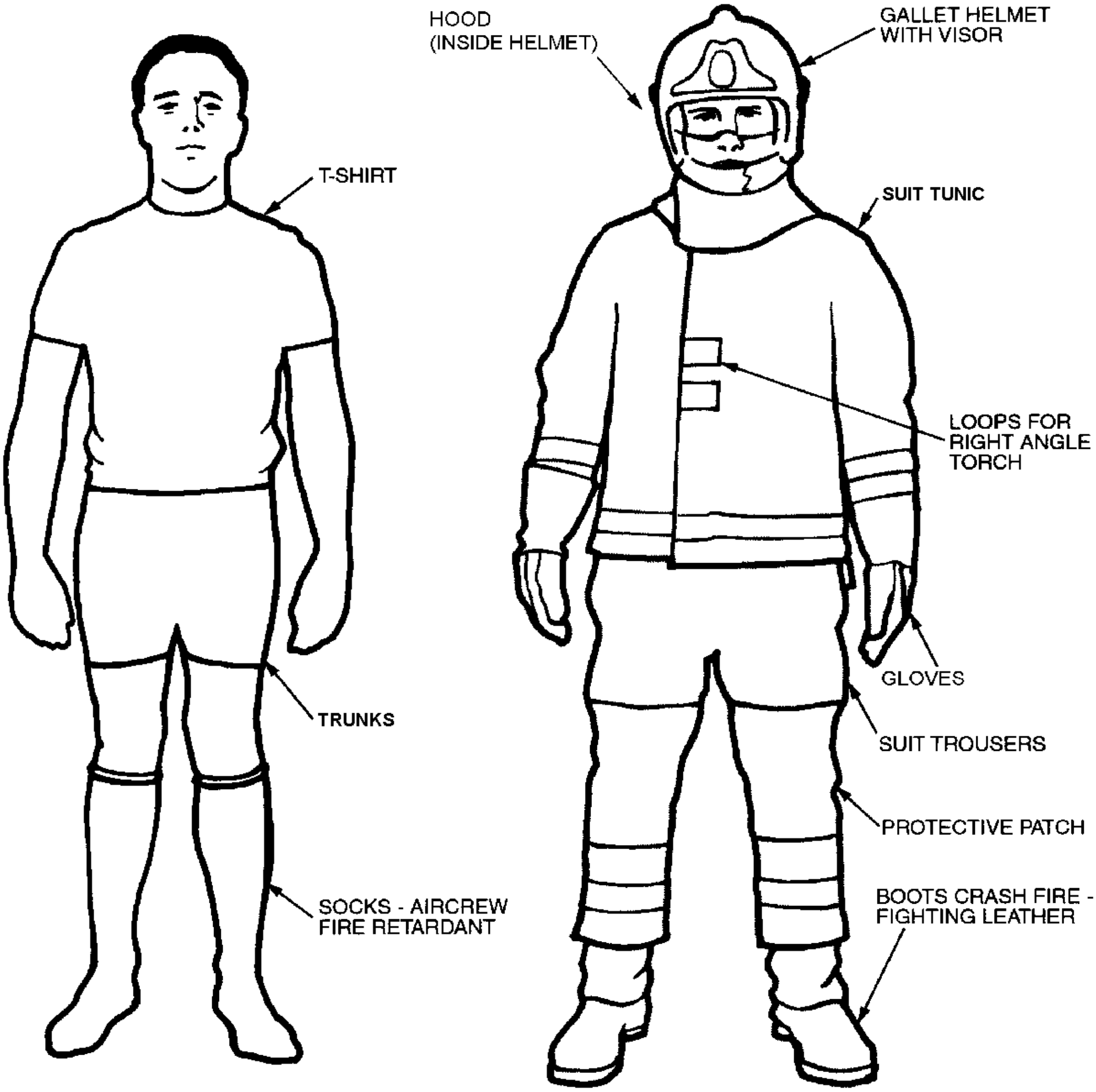

Fig 26-6. Crash Firefighting Ensemble

2632. The suit incorporates a waterproof lining to provide protection from water spray and rain. However, wetting of the clothing does not give better protection against heat, and if the clothing is soaked, the conduction of heat will be quicker and the possibility of scalds is rather greater than the possibility of burns with dry clothing.

2633. The correct fitting of the suit is of great importance in order to provide the maximum protection. The suit should be a loose fit to ensure adequate airflow around the inside of the suit during movement of the body. If the suit is tight in areas, such as the shoulders, across the chest or back, at the waist and the top of the legs, the circulation of air is restricted which may allow the still air to heat up at a faster rate thereby reducing the time of limit of protection. The length of the tunic should be such that when the arms are raised above the head, no exposed areas should be created between the bottom of the tunic and the top of the trousers. The length of the trousers should be that the bottom of the leg is at the level of the ankle in order to ensure adequate overlap between the boots and the trousers to prevent the creation of exposed areas when lifting the legs during climbing.

2634. The underwear, which consists of a T-shirt and trunks for male firefighters and T-shirt, trunks and 'crop top' for female firefighters, is made from 100% cotton. The underwear is to be worn next to the skin and has a primary function of providing support and maintaining hygiene and modesty. It also provides another layer of thermal insulation.

2635. A Gallet helmet gives full protection with two visors that slide into the top of the helmet. The inner visor is for eye protection while the outer visor gives full face protection against radiated heat.

2636. Firesuitmen on single spot ships are to wear ear plugs when wearing the Gallet helmet. The fire-hood is worn between the head and the helmet, thereby giving added protection and ensuring that the ear plugs are not dislodged when the helmet is removed, causing a FOD hazard.

2637. The gloves are made from leather with an aluminised surface on the back of the hands and fingers to reflect radiant heat. The gloves allow, without their removal, manipulation of reasonably small articles. There is a spring band within the fabric around the wrist to secure the glove to the hand, and a long cuff to provide an adequate overlap over the sleeve of the jacket even when the arm is stretched.

2638. The boots are of a short, calf-length, step-in shape. The uppers are made from reversed chrome leather with a chrome lining. A steel toe cap and sole bar are inserted and the sole and heel is a one-piece moulding of neoprene which is resistant to high temperatures and the solvent effects of hydrocarbon fuels. The moulding patterns of the sole and heel are designed to achieve a good grip on smooth surfaces and prevent the picking up of items in the tread which may constitute foreign object damage (FOD) hazards.

2639. Cleaning CFFE

The ensemble is to be cleaned as follows:

a. **Helmet.** Wash with soapy water and polish helmet and visors with a lint cloth.

b. **Fire Hood.** Wash as per manufacturer's instructions and change after 10 washes.

c. **Suit.** Wash as per manufacturer's instructions (not dry cleaned).

d. **Boots.** Wash with hot soapy water and allow to dry naturally.

e. **Gloves.** Wipe clean using a wet cloth and allow to dry naturally.

2640-2649. Spare

2650. Reports of Defective Protective Clothing

On receipt of a failed item at the unit clothing store a judgement is to be made concerning the nature of the failure. Where a failure is judged to have occurred through misuse, negligence or fair wear and tear, appropriate actions is to be taken within the unit. If it is considered that the item has failed for other reasons, the item together with a Clothing Failure Report Form is to besent to the Quality Support Manager, DCT IPT, Caversfield, Bicester, OX27 8TS. Multiple failures in the same range may be reported on a single Clothing Failure Report Form but all failed items are to be sent together with the form.

2651-2659. Spare.

2660. Heat Stress

Detailed instructions for heat stress monitoring are in Chapter 11 of BR 2170(2). A simple endurance guide for medium and heavy work loads in warm and hot climates is at Table 26-1. The balance between clothing protection and work rates should be carefully considered. The following notes are relevant when using the table:

a. Personnel should be fit and acclimatised to local conditions.

b. Medical officers should be consulted and involved in monitoring personnel.

c. Fluid intake is vital and should be encouraged especially during rest periods even if personnel do not feel thirsty. As a rough guide at least one litre per hour per person is required.

d. If an action coverall is being worn, do not remove it. (Removal will assist heat loss but the risk from flash, etc is too great.)

e. Remove fearnought whenever possible, or at least unzip it during rest periods.

f. Rest in a cooler shaded area.

g. The upper deck should be kept wet.

h. Maintain an air flow over the deck and use of awnings should be considered.

Table 26-1. Heat Stress - A Guide to Avoidance in Various Clothing Regimes

Rig	Climate	Work/Rest Ratio-Minutes	Remarks
No 4s or overalls	Hot Warm	105/30 120/15	1. Rest in a cool shady area. 2. Remove fearnought where possible. 3. Enforce drinking at rest. 4. When action coverall is top layer, do not remove.
No 4s + Action coverall	Hot Warm	45/30 (30/30 after 2 cycles) 45/15	
Action coverall only	Hot Warm	45/30 (30/30 after 2 cycles) 75/15	
No 4s + NBC IPE	Hot Warm	45/30 (30/30 after 2 cycles) 45/15, 45/30 (alternating cycles)	
Action coverall + NBC IPE	Hot Warm	30/30 (30/45 after 1st cycle) 45/30	
No 4s + fearnought	Hot Warm	30/90 30/90	3 team system 3 entries only. Rest includes dressing time

Note. *'Warm' climate approximates to conditions likely to be found in air conditioned spaces (26°C). The 'hot' climate approximates to conditions (30°C+) on the upper deck and in the poorly ventilated areas such as machinery spaces, hangar or galley of a ship in tropical waters.*

2661. Alleviation of Heat Stress

When suffering from heat stress and at risk of heat illness, personnel should immerse their hands and wrists (forearms if possible) in water between 10 and 20°C whilst resting for 20 minutes. This will reduce heat stress, lower the risk of heat injury, and increase safe total work times that personnel can undertake. If rest periods are shorter or repeated work/rest cycles are anticipated then 10°C water should be used in preference. If the reduction in heat stress is critical and rest times less than 20 minutes then immersion of both hands and feet in 10°C water could be attempted, although it should be noted that the increased benefit is small and only equivalent to increasing rest time by 2-5 minutes over using hand immersion. The risk of accidental injury to the feet, increased re-dressing time and a greater requirement for chilled water associated with immersing the feet make this option unlikely to be preferable.

2662-2669. Spare.

2670. Protecting the Body from Injury

When an explosion occurs in, or near, a ship there is a danger to personnel from blast, flying debris and the whipping action of the hull. This may also occur during a collision. In order to minimize injuries to personnel caused by these effects the following precautions are to be taken:

a. For prolonged periods under threat at NBCD State 1, personnel not directly involved with fighting the ship are to be dispersed in pairs, or small groups, throughout the ship, avoiding potential blast routes and covering all decks and all sections if possible. This will provide the facility to conduct an immediate, and more effective, blanket search after action damage, and minimize casualties in any one place.

b. When an attack is imminent the order 'BRACE, BRACE, BRACE' is to be broadcast by the Command.

2671. Brace Drill

On hearing the command 'BRACE, BRACE, BRACE':

a. All personnel not directly involved in fighting the ship or in the most protected positions, ie a bunk or a fixed chair, are to stand, face away from any loose material, bend knees, lift heels off the deck and, with bent arms, take a firm grip from beneath a fixed object at waist height. The head, neck and back should remain in a straight vertical line to absorb the effect of shock from the deck.

b. Operations Rooms personnel who are seated during periods of attack and those similarly seated and who are not directly involved in repulsing an attack are to carry out the following procedures:

(1) Personnel sitting in front of a VDU, unless directly repulsing an attack, should close their eyes and extend anti-flash hoods to cover the face.

(2) Firmly grip the sides of their chair seat with both hands. (All chairs which are required for action must be securely fitted to the deck.)

(3) Where possible, the chair should be rotated so that lower limbs are not trapped between the chair and the console.

(4) Lift heels and keep head, neck and back in a vertical line.

Note. *In the case of a nuclear air burst, personnel on the upper deck should carry out the Take Cover Drill detailed in BR 2170(2).*

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CHAPTER 27

BREATHING APPARATUS

CONTENTS

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CHAPTER 27

BREATHING APPARATUS

2701. Categories of Breathing Apparatus

There are two categories of breathing apparatus used in Royal Navy surface vessels and Royal Fleet Auxiliaries:

a. **Breathing Apparatus (Damage Control and Firefighting).** This is the generic term used to describe the breathing apparatus (BA) used by damage repair parties and firefighters. Extended Duration Breathing Apparatus (EDBA) is the current BA(DC&FF).

b. **Emergency Life Support Apparatus (ELSA).** This is only to be used for escape from, or through, smoke-logged compartments. It is not suitable for use by firefighters.

2702-2703. Spare.

SECTION 1 - EXTENDED DURATION BREATHING APPARATUS

2704. Introduction

Extended Duration Breathing Apparatus (EDBA) has a low magnetic signature and is suitable for use in all Royal Navy ships (including Hunt Class and Single Role Minehunters), submarines and RFAs. Full details are contained in BR 8223(1).

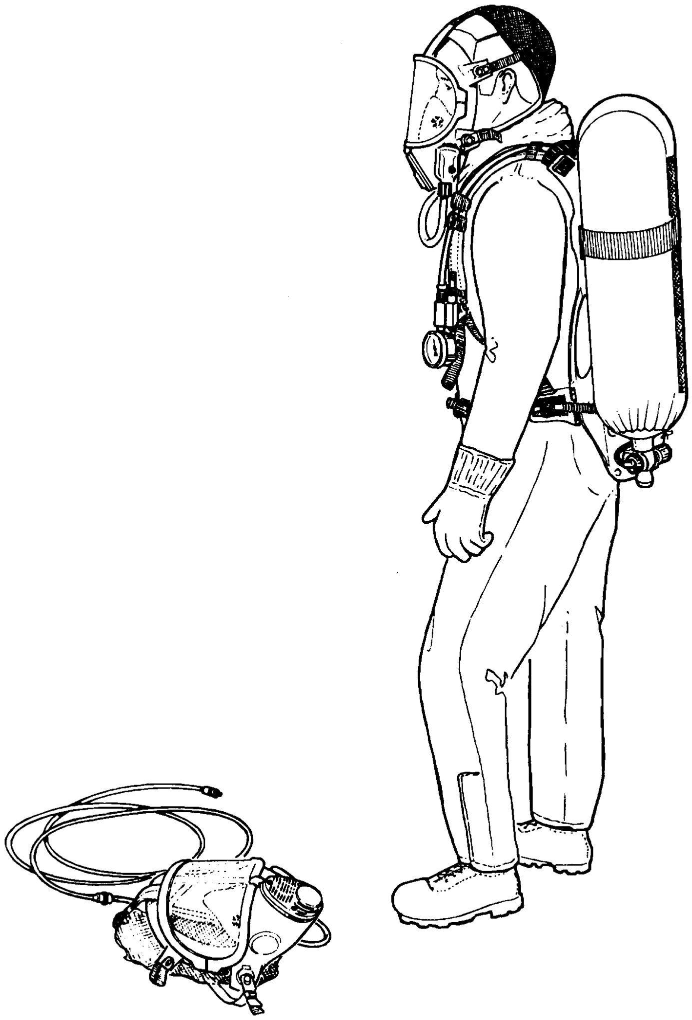

Fig 27-1. EDBA and Rescue Mask

2705. Description

EDBA is a positive pressure, first-breath activated, lightweight, low maintenance set, fitted with a 9 litre air cylinder (free air capacity 2430 litres) capable of being charged to 300 bar. The set comprises a one-size face mask with a net head harness (see Fig 27-2), an ergonomically designed backplate with a comfortable flame retardant harness (see Fig 27-3), a lightweight composite air cylinder, a high pressure reducing valve, a warning whistle and a pressure gauge. The face mask assembly is fitted with an oro-nasal mask, an exhalation valve incorporating a speech diaphragm, and an automatic first-breath operated positive pressure demand valve. The demand valve is designed to be re-set by pressing the black rubber re-set button (on the demand valve). This closes off air to the face mask, enabling it to be removed. The demand valve is also fitted with a manually operated bypass knob, which allows a free flow of air into the face mask, in case the wearer gets into difficulty. A bulb horn distress alarm is to be attached to the left shoulder strap of the EDBA set.

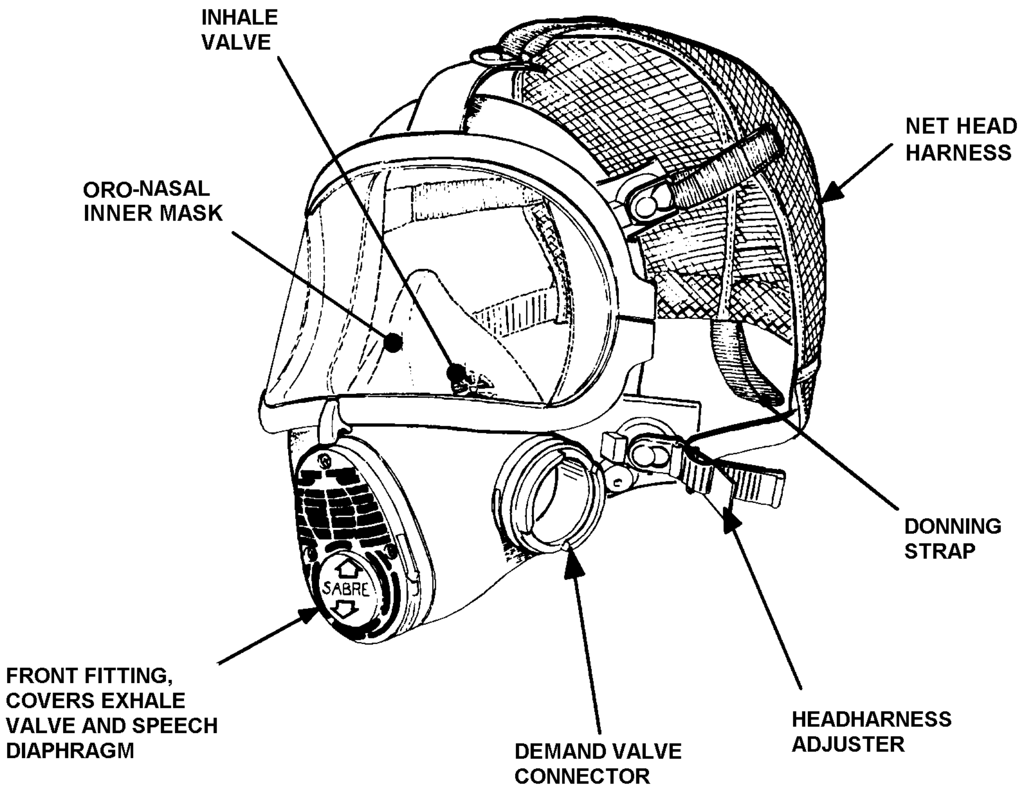

Fig 27-2. Face Mask Assembly

2706. Stowage

EDBA is stowed, in modified BASCCA lockers, ready for immediate use, with all straps fully extended. A tally, detailing the functional and face seal checks, is attached inside the locker door. Control boards are stowed in selected lockers, which are identified by a 50 mm wide white band on the front and sides, 50 mm from the base of the locker. The distribution of control boards is to be detailed in ships' NBCD Orders. The 'set number' tally is attached to the D ring on the left shoulder strap of a stowed EDBA.

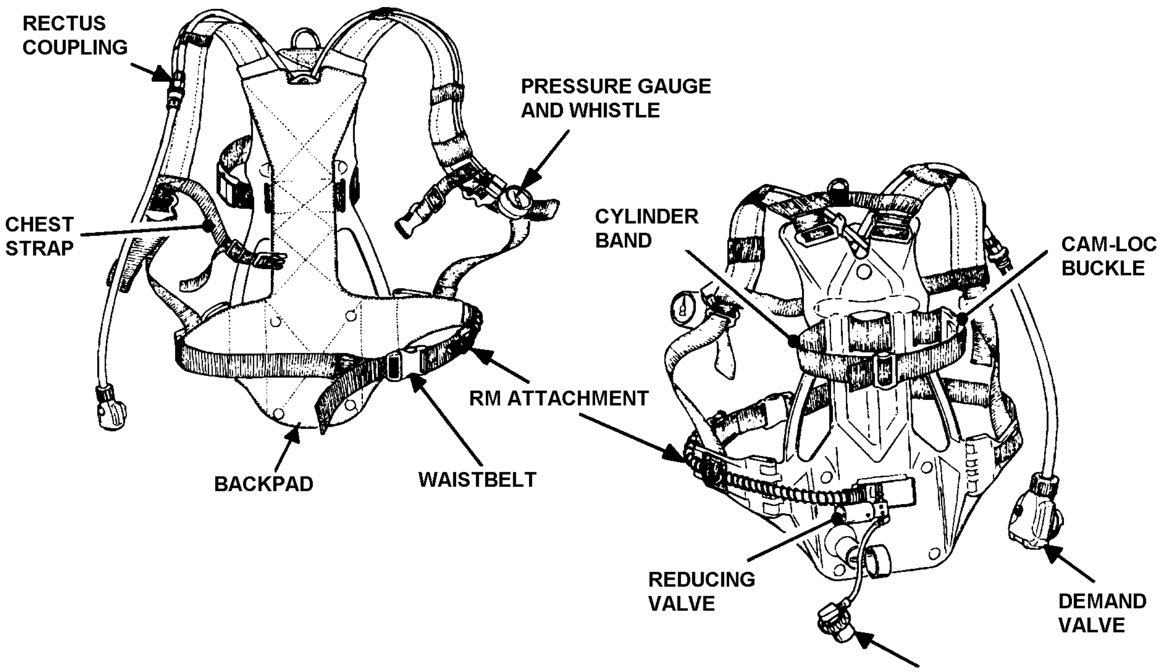

Fig 27-3. Back Plate and Harness

2707. Duration

To maximise duration, EDBA should be charged to the highest pressure available from the HP air system, up to a maximum of 300 bar. However, most ships do not have a HP air system that is capable of achieving this pressure and are therefore to charge EDBA to the maximum working pressure of their system up to 300 bar. EDBA are to be charged when the system ringmain is at maximum pressure. To allow a tolerance for daily checks, cylinder pressures in stowed EDBA sets may be allowed to fall to 10 bar below the full charge, eg if the HP air ringmain delivers 270 bar, stowed EDBA sets are to be charged to 270 bar but may be allowed to fall to 260 bar before recharging. Ships are to ensure that the HP air ringmain is at maximum pressure when EDBA daily checks are carried out. The duration varies with air pressure, as follows:

a. **300 bar:** 48 min working duration + 12 min whistle = 60 min.

b. **240 bar:** 39 min working duration + 12 min whistle = 51 min.

c. **207 bar:** 33 min working duration + 12 min whistle = 45 min.

d. **200 bar:** 32 min working duration + 12 min whistle = 44 min.

e. **160 bar:** 24 min working duration + 12 min whistle = 36 min.

Notes:

1. The warning period will be 12 minutes only if the whistle is correctly set at 55 bar, and will depend on the individual wearer and the task being carried out.

2. These times exceed the work periods for action coveralls or No 4s and fearnought in Table 26-1, so heat stress will normally limit operations before BA endurance.

2708. Extension Equipment

Extension equipment for EDBA (see Fig 27-1) comprises a rescue mask (RM) assembly with head harness, a 2 metre extension hose and a 15 metre extension hose. These items are stowed in a red locker, which has a drop-down door. A tally on the inside of the door gives the operating instructions. Two 15 metre extension hoses can be connected together to give a maximum length of 30 metres. The 2 metre hose is not to be added to this 30 metre length.

2709. BA Control

When EDBA sets are used operationally, a BA Controller must be detailed. The duties of a BA Controller are detailed in Chapter 20.

2710. Donning and Functional Checks

While stowed in its locker, the EDBA must be maintained in a state of readiness for immediate use, with the air cylinder fully charged to the correct working pressure. Approval must be obtained from the officer in charge of firefighting (DCO or OOD), prior to using a set if the pressure is below the minimum approved operating pressure of 160 bar.

2711. With assistance from the BA Controller, the wearer dons the set as follows:

a. Remove the face mask from the stowage clip. Place the face mask neck strap over the head and allow the face mask to hang on the chest. The neck strap must be worn under the firefighter's hood.

b. Release the bands securing the set in its locker, and pass the right arm through the right shoulder strap. Lift the set clear of the locker and pass the left arm through the left shoulder strap.

c. Adjust the shoulder straps by pulling them down and towards the rear. Fasten the waist belt and chest strap, taking care not to overtighten.

d. Check that the bypass knob is *off* and the demand valve (DV) reset button is pressed.

e. Open the cylinder valve fully and check that the warning whistle sounds briefly. If the whistle is not heard to operate when the cylinder valve is opened:

(1) Shut the cylinder valve. Open the bypass knob to reduce pressure to 55 bar, at which point the whistle should sound.

(2) Close the bypass knob. If the whistle still does not operate, it is defective and the set must not be used. The BA Coordinator must be informed.

f. On completion of the test, open the cylinder valve fully. The BA Controller removes and retains the 'set number' tally, and enters the wearer's name on the control board.

2712. Face Seal Check

When the wearer is required to commence a task, the following routine is to be carried out:

a. Place the chin in the chin cup, pull the head harness back over the head and tighten the head harness straps.

b. Inhale sharply to activate the DV first-breath mechanism, then breathe normally.

c. Twist the DV gently to confirm that the locking catch is fully engaged.

d. Open the DV bypass knob and check that there is a free flow of air into the mask. Set the bypass knob to *off*.

e. Shut the cylinder valve and then quickly open it one quarter of a turn. Take a deep breath. Shut the cylinder valve and check that there is no sound of escaping air, and that the pressure gauge reading does not fall by more than 10 bar (one division on the dial) in 10 seconds.

f. Open the cylinder valve fully, breathe normally and check that the gauge reading is steady. If it is not, check that the cylinder valve is fully open. If the gauge fluctuates when the cylinder valve is fully open, do not use the set.

g. Test the distress alarm.

h. Pull up the firefighter's hood, check protective clothing and proceed on task.

Notes:

1. If the wearer is not required immediately, take a deep breath and press the black rubber reset button on the DV to close off air to the face mask. Remove the face mask and allow it to hang on the chest.

2. The face seal check must be performed each time a wearer dons the face mask for operational purposes.

3. On completion of the face seal check, the BA Controller must enter, on the control board, the time at which the wearer starts to breathe from the set.

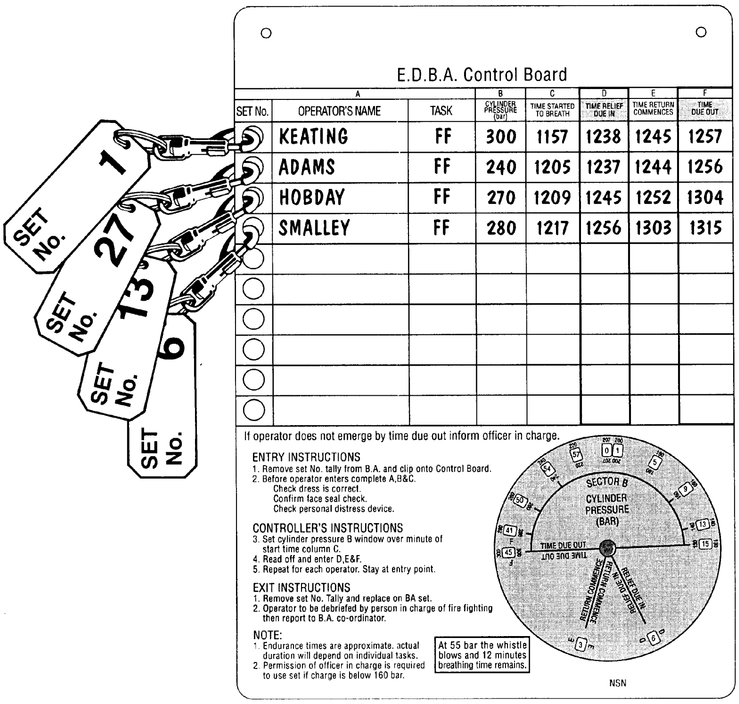

Fig 27-4. EDBA Control Board

2713. Completion of the Control Board

The BA Controller is to carry out the following instructions after the firefighting team has been briefed by the officer/rating i/c of firefighting:

a. **Entry Instructions**

(1) Remove the 'set number' tally from the BA and clip in onto the control board (see Fig 27-4).

(2) Before the wearer enters, complete his details in columns A, B and C. The abbreviations to be used in the task column are FF for all members of firefighting teams, BC for boundary coolers and SAR for search and rescue teams.

(3) Confirm a face seal check.

(4) Check that the wearer's dress is correct.

(5) Check the wearer's personal distress device.

(6) Turn the dial to set the cylinder pressure (B) window over the minute of start time (from column C).

(7) Read off and enter times in columns D, E and F.

(8) Repeat for each BA wearer. Stay at the entry point.

b. **Exit Instructions**

(1) Remove the ‘set number’ tally and replace it on the BA set.

(2) Erase the wearer’s details from the control board.

(3) The wearer is to be debriefed by the person i/c of firefighting at the FCP, and is then to report to the BA Coordinator for removal of the BA set.

2714. MM/PP 2 - Person Attack BA Control Board for EDBA

In all MM/PPs, the Duty Senior Rate (DSR)/BA Controller is to carry on his person at all times a 2-person Attack BA Control Board as shown at Fig 27-5. and a marker pen. The Board is to be partially marked-up with nominated names and the initial BA pressure, entered in column B, which is to be 160 bar. On hearing the emergency broadcast, the time of the initial ‘Fire’ pipe is to be entered in column C as the time started to breathe. Columns D, E and F should then be completed as per the instructions on the board. Note that this Board is only to be used for the first ‘on air’ entry made by the nominated Attack BA firefighters in the Scene of the Incident. For further information on the duties of the DSR/BA Controller see Para 2047.

A			B	C	D	E	F
SET No.	**OPERATOR’S NAME**	**TASK**	CYLINDER PRESSURE (bar)	TIME STARTED TO BREATHER (Pipe time)	TIME RELIEF DUE IN (C + 17 mins)	TIME RETURN COMMENCES (D + 7 mins)	TIME DUE OUT (E + 12 mins)
		FF	**160**				
		FF	**160**				

Fig 27-5. MM/PP 2 - Person Attack BA Control Board for EDBA

2715. BA Tote Board

The BA Coordinator’s Tote Board is illustrated at Fig 27-6. It is used by the BA Coordinator to keep a running record of the location and state of all BA sets and spare air cylinders available for DC&FF.

2716-2739. Spare.

BA CO-ORDINATORS TOTE BOARD

BREATHING APPARATUS

IDENT NO	STOWAGE LOCATION	SERVICEABLE	DEFECTIVE	IN USE	AT BA DUMP
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
TOTAL FROM SHIP					
TOTAL FROM OTHER SOURCES					
TOTAL					

CYLINDERS

IDENT NO	STOWAGE LOCATION	CHARGED	EMPTY	AT BA DUMP
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
TOTAL FROM SHIP				
TOTAL FROM OTHER SOURCES				
TOTAL				

* RE-ENTRY BA – NOT TO BE REMOVED TO BA DUMP

BA CONTROLLER	TASK OF TEAM

BA CHARGING POINTS

	LOCATION	AVAILABLE	OPERATOR NAME
1			
2			
3			
4			
5			
6			

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Fig 27-6. BA Coordinator's Tote Board (not to size)

SECTION 2 - EMERGENCY LIFE SUPPORT APPARATUS

2740. Purpose and Function

The Emergency Life Support Apparatus (ELSA) is a short duration compressed air breathing set which provides a lightweight, easily operated system of respiratory protection for the wearer during emergency escape from an area of toxic, or smoke-filled, atmosphere. The apparatus is not suitable for heavy use (such as firefighting, rescue or repair work) as the air supplied from a fully charged cylinder lasts approximately eight minutes from the time the control valve is opened.

2741. Description

The set, which is fully described in BR 8414, comprises:

a. A yellow coloured carrying bag, complete with sling (except for MCMV's which are supplied with a fluorescent green bag to indicate that it contains an aluminium cylinder).

b. A compressed air cylinder, complete with control valve/reducer/gauge assembly.

c. A transparent plastic hood (with elasticated neckband) which fits over the wearer's head. The hood is connected to the valve assembly by a flexible supply tube, with a swivel connection at the hood end.

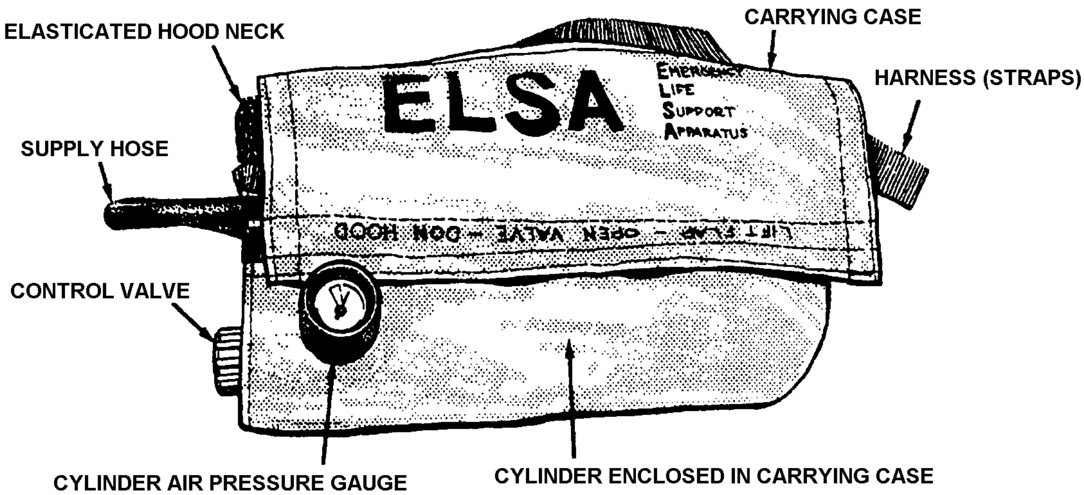

Fig 27-7. Emergency Life Support Apparatus (ELSA)

2742. Operating Instructions

To use an ELSA, proceed as follows:

a. Remove the ELSA from the stowage.

b. Place the carrying strap around the neck, with the carrying case on the chest.

c. Secure the carrying case to the body, using the harness.

d. Open the control valve until the valve wheel spins free.

e. Place the hood over the head, so that the elasticated neck is secured around the wearer's neck.

f. Ensure that the supply hose is to the front and clean air is being delivered to the wearer (the hood will flood with air).

g. Vacate the compartment.

2743. The hood does not have an exhaust port, so the level of carbon dioxide inside it will build up as the wearer breathes out. This may cause the wearer to feel breathless or dizzy. If this happens, the wearer should:

a. Place his fingers under the elasticated neck and pull it away from his own neck.

b. Collapse the hood around his head to force out the carbon dioxide.

c. Release the elasticated neck, allowing the hood to fill with clean air.

d. Loss of vision, caused by condensation, can be corrected by rubbing the insides of the hood together when carrying out the above procedure.

2744. In situations where a chemical threat has necessitated prior donning of NBC respirators, escape from a smoke filled environment can be affected by holding the neck seal of the ELSA hood over the respirator canister. This avoids the hazard and delay in doffing and donning both equipments.

2745. Maintenance

Shipboard maintenance is limited to visual examination, minor replacements and any necessary re-charging of the compressed air cylinder to ensure the pressure, when stowed, is between 180 and 200 bar. The maximum working pressure, 200 bar, is not to be exceeded.

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CHAPTER 28

PUMPING, DRAINING AND BALLASTING

CONTENTS

ANNEXES

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CHAPTER 28

PUMPING, DRAINING AND BALLASTING

2801. Pumping, draining and ballasting arrangements are provided in ships for the following main purposes:

a. To pressurize the HP sea water system for firefighting, domestic use, etc, and to provide water via the LP sea water system for machinery cooling, etc.

b. To remove water that has been let into the ship either deliberately or as a result of damage or firefighting.

c. To introduce sea water into specified compartments to correct adverse heel and/or trim.

d. To introduce sea water into specified compartments or into fuel displacement systems to maintain stability.

This chapter deals with the emergency arrangements provided for pressurizing the HP sea water system for firefighting purposes, with the equipment for removing water, eg by pumping, educting or draining, and that for ballasting to control heel and/or trim and to maintain stability. The Annexes to this chapter give brief details of portable and mobile pumps, used for damage control and firefighting.

2802. Drainage Arrangements

Weather decks and tops of superstructures are fitted with scuppers to drain loose water overboard. Pipes from the scuppers are led directly to ship's side outlets and are not usually fitted with storm valves (simple flap valves). Drains from internal compartments are either led to drain tanks or sumps, or directly overboard. If the latter, they are fitted with storm valves which can be shut. Shutting the storm valve prevents flooding back into the compartment if the ship heels or trims after damage. Storm valves are usually operated from a higher deck through rod gearing. Drain tanks and sumps are pumped out by fixed or portable pumps or eductors. Scuppers and drains are not to be interconnected because of the risk of spreading flooding between compartments and of spreading contamination if prewetting is being operated in an NBC environment. In ships with pressurized citadels, all drains serving compartments inside the citadel must be fitted with 150mm 'U' water seals.

2803. In newer ships (T23 and later) screwed plugs are fitted in some decks to allow excessive water, due to firefighting, to be drained down to lower compartments which are fitted with fixed eductors.

2804. Ballasting Arrangements

The method used to fill a compartment with sea water is through fixed or portable connections from the HP sea water system to the designated compartments for either:

a. Fuel compensation/displacement to maintain ship stability.

b. Ballast tanks to compensate for consumed stores.

c. To improve the ship's attitude after collision or action damage.

In assault ships, a number of ballast tanks are fitted for flooding and pumping to enable the ship to be used as a floating dock. The considerations which govern counterflooding action are referred to in Chapter 15.

2805. Spare.

2806. Suction Lift and Discharge Head

Suction lift refers to the ability of a pump to lift water from below. In the ideal situation, with a perfect vacuum, water can be raised 10m. In practice the pumps used in the Service will lift water through two decks (except for the Godiva GN 500 Pump, which will lift through one deck only). If the lift required is more than 5-6m then a submersible pump must be selected. The head to which a pump will discharge depends on the pump discharge capacity.

2807. Pump Performance

The capacity of a centrifugal pump is related to 'total head' which is the suction lift plus the discharge head (see Fig 28-1). Pumping capacity is affected by system head losses due to fittings in the pipework such as valves, bends etc, friction in the associated pipework and the difference in height between the suction point and the discharge point. Thus, when rigging a pump the shorter the suction hose, and hence suction lift, the better the pump performance for firefighting and pumping out (see Annexes for pump capacities).

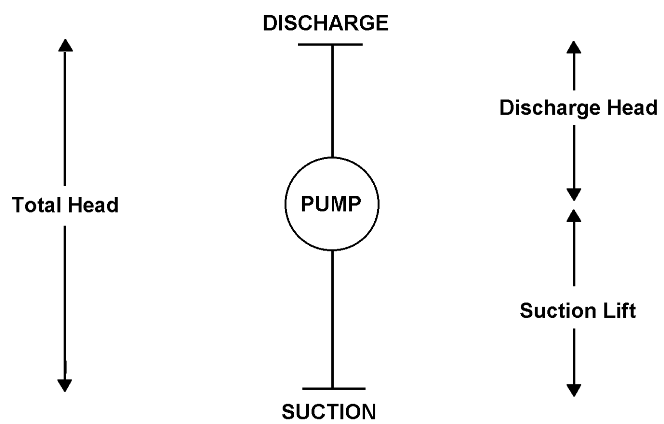

Fig 28-1. Pump Head

2808. Portable and Mobile Pumps

These pumps are defined by as follows:

a. **Portable Pump.** A pump which can easily and quickly be moved without mechanical aids, between compartments and decks of a ship, and not having an appreciably greater weight than 100kg.

b. **Mobile Pump.** A pump which can be moved between compartments and decks of a ship and not falling within the definition of a portable pump.

2809. Pump Allowances

The allowance, for RN surface ships and RFAs, of pumps and eductors detailed in BR 2170(3), is based on the following criteria:

a. **Firefighting**

(1) *Multiple NBCD Section Ships.* Four 100m^3/hr installed emergency diesel driven pumps are to be sited in the ship (except the hangar section). In addition four portable diesel driven pumps per ship are to be provided.

(2) *Single NBCD Section Ships.* Two 100m^3/hr installed emergency diesel / gas turbine driven pumps, to be sited one forward and one aft. In addition, two portable diesel driven pumps per ship are to be provided for flexibility in firefighting.

(3) *Minor War Vessels.* One GN 500 emergency portable diesel driven pump per vessel.

b. **Damage Control**

(1) *Ships with 3 or more FRPPs.* Two submersible high capacity portable electric driven pumps are to be sited at or in the vicinity of each Fire and Repair Party Post.

(2) *Frigates/Destroyers with 2 FRPPs.* Three submersible high capacity portable electric driven pumps are to be sited at each Fire and Repair Party Post.

(3) *Minor War Vessels.* One or two high capacity electric driven pump(s) per vessel. Small vessels below 1000 tonnes may be fitted with one medium capacity electric driven pump. Where vessels are considered too small or are limited by their electrical supplies they are to utilize the portable diesel driven pump supplied for firefighting.

2810. Firefighting Pumps

Mobile and portable, independently driven, diesel pumps (Godiva GN 1700 and Desmi S100 LDW 2004) are provided for firefighting duties when normal HPSW main and electrical power supplies are damaged or destroyed. The Godiva GN 500 pump should never be connected to the HPSW main and should always be used independently. These pumps will also provide emergency standby firefighting capability for ships in dock, or alongside when ship's generating capacity is not available and shore facilities are limited.

2811. Mobile Pump

The mobile diesel pump is to be semi-permanently installed in its working position adjacent, and connected by the portable hoses, to a sea suction standpipe and also the exhaust outlet. The two pump discharges are to be connected by two No 3 delivery hoses to the HPSW system via two hydrants sited in close proximity to the pump position, and two double male instantaneous coupling adaptors provided for this purpose.

Note. *The mobile diesel pump is too heavy for normal mobility, as defined in Para 2808b. In ships where a common working and storage position cannot be achieved a mobile gas turbine pump is provided.*

2812. Portable Diesel Pump

This pump is to be stowed in a readily accessible and sheltered position off the weatherdeck complete with suction, delivery and exhaust accessories. It may also be used for pumping out and for the assistance of other ships or services in distress.

2813. When diesel pumps are used outside the ship (or inside for pumping out free water), the suction hoses are to be fitted with a suction strainer at the free end. When used inside the ship for firefighting, the suction hose is to be coupled to a sea suction standpipe and flexible exhaust hoses (maximum 4 × 3m lengths) are to be provided to carry the exhaust fumes to the open air through doors, hatches or the special exhaust outlets provided in the ship's structure.

2814. Portable Submersible Pumps

Portable, electrically-driven, submersible pumps are provided for damage control duties. They are normally classified as drainage pumps rather than salvage pumps in order to differentiate between the DC pumps used on warships for pumping out and the pumps used by specialized ships for salvage operations. The submersible electrically-driven pumps are provided, primarily, for DC duties but they can also, if needed, be used for firefighting subject to their limitations and the availability of electrical power. (See Annex 28A for series connection of Weda pumps for firefighting).

2815. Eductors

There are two types of eductor, both using HPSW flow through a venturi to create a suction:

a. **Fixed Eductors.** These are fitted in machinery spaces, cable lockers and other compartments, low down in the ship, with a high probability of water ingress.

b. **Portable Eductors.** These are normally stowed at FRPP lockers and can quickly be rigged and supplied by hose from the HPSW main. They are supplied with non-collapsible suction hoses, clamps and a strainer. The discharge is led, by a No 3 hose, to an overboard discharge connection or to the upper deck.

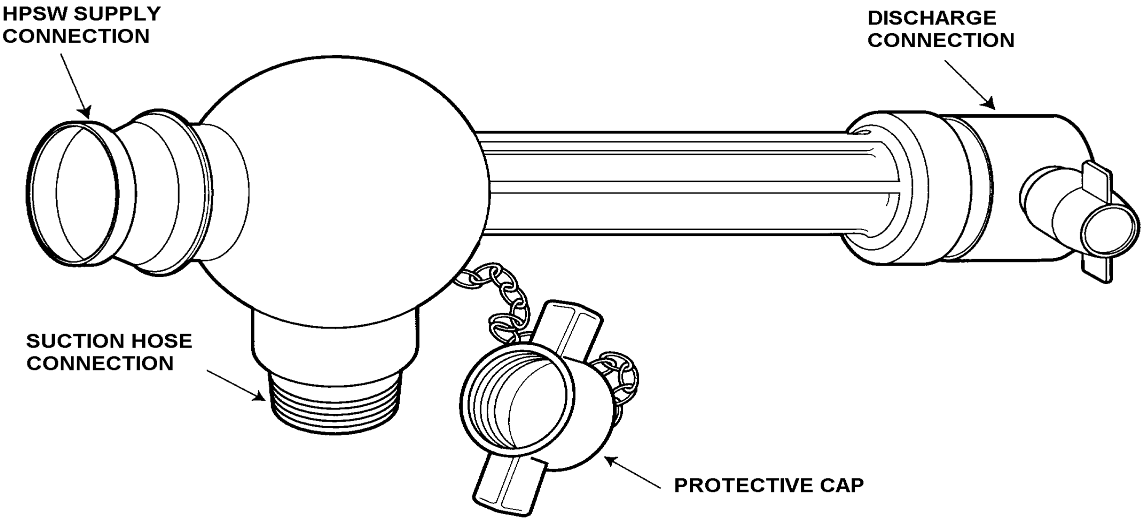

Fig 28-2. Portable Eductor

2816. Pump Sea Suction Standpipes

These are 108mm nominal size and are provided for use with the diesel-driven firefighting pumps. They are fitted one per Fire Zone (which is to include any required for fixed independent pumps). The vertical lift demanded by the sea suction standpipes should not exceed 5m. Sea suction standpipes terminate within the ship approximately 150mm above deck level with a 100mm nominal size male-screwed connection to BS 336. A watertight, lockable, female-screwed cap is fitted to each standpipe. Each sea suction standpipe is fitted with a suction elbow piece which is fitted with a 100mm nominal size female-screwed swivel connector (with locking ring) on the base which connects with the sea suction standpipe. The free end is fitted with a 100mm nominal size male, ribbed, tail end for connecting to the suction hose.

2817. Compartment Standpipes

These are only provided in spaces normally closed in action and into which it is not practicable to introduce a suction hose or submersible pump, eg where entry is by a door. Compartment standpipes consist of a short, vertical, length of 76.1mm nominal size piping fitted with a strainer at the lower end and terminating outside the compartment in a 75mm nominal size male ribbed tail connector (to BS 336), which is fitted with a lockable watertight female-screwed cap. This is to enable the suction hose to be connected direct onto the standpipe with the aid of a 75mm nominal size hose clamp. These compartments are fitted with sounding arrangements.

2818. Overboard Discharge Connections

Overboard discharges are provided for use with portable pumps, in conjunction with collecting head adaptors, (twin female instantaneous connections) to enable a single or twin run of discharge hoses to be connected from a pump. Overboard discharges are fitted at readily accessible positions to a minimum of one in each watertight section along the lowest communication deck, and sited alternately on port and starboard sides of the ship. In larger ships, or where access is not available across the ship, two discharges are fitted in each watertight sub-division, one port and one starboard. Where discharges are sited in an enclosed compartment a tally plate worded PORTABLE PUMP OVERBOARD DISCHARGE INSIDE COMPARTMENT in black letters on a white background is to be sited adjacent to the door of the compartment, (and not obscured by it when it is open).

2819. Electric Submersible Pump Power Sockets

Power sockets for portable pumps are sited on, or near, the centre line of the ship on the lowest communicating deck, on the basis of one in each main WT sub-division in DD/FF and two in each main WT sub-division in larger ships (see Chapter 19 for details).

2820. Spare.

2821. Pump Stowages

Stowages for portable pumps and their accessories are sited on the lowest communication deck adjacent to the FRPP lockers. Covers are provided for pumps which are not stowed within a locker. Securing arrangements are provided for all pumps.

2822. NATO Standard Flange Adaptors

A range of adaptors, specified in Stanag 1169, is carried by NATO ships to facilitate interchangeability of damage control and firefighting hose connections. This allows for the transfer of independently driven portable pumps between ships of different nations. One end of each adaptor has the appropriate national connection, but the common features are the standard NATO flanges at the other end:

a. **NATO Standard Delivery Flange.** 6.5in outside diameter, 2.5in inside diameter, 6 holes at 5.25in pitch circle diameter.

b. **NATO Standard Suction Flange.** 7.5in outside diameter, 3.5in inside diameter, 6 holes at 6.25in pitch circle diameter.

2823. The allowances of the following adaptors, detailed in BR 2170(3), are to be stowed in selected FRPP lockers:

a. NATO standard suction flange to 4.5in (OD) unified female thread. (See Fig 28-3).

b. NATO standard suction flange to 4.5in (OD) unified male thread. (See Fig 28-4).

c. NATO standard delivery flange to 2.5in male instantaneous connection. (See Fig 28-5).

d. NATO standard delivery flange to 2.5in female instantaneous connection. (See Fig 28-6).

e. NATO standard delivery flange to 7in international shore connection flange. (This is referred to as a distance piece, because it is inserted between the NATO flange and the international flange) (See Fig 28-7).

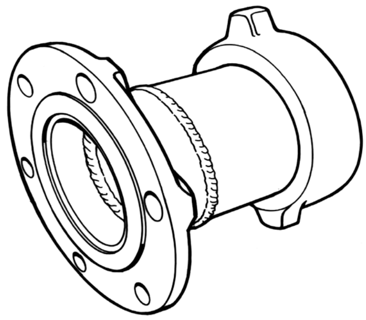

Fig 28-3. NATO Suction Flange/ 4.5in Female Thread Adaptor

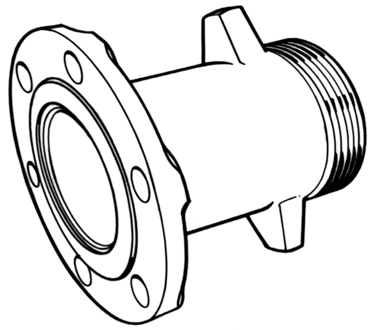

Fig 28-4. NATO Suction Flange/ 4.5in Male Thread Adaptor

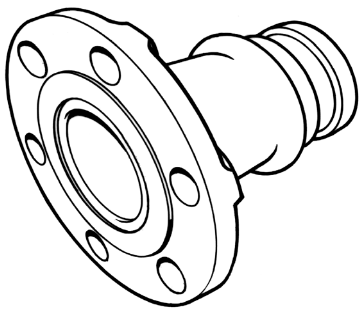

Fig 28-5. NATO Delivery Flange/ Male Instantaneous Adaptor

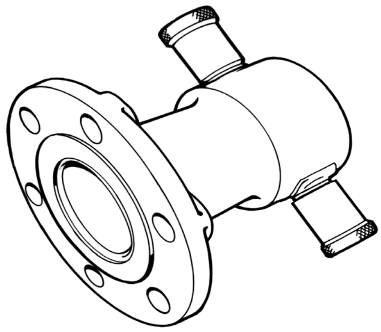

Fig 28-6. NATO Delivery Flange/ Female Instantaneous Adaptor

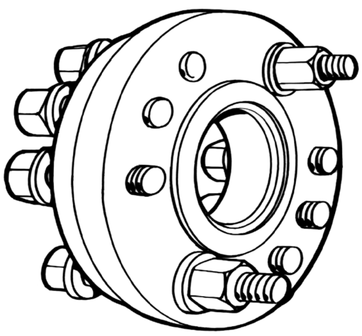

Fig 28-7. NATO Delivery/International Shore Flange Distance Piece

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ANNEX A TO CHAPTER 28

WEDA ELECTRICAL SUBMERSIBLE PUMP

1. Description

The Weda, electrically driven, portable pump operates submerged in the water to be pumped. This pump is provided primarily for pumping out loose water. When two pumps are used in tandem (or series) they provide a very useful emergency firefighting system. In the latter case suction can be taken from overside or from a flooded compartment/tank onboard. The pump must be lifted or lowered using the handle (with rope attached), and not by the electrical cable. The cable is to be whipped to the lowering rope at 450 mm intervals. When using a Weda pump during a flooding incident, consideration should be given to leaving the pump unsecured. If secured, the likelihood of being unable to retrieve the pump should the situation in the compartment deteriorate should be weighed up against the safety of personnel, especially if the ship is in State 1 and further action damage could occur. When the ship is conducting training the WEDA pump may be lashed in position for safe operation.

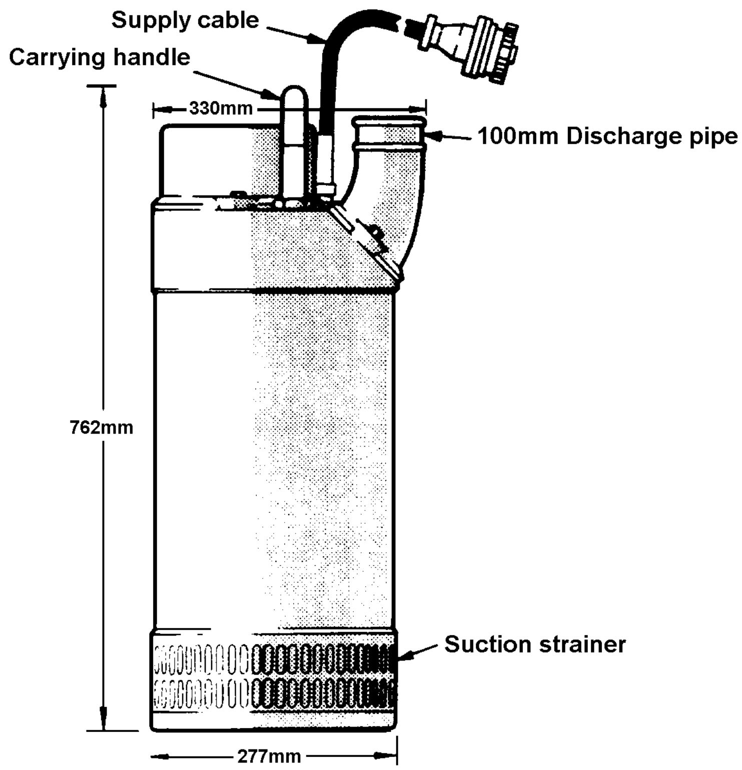

Fig 28A-1. Weda Electric Submersible Pump

2. Pumping Out

When used for pumping out loose water, the Weda pump is to be fitted with the twin discharge piece, which has two female instantaneous couplings. One size 3 hose is sufficient for the pump discharge. If only one hose is used, the unused connection on the twin discharge piece must have a blanking plug fitted. Alternatively, two hoses may be used.

3. Emergency Firefighting

Two Weda pumps, connected in series, can be used in the firefighting mode. The first pump (which is taking suction) is fitted with a 4in discharge adaptor (as supplied) and a 4in discharge hose to the second pump which has the series coupling conversion kit on its suction side. The second pump is fitted with a twin discharge piece, supplying two hoses for firefighting. A total of four hoses may be supplied, by fitting Y pieces, but only in extreme emergency due to the reliance on a single source.

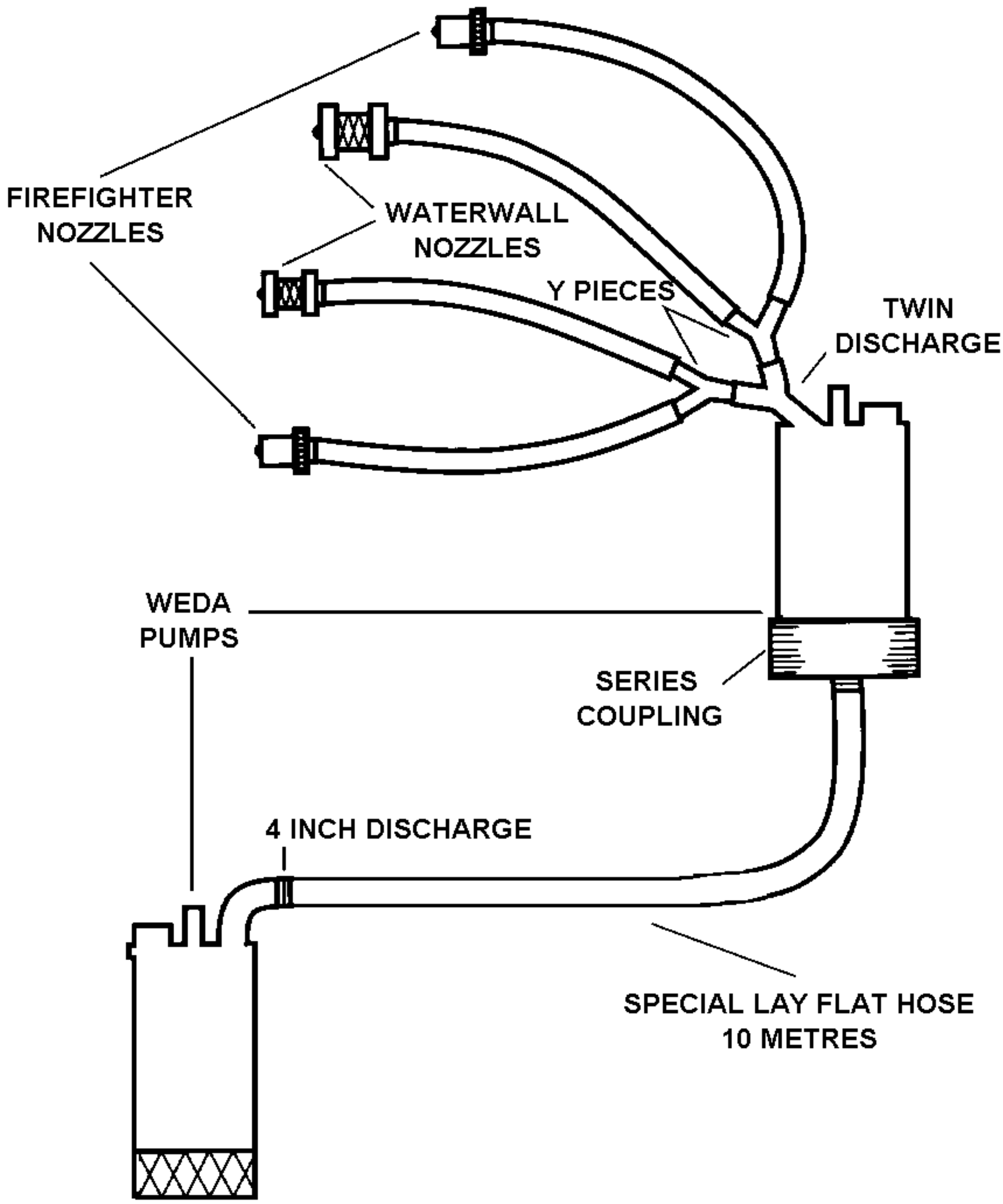

Fig 28A-2. Weda Pumps in Series

4. Pump Accessories

A switched emergency 'rat tail' connector.
A 10m length of 4in discharge hose.
A twin 2½in instantaneous female discharge piece.
Two 4in hose connectors.
One series coupling conversion kit per two pumps.
One electrical adaptor lead per pump. Type A - pre T23, Type B - T23 and later.
A trolley and stowage kit, including an extended handle, a trolley and a stowage bracket.

5. Pump Particulars

Weight (dry)	59kg
Performance	100m^3/hr at 1.8 bar
Size	See Fig 43A-1
Power supplies	440 V 3-phase 60 Hz (full load 13.5 amps)

6. Handbook
Full details are published in BR(F) 6570(662).

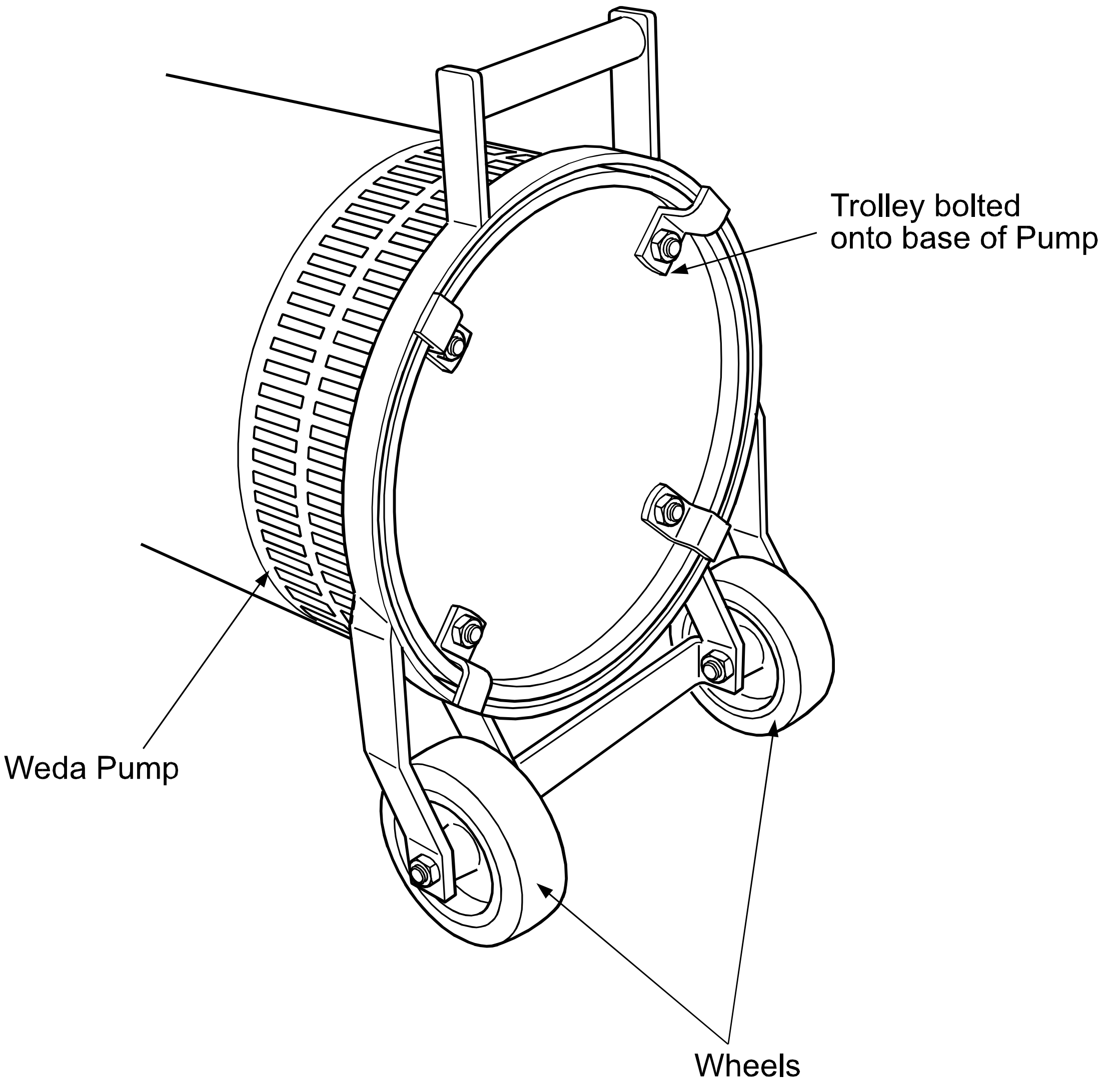

Fig 28A-3. Weda Pump Trolley

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ANNEX B TO CHAPTER 28

GODIVA GN 1700 DIESEL DRIVEN EMERGENCY FIRE PUMP

1. Description

The Godiva GN 1700, diesel driven, emergency fire pump is classified as a mobile pump but it is also used as a static pump with a dedicated sea suction and a riser to the HPSW main.

2. Operating Instructions

The pump should be run for at least one hour per week, either to supply the HPSW main or to discharge overboard. Flushing out is not necessary. The pump must not be left to run against a closed discharge or against an already pressurised HPSW main as the engine will overheat due to lack of secondary cooling water circulation.

3. Pump Particulars

Weight (dry - ex fuel tanks)	272kg
Fuel (diesel) F76	2 × 28.5 litre portable tanks
Performance	100m^3/hr at 7.3 bar
Size	See Fig 43B-1.

4. Handbook

Full details are published in BR 6570(621).

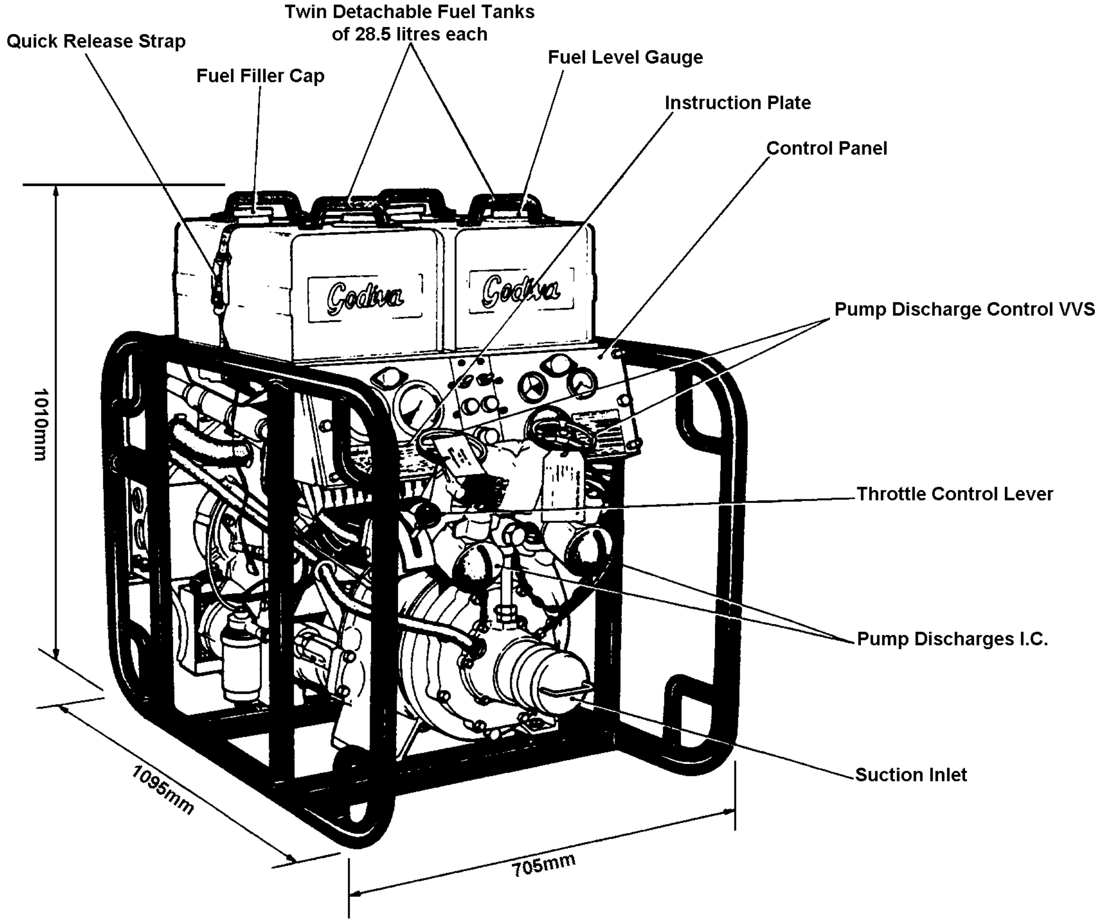

Fig 28B-1. Godiva GN 1700 Diesel Firefighting Pump (Front)

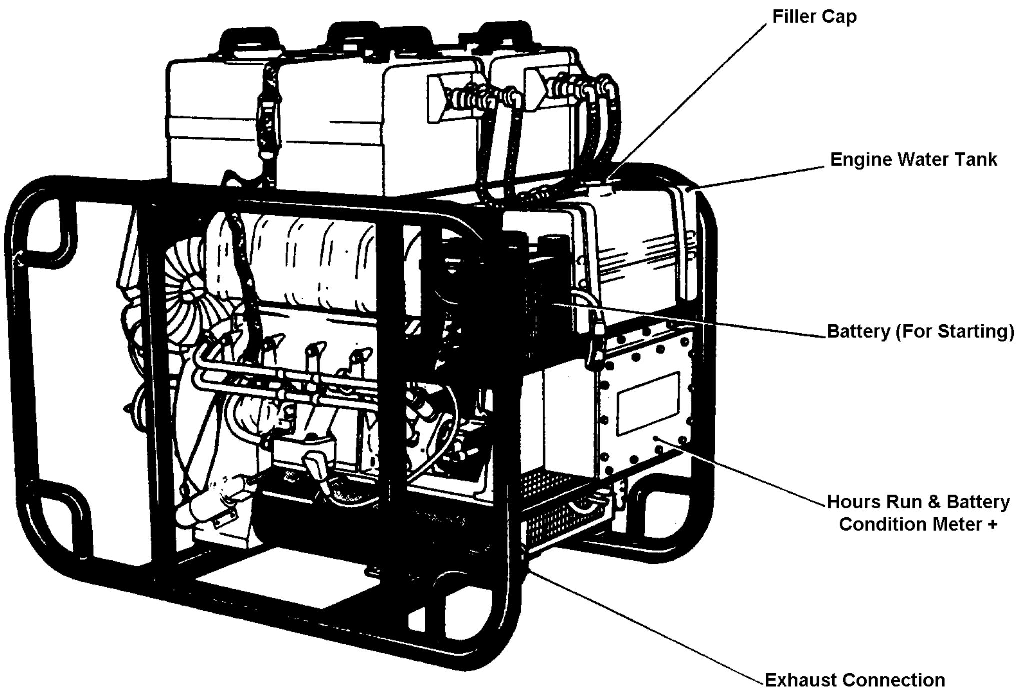

Fig 28B-2. Godiva GN 1700 Diesel Firefighting Pump (Rear)

ANNEX C TO CHAPTER 28

GODIVA GN 500 DIESEL DRIVEN EMERGENCY FIRE PUMP

1. Description

The Godiva GN 500 (previously known as Hathaway HMD7) diesel driven emergency fire pump is classified as a portable pump. It has the capacity to supply two hoses in a waterwall and firefighter combination. It is two-man-portable and can be 'wheelbarrowed' by one person. It can be passed through a 610mm square hatchway.

2. Operating Instructions

The pump should be run once-weekly for an hour using suction hoses over the quarter-deck or from suction standpipe, utilizing the adaptor included with the accessories. The static suction lift is 3.5m (one deck high) and lifts greater than this will cause the pump performance to fall off rapidly. Although primarily a small firefighting pump it can also be used for pumping out loose flood water. Ideally this pump should be stowed in a dry stowage close to the upper deck.

3. Pump Particulars

Weight (dry)	113kg
Fuel (diesel) F76	5.1 litre tank
Performance	$33m^3/hr$ at 2.75 bar
Size	See Fig 28C-1.

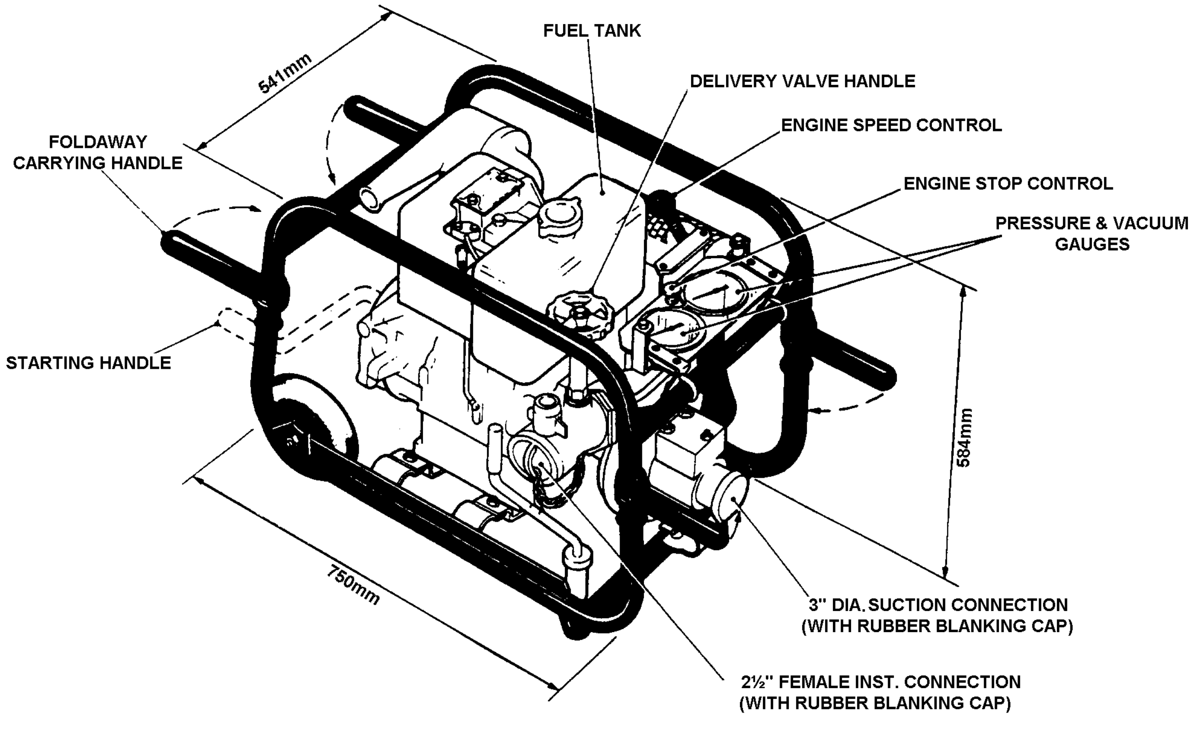

Fig 28C-1. Godiva GN 500, Diesel-Driven, Portable Firefighting Pump

4. Pump Accessories
The following accessories are to be held with each pump:

a. 3 suction hoses.

b. 2 coupling hose joint sleeves.

c. 2 exhaust hoses.

d. 1 suction strainer.

e. 6 hose clamps.

f. 1 suction blanking cap.

g. 1 protective cover.

5. Handbook
Full details are published in BR(F) 6570(620).

ANNEX D TO CHAPTER 28

DESMI S100 LDW 2004 DIESEL DRIVEN EMERGENCY FIRE PUMP

1. Description

The Desmi diesel driven, mobile pump is the successor to the Godiva GN 1700 pump, but is only supplied to ships not already supplied with the latter.

2. Operating Instructions

The pump should be run continuously for at least one hour per week, either to prime the HPSW main or to discharge overboard. Flushing out is not necessary. The unit should not be left to pump against an already fully pressurised HPSW main, as the engine exhaust will overheat due to the lack of secondary cooling water circulation. When the fuel tanks have been removed for refuelling, the self-sealing couplings must be pushed fully home to prevent leakage.

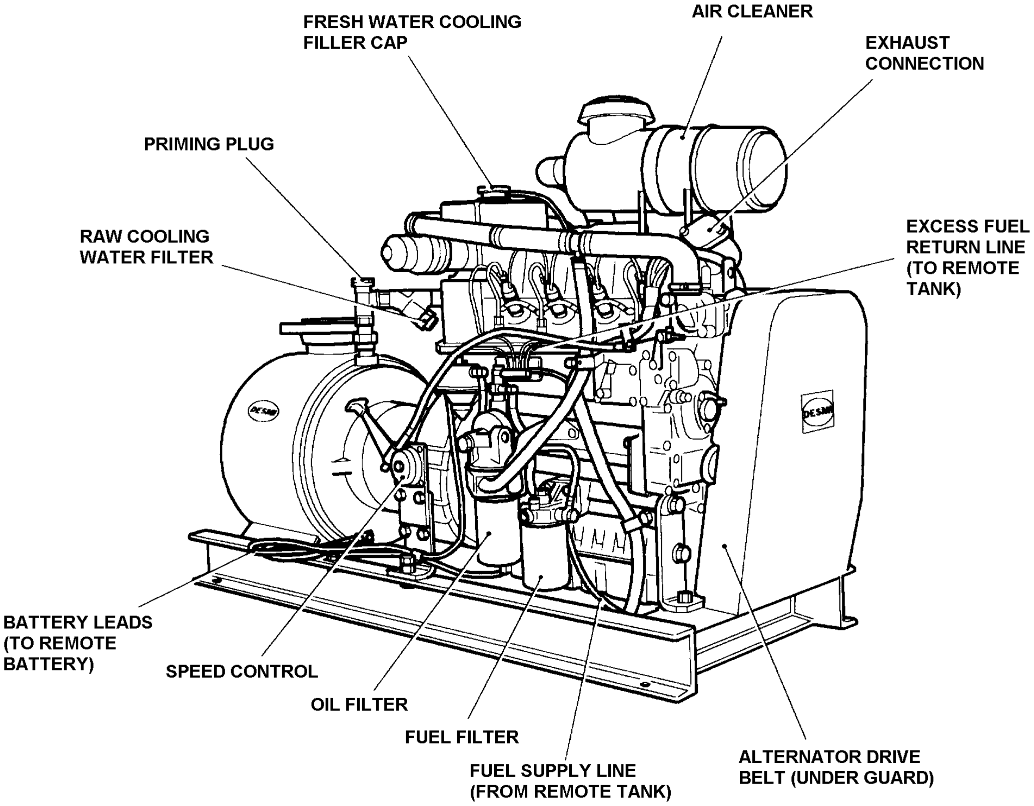

Fig 28D-1. Desmi S100 LDW 2004 Diesel Fire Pump

3. Pump Particulars

Weight (dry)	375kg
Fuel (diesel) F76	Two 25 litre containers
Performance	$100m^3$/hr at 7 bar, at 3.5m suction lift
Size	1325mm x 513mm x 1200mm.

4. Handbook

Full details are published in BR(F) 6570(629).

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ANNEX E TO CHAPTER 28

ARO AIR DRIVEN PUMP

1. Description

The ARO (previously known as Sanseal) air driven portable pump is a general purpose pump which can be used for pumping flammable liquids. It's secondary role is as an emergency bilge pump.

2. Operating Instructions

The pump is self-priming and may be allowed to run dry for short periods, but it will suffer ball valve erosion if this becomes excessive. The power source is the ship's LP air main.

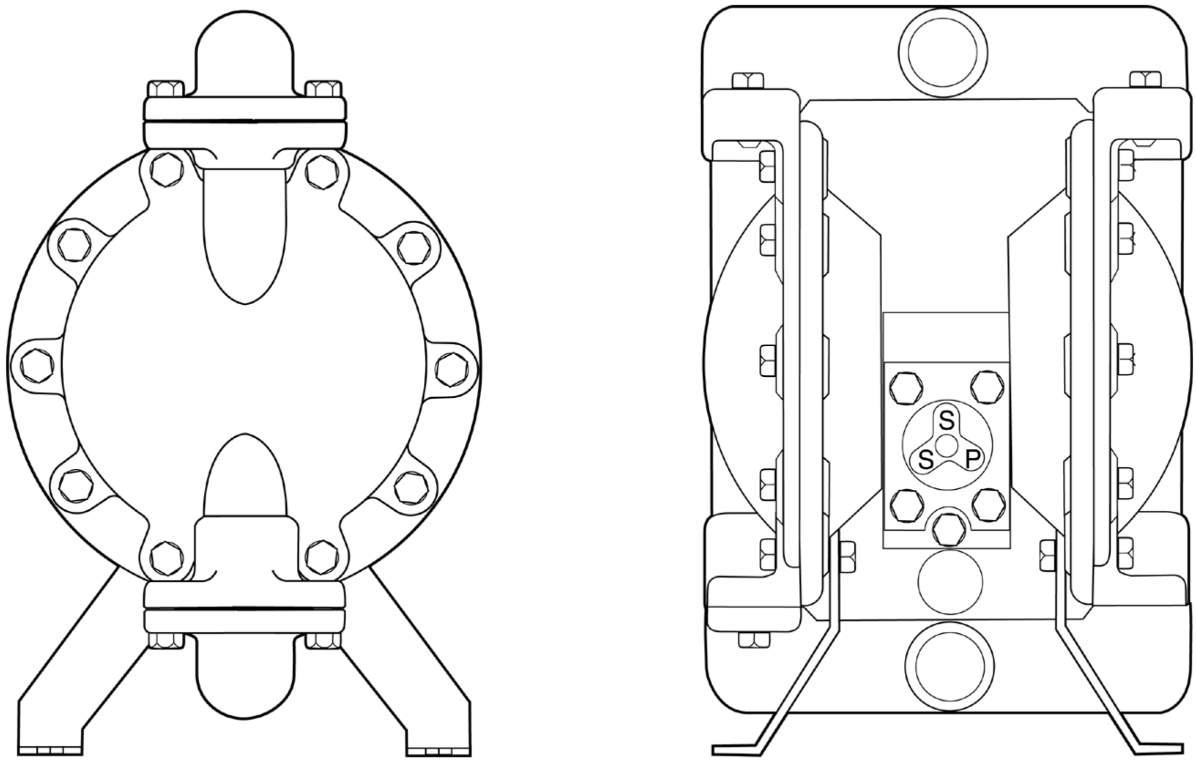

Fig 28E-1. ARO Air Driven Pump

3. Pump Particulars

Weight (dry)	50kg
Power source	LP air at 7 bar
Performance	$12m^3$/hr with air at 4.8 bar
	$15m^3$/hr with air at 7 bar
Size	502mm x 333mm x 292mm

4. Handbook

Full details are published in BR(F) 6570(807).

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ANNEX F TO CHAPTER 28

ROVER GAS TURBINE DRIVEN EMERGENCY FIRE PUMP

1. Description

The Rover (sometimes referred to as Miles or Hunting Hi-volt) gas turbine driven emergency pump is classified as a mobile pump. It is provided primarily to given an onboard emergency firefighting capability but it can also be used for pumping out loose flood water and for assisting other ships. It provides emergency standby firefighting capability for ships in dry dock or for ships alongside when electrical generators are closed down and the shore electrical supply is limited. It does not supply sufficient water for the protection of magazines when explosive stores are onboard. Where practicable, it has been replaced in ships by the Godiva GN 1700 pump.

2. Suction Hoses

The pump suction hoses have camlock couplings (see Fig 28F-2). The pump should be fitted with a flanged/camlock suction adaptor. The suction strainer, which has a threaded coupling, must be connected via a male thread/camlock adaptor. These items are detailed in BR 2170(3).

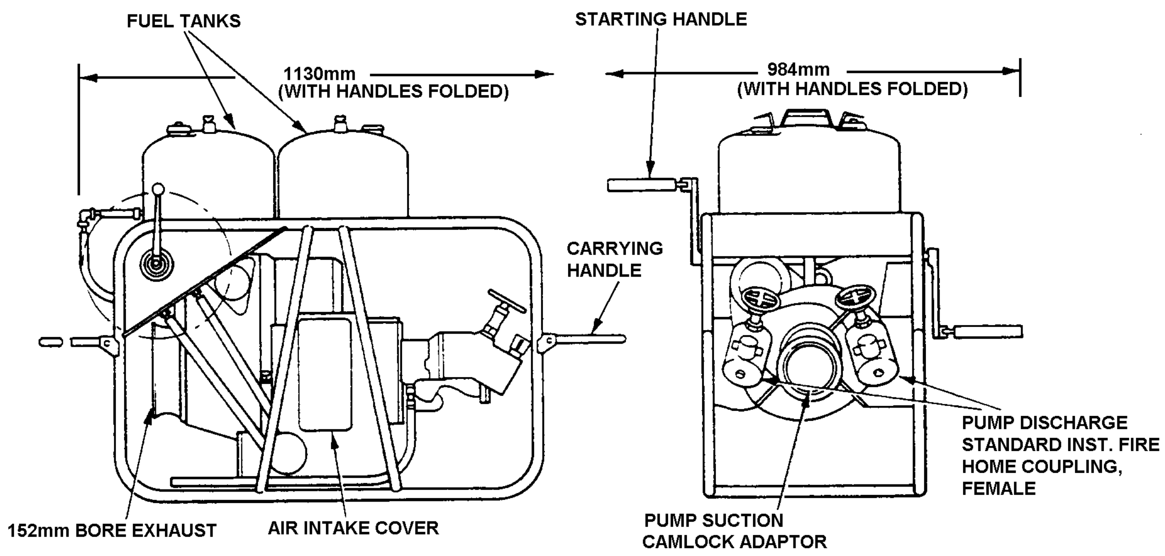

Fig 28F-1. Rover Gas Turbine Portable Pump

3. Operating Instructions

The pump should be run for at least one hour per week, after which it must be washed out with fresh water to prevent corrosion and seizure.

4. Pump Particulars

Weight (dry)	134kg
Fuel (diesel) F76	Two 25 litre containers
Performance	120m^3/hr at 6.3 bar, at zero suction lift
Size	See Fig 28F-1.

5. Handbook

Full details are published in BR(F) 6570(609).

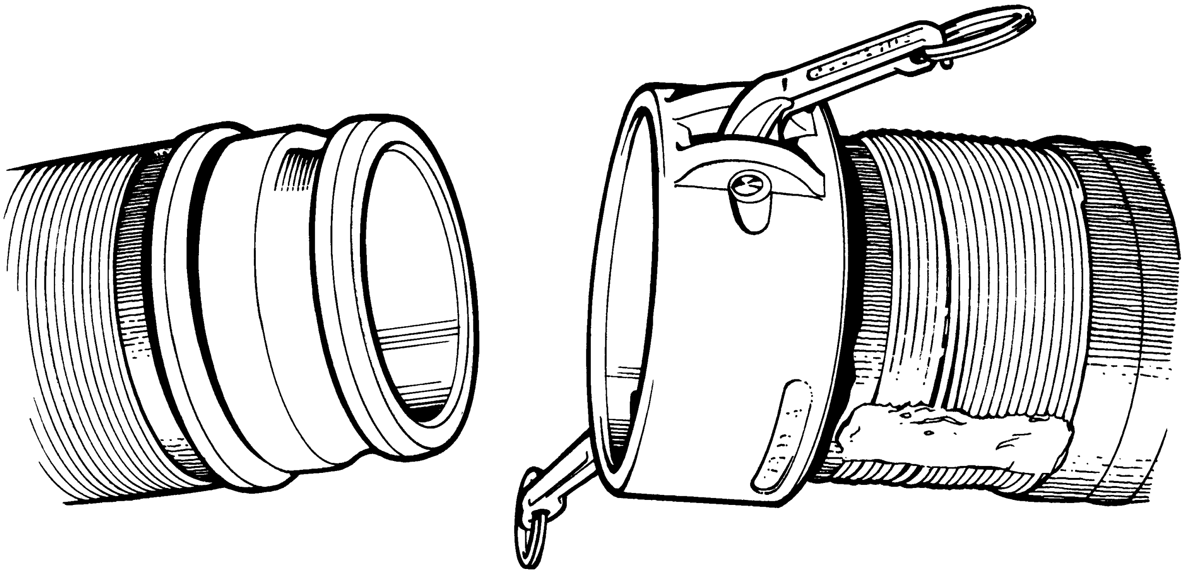

Fig 28F-2. Camlock Hose Coupling

CHAPTER 29

SHIP STRUCTURE AND FITTINGS

CONTENTS

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CHAPTER 29

SHIP STRUCTURE AND FITTINGS

2901. The greater part of a warship's structure is steel plating, welded and held to shape by steel frames, beams and longitudinals. The structure is designed to provide:

a. Strength to withstand all the forces acting on the ship under all conditions of service.

b. Buoyancy and stability.

c. Space, protection and accommodation for machinery, stores, equipment and personnel.

d. Habitability under all conditions of service.

2902. Stresses In Service
The most important stresses met in service by warships are:

a. **Longitudinal.** Stresses in the fore and aft line are caused by the variation in the buoyant forces acting on the ship as a result of the wave action along its length. These cause conditions known as 'hogging' and 'sagging' (see Fig 29-1). The greatest stresses occur in the topmost continuous deck (usually 1 Deck), the vertical and flat keels and the adjoining strakes of plating (garboard strakes) together with the topmost strakes of shipside plating (sheer strake). The bending stresses are usually greatest in the middle of the ship's length.

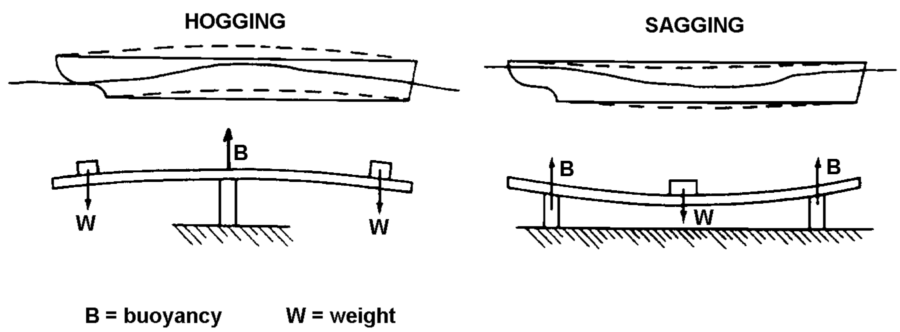

Fig 29-1. Hogging and Sagging

b. **Racking.** Heavy rolling causes stresses which tend to alter the transverse shape of the ship (Fig 29-2) and are resisted by the main transverse bulkheads and framing.

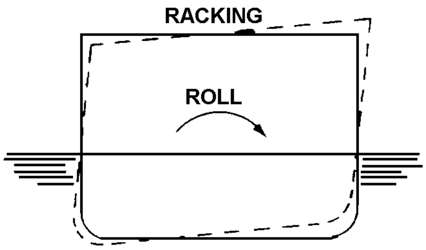

Fig 29-2. Racking

c. **Local.** Local stresses are imposed by heavy weights eg machinery, weapons, etc, by propeller thrust, the firing of weapons, the landing and movement of aircraft, berthing and docking.

All these stresses are accentuated if the ship is structurally damaged or subject to shock or whip (see Chapter 14).

2903. NBCD Design Aspects

There are many features of NBCD which influence, or are influenced by, ship design and layout. Among the more important are:

a. Watertight, and gastight, subdivision, openings and fittings.

b. Structural protection and the thickness of plating.

c. Dispersal, siting and layout of equipment, systems and power supplies, and the arrangements for isolation, duplication, and resistance to shock.

d. Ventilation, air-conditioning and air-filtration systems.

e. Nuclear 'hardening' of certain electrical systems.

f. Chemical hardening of exposed structure and equipment.

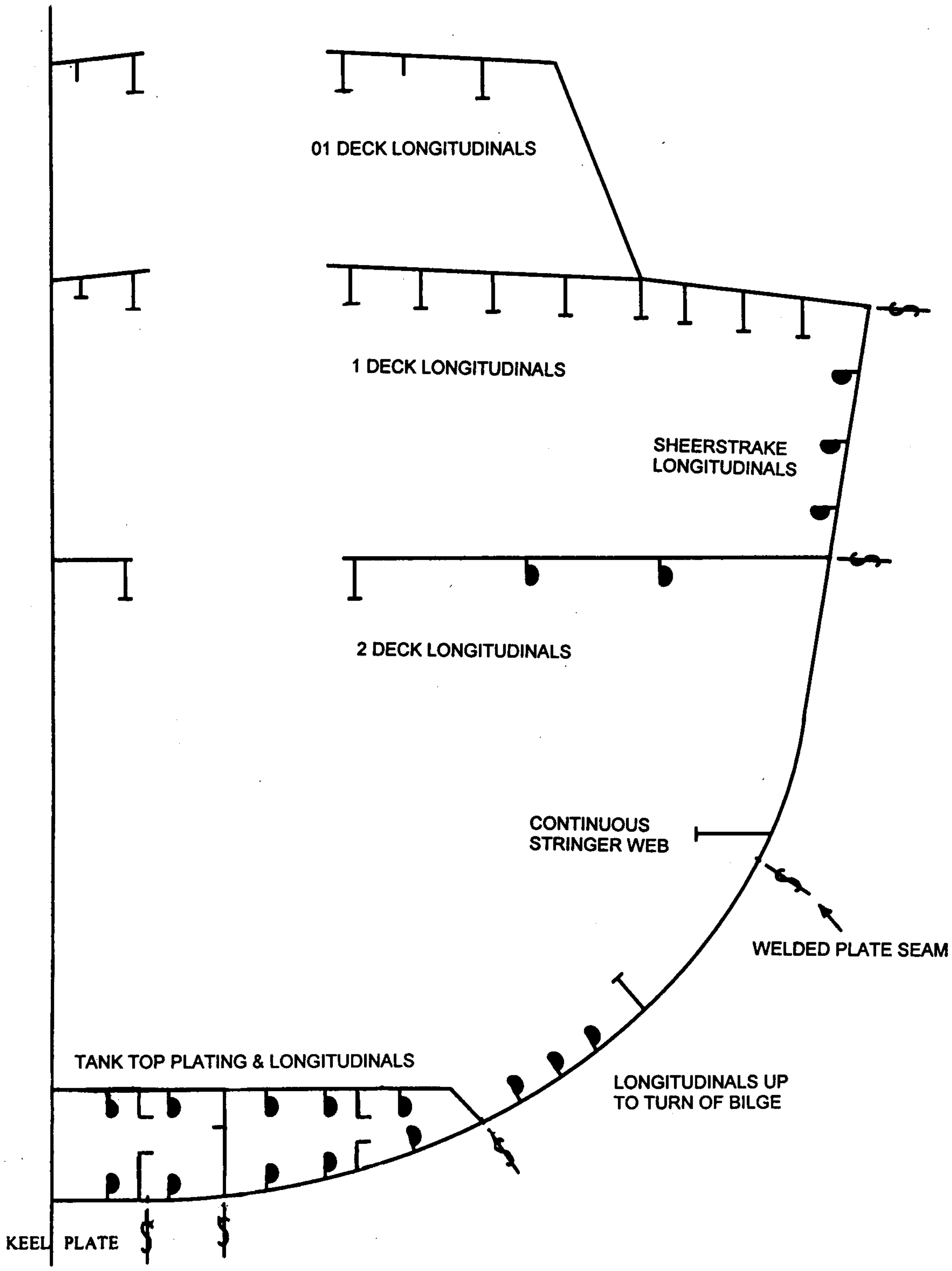

Fig 29-3. Section of a Typical All-welded Frigate

2904. Zoning

Certain RN ships and RFAs incorporate an NBCD zoning system. The principles of this system are:

a. Zone end boundaries are coincident with main watertight bulkheads to No 1 Deck and continued up through the superstructure as fire barrier bulkheads.

b. The combined length of any two adjacent zones is not less than 30% nor more than 50% of the waterline length.

c. If a fire extends over two adjacent zones then essential services (firefighting, sea water, fresh water, chilled water, salvage, electrical power generation and distribution are maintained in the remaining zones.

d. Each zone has its own NBC filter units (AFUs) and ventilation/air conditioning systems; any emergency cross connections have closures operable from both sides and are normally to remain shut. Smoke clearance arrangements are provided in each zone, crash stopping of fans (AFUs and ATUs) are on a zone basis with restart of AFUs similarly based.

e. Each zone has at least one HPSW pump and the HPSW main has remotely operable isolating valves at zone boundaries.

f. Sufficient domestic facilities are provided in each zone for it to be occupied for prolonged periods in high NBCD states.

2905. Subdivision

Subdivision can be either watertight, gastight or non-watertight, as required by the design. Watertight subdivision makes the greatest contribution to the strength of the ship. It is also gastight, though gastight structure is not necessarily watertight. Watertight subdivision localises flooding (and usually fire), preserves buoyancy and provides protection for equipment and personnel. Gastight subdivision is designed to prevent the entry and dispersion of NBC agents. The amount of subdivision is limited by various conflicting requirements, such as:

a. Habitability.

b. Economy in weight.

c. Ease of supply of weapons to their firing point(s), stowage of fuel and stores, ease of movement.

d. The piercing of structure by pipe, electrical and ventilation systems.

e. The size of equipment to be installed, and the need for adequate space for equipment and machinery removal routes.

2906. Subdivision is achieved by the following structures:

a. **Deck and Flats.** These watertight structures divide the ship in the vertical direction (a flat being a short non-continuous length of deck). Weather decks are built with camber and sheer to assist in the drainage of water. The position of the lowest continuous deck in a ship is usually governed by the height of the machinery spaces.

b. **Main Transverse Bulkheads.** These are strong, watertight, structures which continue as high up in the ship as possible. They divide the ship lengthwise into a number of main watertight sections. The foremost bulkhead extends from the keel to the weather deck in smaller ships, and to a suitable deck well above the waterline in larger ships, and is called the collision bulkhead.

c. **Main Longitudinal Bulkheads.** In DD/FF and smaller ships these fore and aft, watertight bulkheads are kept to the minimum possible to reduce the risk of flooding on one side only of the ship. Larger ships have longitudinal bulkheads as detailed by the design requirements, eg where local longitudinal strength is required or where additional protection is needed for magazines etc.

d. **Hull and Inner Bottom.** The part of the hull below the waterline is called the outer bottom. In some large ships an inner bottom is constructed which extends, normally, over an area covered by the machinery spaces and up the ship's side abreast of them. Where an inner bottom is fitted the space between it and the outer bottom is called the double bottom, and this is divided up into suitably-sized compartments by welded transverse and longitudinal framing.

e. **Minor Bulkheads.** These are fitted between decks, usually fore and aft, as required to subdivide the main sections and so provide compartmentation for accommodation, stores, passageways, offices, workshops, etc. These bulkheads may be watertight or non-watertight as required by the design.

Fig 29-4 shows typical arrangements of subdivision in HM ships.

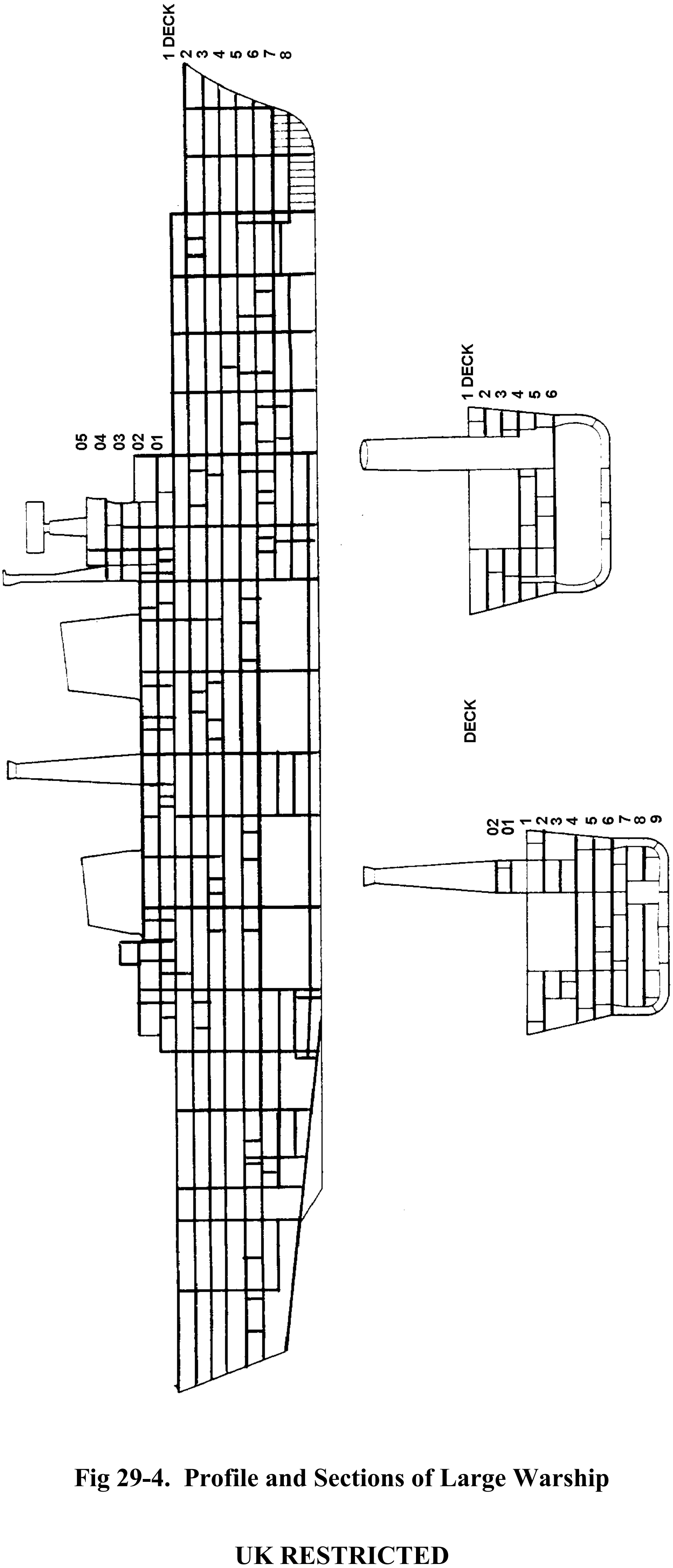

Fig 29-4. Profile and Sections of Large Warship

2907. Openings

Structure must be pierced to allow access to compartments, movement through the ship and passage for ventilation trunking, pipe systems, control systems and electric cables. Watertight and gastight integrity depend on:

a. The design of the openings, which must include arrangements for making them watertight or gastight.

b. Maintenance of openings and the preservation of structure and fittings.

c. Control of openings, as required by the watertight and/or gastight condition set for the ship.

2908. In the design of a ship, the piercing of watertight and gastight structure is rigidly controlled, especially in the Red Risk Zone where immediate flooding is likely after underwater damage (see Chapter 5). Within this zone main bulkheads are not usually pierced for access, and trunks are built through decks so that access may be gained to most of the lower compartments. Where ventilation and other systems must pierce main watertight bulkheads these are taken through, wherever possible, above the Red Risk Zone. Wherever watertight or gastight structure is pierced, provision for maintaining integrity is made by fitting:

a. Watertight (or gastight) doors, hatches, manholes, escape scuttles, fixed windows and side lights.

b. Watertight slide valves, closures and gas-flaps in ventilation systems.

c. Watertight glands to rod gearing, electric cables, propeller shafts and rudder stocks.

d. Bulkhead pieces and stop valves in pipe systems near decks and main bulkheads.

2909. Access Openings

Access openings are in two categories:

a. Those in general or occasional (routine) use, eg watertight doors, hatches and manholes, the opening of which are governed by control markings or a special routine or order (see Chapter 5).

b. Those normally kept closed, eg bolted manhole-covers to tanks and double-bottom compartments and emergency escape exits.

2910. Care of WT Closures

The proper handling of closures to openings helps to maintain safety and efficiency and reduces the maintenance workload. Much useful information is contained in BR 2203 - Ship Husbandry Manual. The following points are important:

a. Hatch and manhole covers should never be dropped, but should be lowered, onto their seatings.

b. Clips on doors must be engaged from above downwards onto the door wedges to make sure that they are not shaken off by vibration or shock.

c. Clips should be tightened in diagonally-opposite pairs using only strong hand pressure. Hammers must never be used for this purpose. If a door, hatch or manhole should be slightly distorted and cannot be made to seat firmly, or to open, by hand pressure on the clips, a tubular steel ‘samson’ (normally stowed adjacent to watertight doors on main watertight bulkheads) should be used to apply the extra leverage required.

d. When gear is being handled through doors and hatches care must be taken to avoid damaging sills, coamings and rubber sealing strips (gaskets) and their fastenings.

e. The rubber gaskets in watertight (or gastight) doors, hatches, manholes, escape scuttles, flaps and covers must never be painted as it will cause the rubber to deteriorate, and degrade the integrity of the closure.

2911. Some hatches are fitted with manholes to give access without the need to open the hatch. Such manholes have covers which can be operated from above and below. Manholes in hatches must not be confused with bolted manholes (see Chapter 3).

2912. Access Ladders

Sloping steel ladders give access to spaces approached by a hatch and in constant use eg accommodation spaces, workshops, stores etc. Sloping ladders, with hatches beneath them, are constructed such that they can be ‘broken’ and hinged back so that they hang down, clear of the hatch below.

2913. Emergency Escape Ladders

Emergency escape ladders (flexible) are fitted where permanent steel ladders are not fitted. They are attached to eyeplates at their upper and lower ends. Emergency escape ladders are to be in position and rigged, in all states of readiness, (except for those which would impede progress through the ship which, in State 3 only, are to be rolled up and stowed). All ladders are to be rigged in an emergency, or individually when required for use. When ladders are stowed they are to be secured by 5mm polyester line and held by a slip knot.

2914. Control of Openings

However efficient the design and maintenance of openings and their closures, watertightness and gastightness ultimately depends on the strict control over all openings which pose the risk of spread of floodwater or the entry of NBC agents. The organisation for this control is given in Chapter 5.

2915. Air Escapes

Air escape pipes rise from the crowns of all compartments which contain liquids or are fitted with flooding arrangements; those from adjoining compartments are sometimes grouped together. Air escapes must terminate outside the Red Risk Zone and those from magazines and compartments containing flammables must be fitted with wire gauze filters as a fire precaution. Care must be taken in maintenance to ensure that the perforations at the outboard ends of air escapes are not obstructed, for instance, by paint. As an NBC precaution, air escapes to fresh-water systems and magazines are sited within the citadel. Magazine air escapes have automatic valves which open only when the amount of flood or spray water in the compartment is enough to cause a predetermined increase in pressure.

2916. Structural Integrity

Watertightness and gastightness can be impaired by:

a. Corrosion.

b. Perished, worn, or painted rubbers on closures to openings.

c. Distorted closures to openings.

d. Defective glands to rod gearing, electric cables and pipes.

e. Unblanked holes such as redundant cable glands, screw and bolt holes etc.

2917. Preservation of Structure

The strength, watertightness and gastightness of a ship can be seriously impaired if corrosion is not prevented in its structure. BR 2203 - Ship Husbandry Manual gives detailed information on this subject. However the following points should be borne in mind:

a. Accumulation of water should be prevented, especially where different metals are in contact in the water. Heat accentuates any adverse reaction caused by these conditions.

b. Any liquid flowing from copper pipes must be run clear of aluminium structure and fittings.

c. Strong alkalis, such as caustic soda, must not be used for cleaning structural materials, particularly aluminium.

2918. Structural Protection

The protection afforded by structure depends upon the thickness and composition of the plating. Much of the protection required for equipment is gained by siting it below the waterline, below the superstructure and, in larger ships, behind longitudinal bulkheads. This also applies to the protection of personnel from blast and radiation hazards.

2919. Fire Barrier Insulation

Bulkheads and decks forming the boundaries of high risk compartments in some ships have a layer of fire barrier insulation applied to them. Care must be taken to preserve the fire barrier properties of these boundaries throughout the life of a ship. Any insulation which is removed or damaged during refit work, etc, must be reinstated as soon as possible.

2920. Classification of Fire Barriers

In RFAs and other vessels built to comply with Safety of Life at Sea (SOLAS) and Maritime and Coastguard Agency (MCA) requirements, the following definitions are used:

a. **Class A Divisions.** These are bulkheads and decks made of steel or equivalent material capable of preventing the passage of smoke and flame to the end of the 60 minute standard fire test. Insulated with an approved non-combustible material, the average temperature on the unexposed surface of the panel will not rise more than 139°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 180°C above the original temperature within the time interval. The divisions are classed to indicate this interval, eg an A-60 bulkhead will not exceed the stated temperature rise in 60 minutes.

b. **Class B Divisions.** These need not be made of steel but must be of non-combustible material and must prevent the passage of smoke and flame to the end of the first 30 minutes of the standard fire test. They are insulated such that the average temperature of the unexposed side will not rise more than 139°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 225°C above the original temperature within the time interval. The divisions are classed to indicate this interval, eg a B-15 bulkhead will not exceed the stated temperature rise in 15 minutes.

c. **Class C Divisions.** These are of non-combustible material. They meet neither requirements for the passage of smoke and flame nor limitations to the temperature rise.

CHAPTER 30

BASIC SHIP STABILITY

CONTENTS

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CHAPTER 30

BASIC SHIP STABILITY

3001. Stability Knowledge Requirements

All members of a Ship's Company should have some knowledge of the elementary principles of ship stability. This chapter provides, in easily understood terms, a basic explanation of those principles and the associated terminology. The subject is dealt with in greater detail in subsequent chapters, so there is intentionally some duplication of information.

3002. This chapter and the succeeding chapters provide guidance to tackle many problems encountered with ship stability. Information and data provided by the NBCD Class Book and issued with the Stability Statement, together with the principles provided in these chapters will allow sensible conclusions to be drawn and appropriate actions to be taken. Submarine stability is covered separately in BR 2170(4). There is no substitute for experience and previous training; whenever possible advice should be sought after any incident or prior to any unusual loading situation which may jeopardise the stability of the ship. Advice can in the first instance be sought from the MEO or DMEO, further specialist advice maybe obtained from any ME 106 trained officer (the HEO of larger ships CVS/LPD/LPH)) or direct from the Naval Support Command. In all circumstances, if the ship is to be operated outside the Design Intent as stated in the Certificate of Safety - Stability, both the Operating and Design Authorities must be informed and a concession sought at the earliest opportunity as required by JSP 430 - Ship Safety Management System Handbook.

3003. The stability of a ship in the transverse or athwartships direction is much more easily prejudiced than that in a fore-and-aft direction; this chapter is therefore almost wholly concerned with transverse stability.

3004. Flotation

A flat sheet of metal placed in a tank of water will sink to the bottom, and the volume of water displaced by it will be equal to the volume of the sheet of metal. If the sheet of metal is moulded into the form of a watertight box it will float on the surface of the water; the volume of water then displaced will be equal to the volume of the immersed part of the box, and its weight will be equal to the weight of the box.

3005. Displacement

The facts are illustrated in Fig 30-1, which represents a boat weighing 2.6 tonnes lowered into a tank of water. When the boat is waterborne, 2.6 tonnes of water are displaced, the volume of which is equal to the immersed volume (shown shaded) of the boat. If a weight of one tonne is placed in the boat she will sink down into the water until 3.6 tonnes of water are displaced, and the volume of water displaced will again be equal to the volume (shown shaded) of the immersed part of the boat. The weight of water displaced always equals the weight of the floating object and is referred to as her *displacement*.

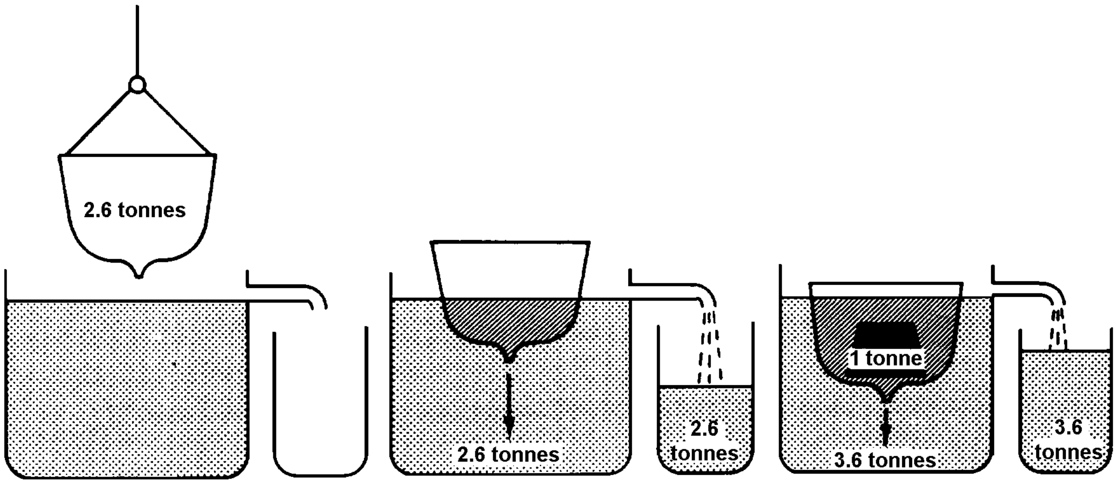

Fig 30-1. Flotation and Displacement

3006. If the boat heels to one side the shape of the immersed part of her hull will alter, but the volume will remain the same. In Fig 30-2 the volume of the shaded portion A equals that of the shaded portion B, and the weight of water displaced is the same in each instance.

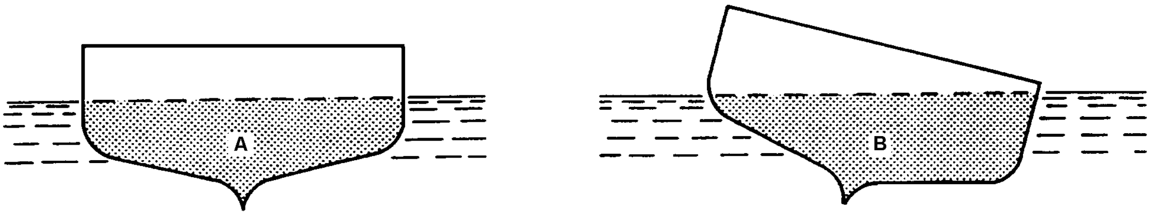

Fig 30-2. Heel and Immersed Section Contour

3007. Buoyant Volume

The buoyant volume of a ship is the volume of the entire watertight part of the hull. That part of the buoyant volume below the waterline is called her *buoyancy*, and that part above the waterline is called her *reserve of buoyancy* (Fig 30-3).

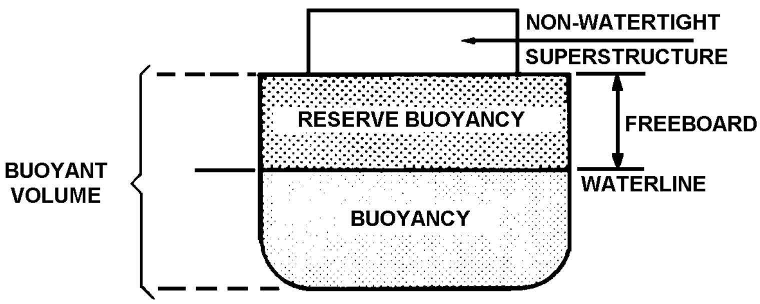

Fig 30-3. Buoyant Volume

3008. Additional loading or flooding after damage will sink a ship lower into the water. Part of the reserve buoyancy then becomes the buoyancy. It is the reserve of buoyancy which largely determines the ship's ability to float after flooding damage.

3009. The *freeboard* is the height above the waterline, at the ship's side, of the highest continuous watertight deck. As most ships are nearly wallsided (perpendicular) above the waterline the freeboard gives an approximate measure of the reserve of buoyancy.

3010. Centre of Gravity and Buoyancy

A ship's ability to float depends upon two factors - her total weight (or displacement) and her buoyancy.

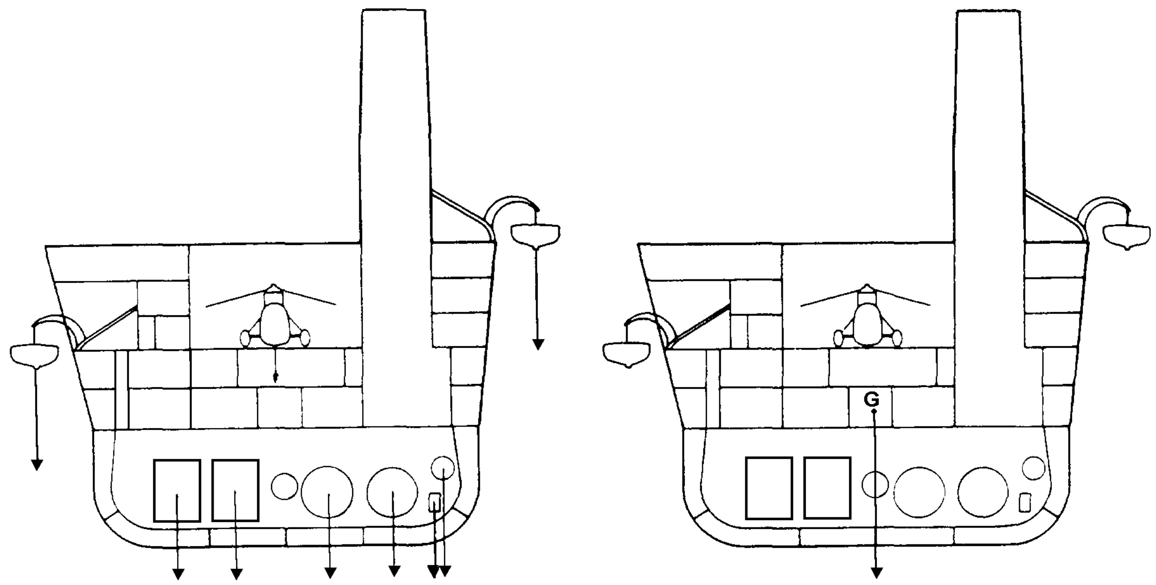

Fig 30-4. Centre of Gravity

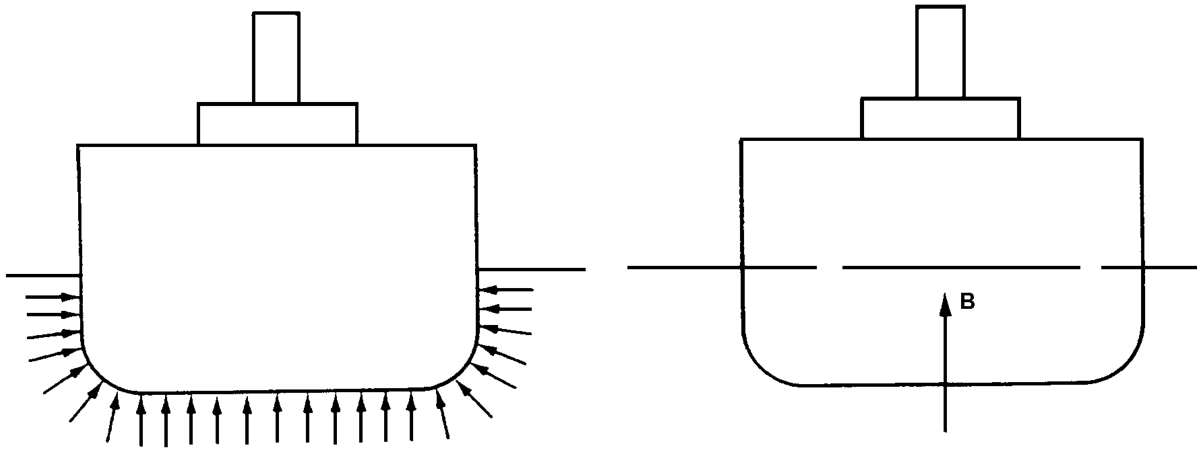

Fig 30-5. Centre of Buoyancy

3011. The total weight is the sum of the weights of everything in the ship, including that of all the structure, machinery, armament, fittings, stores, fuel and Ship's Company, and it can be visualised as the effect of exerting a single force through a central point which is called the *centre of gravity* (usually indicated by the letter G, see Fig 30-4).

3012. Buoyancy is the upward force exerted on the ship's hull by the water when she is floating, and it is equal to the weight of water she displaces. Although this force is distributed over all the underwater surface of the ship's hull it also can be resolved into a single force exerted through a central point which is called the *centre of buoyancy* (usually indicated by the letter B, see Fig 30-5).

3013. A ship's hull is symmetrical about a fore-and-aft vertical plane, so B is on the middle line when the ship is floating upright; and as the weight in this condition must be distributed symmetrically about this plane, G is also on the middle line.

3014. Conditions for Equilibrium

For a ship to float in equilibrium the buoyancy force pushing upward on the underwater part of the hull must be equal to the total weight of the ship, and as these two forces balance one another they must be acting in the same straight line (Fig 30-7(i)).

3015. When two equal and opposite forces acting on the same object are not in line these are known as a 'couple' and produce a moment tending to rotate the object; this moment is found by multiplying the perpendicular distance between the lines of action of the forces by the force of one of them. This is illustrated by the example at Fig 30-6.

Moment = 5 tonnes × 2 metres = 10 tonnes-metres

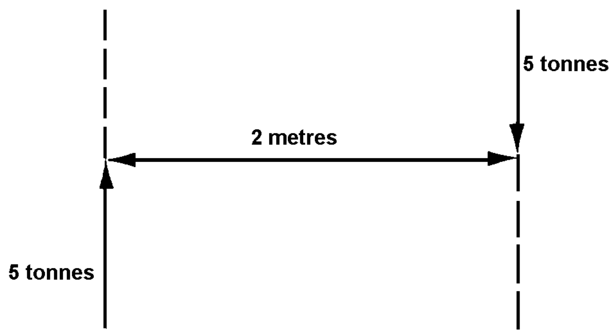

Fig 30-6. Couple and Moment

3016. If a ship is heeled over by some external force such as wind or wave, the weight, and hence the position of the centre of gravity, will, for all practical purposes, remain unaltered; but as the shape of the submerged part of the hull will be changed, the centre of buoyancy, B, will move from the middle line towards the lower side of the ship to B_1, as shown in Fig 30-7(ii). Hence the forces of weight and buoyancy are out of line and therefore produce a moment tending to return the vessel to an upright position and she is said to be in *stable equilibrium*.

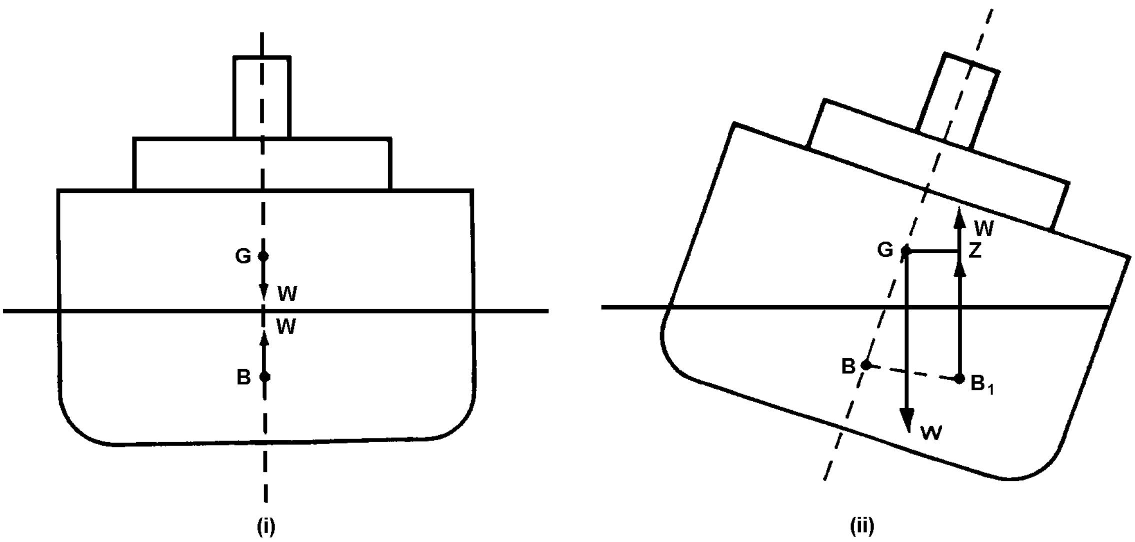

Fig 30-7.

3017. Righting Moment and Righting Lever

In Fig 30-7(ii) the *righting moment* acting on the ship is calculated by multiplying the displacement, W, by the horizontal distance between the resolved forces of weight and buoyancy, GZ. This horizontal distance GZ, which separates the forces of weight and buoyancy as the ship heels, is called the *righting lever*.

3018. The stability of a ship (ie her resistance to heeling forces) at any angle of heel is given by her righting moment, which depends on the size and shape of the submerged part of the hull (which determines the position of B) and also on the distribution of the weights of stores, fuel, weapons, machinery, etc (which determines the position of G). As the weight and the centre of gravity of a ship remain unaltered (apart from small differences due to free liquids) when she is heeled by an external force, her stability can be judged by the length of the righting lever GZ at the particular displacement.

3019. Thus it will be seen that the stability of a ship depends on three factors:

a. The shape of her hull (both of the part normally underwater and the part liable to be submerged as the ship rolls) which determines the position and movement of the centre of buoyancy.

b. The arrangement of all weights such as the hull, machinery, stores, weapons and fuel, etc, which determines the position of the centre of gravity.

c. The positions of the centres of gravity and buoyancy in relation to each other and to the ship.

3020. In designing a ship's hull, a compromise must be reached between the requirements of speed, capacity and stability. Too much weight above the centre of gravity, due to superstructures, weapons, radar equipment, etc, may raise the centre of gravity enough to make her top heavy and endanger her stability. Again, a ship whose beam is unduly narrow may not have a sufficiently large righting lever (and thus righting moment) to enable her to recover from a heavy roll. A warship, also, must be designed with enough margin of stability to keep her stable when damaged and partly flooded.

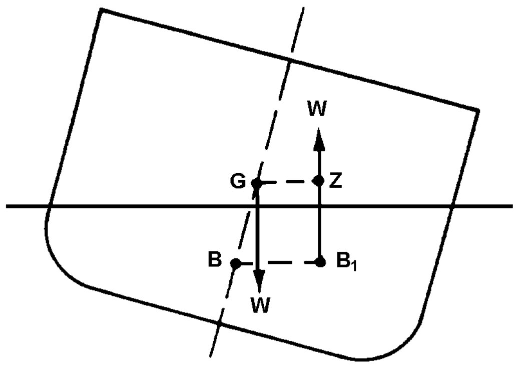

Fig 30-8. Period of Roll

3021. Period of Roll

When a ship is rolling, the righting moment produced depends upon the severity of the roll, ie how far the ship rolls from the upright. This righting moment (W x GZ in Fig 30-8) will oppose the roll away from the upright position and hasten the roll back to it.

3022. A ship with a large righting moment (ie good stability) will usually roll rapidly. Conversely, a ship with a small righting moment (ie poor stability) will usually roll sluggishly. The period of a ship's rolling can thus give an indication of her stability.

3023. A ship which is too lively will be uncomfortable; her violent movements may even carry away fittings and, if a warship, will make it difficult to use the weapons effectively or operate aircraft. If too sluggish, however, she will be unsafe in heavy weather, so a compromise in these respects has to be achieved by the designer.

3024. Heel and Trim

a. **Heel.** This is the athwartships inclination of a ship to either side from the vertical however caused; a sailing vessel, for example, may be heeled by the wind to her leeward side.

b. **List.** This is a heel caused by off-centre loading, ie G is not on the middle line.

c. **Trim.** This is the inclination of the ship's designed horizontal fore and aft plane with the surface of the water in which she floats. It is the difference between the draughts forward and aft. Warships are generally trimmed (down) by the stern.

3025. Effects of Loading

The effects on her stability of adding a weight to a ship will depend on the size and position of the weight, but it will always result in the mean draught of the ship being increased and in her centre of gravity being moved towards the added weight. The latter effect can be illustrated by the simple example given in Figs 30-9 and 30-10.

3026. If two equal weights are hung equidistantly from the middle point of a metal bar it will balance about that point because that is the centre of gravity of the whole (Fig 30-9).

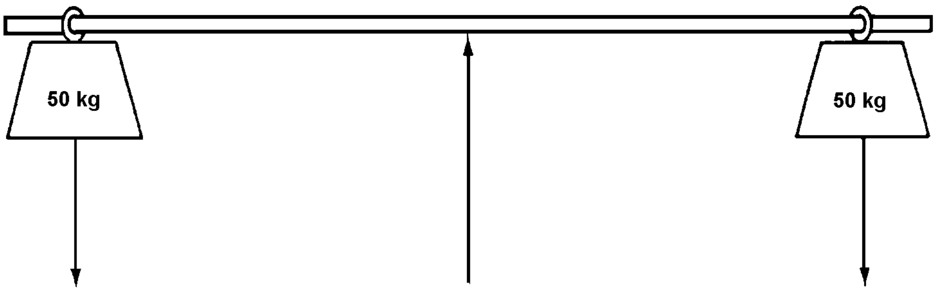

Fig 30-9. Centre of Gravity

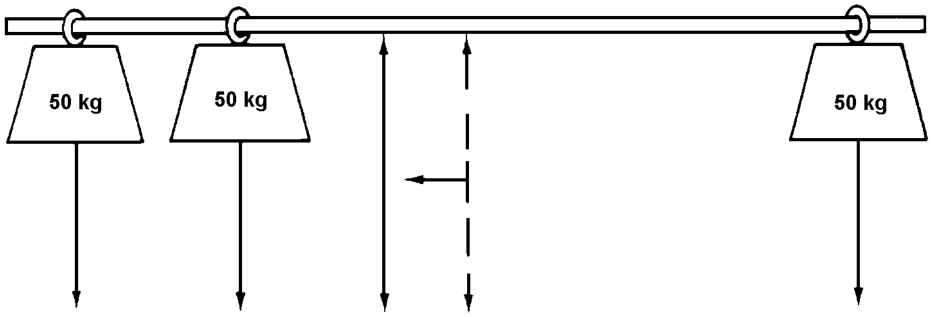

Fig 30-10. Movement of Centre of Gravity

3027. If another weight is added on one side of the support (as shown in Fig 30-10, the support will have to be moved from the middle towards the heavier end in order to preserve the balance of the whole. In other words, the centre of gravity of the whole has moved towards the added weight.

3028. Off-Centre Loading

When a heavy weight is added on either side of a ship, her centre of gravity moves towards that of the added weight, ie from G to G_1 in Fig 30-11(i). The weight and buoyancy forces are no longer in the same vertical line and so they produce a moment which will list the ship towards the side on which the weight was added. As the ship lists, so B moves towards the low side until it reaches position B_1 vertically below G_1 as shown in Fig 30-11(ii).

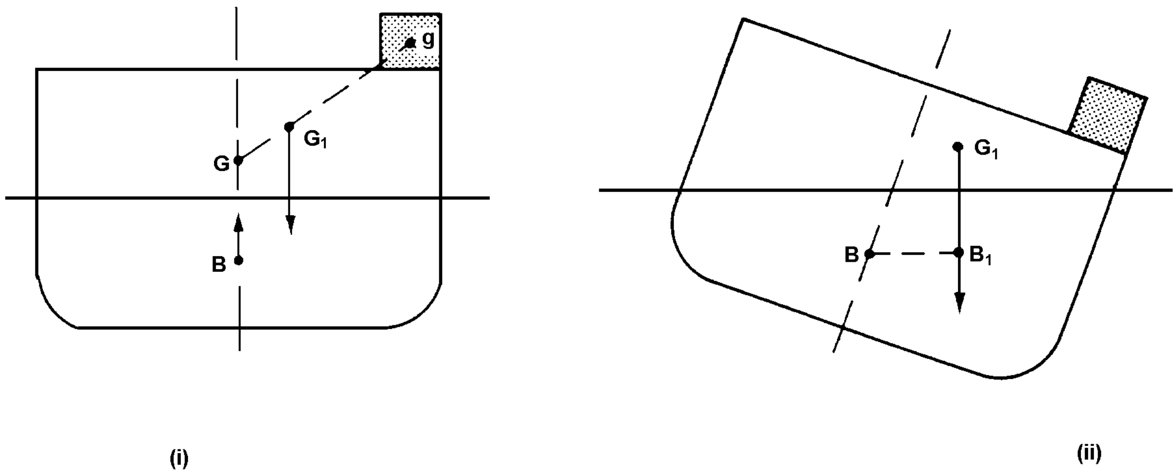

Fig 30-11. Effect of Off-Centre Loading

Then, with the centres of buoyancy and gravity once more in the same vertical line, the ship will float in equilibrium in the inclined or listed position. The opposite effect is caused by removing a weight, ie the centre of gravity moves away from the centre of gravity of the removed weight and the ship will list away.

3029. Effect of List on Stability

It may be said that the stability of a ship is reduced by a list because G has moved off the middle line. (In Fig 30-12, G has moved to G_1 and B has moved to B_1.) Any further heel by an external force in the same direction as the list will produce a smaller righting lever at the particular angle of heel than it would if G were still on the middle line; in Fig 30-12, for example, G_1Z_1 is less than GZ.

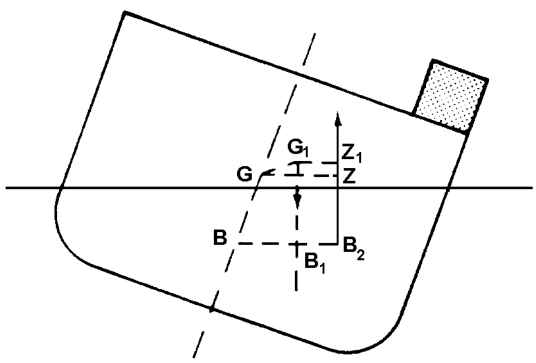

Fig 30-12. Effect of List on Stability

3030. Effect of Ballast

If ballast is added low down in a ship, the position of the centre of gravity will be lowered and stability will be increased. (In Fig 30-13, G has moved to G_1 making G_1Z_1 greater than GZ.)

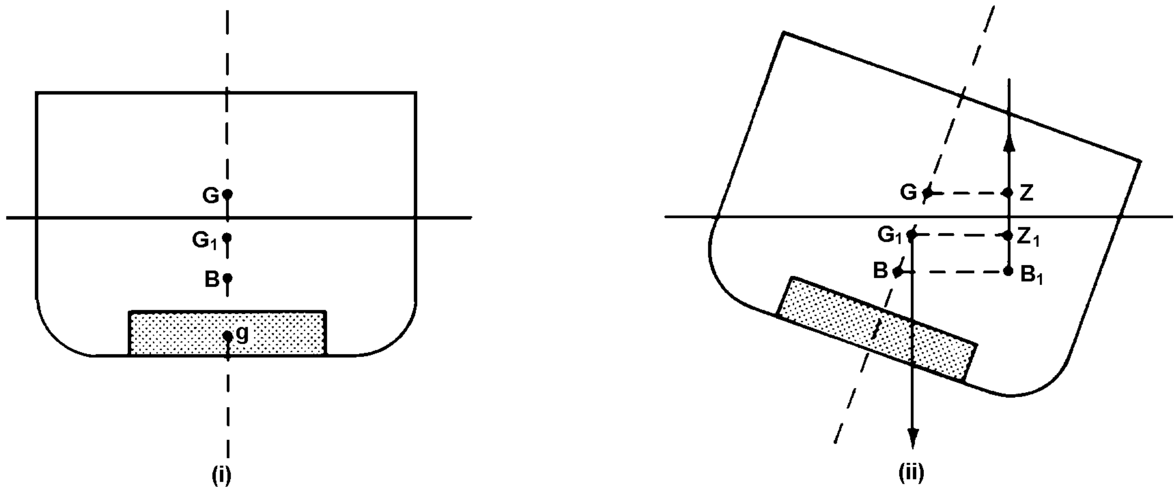

Fig 30-13. Effect of Ballast

3031. Topweight

If a weight is added high in the ship the centre of gravity will be raised, eg from G to G_2 in Fig 30-14(i), and the stability will then be reduced. In Fig 30-14(ii), for example, G_2Z_2 is less than GZ. Top-weight is therefore dangerous and must be kept to the essential minimum. A similar effect results from raising weight vertically in a ship. Removal of top-weight, however, lowers G and improves stability. Increase in top-weight can arise from such diverse causes as unauthorized additions (to structure or fittings), unnecessary accumulations of paint coatings, equipment and obsolete fittings, and severe icing of topsides. Ships operating in or near the Arctic or Antarctic may experience heavy icing of superstructure, weather decks and exposed equipment. Apart from the loss of stability caused by topweight, the ice may be asymmetrical (lopsided) and will then cause list. (Other evils are overloading of decks, masts and aerials; slippery decks, interference with the handling and operation of topside weapons and equipment.) Information on ice prevention and removal is given in Chapter 17.

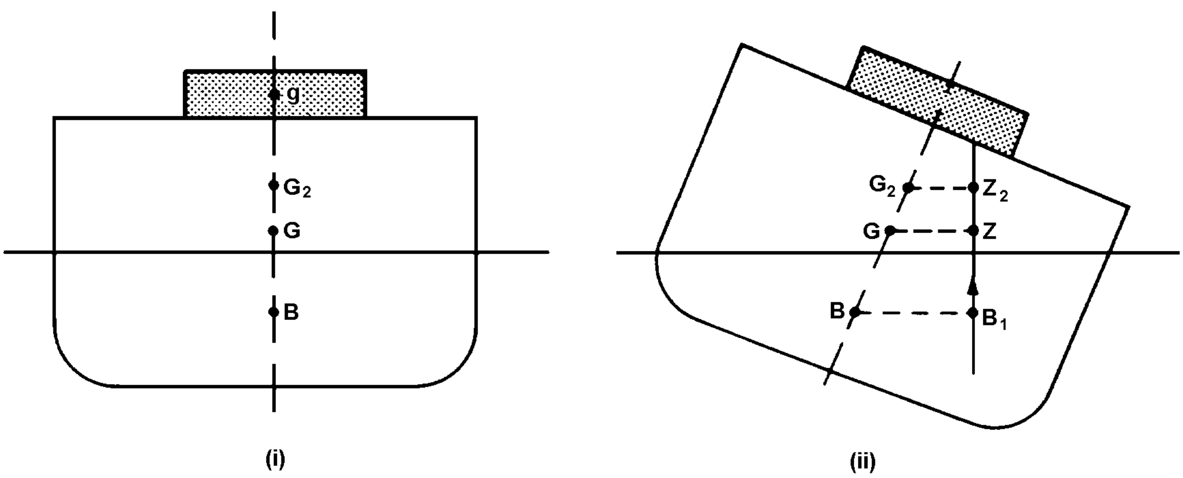

Fig 30-14. Effect of Topweight

3032. Effects of Flooding

Completely flooding a compartment will have exactly the same effect on the stability of a ship as adding a solid substance of equal weight at the centre of gravity of the flood water (Fig 30-13). For example, completely filling a centre line fuel tank would ballast the ship and so improve her stability.

3033. Free-Surface Liquids

If a fuel or other tank is only partly filled, however, the liquid in it has what is called a *free surface*, being free to run across to the low side as the ship heels or rolls. This will have the effect of moving the centre of gravity of the ship towards the low side, thus reducing the righting lever, so that in the example in Fig 30-15, G_1Z is less than GZ.

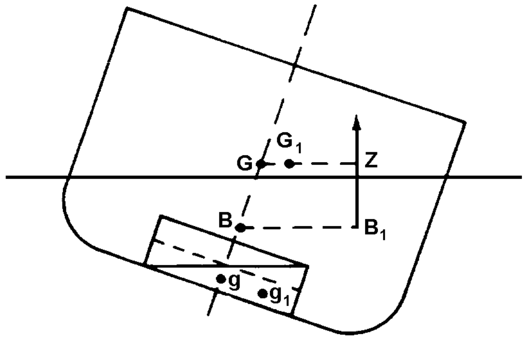

Fig 30-15. Effect of Free-Surface Liquid

3034. Free-surface liquid therefore reduces stability. The *free-surface effect* (ie reduction of stability) depends on the area (mainly width) of the free-surface liquid but not on the quantity. If liquid with a free surface is added to compartments high up in the ship, during firefighting for example, it will have a more adverse effect on the ship's stability than if it were added low down, because it will combine the bad effects of free surface and topweight.

3035. Subdivision of Free-Surface Liquids

If the tank in the example above were fitted with a middle-line bulkhead (Fig 30-16) the centre of gravity of the liquid in it will not move so far from the middle line when the ship heels or rolls, because the two smaller volumes of liquid will move through shorter distances; the loss of righting lever and stability will therefore not then be so great.

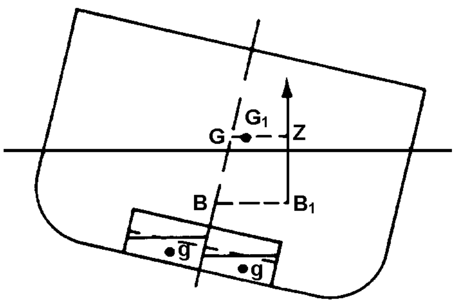

Fig 30-16. Subdivision of Free-Surface Liquid

3036. For this reason longidinal bulkheads may be fitted in fuel and water tanks to break up the free-surface and so reduce its effect on the ship's stability. For the same reason, and excepting hangars, large areas of unbroken deck space are avoided in warship design as far as possible.

3037. Correction of List

Unless caused by damage, list is usually easy to correct. All that is required is to balance the ship and so bring the centre of gravity back to the middle line. There are three ways of doing this:

a. By removing the off-centre loading, or an equivalent weight on the low side.

b. By adding an equivalent weight on the high side.

c. By shifting weights from the low side to the high side.

3038. For a damaged ship with off-centre flooding causing a list (that is, generally, a large ship) the first method is usually impracticable because flood water cannot be removed from compartments which are open to the sea, and the weight of this water is so great that there is nothing that can be removed from the low side heavy enough to compensate it.

3039. The second method usually affords the quickest way to correct list because, in big ships, the equivalent weight can be added by admitting sea water to wing compartments on the high side as counterflooding. In such ships, valves are usually fitted low down in wing watertight compartments so that they can be flooded direct from the sea.

3040. The last method is theoretically the best because it avoids the increase of the ship's displacement produced by method b. In practice, however, it usually means transferring fuel or other liquids across the ship, which is a slow process and not suited to the rapid correction of list. However, when the list has been reduced to a safe angle by counterflooding, pumping across of liquids is undertaken and, concurrently, pumping out counterflood water.

3041. List caused by flooding is unusual in DD/FF and smaller ships because there is little or no longitudinal subdivision.

3042. Loll

The term *loll* is applied to the state of a ship which is unstable when in an upright position and therefore floats at an angle or heel to one side or the other indifferently. If disturbed by some external force, such as wind or waves, the ship will lurch to the same angle of loll on the opposite side. Loll is quite different from list, being caused by different circumstances and requiring different countermeasures to correct it, and it is therefore most important that sea-going personnel should be able to distinguish between the two.

3043. Loll may be caused either by a large area (especially breadth) of free-surface liquid inside the hull or by a large addition of top-weight; the following example shows how it may be caused by free-surface liquid.

3044. In the description of free surface it was shown that the effect of free-surface liquid was to reduce the righting lever by shifting G towards Z. The greater the extent of flooding by free-surface water the further will G move away from the middle line when the ship heels.

3045. Consider a frigate with free flooded main-compartments extending right across the ship. If the ship heels to starboard, for example, as shown in an exaggerated form in Fig 30-17, the water in the flooded compartments will run across to starboard and shift G so far that it may well pass beyond B_1 to the position G_1.

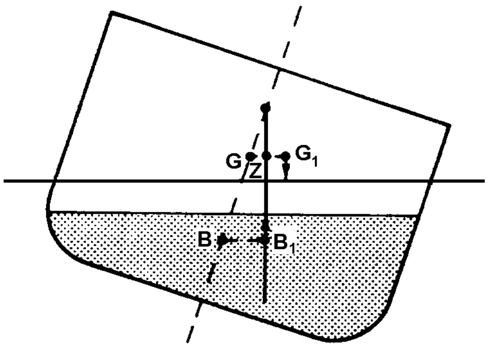

Fig 30-17. Free-surface Liquid Effect on G

3046. The centre of gravity G_1 of the flooded ship is now beyond the centre of buoyancy B_1, and these two forces are tending to heel the ship still more instead of returning her to the upright position.

3047. As the ship heels over further, however, the centre of buoyancy will also move further to starboard and the ship will come to rest at an angle of heel at which the centres of gravity and buoyancy, G_1 and B_1, are again in line as shown in Fig 30-18. The cross-sectional shape of the hull determines the extent to which the centre of buoyancy can move, and if G_1 is still beyond B_1 when the latter has reached the limit of its travel, the ship will capsize.

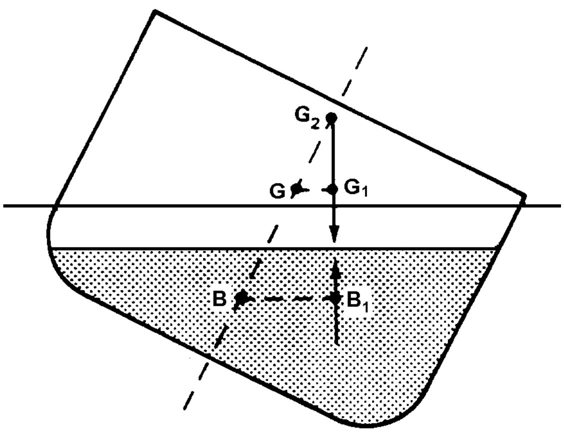

Fig 30-18. Loll to Starboard

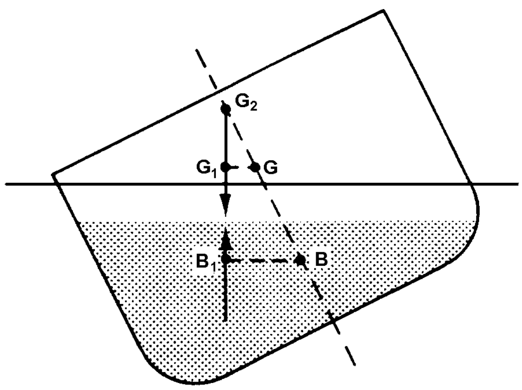

Fig 30-19. Loll to Port

3048. If, due to a change of course or to action by wind or waves, the ship heels over to port, the water in the flooded compartments will flow across the ship from starboard to port, and she will come to rest heeled to port at an angle equal to that of her previous heel to starboard (Fig 30-19).

3049. An exactly similar effect would be caused by an excessive amount of top-weight being placed in the ship, thereby raising the centre of gravity to a dangerous extent. This is illustrated in Figs 30-18 and 30-19, in which G_2 represents the raised centre of gravity caused by top-weight. It will be seen that the vertical line of action of the force exerted by the weight of the ship passes through both G_2 and G_1. In this case the centre of gravity is fixed and does not move from one side to the other with the heel of the ship, but the effect is the same as that caused by free-surface liquid.

3050. In each case the ship is unstable when upright and also when heeled to port or starboard up to the angle where B and G are in the same vertical plane.

3051. Reduction of Loll

There are four ways to reduce loll:

a. Remove weights from high up in the ship.

b. Reduce the area, especially the breadth, of free-surface liquid.

c. Add weight low down in the ship.

d. Shift weights from high in the ship to lower levels.

3052. The choice of method or methods to be used depends on the causes of the loll and the means available in the ship for correcting it.

3053. The first method is probably the most practicable, especially in small ships, and produces a double improvement because it lightens the ship, increasing her reserve of buoyancy, and also lowers her centre of gravity. It is effected by jettisoning movable gear from the upper decks, but care must be taken to do this evenly each side of the middle line, and not to jettison damage-control, firefighting or lifesaving equipment, or ready-use ammunition if further attack seems probable. Lists of suitable equipment should be prepared in the order in which they may be jettisoned so that this method can be used quickly and correctly should the need ever arise. Such items as boats (which should be tied up aft), torpedoes, helicopters and anchors may be included. Some guidance on preparing a Jettison Bill for the ship is given in Chapter 10.

3054. The second method is to plug leaks and pump out water; drain to lower and, if possible, narrower compartments; use longitudinal dwarf bulkheads - which may be quite temporary arrangements - to break up the free-surface area; or completely empty (or fill) tanks which contain liquid, according to whether they are high or low in the ship.

3055. The third method is to flood compartments or tanks low down in the ship to their full capacity and thus ballast the ship. It is effective in lowering the centre of gravity, but has the disadvantage of loading the ship still further and thereby reducing her reserve of buoyancy. If this method is employed it is important that the flooding should be carried out evenly each side of the middle line of the ship to avoid introducing a list in addition to the existing loll.

3056. Apart from draining down of floodwater, the fourth method is usually impracticable because movable objects small enough to be lowered through hatches are not usually of sufficient weight to appreciably affect the centre of gravity. If they were heavy enough, they would then be difficult to shift, particularly if the ship was lolling to a large angle.

3057. Use of Fin Stabilizers After Damage

Fin type stabilizer are fitted to warships to minimize roll and assist in weapon operation. They should not be used for heel correction after damage for two reasons:

a. Ships with fin stabilizers are designed so that list after damage is slight, if any. If the ship has a large angle of heel after damage, she is almost certainly lolling. Any attempt to correct loll by applying heeling moments, using the stabilizers, could result in the ship lolling to a greater and possibly dangerous angle on the side remote from the original loll.

b. Conventional methods of heel correction after damage (Para 3037) restore to the ship a capacity to withstand further damage which does not depend on maintenance of ship speed. Should initial heel correction be obtained by the use of stabilizers, and further damage cause serious loss of mobility, the resulting heeling moments and/or loss of stability from both incidents would be cumulative, possibly with serious consequences.

3058. If enough speed can be maintained after damage to make the stabilizers effective, they may be used to minimize roll, thus effectively augmenting the inherent ship stability remaining after heel correction and damage control action have been taken.

3059. Effect of Heel and Trim on Fighting Efficiency

Excessive heel from any cause will reduce the fighting efficiency of the ship in a number of ways, of which the following are examples.

a. It is difficult for personnel to get about the ship and carry out their duties properly when the ship is heeled.

b. Heel may restrict the effectiveness of weapons. It also entails increased effort to move any manually trained equipment. Six degrees is about the largest angle of heel at which a ship's armament can be effectively fought.

c. Speed and manoeuvrability are reduced by heel.

d. The efficiency of some machinery, such as fixed pumps which depend for their operation on the maintenance of a steady liquid level, is reduced if the ship is much heeled.

3060. For information on the effects of heel on the operation of aircraft and helicopters refer to BR 766 - Aircraft Operating Handbook.

3061. Trim does not have any appreciable effect on fighting efficiency or stability unless it is so large that the freeboard at the low end is reduced to the point where the seaworthiness of the ship is endangered, or the forecastle or quarterdeck is under water.

3062. Stability Information

All ships are supplied with the following stability information:

a. Stability statement.

b. Curves of statical stability (GZ curves).

c. Hydrostatic particulars.

3063. All RN surface ships and RFAs have an NBCD Class Book (CB 4538 Series), which contains much useful information, including stability characteristics and also various examples of flooding with the resulting stability conditions. Some ships are issued with a Ship Stability and Survivability Book in the CB 9500 Series.

3064. Stability Statement

This gives draught, metacentric height, angle of maximum stability and range, usually in the light, average action and deep conditions (or deep, light seagoing and light harbour conditions), which are defined in the statement. Details of any fixed ballast and instructions on working of fuel may also be given.

3065. Curves of Statical Stability

These, generally called 'GZ curves', are usually given for the same conditions of loading as the stability statement. They show the length of the righting lever at all angles of heel, up to the angle at which the ship loses all transverse stability in the particular condition, and indicate the angle at which the deck edge will be immersed and the angle at which the righting lever is greatest.

3066. Hydrostatic Particulars

These are tables which give, for different draughts over a wide range, the designed stability characteristics of the ship, including displacement, tonnes per centimetre immersion, moment to change trim one centimetre, height of transverse and longitudinal metacentres, and fore-and-aft position of the centre of flotation.

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CHAPTER 31

STABILITY OF THE INTACT SHIP

CONTENTS

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CHAPTER 31

STABILITY OF THE INTACT SHIP

3101. Determination of Stability Characteristics
Two things determine the stability characteristics of a ship:

a. The geometry of the underwater form of the hull.

b. The loading of the ship.

Of these, the former is determined by the Naval Architect and can not be altered by the operator. This information is provided by means of hydrostatic data. The latter is planned by the Naval Architect, however its control is the predominate concern of the operator both on a daily and longer term basis.

3102. To fully understand the implications of the operator's actions on the stability of the ship it is first important to appreciate the mechanics and principles of ship stability.

3103. Forces Operating
When a ship is floating in water there are three forces operating on the structure.

a. The total weight of all the constituent parts of the ship and contents, which exerts a force vertically downwards through the centre of gravity.

b. The buoyancy force created by the underwater form of the hull displacing water, which exerts a force vertically upwards through the centre of buoyancy.

c. Other forces which cause the ship to move as a result of their action, such as propulsive forces, resistance, wind, waves and changes in loading.

The primary concern of ship stability is to ensure that the first two forces act together in such a way as to provide a stable platform that can cope with the last group of forces without capsize.

3104. Buoyancy
Archimedes' Principle states that:

A body fully or partially immersed in a fluid will experience an upthrust equal to the weight of fluid displaced.

This upthrust is called the *buoyancy force*. In order to calculate the magnitude of this force the Volume Displacement of the ship (∇) and the density of the sea (ρ) must be multiplied to give a value for the Mass Displacement of the ship (Δ).

$$\Delta = \nabla\rho$$

The value of Δ is most easily found from the hydrostatic data for the ship where it is given for various mean draughts (T) in standard seawater of density 1.025 tonnes/m^3. The buoyancy force, which is equal to Δ, will act vertically up through the centre of buoyancy (B) which is the centroid of the underwater volume of the hull. Again its position is provided in the ship's hydrostatic data for different values of T and expressed as a distance (KB) above the ship's keel (K). The buoyant volume of a ship is the volume of the entire watertight part of the hull. That part of the buoyant volume above the waterline is called the *reserve of buoyancy*.

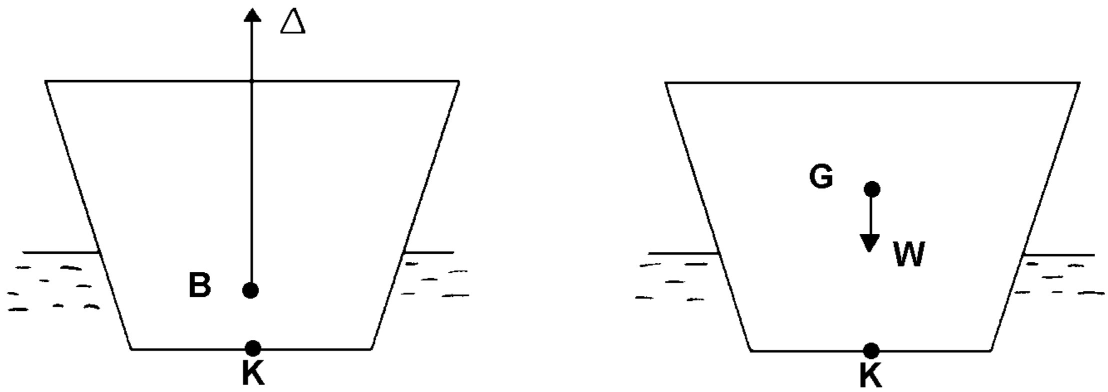

Fig 31-1. Buoyancy and Weight

3105. Weight

The weight (W) of a ship is difficult to measure due to the size of the structure. It is possible to calculate this during the design stage by summing all the individual components but this is impractical for the operator. Instead, finding the total weight relies on the condition of equilibrium the ship adopts when it is freely floating. The weight of the ship acts vertically down through the centre of gravity (G) which again is difficult to find as it depends on the position and weight of all the individual components of the ship. The position of G is found by conducting an Inclining Experiment, the results of which are provided to the operator in the form of the Stability Statement whereby its vertical distance (KG) above the keel (K) is stated for various standard loading conditions. Alterations to these standard conditions to find the position of G for specific loading conditions are relatively simple.

3106. Standard Loading Conditions

Generally ships have three standard loading conditions:

a. **Deep Condition.** The ship is in all respects complete; fully complemented, ammunitioned, fuelled, stored and provisioned.

b. **Light Seagoing Condition.** The lightest condition of a ship at sea including any liquid loading restrictions required to meet the minimum stability criteria.

c. **Light Harbour Condition.** The lightest condition of a ship in harbour including any liquid loading restrictions required to meet the minimum stability criteria.

3107. Equilibrium

Under normal circumstances a surface ship would be in a condition whereby it will sink until such time as it reaches a draught great enough to provide an underwater volume displacing enough weight of water to produce a buoyancy force equal to the weight of the ship. Generally this is expressed by describing both the weight of the ship and the buoyancy force produced as being equal to the *Mass Displacement* of the ship (Δ). Although mass displacement is measured in tonnes it is treated as a force; neglecting the gravitational constant in all further expressions.

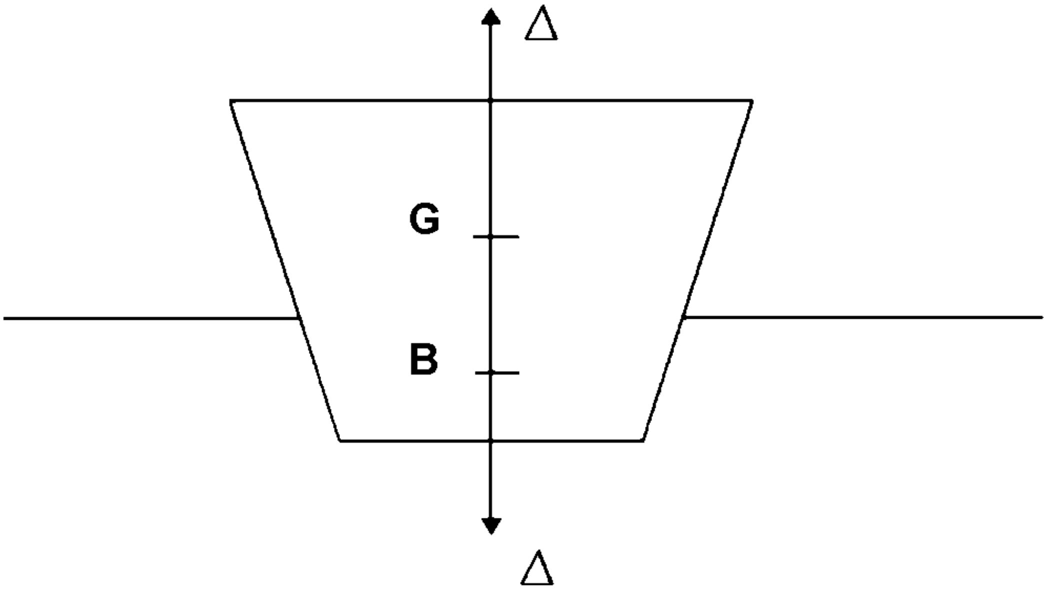

Fig 31-2. Equilibrium

3108. Addition of Weight

The Centre of Flotation (CF) is the centroid of the waterplane at which the ship is currently floating, the ship will trim and heel about this point, which is generally on the centreline and abaft midships. If a weight (w) is added to the ship so that its centre of gravity (g) is above CF, so that there is no heeling or trimming moment, the ship will sink until the increase in draught produces an increase in volume displacement, producing and additional buoyancy force equal to the added weight. An increase of draught in this way, where there is no heeling or trimming moment induced, is called *Parallel Sinkage(s)*.

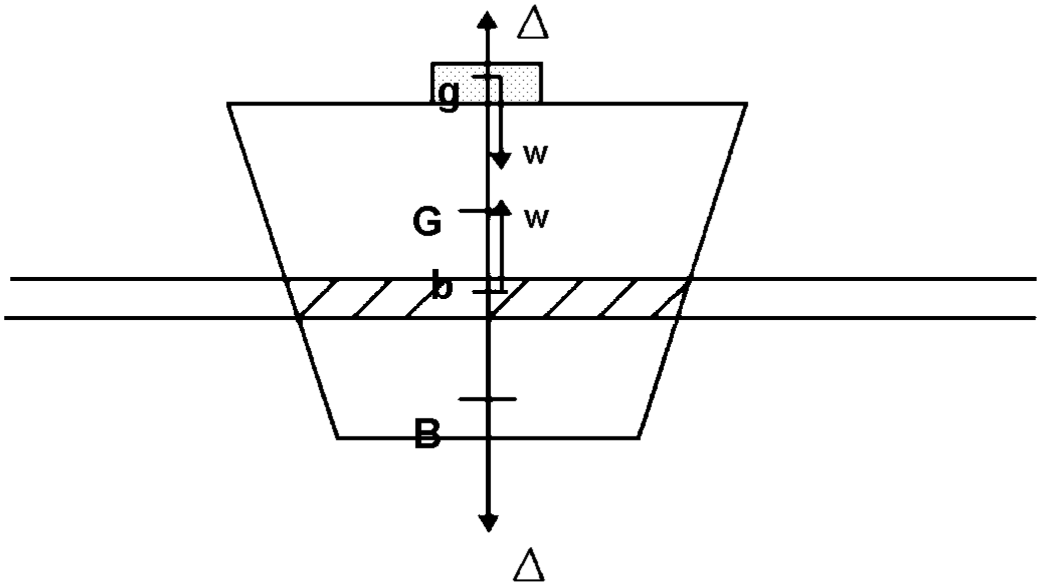

Fig 31-3. Addition of Weight

It can be seen from Fig 31-3 that the buoyancy force created by the additional layer of displaced volume acts through a point b and must be equal to the added weight, w.

3109. Tonnes Per Centimetre Immersion (TPC)

For reasonably small additions of weight warships can be assumed to be wall-sided (having vertical side plating). This assumption allows the calculation of parallel sinkage produced by a known addition of weight to be greatly simplified. The weight (in tonnes) required to sink the ship by 1cm can be found and plotted against the original draught of the ship, this figure is known as the *Tonnes Per Centimetre Immersion (TPC)*, and is presented in the ship's hydrostatic data for values of mean draught.

3110. Given that the TPC for the original draught of the ship is known, the parallel sinkage (s) caused by any addition of weight (W) can be calculated such that:

$$s = \frac{w}{TPC} \text{ (cm)}$$

Particular care should be taken using this expression for large additions of weight, especially where the value for TPC changes considerably in the area of the parallel sinkage. In this case it is prudent to calculate the parallel sinkage using both the TPC at the original draught and the TPC at the new draught and averaging them.

3111. Movement of Centres of Buoyancy and Gravity due to Changes in Loading

An alteration to the loading of the ship will effect the positions of B and G:

a. B will always move upwards due to the addition of weight, ie towards the centroid of the new slice of displaced volume (b).

b. G will always move towards the centre of gravity of the added weight (g). The opposite is true if the weight is removed.

The new positions of the centre of buoyancy (B_1) and gravity (G_1) can be found by taking 1st moments, multiplying the force by its lever arm, about the keel and dividing by the total mass displacement.

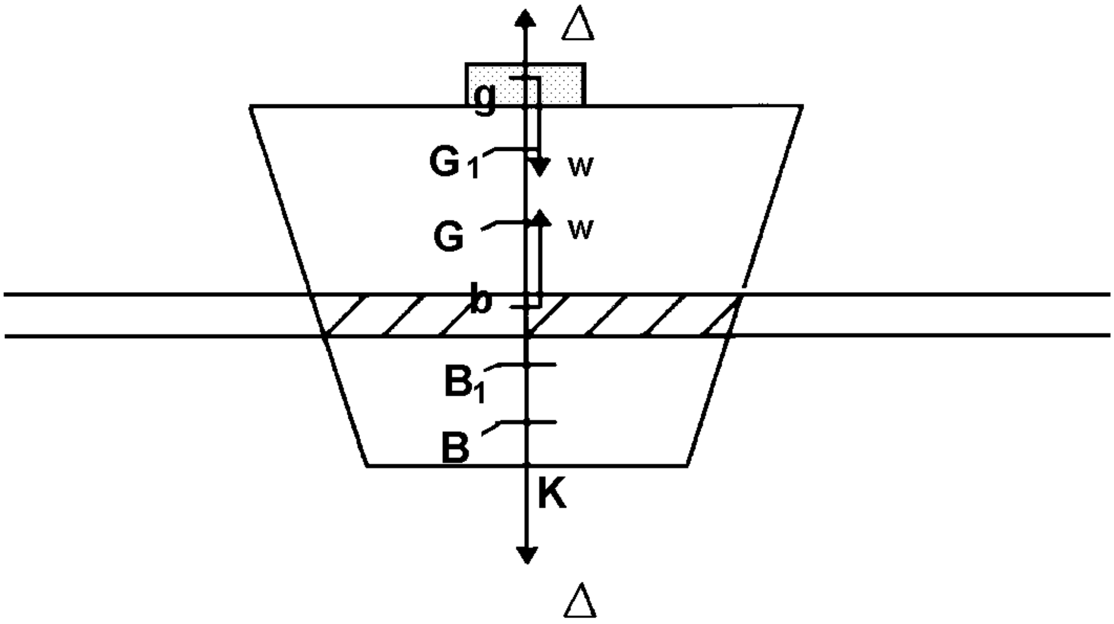

Fig 31-4. Movement of Centres of Buoyance (B) and Gravity (G)

$$KB_1 = \frac{KB.\Delta + Kb.w}{\Delta + w}$$

where: $Kb = T + 0.5 \times s$

T = original draught

s = parallel sinkage

$$KG_1 = \frac{KG.\Delta + Kg.w}{\Delta + w}$$

3112. Reserve of Buoyancy

When a surface ship is floating some of its hull is normally above the surface of the sea. If a weight is added the ship will sink further into the sea so that Δ increases. Weight could continue to be added to the ship until such time as its uppermost watertight deck is underwater whereafter it would sink. The portion of the ship's watertight hull above the waterline is known as the *Reserve of Buoyancy*, and is expressed as a proportion or percentage of the immersed volume. The reserve of buoyancy of a surface warship is of the order of 100% or more and therefore loss of ships by bodily sinking is very unusual.

3113. Transverse Stability

When a ship heels over due to an internal movement of weight or as a reaction to an external force there is no increase in the weight of the ship and hence no increase in Δ. So long as none of the weights making up the total weight of the ship move, ie the ship is secured for sea, G will not move, irrespective of the angle of heel. The weight of the ship, equal to Δ will continue to act vertically down through G. The position of B, however, depends on the shape of the underwater volume of the ship and will move as the ship heels over. As the ship heels over a wedge of additional buoyancy is formed on the lower side and a corresponding wedge emerges from the other side to keep the buoyancy force the same. These wedges have their own centroids and by taking moments it can be seen that the ship's centre of buoyancy will move towards the Immersed Wedge (Fig 31-5).

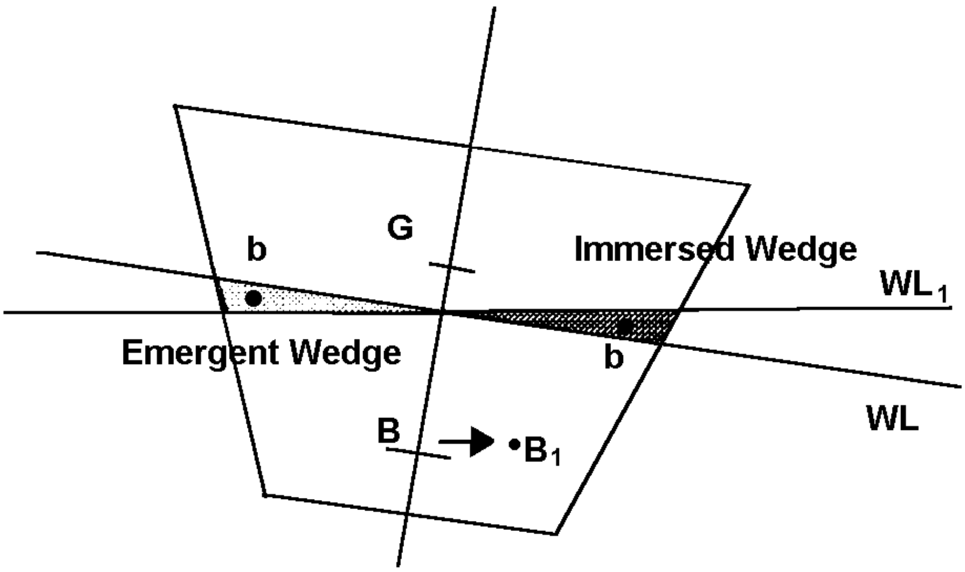

Fig 31-5. Movement of Centre of Buoyancy (B)

The buoyancy force (Δ) continues to act vertically upwards through the centre of buoyancy which has a new position B_1, but now buoyancy and weight forces are separated and under normal circumstances will attempt to return the ship to the upright position.

3114. Metacentre

The point at which the line of action of the buoyancy force intersects the original vertical centreline of the ship is known as the *Metacentre (M)*, as shown in Fig 31-6. The buoyancy force and the weight under these circumstances continue to be equal to the mass displacement of the ship, as no weight has been added, but now act as a moment couple which will try to bring the ship upright.

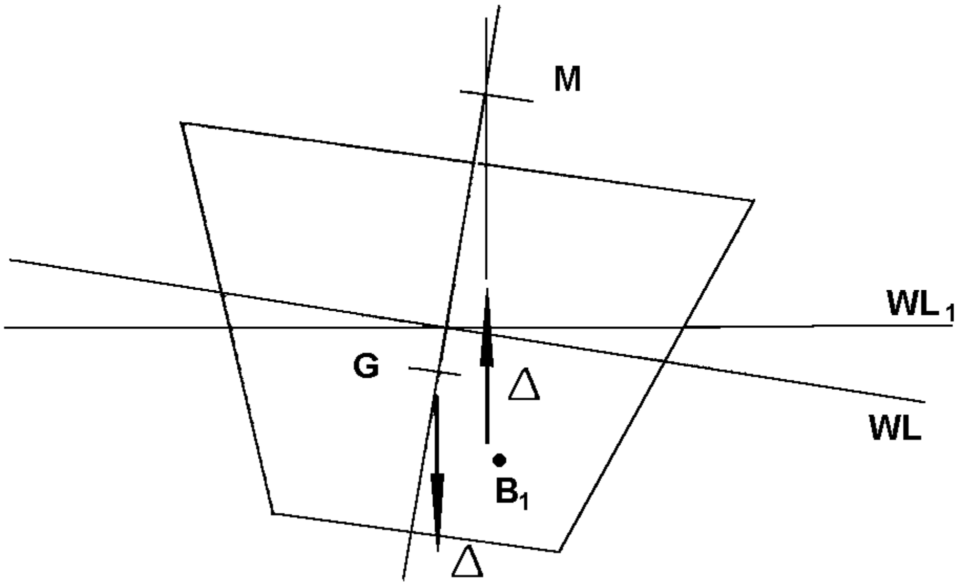

Fig 31-6. Metacentre (M)

It can therefore be seen that the ability of the ship to return itself to the upright position is dependant on this moment couple, formed by the movement of the centre of buoyancy, being positive. This moment couple will remain positive whilst the metacentre is above the centre of gravity. The position of M can be found from the ship's hydrostatic data at various mean draughts, as a distance (KM) from the keel of the ship.

3115. Righting Moment

By taking moments about the keel (Fig 31-7) it can be seen that the moment acting to return the ship to the upright position is given by:

Righting Moment = GZ x Δ

now: $GZ = GM \sin\varphi$

so: Righting Moment = $\Delta GM\sin\varphi$

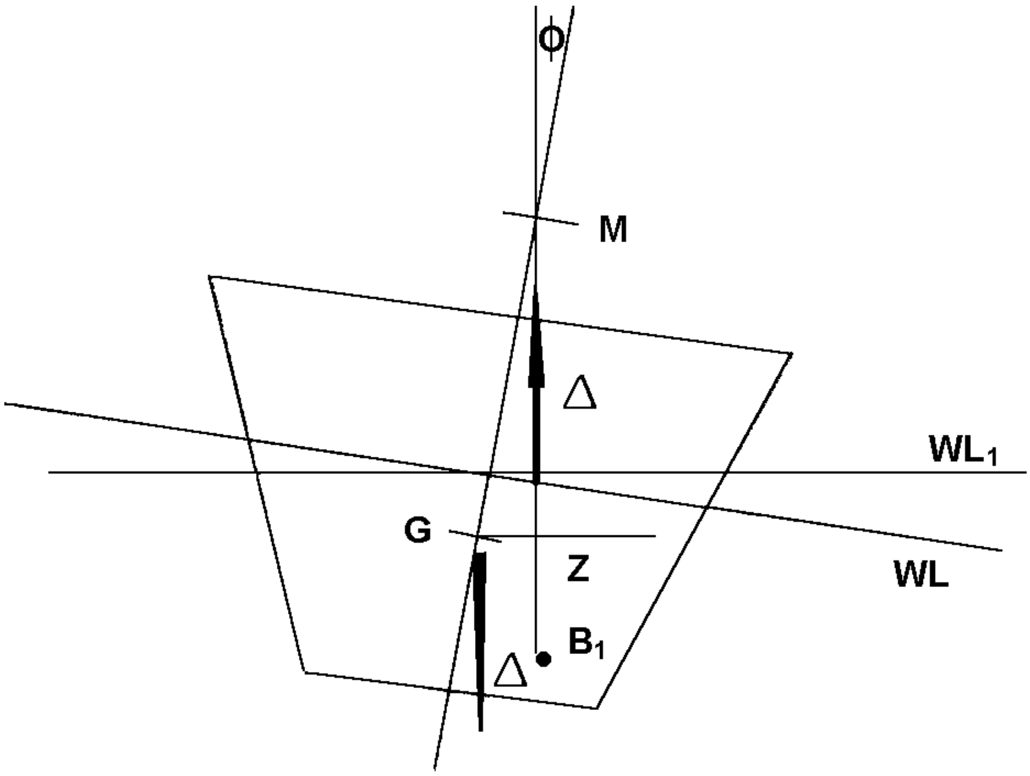

Fig 31-7. Righting Moment

The distance GM therefore provides a measurement of the stability of the ship. It is known as the *Metacentric Height*.

3116. Metacentric Height

By examination of the metacentric height and Fig 31-7 it can be seen that three states of stability exist.

a. **Positive Stability.** If the metacentric height is positive the ship will be stable.

b. **Neutral Stability.** If the metacentric height reduces to zero, ie G and M coincide then the ship becomes neutrally stable.

c. **Negative Stability.** If the metacentric height is negative then the ship is negatively stable and will tend to heel to a greater angle.

The size of the metacentric height also indicates the amount of stability a ship possesses; a large positive metacentric height will provide a large righting lever and consequently the ship will be very stable. Conversely a small metacentric height will provide a small righting lever and the ship will be less stable. A ship with a large metacentric height is said to be *stiff* and one with a small metacentric height is known as *tender*.

3117. The metacentric height of a ship depends on two things:

a. The position of G.

b. The position of M.

The position of G is found by adjusting the value for KG given in the Stability Statement for a standard loading condition, by using the equation at Para 3111 for movements of weights away from this standard condition. The complete method is provided at Para 3130. The position of M is dependant on the position of B as it moves with the angle of heel. The distance of M above B relies on the volume displacement of the ship and the second moment of area of the waterplane of the ship. Calculation of this second moment of area is time consuming and impractical for the operator requiring quick answers to concerns over the ship's stability. It is enough to appreciate that the dominant factor in producing a high position for M and thus generally increasing GM is the breadth of the ship and is thus outside the control of the operator. In practice the position of M when the ship is in an upright condition is gained by reference to the ship's hydrostatic data for the draught at which the ship is floating. The metacentric height can therefore be found as:

$$GM = KM - KG$$

3118. Stability at Small Angles of Heel

The movement of the centre of buoyancy as the ship heels over is dependent on the shape of the underwater form of the ship and this in turn determines the position of the metacentre and hence the magnitude of the metacentric height. The shape of the ship's hull as it heels is not regular and so B cannot be generally expected to move in a regular pattern therefore the position of M will change with heel angle. However, the shape of a ship can be thought of as regular for angles up to 10°, therefore the position of M can be assumed to be fixed for angles of heel within this range. The metacentric height found for the ship in an upright position in Para 3117 can therefore be used for all angles of heel up to 10°.

3119. Finding the Angle of Heel for Small Movements of Weight

The heeling moment acting as a ship caused by the horizontal movement of a weight is given by:

$$\text{Heeling Moment} = wd\cos\varphi$$

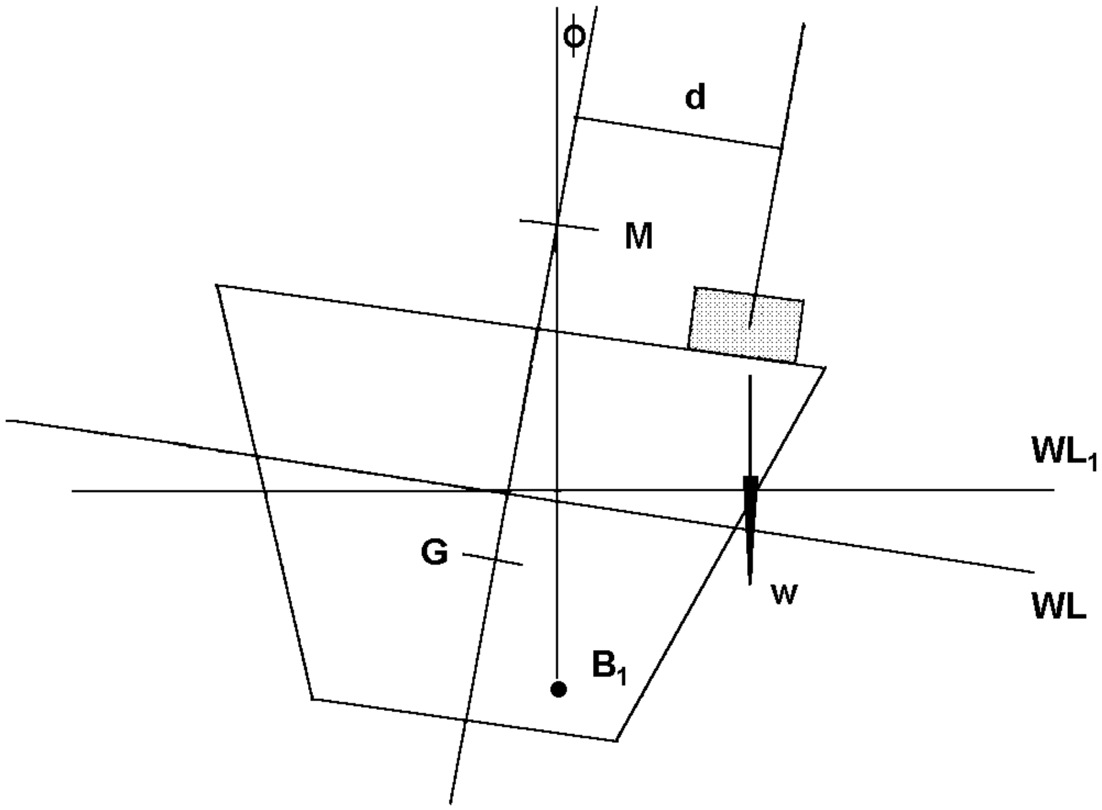

Fig 31-8. Angle of Heel for Small Movement of Weight

Therefore, to find the angle of heel the heeling and righting moments can be equated to give:

Heeling Moment	=	Righting Moment
$wd\cos\varphi$	=	$\Delta GM\sin\varphi$

$$\text{so} \quad \tan\phi = \frac{wd}{\Delta GM}$$

This equation can now be solved by assuming that GM remains constant for angles of heel up to 10°.

3120. Free Surface Effects

Liquid in any compartment, anywhere in the ship, which does not entirely fill the compartment has an adverse effect on the stability of the ship. Such liquid is said to have free surface. As the ship heels, the centre of gravity of the liquid shifts to the low (inclined) side. The result of this can be viewed as either an increasing heeling moment, or a reduction in the righting lever. In practice we normally regard the effect as equivalent to raising the centre of gravity, which has the effect of reducing the metacentric height and hence the righting lever. It can be shown that for small angles of heel the reduction in GM is given by:

$$\text{Loss of GM} = \frac{i\rho_1}{\nabla\rho_s}$$

where: i = the second moment of area of the liquid surface area about a principal axis parallel to the axis of rotation of the ship.
ρ_l = the density of the liquid concerned.
ρ_s = the density of the sea water.
∇ = the volume displacement of the ship.

The righting lever for the ship can now be assumed to be dependent on this reduced GM, often termed the GM_{fluid} which is given by:

$$GM_{fluid} = GM - \text{loss in GM}$$

Calculation of the second moment of area for an irregular shape is time consuming. However many compartments in a ship are rectangular or close to being so and the second moment of area of a rectangle length a (longitudinally) and breadth b (transversely), is:

$$i = ab^3/12$$

3121. This loss of initial stability is entirely dependant on the Second Moment of Area of the free surface, and in particular the breadth. The depth, volume or weight of liquid present play no part in the formula. Also the loss of GM occurs irrespective of the position of the free surface in the ship. However the position of G is also affected by weight: low down the weight serves as ballast; high up is to topweight, and to port or starboard it is off-centre weight. It can be seen that the worst combination is of a free surfaced liquid high up in a ship causing loss of GM by topweight and free surface effect. This rise in the G can quickly result in a state of loll with the associated loss in stability and requires rapid and correct reactions to be taken to avoid putting the ship in danger of capsize. High free surface effects can easily be caused by water used in firefighting and boundary cooling, many ships have capsized because firefighting water was not pumped out, drained overboard, or drained down. The free surface can rapidly become more dangerous than the fire itself. If the free surface cannot be removed, every effort should be made to divide its breadth. The division need not even be completely watertight to be effective, and mess tables on edge can be most successful. Dividing the compartment into two units of equal breadth reduces the loss in GM by four (division by three would reduce loss by nine, and so on). Conversely, if a free surface area is doubled in breadth, the loss in GM becomes eight times as great. The complete method for assessing stability with a free surface effect is given at Para 3131.

3122. Stability at Larger Angles of Heel

Fundamentally the mechanics involved with stability at larger angles of heel are identical to those previously discussed with the exception that GM can no longer be assumed to remain constant. It was shown in Para 3115 that:

$$\text{Righting Moment} = \Delta GZ$$

This equation still holds for all angles larger than 10° but now account must be taken of the changing underwater form of the hull, which will change the magnitude of GZ for different angles of heel; the metacentre can no longer be thought to be stationary. Determination of the magnitude of GZ involves complicated calculations far beyond the abilities of the average operator. To this end values of GZ are provided for the ship in the form of a *Curve of Statical Stability*.

3123. Curves of Statical Stability

Curves of Statical Stability are provided to the ship as part of the Stability Statement. Normally three curves are presented, one each for the standard loading conditions. The curve shows the value of the righting lever for angles of heel throughout the range of stability of the ship; the righting moment at any angle of heel can therefore be found by multiplying GZ by Δ. The GZ curve for a conventional ship in a normal condition will appear as shown in Fig 31-9.

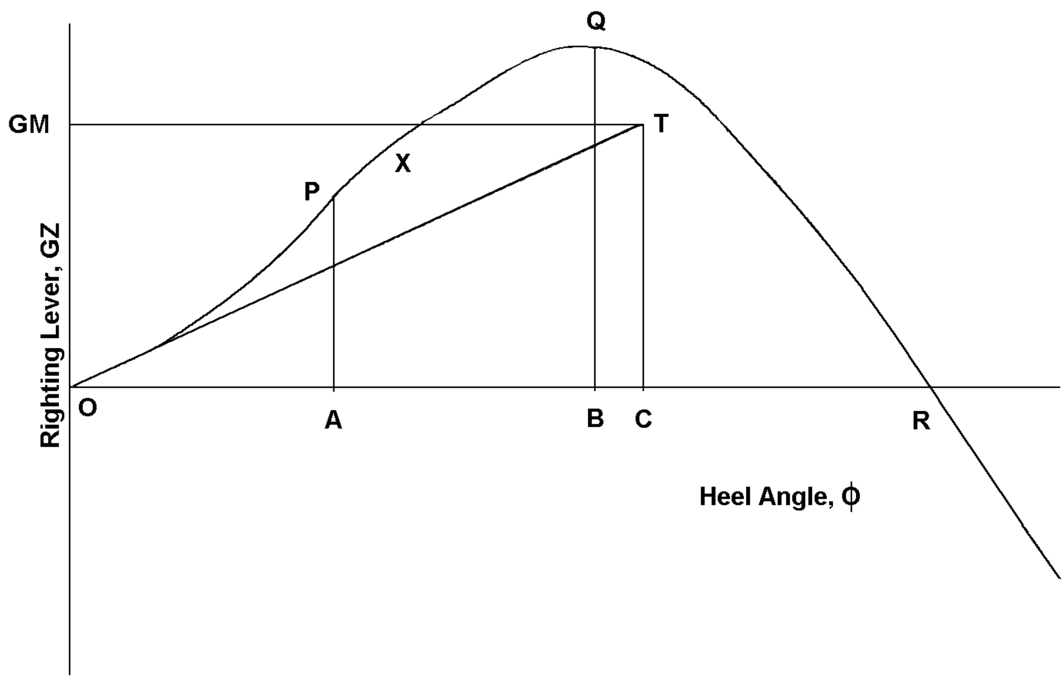

Fig 31-9. Curve of Statical Stability

Several points and lines have been marked on this figure. They have the following significance:

a. At any angle of heel OA, the ship has a right moment of ΔxPA. It requires a steady inclining moment, such as wind pressure or an off-centre weight, of this magnitude to hold her over at this angle.

b. At small angles of heel, the righting lever depends on the metacentric height. This is confirmed in the diagram by the coincidence of the tangent to the curve at the origin 0, and the curve for a few degrees of heel.

c. As the angle of heel increases (about say 10°), the curve shows positive curvature, ie the steepness of the curve increases. At the point X the curvature changes and the steepness decreases. The point of inflexion at X reflects the immersion of the edge of the main weatherdeck.

d. As the heel increases further, the curve becomes horizontal at the angle B of maximum lever Q.

e. Thereafter the curve descends, at first with increasing steepness, then more steadily. It crosses the base line at a point R called the point of vanishing stability, at which there is no righting lever, and beyond which a capsizing lever is set up. This point defines the range of stability of the ship for her particular condition of loading and the angle OR is generally known as the range.

f. Since the greatest righting moment that the ship can exert is ΔxQB, corresponding to the maximum lever QB, it follows that this is the greatest steady upsetting moment which she can resist. The angle of maximum righting lever, therefore is the greatest angle of steady heel the ship can take up without capsizing when inclined by a steady heeling moment.

Some of these points on the curve, particularly at higher angles of heel, are somewhat academic as the point at which non-watertight openings are immersed represents a more realistic range of stability for the ship. Generally the non-watertight openings of most concern are the engine downtakes and their angle of immersion will be marked on the GZ curve provided to the ship. Angles of heel past this angle will usually result in unrestricted flooding of large compartments of the ship therefore seriously compromising the stability of the ship.

3124. Adjustment of the GZ Curve for Loading Conditions

It should be appreciated that the value of GZ presented on the curve is dependent on the position of the centre of gravity, this is why the curves are provided for the three standard loading conditions. In practice a ship is unlikely to be operating at a standard loading condition and so alterations have to be made to the curves to ascertain the true behaviour of the ship.

3125. Horizontal Movement of Weights

The movement of any weight which constitutes a part of the whole displacement of a ship in a horizontal direction will cause G to move in the same direction. By taking moments about original centre of gravity (G) the distance to the new centre of gravity (G_1) can be found such that:

$$GG_1 = \frac{wd}{\Delta}$$

By referring to Fig 31-10, below, it can be seen that this movement of G will have an effect on the righting lever so that:

$$G_1Z_1 = GZ - GG_1\cos\varphi$$

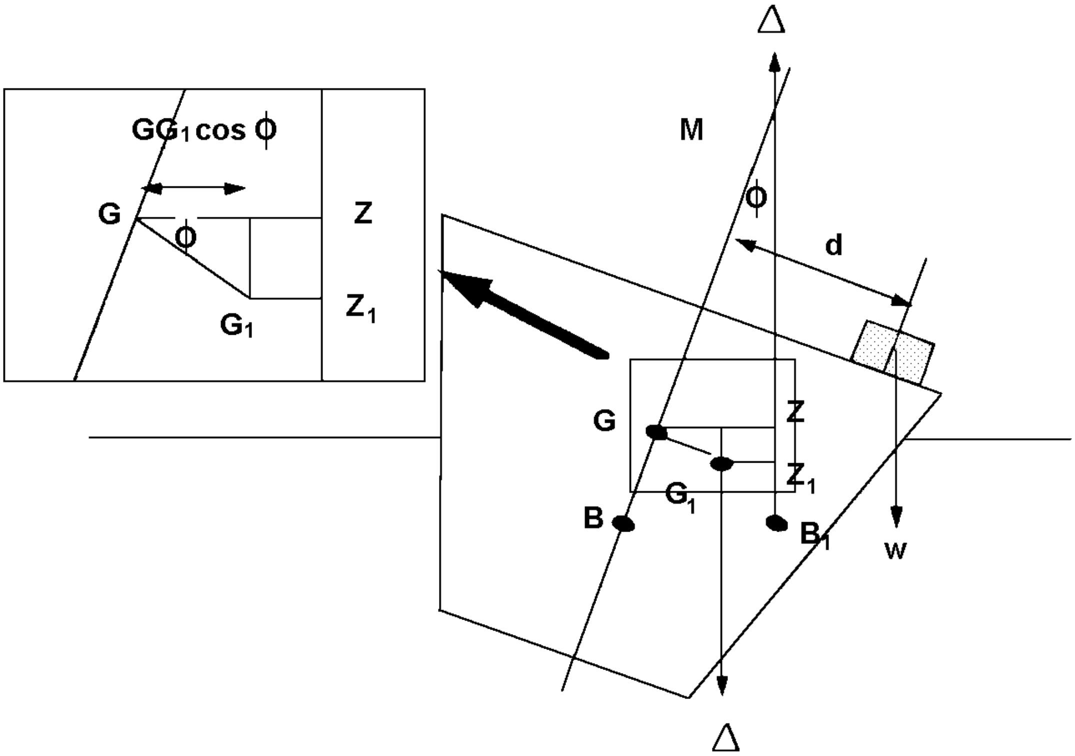

Fig 31-10. Horizontal Movement of Weight

Consequently the modified GZ curve over the range of heel angles can be redrawn by subtracting the curve $GG_1\cos\varphi$ from the original GZ curve. The resulting GZ curve is shown as the 'net righting lever' in Fig 31-11.

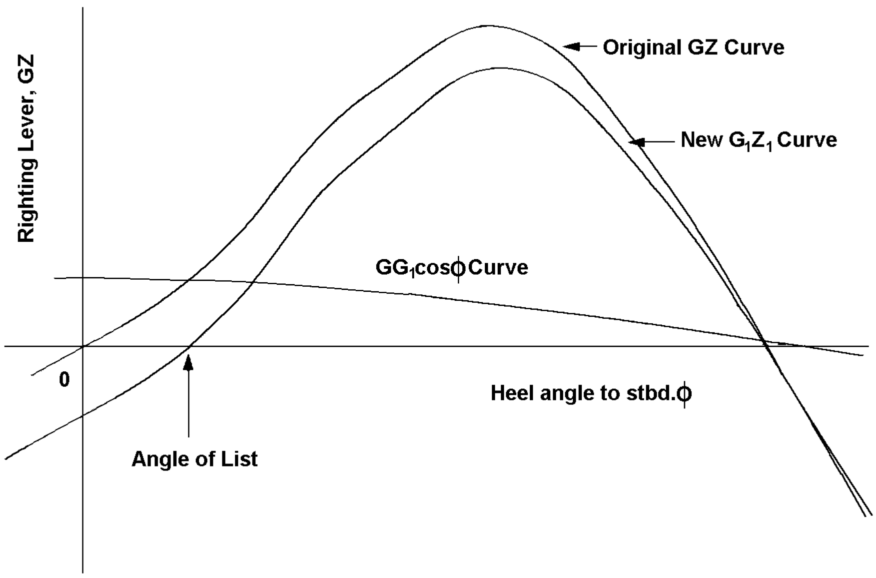

Fig 31-11. Net Righting Lever

The movement of the ship's centre of gravity away from the centreline will result in the weight force and buoyancy force not being collinear, they will not, therefore, be in equilibrium and the ship will heel over until the two points are aligned vertically. The angle of heel will be steady and, so long as the metacentre remains above the centre of gravity, the ship will be stable. This condition of heel is known as *List*, and can be found as the intersection of the net righting lever curve with the x-axis on the curve in Fig 31-11.

3126. Vertical Movement of Weights

The movement of any weight which constitutes a part of the whole displacement of a ship in a vertical direction will cause G to move in the same direction. By taking moments about the original centre of gravity (G) the distance to the new centre of gravity (G_1) can be found, such that:

$$GG_1 = \frac{wd}{\Delta}$$

By referring to Fig 31-12, below, it can be seen that this movement of G will have an effect on the righting lever so that:

$$G_1Z_1 = GZ - GG_1\sin\varphi$$

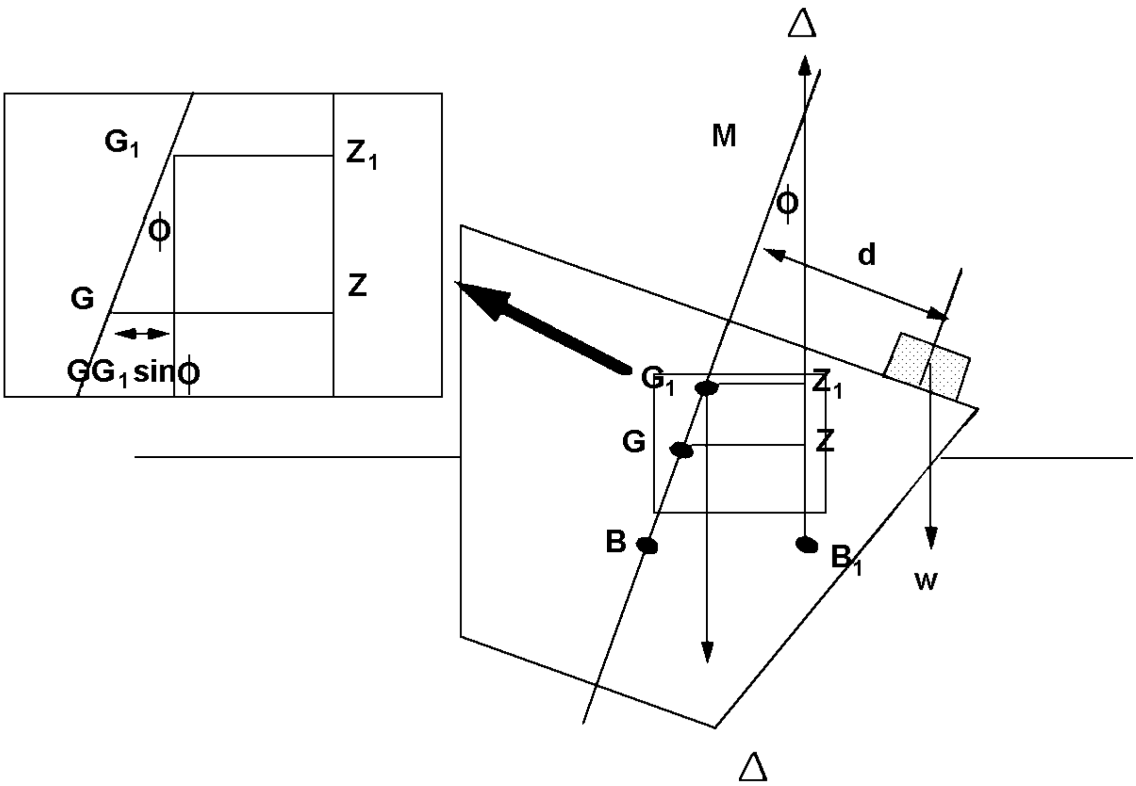

Fig 31-12. Effect of Vertical Movement of Weight

Consequently the modified GZ curve can be drawn over the range of heel angles by subtracting the curve $GG_1 \sin\varphi$ from the original GZ curve. The resulting GZ curve is shown as the 'net righting lever' in Fig 31-13.

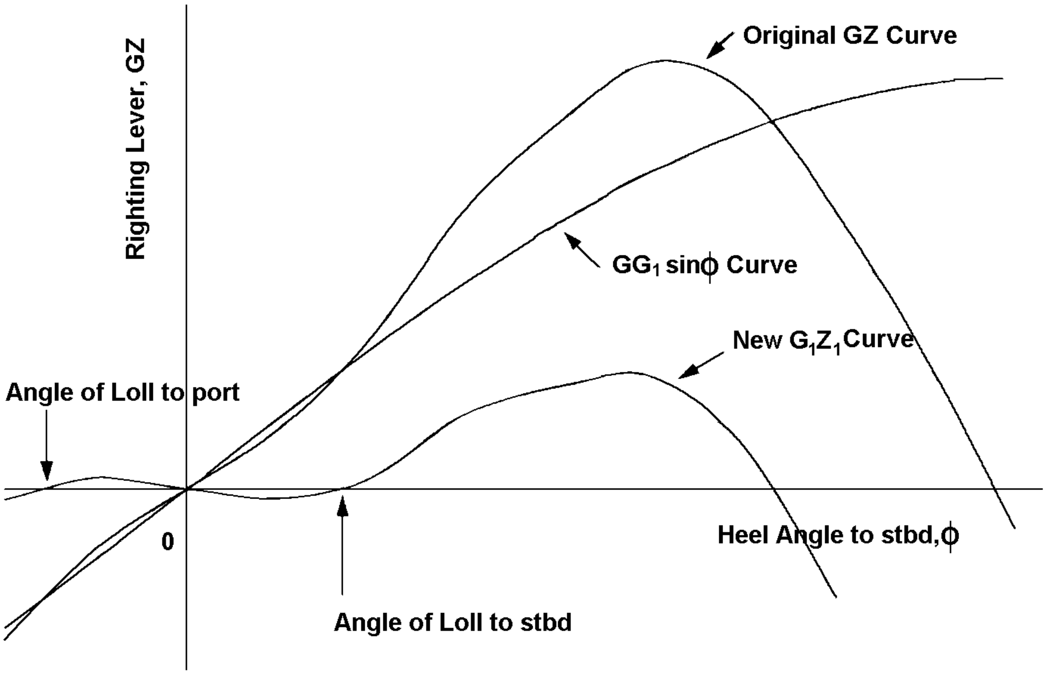

Fig 31-13. Effect of Rise of G

The general effect of the centre of gravity rising in the ship is to reduce the maximum righting lever and range of stability of the ship. However, an interesting case occurs when GG_1 is sufficiently large to take G above M, so that in the upright condition GM is negative. Rather than causing the ship to capsize, which might be expected, depending on the precise hull shape of the ship and the magnitude of the negative GM, a real situation can be reached where the ship will lurch to one side but recover a measure of stability. This is illustrated in Fig 31-13. The angle of heel is known as the angle of *Loll*. While the diagram shows that because of the nature of the GZ curve, the ship should loll to either side, in practice she would have a slight preference to one side (slightly off-centre G, wind direction, etc). Having lolled over to one side a further heeling moment in that direction will be met by a righting lever which rises to a maximum and then tails off to the angle of vanishing stability. The same is not true in the reverse direction; if from an angle of loll a moment is applied to bring the ship upright, this will initially be met with a moment trying to restore the angle of loll. A point is reached before she becomes upright where this restoring moment reaches a maximum and the ship will then lurch through the upright and over to the angle of loll on the other side plus a further heel angle brought about by the moment which has been applied. When a ship is in a state of loll, her GZ curve will have become relatively flat, and consequently the effects of this additional moment could be catastrophic. Loll is a very dangerous situation and to be avoided at all costs and if encountered reacted to rapidly. The method for calculating the GZ curve for a more general movement of weight in both a horizontal and vertical direction is given at Para 3130.

3127. Causes of and Reactions to List and Loll

a. List is caused by an upsetting moment which causes a heeling moment, such as:

(1) An off centre weight.

(2) Any other external force causing an upsetting moment.

b. In order to correct an angle of list:

(1) Remove the off centre weight or moment.

(2) Counter balance the off centre weight or moment with an equal and opposite one.

c. A state of loll is caused by a high centre of gravity. This may be due to one of three causes:

(1) Excessive weight high up, eg flood water in the superstructure, unusual loading.

(2) Insufficient weight low down, eg fuel, other liquids run down too far.

(3) Free surface effects.

d. The correct response is to take measures to:

(1) Reduce topweight.

(2) Increase weight low down.

(3) Reduce free surface effects.

3128. Longitudinal Stability

The mechanics involved in longitudinal stability are fundamentally the same as for transverse stability. However there are several differences which should be noted:

a. The second moment of area of the waterplane is far greater longitudinally than transversely. Consequently the height of the longitudinal metacentre is far greater than the transverse metacentre; in fact approximately 100 times as large.

b. Unlike the transverse case, where the ship is symmetrical about the middle line, there is no axis of symmetry longitudinally and it is necessary to take account of the longitudinal position of the Centre of Flotation, LCF.

c. Angles of trim are generally much smaller than those of heel therefore trim is normally described in terms of the difference between the draughts at the perpendiculars and measured in metres.

In looking at the longitudinal stability of a ship, the main concern is in controlling trim because although the ship is extremely 'stiff' longitudinally, it is exposed to much greater moments, due to the large lever arms, when transferring weights fore and aft rather than athwartships. As a consequence of the longitudinal metacentric height being so large the effect of vertical movements of the centre of gravity are insignificant, therefore allowing the assumption that it is constant at each draught. By considering the balance of righting moment and trimming moment in the longitudinal case a simplified formula can be found giving the trimming moment required to cause a change of trim of 1m between the perpendiculars (BP), such that:

$$\text{Moment to Change Trim 1m BP} = \Delta GM_1 \left(\frac{1}{L_{BP}}\right)$$

Note. *The accepted convention is to calculate Change of Trim in centimetres so:*

$$\text{Moment to Change Trim 1cm BP} = \frac{D \text{ x } GM_L}{100 \text{ x } L_{BP}}$$

This formula, therefore, provides a simple solution comparable to that for TPC for parallel sinkage. The Moment to Change Trim 1cm BP (MCT1cmBP) is dependent wholly on the draught of the ship and is provided in the ship's hydrostatic data. Now given a moment causing the ship to trim the change in trim of the ship between the perpendiculars can be found as:

$$\text{Change in Trim BP} = \frac{\text{trimming moment}}{\text{MCT1cmBP}}$$

Having found the trim change between the perpendiculars the rule of similar triangles can be applied to find the trim change caused at any point along the ship's length by:

$$\text{Change in Trim} = \text{Change in Trim BP x} \left(\frac{\text{(Distance from LCF)}}{L_{BP}}\right)$$

This is particularly useful for calculating the new draught extreme at the propellers for example, or predicting draught mark values. The method for calculating the change in trim at any point along the ship is given at Para 3133.

3129. Stability Methods

The following give clear logical methods for solving common stability problems using the information available to the ship.

3130. Addition of Weight and Daily Stability Assessment

In order to assess the stability of the ship on a daily basis (or after changing the loading condition), thus providing a valid datum point prior to further incidents, it is necessary to find GM and Δ for the actual loading condition.

a. Compare actual loading state (tank states, stores, aircraft etc) with a standard loading condition or known datum point. For this example assume that a weight w_1 has been added Kg_1 above the keel, a weight w_2 has been removed Kg_2 above the keel and a weight w_3 has been moved vertically upwards a distance d_3, compared to the Deep condition.

b. Calculate the actual displacement:

$$\Delta_1 = \Delta_{Deep} + w_1 - w_2$$

c. Find the parallel sinkage caused by the additional weight:

$$s = \frac{w_1 - w_2}{TPC_{Deep}}$$

d. Find the actual draught for Δ_1:

$$T_1 = \frac{T_{Deep} + s}{100}$$

e. Find the metacentre from the hydrostatic data at this draught T_1:

KM_1

f. Calculate the actual position of G:

$$KG_1 = \frac{KG_{Deep} \times \Delta_{Deep} + Kg_1 \times w_1 - Kg_2 \times w_2 + d_3 \times w_3}{\Delta_{Deep} + w_1 - w_2}$$

g. Calculate the metacentric height:

$G_1M_1 = KM_1 - KG_1$

3131. Addition of Liquids

In order to assess the effect of adding a liquid to a ship currently floating at draught T with a centre of gravity KG, both the effect of the added weight and the effect of any free surface must be taken into account:

a. Find the total weight added:

$w = \text{volume x density}$

b. From hydrostatic data find Δ and TPC at the original draught T.

c. Find the parallel sinkage:

$$s = \frac{w}{TPC}$$

d. Find the new draught:

$$T_1 = T + \frac{s}{100}$$

e. At the new draught T_1 find KM_1 from the hydrostatic data.

f. Calculate the movement of the centre of gravity due to the addition of weight:

$$KG_1 = \frac{KG \times \Delta + Kg \times w}{\Delta + w}$$

g. Calculate the metacentric height after the weight is added:

$$GM_{solid} = KM_1 - KG_1$$

h. Take account of the free surface effects reducing the metacentric height assuming a rectangular compartment; length a, breadth b and the seawater in it of standard density:

$$\text{Loss of GM} = \frac{ab^3 \times 1.025}{12 \times \Delta}$$

i. Calculate the effective metacentric height:

$$GM_{fluid} = GM_{solid} - \text{Loss of GM}$$

3132. Adjusting the GZ Curve for Movements of Weight

To find the effect on the stability of the ship over the whole range of heel angles due to a large movement of weight, w, and to determine whether the ship is suffering from list or loll the following method should be used to adjust the GZ curve:

a. Resolve the movement of weight compared to a standard loading condition into horizontal (d_{horz}) and vertical (d_{vert}) movements.

b. Find the movement of G in a vertical direction:

$$GG_1 = \frac{w \times d_{vert}}{\Delta}$$

c. Find the movement of G_1 in a horizontal direction:

$$G_1G_2 = \frac{w \times d_{horz}}{\Delta}$$

d. Select suitable increments from the original GZ curve (eg 10°) and find values for GZ at each of these angles.

e. Calculate the values of $GG_1\sin\varphi$ and $G_1G_2\cos\varphi$ at each of the selected angles above.

f. Subtract $GG_1\sin\varphi$ and $G_1G_2\cos\varphi$ from the original values of GZ at each selected angle of heel to give a value for G_2Z_2:

$$G_2Z_2 = GZ - GG_1\sin\varphi - G_1G_2\cos\varphi$$

g. Replot the curve for G_2Z_2 against angle of heel.

3133. Change in Trim Due to Movement of Weight Longitudinally

To find the change in trim at any point along the ship due to a movement of weight longitudinally:

a. Find LCF and MCT1cmBP from the hydrostatic data for the mean draught of the ship.

b. Calculate the trimming moment, the distance the weight has moved multiplied by its weight; if the weight has been added this is the distance from the LCF.

c. Calculate the change in trim between perpendiculars:

$$\text{trim change BP} = \frac{\text{trimming moment}}{\text{MCT1cmBP}}$$

d. Calculate the trim change at any point:

$$\text{trim change} = \frac{\text{trim change BP x distance from LCF}}{L_{BP}}$$

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CHAPTER 32

STABILITY OF THE DAMAGED SHIP

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CHAPTER 32

STABILITY OF THE DAMAGED SHIP

3201. Complete assessment of a ship's overall stability after damage involves very complicated mathematical calculations, which take a lot of time and are therefore impractical during the immediate period after an incident. The ship's NBCD Class Book provides a number of examples for typical damage which can be consulted to give a quick and sure answer in these circumstances. However, in practice the actual extent of damage is unlikely to conveniently match one of these examples exactly and so a knowledge of how to predict the stability of the ship in situations other than those provided is necessary.

3502. The paragraphs that follow are intended to provide the background knowledge required to carry out calculations to predict stability after damage. It should be remembered that completing these calculations accurately is a lengthy process and requires a large amount of concentration and this should be taken into account before attempting to start them in the noisy environment of HQ1 at State 1. In order to reduce the time required to carry out these calculations and to provide quicker indications of the state of the ship's stability, carpet plots are often provided with the ship's stability information and these are discussed at the end of the chapter.

3203. Estimating Stability after Damage

a. When a ship is damaged to the extent that some length of her is open to the sea, and as far as watertight bulkheads permit, she is flooded to the waterline, there will be resulting sinkage and probably trim and heel. Chapter 31 explained how to carry out some useful calculations for the effects of modest loadings on heel and trim. This is largely possible because under normal loadings the changes in heel and trim can often be assumed to be 'small' and:

(1) Hydrostatics can be assumed unchanged through small angles of heel or trim.

(2) Cross-coupling effects on hydrostatics between heel and trim can be ignored.

When extensive flooding occurs in a ship the effects are often so substantial that these assumptions would give a false analysis.

b. There are two methods by which damage stability may be calculated:

(1) The added weight method.

(2) The lost buoyancy method.

The first method is the more simple and logical method and draws very much on the principles discussed in Chapter 31. The flood water is treated as an added weight and any free surface effects taken account of by an effective reduction in GM. This method is particularly useful for compartments below the waterline which will free flood and present only small free surface effects. The problem with this method is that it involves a lot of iteration if the compartment is large and cuts the waterline of the ship, because the level of water in the compartment will only rise to the waterline and as it does the ship will sink further until an equilibrium is reached. In these circumstances the second method which relies on calculating the loss of buoyancy due to the flood provides a better answer, however, it is a lengthy calculation.

3204. Permeability

If a compartment is filled with water and an attempt to estimate the weight of water within it is made, an allowance must be made for the volume of the compartment that is occupied by such things as fittings, equipment, stores and machinery. This allowance is called the permeability of the compartment as is expressed as a percentage of the gross volume of the compartment. The exact value of permeability will obviously change from compartment to compartment and from day to day and therefore a good approximation is required in order to carry out damage stability calculations. The following figures are given as a guide and adjustments should be made based on ship's knowledge, experience and loading conditions:

Watertight compartments	97%
Accommodation Spaces	95%
Machinery Spaces	85%
Stores	60%

3205. The Added Weight Method

The added weight method is the simplest to understand but can be quite lengthy, particularly if the flood is large, because of the iterations required. It is fundamentally the same as the methods described in Chapter 31 for adding a liquid weight to the ship and involves a parallel sinkage and adjustment to the centre of gravity and metacentre and then an allowance for free surface effects. The method is as follows, refer to Chapter 31 for further explanation.

a. Estimate the volume of water in the compartment to the waterline. An allowance should be made for permeability (the percentage of the compartment not occupied by fittings, equipments, stores, etc). For this the added weight of flood water can be estimated.

b. Knowing the added weight calculate the parallel sinkage, using TPC for hydrostatic data at the original draught.

c. From the new draught a second iteration can then be made of the weight of flood water up to this level (it will be more than the first iteration), and again the parallel sinkage calculated and the new draught found.

d. At this new draught find the position of the metacentre (KM_1) from the hydrostatic data and calculate the new position of the centre of gravity (KG_1).

e. The metacentric height can then be calculated as if the flood water was a solid weight:

$$GM = KM_1 - KG_1$$

f. Now make an adjustment to the GM for any free surface effects, assuming the compartment is rectangular:

$$GM_{fluid} = GM - \frac{ab^3 \times 1.025}{(12 \times \Delta)}$$

g. It is quite possible under severe cases of damage that the GM will become negative and the ship will loll. Because the ship side is free flooding, as the ship rolls there is likely to be a change in the weight of flood water and so further iterations will be required.

Ultimately an accurate result can be obtained by this method. In spite of the tedium of the iterations required it has its merit in that at each iteration an accurate assessment of the changing weight of flood water can be made, in particular allowing for watertight decks overhead which may be able to restrict flooding vertically.

3206. The Lost Buoyancy Method

a. The alternative approach is to consider that as a result of damage the volume of the hull and area of the waterplane which contribute to the buoyancy and hydrostatics of the ship have been modified. The method involves transferring the buoyancy previously provided by the new flooded compartment to a new layer of buoyancy above the original waterline and reducing the waterplane area. These have the effects of:

(1) Altering transverse and longitudinal GMs.

(2) Sinking the ship lower in the water.

(3) Heeling the ship.

(4) Trimming the ship.

b. The analysis of the results of damage can be calculated in three distinct stages:

(1) Estimate sinkage.

(2) Estimate damaged transverse metacentre and heel.

(3) Estimate damaged longitudinal metacentre and trim.

3207. Sinkage

a. As with the added weight method, first an estimate of the weight of flood water must be made, this is also the loss of buoyancy (w), also the position and the size of the compartment must be estimated.

b. Estimate the area of the waterplane lost by assuming the compartment is a rectangle (length a, breadth b):

Lost WPA = a x b

c. Find the remaining TPC from the formula which transforms the lost WPA to a weight of sea water 1cm thick:

$$\text{Remaining TPC} = \text{TPC} - \frac{\text{lost WPA}}{97.5}$$

d. Calculate the parallel sinkage (s) in cm:

$$s = \frac{w}{\text{remaining TPC}}$$

3208. Heel

a. Estimate the shift of the centre of flotation off the centreline caused by the loss of waterplane area:

$$FF_1 = \frac{a \times fF}{A - a}$$

where:

where:	A	=	original WPA (TPC x 97.5)
	a	=	lost WPA (a x b)
	fF	=	distance from the centreline of the middle of the flooded compartment.

b. Calculate the second moment of area of the lost waterplane area from the fore and aft axis through the new centre of flotation. For a rectangular compartment (length a, breadth b) a distance d from the new centre of flotation's axis:

$$i = a \times b \times d^2 + \frac{(a \times b^3)}{12}$$

c. Find the fall in the transverse metacentre (M_T) due to the lost waterplane area:

$$\text{Fall of } M_T = \frac{i \times \rho}{\Delta}$$

d. Find the rise of the centre of buoyancy due to the parallel sinkage:

$$\text{Rise of B} = \frac{w \times Bb}{\Delta}$$

where: Bb = distance from the original centre of buoyancy (found from hydrostatic data) to the centre of the parallel sinkage $\left(\frac{T + s}{200}\right)$

e. The centre of gravity is unchanged so the transverse metacentric height is only changed by the fall in metacentre and rise in centre of buoyancy:

$GM_T(\text{damaged}) = GM_{original} - \text{fall of } M_T + \text{rise of B}$

f. The angle of heel can now be found. The heeling moment is given by the loss of buoyancy, w, multiplied by the distance from the centre of the lost waterplane area to the fore and after axis of the centre of flotation:

$$\tan\phi = \frac{\text{heeling moment}}{\Delta \times GM_T(\text{damaged})}$$

3209. Trim

Calculation of trim is similar to calculation of heel:

a. Estimate the fore or aft shift of the centre of flotation due to the lost waterplane area (Para 3208a).

b. Calculate the loss of second moment of area of the waterplane where the centre of the compartment is a distance, e, from the athwartships axis through the new centre of flotation. The formula in Para 3208b becomes:

$$i = a \times b \times e^2 + \frac{(b \times a^3)}{12}$$

c. Find the fall in longitudinal metacentre due to the loss of waterplane area:

$$\text{Fall of } M_L = \frac{i \times \rho}{\Delta}$$

d. The rise in centre of buoyancy due to parallel sinkage is the same as in the transverse case therefore:

$$GM_L(\text{damaged}) = GM_{original} - \text{fall of } M_L + \text{rise of B}$$

where: $GM_{L\ original}$ can be found from:

$$GM_{L\ original} = \frac{MCT1cmBP_{original} \times L_{BP}}{\Delta}$$

e. Now the MCT1cmBP for the damaged ship can be calculated:

$$MCT1cmBP_{damaged} = \frac{\Delta \times GM_{L\ damaged}}{L_{BP}}$$

f. The trimming moment is found by multiplying the lost buoyancy by the longitudinal distance between the centre of the flooded compartment and the new centre of flotation. Therefore:

$$\text{Change in Trim} = \frac{\text{trimming moment}}{MCT1cmBP_{damaged}}$$

3210. Both of these methods will allow prediction of ship stability with reasonable accuracy up to approximately 15° of heel. At greater angles of heel or at large angles of trim, particularly if the deck edge is immersed or large areas of weather deck are submerged forward or aft, improvement of stability must be of prime importance and reference should be made to the damage examples given in the NBCD Class Book.

3211. As can be seen above both of these methods are extremely long and tedious and fraught with the risk of calculation errors particularly during the stress of State 1. Therefore every attempt should be made by the officers responsible to fully familiarise themselves with the examples in the NBCD Class Book and attain a suitable level of ship's stability knowledge to recognise when an incident may start to present a stability problem and should be studied more closely.

3212. Carpet Plots

To make the task of assessing the effect of flooding on ship's stability very much quicker and less likely to create an error, Carpet Plots are often issued to ships to aid the HQ1 team. These plots provide a quick visual guide to the state of the ship's stability dependent on the length of the flood. With reference to Fig 32-1, carpet plots are used in the following manner:

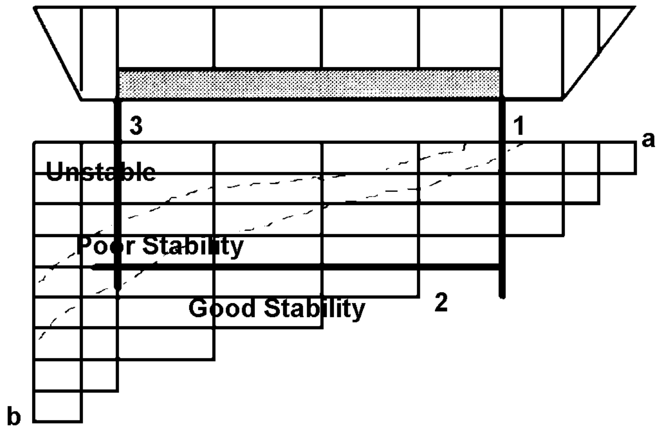

Fig 32-1. Carpet Plot

a. The longitudinal extent of the flooding is marked on the diagram of the ship (see shaded area).

b. A line (1) is drawn vertically down from the fore most boundary of the flood until it reaches the right hand diagonal (ab) of the plot.

c. A horizontal line (2) is plotted from this intersection with the diagonal.

d. A vertical line (3) is drawn down from the after most boundary of the flood.

e. The stability of the ship is shown by the region in which the horizontal plotted line intersects with the after vertical line.

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CHAPTER 33

DOCKING AND GROUNDING

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CHAPTER 33

DOCKING AND GROUNDING

3301. A ship may be docked for normal maintenance or for repair work and may be grounded by accident or to prevent her total loss after damage. The stability problems associated with either of these situations are similar except that docking is a more controlled evolution with the hands on experience of a Dockmaster to ensure the necessary precautions are taken.

3302. This chapter examines the forces developed during docking or grounding and discusses the impact these can have on the stability of the ship.

3303. Grounding and docking introduce an external force, the reaction between the floating body and the block or ground, consequentially buoyancy will not equal weight. The hydrostatic data for the positions of LCF, centre of buoyancy and the metacentres will all remain appropriate for the draught of the ship. However, the weight of the ship will not be equal to the mass displacement given for that draught in the hydrostatic data, rather this figure will represent the buoyancy force and to find the weight of the ship the reaction force has to be added to it. Since the body will be in equilibrium under 3 forces, weight, buoyancy and the reaction; buoyancy and weight will not necessarily act in the same straight line - B will not necessarily be under G.

3304. Docking

During the docking procedure, as the water level in the dock falls, it can be difficult to keep the position of the ship accurately above the dock blocks she will rest on, especially if there is any wind. To minimise the risk of docking skew to the blocks, with consequential problems for the stability of the blocks and indeed the ship, and the possibility of excessive forces being produced, the normal practice is first to concentrate on centring one end of the keel on the blocks. Then, as the water level falls, the weight taken anchors that point and closer attention can be given to the other end. Most ships are designed to trim by the stern and the 'after cut up' (ACU) is made of sufficient width and strength to take the normal docking loads without undue damage to dock blocks. Hence it is usual before docking to arrange the draughts so that the ship is trimmed by the stern to ensure the 'after cut up' sues first.

3305. Flotation During Docking

Assuming that the vessel is trimming by the stern relative to the blocks so that it sues first at the 'after cut up'.

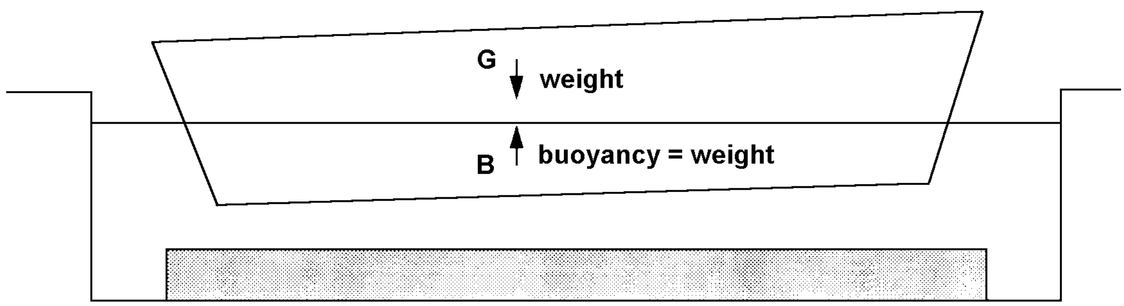

Fig 33-1. Afloat in Dock

Until the keel touches aft the situation will be normal, ie buoyancy = weight, as in Fig 33-1. Once the keel touches and the water in the dock falls relative to the ship, a force P will be created. Being aft of the LCF, P will cause the ship to trim forward, thus moving B forward to regain equilibrium as shown in Fig 33-2.

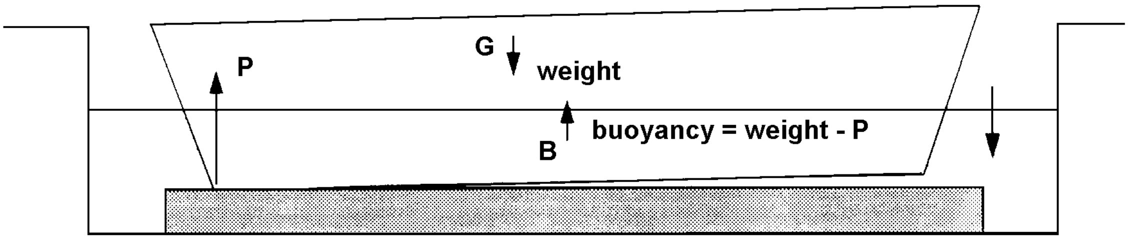

Fig 33-2. Keel Touching the Dock Blocks

The conditions of equilibrium are now:

a. Weight = buoyancy + reaction P.

b. The moment of the three forces about any axis is zero.

If the ship is symmetrical and remains upright, the three forces will lie in the centre plane of the ship and only the longitudinal moments need to be considered. As a result of the trimming effect of the force P, the ship will eventually touch the dock blocks all along. Thereafter the reaction force will be distributed along the length of the keel and further considerations of the combined moments of the forces should become academic.

3305. Magnitude of Reaction when a Vessel Sues All Along the Blocks

The reaction force, P, will reach its maximum just prior to the keel touching all the way along its length. At this time the blocks and the keel structure at the after cut up must be capable of withstanding this force without crushing or tripping. Apart from structural concerns the magnitude of P at this time is also important for transverse stability. As P increases, draught reduces, the LCF will, in general, change position and MCT will change, though for small initial trims the effect of their change can be ignored. Thus, a first estimate of P is made as:

$$Pj = \text{(trim change required to align keel with blocks) x MCT1cmBP}$$

where: j is the separation of the ACU from CF
trim change required = trim by stern - declivity of dock blocks

$$P = \frac{\left(\text{trim change required to align keel with blocks) x MCT1cmBP}\right)}{j}$$

The resulting draught reduction at LCF will be P/TPC. This will provide a new mean draught from which new hydrostatic data for the position of LCF, TPC and MCT 1m can be found. Using these new figures a second iteration of the above calculations can be made to find a more accurate answer for P.

Note. *Most Naval Dockyards no longer have any dock block declivity, however this maybe experienced in some areas of the world.*

3306. Transverse Stability During Docking

The introduction of a force p at the keel reduces the righting moment generated when the ship is disturbed from the upright condition. From Fig 33-3 it can be seen that by taking moments about the keel (K) the net righting moment allowing for the effects of the reaction force P is:

$$\text{Righting Moment} = (\Delta - P)KM\sin\phi - \Delta.KG\sin\phi$$

$$= (\Delta.KM - \Delta.KG - P.KM)\sin\phi$$

$$= (\Delta.GM - P.KM)\sin\phi$$

$$= \Delta\left(GM - KM.\frac{P}{\Delta}\right)\sin\phi$$

This parallels the normal afloat relationship (righting couple = ΔGMsinφ, and so the expression (GM - KM.P/Δ) is sometimes referred to as the 'effective GM'. However it must be remembered that the GM in this expression changes as the ship sues because as the water level falls away from the ship the position of M will move.

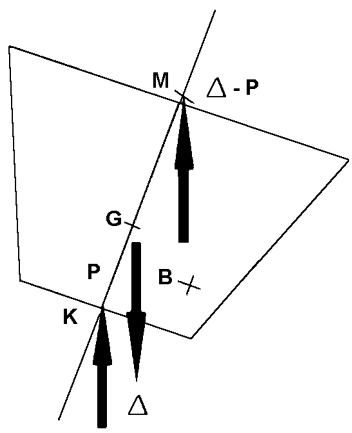

Fig 33-3. Transverse Stability During Docking

The ship will remain stable so long as (KM.P/Δ)<GM. It will be seen that this condition will be threatened if either GM is low, or if the reaction force P is high. As we have seen the magnitude of P is determined by the trim change required to align the keel with the blocks, the distance of the point the keel first touches (usually the ACU) from the LCF, and the ship MCT 1m at the docking draught. Assuming MCT 1m is outside control, to minimise the risk of instability during suing, the following conditions should be sought:

a. Maximum GM practical (this may sometimes demand ballasting, and may be stipulated in the Stability Statement). As usual, free surfaces must be kept to a minimum.

b. The change in trim required to sue all along should be the minimum consistent with the requirements for the docking procedure (no more than about 0.6m should be necessary). There may however be occasions when in a light condition the ship has a very large trim, in which case ballasting may be necessary to reduce P - not just for stability but also to protect the dock blocks.

c. The point at which the ship first touches should be as far as possible from the LCF. Although the LCF is usually abaft midships for surface warships, and the ACU is well forward of the stern, as stated above it is normal to use the ACU for this purpose rather than the forefoot as it presents less problems when strengthening the local structure in this area.

3307. Grounding

With the exception of the special cases of docking or amphibious landings, grounding is a condition to be avoided in ships such as warships which are not designed with grounding in view. Ships so designed have flat bottoms and ground on mud or soft sand which equalises the bearing pressures. Analysis of the reaction force apparent after grounding requires the following information:

a. The point at which the ship has grounded.

b. The state of the tide relative to that at which the ship grounded:

(1) *If the tide rises* the vessel will be able to float off providing there has been no increase of weight and no flooding has resulted from the grounding.

(2) *If the tide falls* the reaction between ship and ground will increase. The additional upward force will reduce the buoyancy and hence the volume of displacement. For equilibrium the centre of buoyancy will move away from the point of grounding - as in docking - and the vessel will take up a heel or trim away from the point of grounding to accomplish this.

The condition to apply is that the reduction in draught at the point of grounding due to the parallel rise, the change in trim, and effects of heel, must be equal to the fall in tide. There are two situations of grounding which are best examined separately; centreline grounding when heel effects can be ignored and grounding off the centreline when all three effects must be considered.

3308. Analysis for Grounding On the Centreline

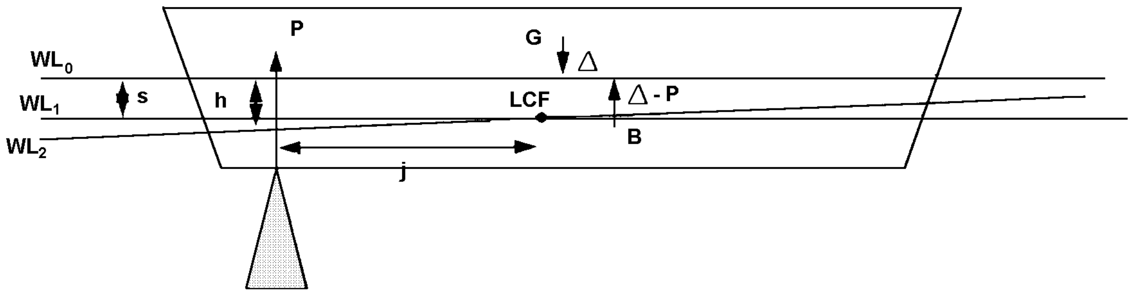

Fig 33-4. Grounding On the Centreline

Referring to Fig 33-4, with no heeling moment:

Let: s = parallel rise
h = the fall in tide
j = the distance from the CF of the point of grounding
t = the change in trim between perpendiculars caused by the moment of the grounding force P

then, the reaction force P will cause parallel sinkage s given by:

$$s = \frac{P}{TPC} \quad \text{(in cm)}$$

and the change in trim caused by the reaction force P will be:

$$t = \frac{P \times j}{MCT1cmBP} \quad \text{(in cm)}$$

(j and MCT 1cm being the respective figures for the waterline after parallel rise s (WL_1))

The effect of parallel rise and trim at the point of grounding must equal the fall in tide. Hence:

$$h = s + \left(t \times \frac{j}{L_{BP}} \right)$$

These 3 equations can now be solved to give P.

Note that an improvement in accuracy can be made by using the TPC and position of LCF between WL_0 and WL_1, but it should be appreciated that when a ship is grounded, precise calculations will rarely be necessary.

3309. Grounding Countermeasures

In considering countermeasures to grounding, the moment of P x j (Fig 33-4) gives an indication of the moment required by:

a. Counterflooding.

b. The removal of weights from the grounded end.

c. The transfer of weights to the free end.

While counterflooding may have the advantage of being the quickest of the three methods, it will incur an element of parallel sinkage and in practice there is a limit to the number of tanks available for this purpose. The removal of weights from the area of impact will reduce pounding at this point, thereby limiting the degree of structural damage, and the transfer of liquid and solid weight to the free end, if sufficiently large, will trim the ship to the point where it can be pulled free. In most ships the limited capacity for each of these procedures may necessitate a combination of all three to be effective. The removal and transfer of solid weights and liquids, combined with counterflooding may be insufficient to release the ship. Therefore early consideration should be given to the flooding of other compartments in addition to tanks and void spaces.

3310. Transverse Stability after Grounding On the Centreline

It will be evident that if grounding occurs towards either end the point of contact will be approximately on the middle line. Under these circumstances transverse stability will be affected similarly to stability after docking, such that the ship has an effective GM:

Effective GM = GM - KM x (P/Δ)

3311. Grounding Off the Centreline

Grounding away from the centreline presents more problems as the reaction force will also result in the ship heeling.

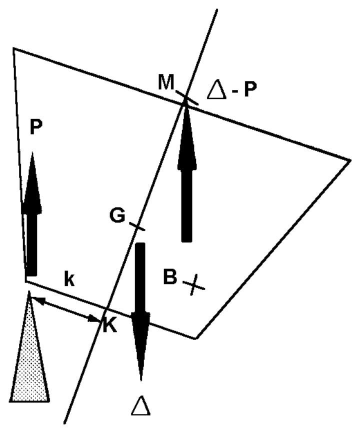

Fig 33-5. Grounding Off the Centreline

With reference to Fig 33-5, if the grounding force P acts a distance 'k' off the centreline, it will cause a heeling moment P x k(cosφ) which will be resisted by the righting moment Δ x (GM - (P/Δ)KM)sinφ. For equilibrium:

$$Pk\cos\phi = \Delta\left(GM - (P/\Delta)KM\right)\sin\phi$$

$$\tan\phi = \frac{Pk}{\Delta\left(GM - (P/\Delta)KM\right)}$$

The result of the angle of heel is to cause the draught at the point of grounding to fall by an amount, say f:

$$\text{so} \quad \tan\varphi = f/k$$

It can be said that:

$$f = \frac{Pk^2}{\Delta\left(GM - (P/\Delta)KM\right)}$$

Hence it can be seen that the effect of an upward force P at any point will cause the draught to decrease at that point by an amount due to parallel sinkage, an amount due to trim, and an amount due to heel. A first approximation to that total, which will equal the fall in tide, will following the earlier analysis be:

$$h = \frac{P}{(100TPC)} + \frac{Pj^2}{MCT1cmBP\ L_{BP}} + \frac{Pk^2}{\Delta\left(GM - (P/\Delta)KM\right)}$$

3312. Transverse Stability after Grounding Off the Centreline

Assessment of the transverse stability of a ship grounding off the centreline is somewhat more difficult than before. Essentially, the righting moment itself is the same as for the centreline grounding case but the ship has already adopted an angle of heel due to the grounding reaction force and any additional movement of weight will act about this angle not the upright. It is important to note that this analysis of stability after grounding relies on small angle theory and angles of heel due to off centreline grounding will quickly exceed 10° so that this theory is invalid. This situation is exceptionally dangerous and difficult to predict, particularly if the range of tide experience is high, resulting in angles of heel approaching the angle of downtake immersion. Earlier advice to increase GM, so increasing the ship's stability, by ballasting low in the ship still holds except that obviously ballasting on the centreline will in this case increase the angle of heel, this problem could be eased by ballasting low in the ship on the same side as the grounding point.

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CHAPTER 34

DAMAGE CONTROL AND FIREFIGHTING STORES

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CHAPTER 34

DAMAGE CONTROL AND FIREFIGHTING STORES

3401. The majority of damage repair stores are supplied initially as either permanent or consumable naval stores, with some supplied as armament stores, (eg charges for the Ramset explosive-powered fastening tool). A guide to the allowances for ships is given in BR 2170(3) - Catalogue of NBCD Stores for Surface Ships and RFAs, and for submarines in BR 2170(4) - Ship NBCD Manual (Submarines).

3402. Generally, stores used for damage repair consist of the following:

a. Materials for shoring and the necessary tools for cutting and setting up shores.

b. Leakstopping materials such as wedges, splinter boxes, patches and patch packs for the prevention of flooding through splinter holes and damaged structure.

c. Equipment and tools for effecting pipe repairs, and the Ramset explosive-powered tool for light structural repairs, etc.

d. Electrical equipment such as floodlights, lamps, fuses, etc, for effecting emergency repairs to the electrical system and for supplying light and power to areas being repaired.

e. Equipment for wreckage clearance such as heavy and portable cutting apparatus and lifting gear.

f. Portable lighting such as torches, caplamps, battery operated floodlights and Cyalume chemical illuminators which, when needed, provide emergency lighting for damage control and first aid parties, etc.

3403. Stowage

In most ships much of the different equipment required for damage repair is contained in built-in lockers sited at each Fire and Repair Party Post. Material such as shoring timber, softwood planks, adjustable steel shores, etc, which are too large to fit in the stowages should be distributed throughout the ship, with particular attention being given to accessibility under possible damage conditions. Damage repair stores should not be stowed so low in the ship as to be inaccessible should the compartment be flooded.

3404. Custody

It is not easy to ensure the safe custody of equipment in open stowages throughout the ship, but the loss of damage repair or firefighting equipment might have very serious consequences in an emergency. The responsibilities of officers in regard to NBCD equipment are given in Chapter 2, and as follows:

a. Damage repair stores are initially taken into account by the Supply Officer and the Armament Stores Accounting Officer (for explosive items).

b. Damage repair stores (except explosive stores) are to be issued to the MEO/NBCDO and placed around the ship as shown in the NBCD Class Book. The MEO/NBCDO is responsible for ensuring that these stores are periodically mustered and kept in a sound, workable, condition.

c. Firefighting stores, including breathing apparatus, are to be issued to the MEO and placed around the ship in authorized stowages as shown in the NBCD Class Book. They should be marked as suggested in the following paragraph, and issued by the MEO to the officers in whose departmental spaces they are normally stowed. Day-to-day care of the equipment is to be managed by the officer responsible for the particular space. The MEO is responsible for the periodical testing, maintenance and replenishment, as necessary, of all the issued equipment in accordance with the relevant maintenance schedules.

d. The few stores items needed for the maintenance and upkeep of the damage repair and firefighting equipment should be stowed in the MEO's ready-use store.

3405. Marking

A standard method of marking all damage repair and firefighting equipment should be used to establish ownership and responsibility, deter personnel from unauthorized removal (or help in subsequent tracing) and facilitate mustering and maintenance. Suitable identification tallies can be made by ship's staff and secured to all such portable equipment except hoses and nozzles.

3406. Explosives and Pyrotechnics for NBCD

Explosives and pyrotechnics supplied for NBCD purposes are to be taken into account by the Armament Stores Accounting Officer and stowed in the magazines and stores as laid down in BR 862 - Naval Magazine and Explosives Regulations. They are to be issued to the MEO or the NBCD Officer when needed.

3407. Arrangements in War

In peacetime much of the personal issue NBCD equipment is held in the Supply Officer's stores. In war this will be issued to individuals as directed and arranged by the NBCD Officer. The items then become the personal responsibility of the recipients, Divisional Officers being responsible for their periodical mustering, inspection and testing. In war, as in peace, medical stores for first aid purposes are to be placed around the ship by the Medical Officer in the first aid stowages at quarters and first aid posts. The Medical Officer is responsible for their periodical mustering and turnover.

3408. Access to Equipment Lockers at Fire and Repair Posts

Quick access to fire lockers in an emergency is ensured by the provision of a duplicate key in a glass-fronted key box secured to these lockers. The remaining keys of the fire lockers and damage control lockers are held in HQ1/SCC for distribution when required. It is possible that a physical barrier, caused by smoke, fire or damage, might delay the delivery of keys from HQ1/SCC to the fire and repair party post needing them. Therefore, duplicate keys of damage control lockers are to be clearly tallied and placed in a small box or bag and stowed within the appropriate fire locker.

3409. FRPP Locker Contents and Contents Lists

HM Ships (excluding MM/PP, submarines and RFAs) are provided with standardized Fire and Repair Party Post lockers containing an allowance of NBCD stores in dedicated stowages. Large items are stowed near the lockers. These standard lockers are combined for damage control, electrical repair and fire party stores. Dedicated ‘M’ and ‘L’ toolkits can be taken to the scene of an incident by maintainers, enabling simple repairs without constant recourse to the tools in the FRPP locker. A list of standard locker contents and a diagram of locker layout is published in BR 2170(3). A copy, together with a list of the larger items stowed nearby should be displayed on the inside of the locker doors. MM/PPs and RFAs which are not provided with standard lockers are to retain the stores listed in Chapter 3 of BR 2170(3) and display a list of locker contents, and larger NBCD stores stowed nearby, on the inside of the locker doors.

3410. Defective NBCD Equipment

Reports of defective material or design in NBCD equipment are to be forwarded on Form S.2022, in accordance with BR 1313 - Maintenance Management in Ships. The procedure for reporting defective NBCD clothing is detailed in Chapter 26.

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CHAPTER 35

NBCD ORDERS

CONTENTS

ANNEXES

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CHAPTER 35

NBCD ORDERS

3501. Introduction

This chapter specifies the recommended formats for Ship's NBCD Orders and the NBCD chapter of Ship's General Orders. The formats are to be adapted as necessary to reflect any special equipment, fittings, organisation or procedures in each individual ship. Cross references to the BR 2170 Series should refer to volume and chapter numbers only, not specific paragraph numbers. This will reduce the amendment task for Ship's Staff as the BRs are regularly updated.

3502. Ship's General Orders

Basic NBCD forms Chapter 15 of Ship's General Orders in accordance with FLAGO. The format, at Annex A to this Chapter, aims to avoid unnecessary duplication of the BR 2170 Series, although some overlap is necessary to explain the application of NBCD in basic terms.

3503. Ship's NBCD Orders

The format for Ship's NBCD Orders is at Annex B to this Chapter. Duplication of generic information in the BR 2170 Series should be avoided in these Orders. The format should be followed where applicable to the ship, but variations or additions may be necessary to reflect non-standard equipment or manning (eg ships without built-in collective protection or large numbers of embarked forces).

3504. The format gives only broad guidance for the content of chapters; the details for inclusion are to be completed by the individual Ship's Staff. The layout of pages and paragraphs is to be similar to that used for Ship's General Orders. Paragraph numbers are not specified in the format, to allow Ship's Staff to locate, insert or delete paragraphs, as applicable to the ship. Check lists, standard operating procedures, route cards, etc should be included as annexes to the related chapters, to facilitate duplication for users/operators.

3505. The security classification of Ship's NBCD Orders should be Restricted.

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ANNEX A TO CHAPTER 35

FORMAT FOR CHAPTER 15 OF SHIP'S GENERAL ORDERS

CHAPTER 15

Basic NBCD

1501. NBCD in HMS/RFA .....

1. A general statement on the relevance and importance of NBC Defence, including medical countermeasures.

2. A statement on how NBCD concerns all members of the Ship's Company and embarked personnel.

3. The requirement for all personnel to undertake NBCD tasks outside their normal specialist duties.

4. A brief explanation of the application of NBCD in the particular ship, highlighting any deviations from normal RN/RFA practice.

5. Cross references to Ship's NBCD Orders, BR 2170, CB 4538 Series - NBCD Class Book, CB 9500 Series - Stability and Survivability Book and BR 875 (for RFAs), as appropriate, stating the relationship of these Orders to each other.

1502. SHIP KNOWLEDGE

1. The importance of all personnel having a good ship knowledge to enable them to react to emergencies at sea or in harbour.

2. A summary of the ship's NBCD facilities with which personnel must be familiar.

1503. NBCD ORGANISATION

1. An explanation of the day-to-day administation of NBCD matters, including the role of HQ1/SCC and/or Gangway Watchkeepers.

2. The roles of the SSEP and HFEP.

1504. FIRE AND FLOOD PREVENTION

1. Attention to correct working practices.

2. Cross reference to the welding and hotwork orders in Chapter 2 of SGOs.

1505. ACTION TO BE TAKEN ON DISCOVERING FIRE, FLOOD OR DAMAGE

1. Alarm procedure.

2. Actions to deal with the incident.

1506. ACTION TO BE TAKEN ON HEARING A FIRE, FLOOD OR DAMAGE ALARM

1. Actions to be taken at the scene of the incident.

2. General instructions for the Ship's Company (SSEP and HFEP actions in NBCDOs).

3. Touch drill only for LAFB call-out during exercises.

1507. EMERGENCY STATIONS

1. Instructions specific to NBCD parties.

2. Cross reference to Chapter 2 of SGOs for the general Emergency Stations and Liferaft Stations procedures.

1508. CLEARING AWAY AND SECURING FOR ACTION

1. Responsibility.

2. Actions.

ANNEX B TO CHAPTER 35

FORMAT FOR SHIP'S NBCD ORDERS

Preliminary Pages

- Title page
- Introductory statement by the CO, highlighting any special NBCD features of the ship, referring to the NBCD Class Book for ship-specific data and BR 2170 for generic information.
- Readers' signature page(s).
- Distribution list.
- Record of changes
- Contents list (chapter headings)

Chapter 1 - Responsibilities

- Definition of the NBCD organisation, with a family tree diagram.
- Responsibilities of the following personnel, **if different from those detailed in BR 2170**:
- The Command
- XO
- MEO
- WEO
- SO
- MO
- Flt Cdr
- PWO
- NO
- NBCDO (if separate from XO)
- Specialist post officers (eg FDO, Assault Systems Officer)
- Part of Ship Officers
- Divisional Officers
- Whole-ship NBCDQ
- Departmental NBCDQs
- OOW
- DCO
- NBCPO
- NBCPOA
- I/C and 2I/C FRP (and Section Bases, where applicable)
- Electrical Repair Parties
- Mobile Repair Party
- NBCD Patrols
- OOD/Duty CO
- HQ1 Watchkeeper
- Gangway Watchkeepers

Chapter 2 - Command, Control and Communications

- C2 organisation in States 1, 2 and 3
- Defence watch NBCD manning
- Location and manning of HQ1, HQ2 & Section Bases (in large ships), AHQ, FRPPs, WSB, AWSB, MRP, ERPs, MHQ, SMP and FAPs
- HQ1 and FRPP relocation plans
- NBCD information and display systems
- Definition of areas covered by each FRP
- Embarked personnel (Air Groups, Military Forces, etc)
- Dispersal of personnel at State1
- Blanket search procedures (routes as annexes)
- NBCD patrol routes (annexes)
- Aides memoire for key personnel (annexes)
- Availability of the NBCD Class Book in HQ1
- SSEP organisation
- HFEP organisations (in Naval Base or other ports)
- Details of all communications systems used for NBCD
- Allocation of channels for DC&FF radio communications

Chapter 3 - States and Conditions

- Responsibility for ordering changes to the NBCD State
- Mandatory changes of State
- State 1 preparations (check list in annex)
- Dispersal of personnel at State 2 and other State 2 responses to the threat
- Ordering and control of the NBCD Condition
- Watertight Integrity Log
- Allocation of MBLO discs
- X, Y and Z closing down check lists (annexes)

Chapter 4 - Damage Control and Stability

- Zoning arrangements
- Flood warning system(s)
- SOPs for flood alarms (annexes)
- Location of DC equipment not in FRPP lockers
- Emergency pumping arrangements
- Arrangements for draining down floodwater
- Ballast/counterflooding arrangements and procedures
- Jettison Bill (list in annex)
- Emergency electrical supply arrangements

Chapter 5 - Firefighting

- Action to be taken by the SSEP or HFEP on hearing a fire alarm
- Fire warning systems
- Fixed firefighting systems
- HPSW system instructions

- Extent of fire barrier insulation (eg A60 bulkheads)
- Areas of special fire risk (eg aluminium structure, non-standard materials)
- SOPs for specific fires (in annexes)
- SOPs for containment (in annexes)
- SOPs for flight deck emergencies (in annex)
- SOP for ventilation control
- Smoke clearance plans
- Location of TMS temperature monitoring points
- MMS re-entry briefs (annexes)
- Firefighting aides memoire for key personnel at sea and in harbour (annexes)
- Arrangements and procedures for LAFB assistance
- Location of BA(DC&FF) and escape BA (annexes)
- Identification systems for FF equipment, BA, FF communications, etc
- Custody and maintenance of firefighting equipment

Chapter 6 - NBC Defence

- Collective protection arrangements (in citadel ships)
- UCPS or sanctuary arrangements (in non-citadel ships)
- Check lists for assuming Condition Alfa (annex)
- Relaxation of Condition Alfa
- Habitability arrangements in Condition Alfa
- Citadel entry and exit, including instructions for sentries
- Cleansing station arrangements
- Aircrew and Embarked Military Forces entry/exit procedures
- Access to/from machinery spaces
- Action in the event of a citadel breach
- Shelter stations, parties and routes
- Location and contents check list for cleansing lockers
- Custody of NBC equipment
- NBC detection systems
- Prewetting arrangements and procedures
- Monitoring routes and reporting method (route cards in annex)
- Decontamination routes (annex)
- BRACIS/ATP45 warning & reporting application in the particular ship
- Allocation of personal dosimeters
- Allocation of personal chemical detection equipment
- NBC medical countermeasures
- Orders for the removal of facial hair
- Annual respirator testing

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CHAPTER 36

INSPECTIONS, TESTS AND TRIALS

CONTENTS

ANNEXES

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CHAPTER 36

INSPECTIONS, TESTS AND TRIALS

3601. The implementation of good NBCD practice depends largely upon the efficiency of watertight structure, doors, hatches and fittings and NBCD equipment. To ensure this efficiency, numerous inspections, trials and tests and conscientious maintenance must be carried out. For most items, the necessary procedures and their periodicity are clearly set out in the appropriate maintenance schedule to which reference must always be made.

3602. During the construction of a warship, watertight compartments are detailed in the 'tabular statement of watertight compartments', a document which forms part of the ship's drawings. The compartments listed are water-pressure tested before the ship is launched and measures taken, if necessary, to provide additional stiffening and to make good any leaks discovered. Once a ship is in service, watertight compartments are given periodic visual inspections which will indicate obvious threats to watertight integrity. Reference must be made to BR 2000(6) - Naval Marine Engineering Practices (Hull), should it be necessary to water-pressure test any compartment of a ship in commission. The only compartments likely to require such testing are those that normally contain fuel and which have been subjected to repairs affecting their integrity.

3603. Ministry of Defence Inspections

Inspections of NBCD material arrangements are carried out in all new construction ships. The inspections are made by the platform Integrated Project Team (IPT). Associated with the inspections are representatives of the Resident Project Officer (RPO) and the appropriate ship's officers. These inspections are included in the programme of inspections and trials prior to completion of the ship.

3604. In MM/PP and larger ships two such inspections are held:

a. **Preliminary.** Carried out when work on the NBCD arrangements is approximately sixty per cent complete. This inspection is mainly to provide guidance on the application of all the relevant drawings and specifications before the work is too far advanced.

b. **Final.** Carried out when work on the arrangement is at least ninety per cent complete, with all the equipment in place in the ship and fully operational (otherwise it is impracticable for the inspecting officers to carry out a proper check).

3605. The principal arrangements to be covered by the inspection(s) are:

a. The layout and equipment of HQ1 and HQ2, if applicable.

b. The layout and equipment of Section Bases in large ships or of Fire and Repair Party Posts in small ships.

c. NBCD equipment, materials and stores.

d. Firefighting arrangements generally. This is in addition to the trials and inspections referred to in BR 1921 - Procedure for the Supervision of Ships and Vessels Building by Contract.

e. NBC storerooms, cleansing stations and arrangements for decontamination.

f. NBCD markings.

g. Citadel arrangements.

h. Ventilation arrangements.

3606-3609. Spare.

3610. Citadel Tests

To exclude contamination, it is necessary for the citadel pressure to exceed the static pressure exerted by the relative wind at leaking positions in the citadel boundary. An in-service citadel pressure of 50mm water gauge (WG) minimum is the acceptable standard. This is equal to the static pressure exerted by a 56-knot relative wind. If the citadel pressure was reduced to 25mm WG this would be sufficient only in a 40-knot relative wind. Test procedures aim at achieving a minimum standard of 6.875 mbar (70mm WG) at the HAT (citadel) with a corresponding pressure of 5 mbar (50mm WG) at the SAT (citadel), and are operationally essential in new construction ships.

3611. Test requirements for air filtration units (AFU) are specified in BR 6590(003), for Filter Unit NBC No 3 and in BR 6590(002) for Filter Unit NBC No 6 and 7.

3612. Types of Citadel Test

The citadel concept cannot be effective unless rigorous air tests are enforced to ensure the boundaries are initially tight and subsequently do not decline during service. The two tests are:

a. **Vacuum Test.** Carried out for leak detection, for subsequent repair.

b. **Pressure Test.** Carried out to determine the degree of air-tightness of the citadel boundaries.

3613. Vacuum Test

a. Close all known openings in the citadel boundary, ie doors, hatches and ventilation openings (except para d below).

b. Shut off all ventilation in the citadel.

c. Stop as much machinery as possible to achieve a quiet ship.

d. Run an exhaust fan of adequate size to draw an initial vacuum large enough for leaks to become evident by hissing, and arrange to measure the fan output as in Para 3615. A 250mm or 310mm centrifugal fan such as fitted in the galley is normally sufficient for the whole citadel in a small ship or up to a 2,830 cubic metres section in a large ship.

e. Plug leaks with temporary sealant, noting the location of each leak.

f. Once the large leaks have been sealed, the vacuum will increase and the smaller leaks will become more apparent. As these are progressively stopped the corresponding degree of tightness will be indicated by the higher readings on the U-tube. The test is not complete until all measurable leaks have been stopped. The fan output is then measured and the maximum U-tube reading taken when steady. For a successful test, the leakage worked out from the formula given must be within the capacity of the number of AFUs fitted.

g. If the test is not successful, the search for leaks must be continued. An important conclusion to the test is to make good the temporary stoppings by permanent repair and to re-test the whole citadel.

h. Classes of ships are provided with check-off lists detailing all citadel openings. Ships are responsible for up-dating these lists as As and As are completed. Ships without check-off lists are to make full use of 'as fitted' drawings including the NBC arrangement drawing.

3614. Pressure Test

a. Close all Alfa openings and open Romeo openings.

b. Restrict access to and from the citadel to the minimum essential numbers, using only the recognised airlocks.

c. Run the ventilation system in its normal closed-down recirculation condition and start the AFU fans. Run machinery space fans. Care must be taken to ensure that the recirculating fans do not contribute to the citadel pressure by drawing air from the outside atmosphere through leaking flap closures.

d. Record the internal pressure shown by the manometer(s).

3615. Instrumentation for Testing

a. **Pressure and Vacuum.** A 150mm U-tube or an electronic manometer can be used for sensing citadel pressure or vacuum. See BR 2170(2) for details of both instruments.

b. **Exhaust Fan Output.** For vacuum tests, a velometer is used. This measurement will give the fan output against the vacuum achieved. To calculate the leakage area either of the following formulae may be used:

(1) *S.I. Units*

$$A = \frac{10^6 Q}{12.0\sqrt{P}} \text{ mm}^2$$

Where A is the area of leakage in sq mm, Q is the fan output in m^3 per second and P is the pressure on the U-tube water gauge in millibars.

(2) *Imperial Units*

$$A = \frac{0.036Q}{\sqrt{P}} \text{ sq in}$$

Where A is the area of leakage in sq in, Q is the fan output in cu ft per minute and P is the inches of water gauge pressure measured on the U-tube.

Note. *1 inch water gauge is equivalent to 2.5 millibars.*

3616. Harbour Acceptance Trial (Citadel)

Ships being built or undergoing Upkeep Periods are to be given a HAT (Citadel) before entering service. For ships building, the HAT (Citadel) is to be undertaken by the shipbuilder and completed to the satisfaction of the Resident Project Officer. In other instances the trial will be the responsibility of the Upkeep Authority and carried out by them with the assistance, if necessary, of the Ship's Staff. The trial is to be included in the completion programme and is not to be undertaken until all fitting-out or repair work affecting the citadel is complete. The HAT (Citadel) is to be conducted in two parts as follows:

a. **Pre-HAT (Citadel).** A vacuum test is to be carried out using temporary sealing as necessary to determine leaks. A pressure test is to be conducted to check the running of the AFUs and the citadel pressure. If the pressure fails to reach the minimum standard set by MOD(N) a further search is to be made for leaks. All leaks found are to be made good and at least one week is to be allowed between pre-HAT and HAT for this purpose.

b. **HAT (Citadel).** This need only be a pressure test, providing a pressure of at least the minimum standard set by MOD(N) is achieved without the use of temporary sealing. If this pressure is not achieved, leaks are to be found, repaired permanently and the test repeated until the minimum standard is achieved.

3617. Sea Acceptance Trial (Citadel)

To prove the operational material state of the citadel, a pressure test is to be conducted at sea during post-upkeep trials, or Part IV programme for new construction ships. If a pressure of at least the minimum standard set by MOD(N) is not achieved, leaks are to be located (if necessary by vacuum test) and rectified by DEFREP procedure. The trial is to be repeated on completion.

3618. Spare.

3619. Firefighting Equipment Inspections

In new construction ships, a series of inspections of firefighting equipment is carried out. The inspections aim to ensure that all fixed and portable firefighting equipment is available, in the correct place and that the relevant Test Forms have been completed and signed. These activities should be complete by Contract Acceptance Date (CAD), which is also the date at which the vessel is accepted into naval service.

3620. Inspections are the responsibility of the platform Integrated Project Team (IPT), who may call upon MCTA to provide specialist support and advice for the following serials:

a. **Preliminary Inspection.** Normally conducted by the Resident Project Officer (RPO) staff, with the Shipbuilder and Ship's Staff, this is a check, against the firefighting general arrangement drawings, to ensure that the basics are in place.

b. **Pre-Contractor's Sea Trial (CST) Inspection.** This is conducted by the IPT, with the RPO, Shipbuilder and Ship's Staff. This inspection is part of the requirement to obtain Fire Safety Certification, which the ship must have prior to proceeding to sea for the first time (on CSTs). It should be noted that for CSTs the portable firefighting equipment embarked is normally non-MOD pattern, supplied by the shipbuilder. The inspection will ensure that the portable equipment is in sound working order and is stowed in the correct place (normally as per RN fit). An audit of the relevant Test Forms will also be undertaken to ensure that the fixed systems (ie engine room gas drench and the HPSW system) required for CSTs are complete in all respects. The inspection will also ensure that the Ship's Staff (who normally form the SSEP during CSTs) have had adequate time to conduct firefighting training onboard and are familiar with the equipment.

c. **Final Inspection.** This is conducted prior to Acceptance of Contract (AoC)/Programme Acceptance Date (PAD) by the IPT with RPO staff, the Shipbuilder and Ship's Staff in attendance. The aim is to ensure that the full RN fit of equipment is in place and in sound working order. The general arrangement drawings will again be used and the HAT(NBCD) document completed as far as possible. A final audit of the relevant Test Forms will also be undertaken.

3621. At each of the above inspections, any defects or deficiencies are recorded in the Defect and Deficiencies Data Base (D3B), which forms part of the acceptance documentation.

3622. Practical discharge tests of fixed foam systems are conducted as part of the relevant Test Forms, and in First of Class Ships, a full discharge trial of any gas drench system will normally be undertaken to ensure that concentration levels are in line with calculations.

3623. Damage Control Equipment Inspections

Damage control is covered in the same way as firefighting, with a pre-CST inspection, to ensure that the agreed minimum of equipment is in place for sea trials, and a final inspection which covers the full outfit. As with firefighting, the opportunity is taken, during the final inspection, to complete as much of the HAT(NBCD) document as possible, although in both cases it is the material aspects that are looked at in detail. Ship's Staff are responsible for ensuring that procedures are in place, in accordance with current Safety and Readiness Check (SARC) documentation.

3624. The operation of portable pumps and other portable equipment is either conducted as part of a Test Form activity or as individual trial; Ship's Staff will always be involved.

3625 to 3626. Spare.

3627. Fire Safety Certification

All Royal Navy ships, submarines and RFAs are to be issued with a Design and Material State Fire Safety Certificate by the relevant IPT Team Leader. This certificate, which is part of the overall ship safety assessment, verifies that the residual fire safety risks have been reduced to a level that is as low as is reasonably practicable (ALARP). The fire safety of the ship is also dependant on the competence and training of the Ship's Staff and the ongoing routine maintenance of firefighting systems; these are the responsibility of CINCFLEET and are not covered by the certificate.

3628. The certificate validity will initially be from CSTs to first refit. The certificate will then be re-validated near the end of the refit before the vessel proceeds to Sea Acceptance Trials. The Platform IPT will suspend the certificate during major upkeep periods between refits if the volume or nature of work significantly degrades the ships firefighting capability or adversely affects the vessels fire safety. The certificate will be re-instated on completion of a satisfactory material state assessment.

3629. The issue of a Fire Safety Certificate by the MOD does not preclude the requirement to obtain Maritime and Coastguard Agency (MCA) fire safety certification for vessels which are certified by maritime regulating authorities, such as Lloyds Register of Shipping. In these instances the MCA and MOD certificates will be complementary, with the latter covering any aspects such as military equipment not covered by the MCA.

3630. Spare.

3631. Harbour Acceptance Trial (NBCD)

A HAT(NBCD) is to be carried out by Ship's Staff, towards the end of an upkeep period, using Check Lists copied from the Annexes to this Chapter. The administrative procedures are detailed in Fleet Engineering Orders (FEO), including the auditing of completed Check Lists by the Fleet Base Port Waterfront Organisation (FWO). The three stages of a HAT (NBCD) are:

a. Checks to be completed prior to Ship's Staff Move Onboard (SSMOB) - Part I, as part of SARC 1.

b. Checks to be completed prior to Ready For Sea Date (RFSD) - Part II, pas part of SARC 2.

c. Checks to be completed prior to Fleet Date Inspection (FDI) - Part III, as part of SARC 3.

3632. A Ship's Officer is to be appointed HAT (NBCD) Coordinator and is to be responsible for:

a. Overall coordination of the HAT(NBCD) inspections, ensuring full compliance with the HAT documentation.

b. Devising and implementing personnel and whole-ship NBCD training serials in accordance with SARC requirements. These are to be achieved prior to:

(1) SSMOB - SARC 1.

(2) RFSD - SARC 2

(3) FDI - SARC 3

c. Compilation of a HAT(NBCD) report for each Part (ie Part I, II or III), detailing items outstanding, emphasising any 'starred' items outstanding which affect achievement of a successful HAT(NBCD).

d. Presentation of the completed HAT(NBCD) documentation to the Commanding Officer (via XO/NBCDO) for approval.

e. Drafting the achievement signal for each Part of the HAT(NBCD) for the Commanding Officer, in accordance with the SARC DCI and BR 9274 - Maintenance of Operational Capability (Surface Ships).

f. Arranging for the Base Part FWO, Local FWO or FOST to audit the completed HAT(NBCD) Check List for each Part.

g. Presentation of completed HAT(NBCD) documentation to the FDI inspecting authority.

3633. The Whole-ship NBCDQ, as directed by the HAT(NBCD) Coordinating Officer, is responsible for the conduct of the HAT(NBCD) inspection and for:

a. Ensuring that personnel undertaking the HAT(NBCD) inspections are in possession of the correct documentation and are made aware of their duties.

b. Correlating the results of Parts I, II and III of the HAT(NBCD) inspections and presenting the results to the HAT(NBCD) Coordinating Officer.

c. Ensuring that any discrepancies or deficiencies are dealt with in a timely manner, paying particular attention to 'starred' items which must be completed to achieve the HAT(NBCD) Parts I, II and III standards.

3634. Ship's Staff are to note the following when preparing for a HAT(NBCD).

a. The date chosen for the inspections must be discussed and agreed by all parties involved with the ship's upkeep period. Careful coordination is required to ensure that equipment/lockers/signwriting/communications facilities are in place prior to the Ship's Staff inspections for each HAT(NBCD) Part. Possible constraints/limitations which may affect the conduct of, or the ability to achieve, a satisfactory HAT(NBCD) standard are to be discussed with the appropriate FWO (or Squadron for MM/PP) Staff and PCM.

b. Certificates of compliance (clean air certificate) must be current and available for inspection by FWO/Squadron Staff during the audit.

3635. Spare

3636. Prewetting - Sea Acceptance Trial

During Part 4 acceptance trials and post upkeep period sea acceptance trials, ships are to carry out a trial of their prewetting system(s). Stabilized ships can apply an enforced roll through a moderate angle to improve the sluicing effect. The trial is to ensure that all nozzles are clear, that no leaks exist and that no work undertaken during the build or upkeep period has adversely affected the desired coverage. Defects discovered during the trial are to be treated as DEFREPs and instances of poor coverage or inadequate drainage are to be reported, giving the following information:

a. The area not wetted.

b. Direction and speed of relative wind.

c. Ship motion during trial, ie steady, rolling, pitching, stabilized, etc.

d. Number of pumps in use and pressure in system.

e. Other pertinent factors.

ANNEX A TO CHAPTER 36

HAT (NBCD) PRE-SSMOB CHECKS

HMS ....

Check	✓	Reason for any Deviation
Escape Routes 1. Are all escape hatches/panels clearly identified with ‘ESCAPE’ on both sides and also on adjacent structure with direction arrows? 2. Are all escape hatches/panels operable from all positions, with openings/routes free from obstruction? 3. Are all ladders stowed correctly? (ladders that cannot remain permanently rigged are to be rolled up and secured by 5 mm polyester cord, with a slip knot) 4. Are portable wire ladders correctly fitted with hardwood rungs and securely connected to the deckhead? 5. Are escape hatch handwheels fitted with extension bars? (MM/PPs only.) 6. Are escape routes marked correctly and logically throughout the ship? (‘ESCAPE’ and arrow signs 1500 mm from deck and dot arrows on deck adjacent to notices. Are escape route ladders clearly identified?) 7. Are handwheels/operating levers and T-bar operating handles painted with photoluminescent material? 8. Is there a routine for regularly proving all escape hatches?		
Escape BA (ELSA) 1. Are holdings in accordance with the allowance? 2. Are they distributed and stowed correctly? 3. Are they charged to 180-200 bar? 4. Are the cylinders in-date for test? 5. Are all hoods and hoses within their shelf lives? (BR 2170(3)) 6. Are sets numbered for maintenance purposes? 7. Are ‘ESCAPE BA’ signs posted on all ELSA stowages? 8. Are custody, accounting and maintenance procedures correct? 9. Have all ELSA stowage straps been modified? (centre clip broken out of the buckle) 10. Are relief valves on dedicated charging panels set to 207 bar? 11. Are checks carried out, at least monthly on all ELSAs?		
Watertight Integrity Organisation 1. Is there an effective watertight integrity organisation? 2. Is the S 326 Watertight Integrity Log maintained correctly? 3. Are ship-specific instructions for the issue of ‘MAY BE LEFT OPEN’ tallies included inside the front cover? 4. Are the instructions in accordance with the ship’s SGOs and NBCD Orders? 5. Are the correct numbers and types of MBLO tallies held in HQ1?		

Check	✓	Reason for any Deviation
NBCD Training and Material Assessment Log 1. Do the contents comply with the instructions in BR 2170(5)? 2. Has the Log been weeded to dispose of unwanted records? 3. Do the signatories regularly inspect the Log? 4. Are recorded shortcomings being actioned?		
Harbour Watch Training Log 1. Do the contents comply with the instructions in BR 2170(5)? 2. Has the Log been weeded to dispose of unwanted records? 3. Do the signatories regularly inspect the Log? 4. Is the Harbour Watch Training Plan sound and up-to-date? 5. Are the full range of Lecture Plans at the Annexes to BR 2170(5) Chapter 5 available to Duty Watches? 6. Are recorded shortcomings being actioned?		
NBCD Organisation 1. Is the number and employment of key NBCD personnel in accordance with BR 2170(1) Chapter 2? 2. Do they all have the appropriate NBCD qualification in accordance with BR 2170(5)? 3. Is there an effective system for accounting for all personnel in the event of a harbour fire? 4. Is HFEP training carried out daily, using the lesson plans in BR 2170(5)?		
NBCD Command & Control Facilities 1. Are the HQ1 (and HQ2) information boards in place, as detailed in the BR 2170(1) Annex 8A, and in good condition? 2. Are the Incident Boards as large as practicable and is the symbology in accordance with BR 2170(1) Annex 8B? 3. Are the securing arrangements for all boards adequate? 4. Does Incident Board emergency lighting work effectively? 5. Are there sufficient pegs, marker pens, etc? 6. Are master copies of closing down cards for X, Y, Z, A, and M openings held in HQ1? 7. Is a full set of Kill Cards (S3021), in plastic covers, held in HQ1? 8. Are Smoke Clearance Plans held? 9. Is the ‘Green Line to FRPPs in working order? 10. Do the Main Broadcast microphone and alarm-push operate correctly? 11. Are the correct number of MBLO tallies held, as specified in the ship’s orders? 12. Is a working clock fitted? 13. Is there a working manometer for each sub citadel? 15. Is the duplicate key stowage in good order and an organisation in place for the distribution of duplicate key boxes? 16. Is an Aide Memoire readily available for the OOD to cover fire/flood incidents? 17. Is the 999 telephone system working? 18. Is there a fluids stateboard?		

Check	✓	Reason for any Deviation
Petrol Stowages (MM/PPs ONLY) 1. Are fuel tanks painted grey and contents identified with 25 mm red lettering? 2. Are stowages marked 'PETROL STOWAGE NO SMOKING' in white letters on a red background? 3. Is the remote release at least 5 m from the stowage? Is the quick-release handle clearly identified? 4. Does the mechanism appear operable? Is it in-date for functional test?		
Flammable Gas Bottle Stowages 1. Are all bottles correctly stowed? 2. Are the stowages correctly marked, identifying the gas? 3. Are the spray operating valves clearly marked and operable? 4. Are the valves locked, with the keys available nearby?		
Smoke Curtains 1. Do the curtains meet the specification in BR 2170(1) Chapter 23? 2. Do they appear to be smoketight? 3. Is the fabric in good condition? 4. Can they be easily deployed and tied back?		
Galley(s) 1. Can the power switches be locked OFF only? 2. Are the switches painted red and marked 'SWITCH OFF IN THE EVENT OF A GALLEY FIRE'? 3. Is the exhaust vent flap operable from outside the galley, and are all operating positions clearly marked? 4. Is a Kill Card, highlighting the position of the deep fat fryer, displayed outside the door? 5. Are AFFF extinguishers available at each galley door? 6. Are viewing ports / spy holes fitted to doors/shutters, giving a view of the deep fat fryer? 7. Are food/provision lift doors marked 'KEEP SHUT WHEN NOT IN USE'? 8. Are Galley vent flaps fitted, functional and clearly marked? 9. Are Galley fan starters identified as per BR 2170(1) Chapter 3?		

Check	✓	Reason for any Deviation
Breathing Apparatus (DC&FF) 1. Are BA holdings in accordance with the allowance? 2. Are BA lockers and spare cylinder stowages sited in accordance with the Class Book? 3. Is there a qualified BA maintainer, and the correct MMS. 4. Are all cylinders and charging panel gauges in-date for test? 5. Are all cylinders numbered correctly? 6. Do charged spare cylinders have the connection taped over? 7. Do nominated, correctly marked, BA lockers contain guidelines? (iaw Annex 21E to BR 2170(1)) 8. Does each locker contain a pre-wear check list? 9. Does each BA have a distress alarm fitted? 10. Does each BA have a 'set number' tally attached? 11. Are BA control boards, with marker pen, stowed in nominated, correctly marked, BA lockers? 12. Does each locker contain a firefighter's hood and anti flash gloves? 13. Are all sets fully charged? (Minimum 10 bar below max HP air system operating pressure.)		
BA Extension Equipment 1. Are the holdings in accordance with the allowance? 2. Are the lockers correctly stowed with one 2 m extension fitted to a rescue mask and one separate 15 m extension? 3. Are instructions displayed on the inside of the locker door? 4. Are the rescue masks clean and the hoses in good condition? 5. Are the lockers portable?		
BA Charging Panels 1. Are all BA charging points fully functional (or correctly tagged out)? 2. Has the air at each charging point been tested and does it meet the specification for breathing air? 3. Are ear defenders and goggles available at each charging panel? 4. Is the charging hose restraining wire attached to the hose and clipped to the panel? 5. Are charging instructions displayed? 6. Are the cylinder stowages used for recharging marked 'ONLY TO BE USED FOR RECHARGING CYLINDERS'? 7. Is HQ1 (OOD/SSC on MWV) aware of current status of all BA charging points?		
Fresh Air Breathing Apparatus (1PBS Patrol Boats only) 1. Is the apparatus easily available for entry from the weather deck? 2. Is it in good repair and working order?		

Check	✓	Reason for any Deviation
HPSW Hydrants and Softwall Hoses 1. Are all hoses the correct size and in good condition? 2. Are hoses correctly stowed in twin baskets? (Outer hose rolled ready for running. Inner hose faked in basket, connected to hydrant, and correct nozzle fitted. Waterwall on weather decks and Firefighter between decks.) 3. Are the rubber seals in all female hose connections in good condition? 4. Are through-bulkhead connections painted red, fitted with rubber seals and blanking caps? 5. Are all blanking caps fitted with retaining chains? 6. Is there a hose basket adjacent to all hydrants? 7. Have redundant blanking caps been removed from hydrants which have hoses connected?		
Nozzles 1. Are all nozzles operable through the full range of travel? 2. Are all nozzles stowed in the closed position? 3. Are fixed hatch waterwall nozzles set at the correct angle, and clear of obstruction? 4. Are all FHWW fitted with operable instantaneous blanking caps, bearing the same watertight and gastight markings as the parent hatches?		
Centre Feed Hose Reels 1. Are all CFHR set up in accordance with BR 2170(1)?: **Two HPSW valves fitted.** a. HPSW isolating valve pinned open. b. HPSW valve adjacent to the inductor panel shut. c. Three-position selector valve set to FOAM (Mk 1) or foam/water selection lever set to FOAM (Mk 2). d. Nozzle valve shut. **One HPSW Isolating Valve Adjacent to Inductor Panel.** a. HPSW valve adjacent to the inductor panel shut. b. Three-position selector valve set to FOAM (Mk 1) or foam/water selection lever set to FOAM (Mk 2). c. Nozzle valve shut. **One HPSW Isolating Valve Not Adjacent to the Inductor Panel (not applicable to Mk 2).** a. HPSW valve pinned open. b. Three-position selector valve shut. c. Nozzle valve shut. 2. Are all CFHR hoses, nozzles and pick-up spills in good condition? 3. Are operating instructions displayed adjacent to each CFHR? 4. Are shaded deck plans, indicating the compartments served, displayed adjacent to each CFHR? 5. Is the foam position clearly marked using photo-luminescent tape?		

Check	✓	Reason for any Deviation
Foam Making Equipment 1. Are FB5X branchpipes sited only between decks and in the UDRFPP with the spill pick ups fitted? 2. Are only Mk 2 FB5X branchpipes held and checked as follows: a. Pick-up suction holes clear? b. Rubber tubing not cracked, perished or distorted? c. Strainer clear? d. Pick-up spill connected to branchpipe? e. Foam mix selector set to 6 %? f. Non-return valve fitted in spill pick-up coupling? 3. Are FB10/10 branchpipes located only at the hangar / flight deck, and checked as follows: a. Are the control vanes greased and free? b. Are they stowed under cover unless at Flying Stations? 4. Are the caps on all AFFF drums only hand tight, with an unbroken security seal? 5. Are the holdings of AFFF drums in accordance with the allowance and in-date for shelf life? (20 years) 6. Are all FBU5 inductors stowed with a 2m hose? 7. Are the holdings of FBU5 inductors and associated 2 m hoses correct? 8. Are FBU5 inductors stowed adjacent to machinery spaces? 9. Where fitted, are AFFF storage tanks marked with 20 mm white letters on a red background '5 MINUTES TOTAL CAPACITY OF AFFF'?		
Foam Tubes 1. Are the caps free and fitted with sealing washers (and retaining chains where applicable)? 2. Are notices posted, stating the compartment served and the number of AFFF drums required for full bilge coverage? 3. Are the caps engraved to indicate the compartment served? 4. Where deck caps are fitted, are keys sited adjacent to each one? 5. Are AFFF drums stowed adjacent to all foam tubes?		

Check	✓	Reason for any Deviation
Portable Fire Extinguishers 1. Is the number of AFFF, dry powder and CO_2 extinguishers in accordance with the allowances? 2. Does each extinguisher and stowage have a clearly marked, unique identification mark / number? 3. In compartments fitted with CO_2 injection points, is the correct type of diffuser fitted to CO_2 extinguishers? 4. Are portable extinguishers fitted with safety pins and anti-tamper tags, fully charged, serviceable and in-date for test? 5. Is there adequate provision of bulk AFFF for recharging extinguishers, stored separately from AFFF drum stowages? 6. Is the SPE recharging cylinder in-date for test?		
Fixed Firefighting Systems 1. Are system valves, etc clearly identified? 2. Are operating instructions displayed and correct? 3. Are keys / operating handles available at all operating positions 4. Where applicable, is the back-up system correct? (eg water/AFFF back-up to gas drench) 5. In compartments fitted with steam or CO_2 drench, is one ventilation flap marked 'TO BE SHUT BUT NOT CLIPPED WHEN STEAM/CO_2 DRENCHING'? 6. Are warning signs posted at the entrance to compartments, denoting gas used? (including gas bottle stowages). 7. Are the visual and audible warning alarm systems functional? 8. Is the operating CO_2 bottle fitted / available with safety pins fitted? 9. Are all operating positions functional? 10. Is the Halon / CO_2 bottle store correctly identified?		
Firefighters' Clothing 1. Are the holdings iaw BR 2170(3)? 2. Are the fearnought suits, boots and stockings held in good condition? 3. Do all BA lockers contain one firefighter's hood and one pair of anti-flash gloves, and are they in good condition?		
Firefighters' Helmets 1. Are the holdings of helmets in accordance with the allowance? (iaw BR 2170(1)) 2. Do the built-in radios and hand-held radios provide clear communications? 3. Do the ship's orders provide clear guidance on the selection of radio channels?		

Check	✓	Reason for any Deviation
Thermal Imaging Cameras 1. Are all TIC stowed with Duracell batteries fitted? 2. Are all TIC regularly proved by a functional test? 3. Are spare batteries readily available in either the TIC box or at the FRPPs?		
Electric Submersible Pumps 1. Is a 12 mm diameter lowering line spliced to each pump? 2. Are the power cables whipped to the lowering lines? 3. Are the Weda pump accessories held? (see BR 2170(1)) 4. Are the pumps secured properly? 5. Is a functional test regularly completed? 6. Are the power sockets painted yellow and numbered in black? 7. Are the socket interlocks effective? 8. Are Type A or Type B adaptor leads held (iaw BR 2170(1)) 9. Are all pumps in date for electrical testing?		
Diesel and Gas Turbine Driven Pumps 1. Is the full outfit of accessories held in accordance with BR 2170(1) Chapter 28 and the pump BR? 2. Is a functional test regularly completed? 3. Are the pumps secured properly? 4. Do all suction hoses have good coupling seals?		
Portable Eductors 1. Are the holdings of eductors and associated accessories at each FRPP in accordance with BR 2170(3)? 2. Is a functional test regularly completed? 3. Do the suction hoses have good coupling seals?		
Indicator Test Plugs 1. Are ITPs easily workable by hand and unpainted? 2. Are leather/fibre and metal washers fitted? 3. Do those fitted to magazines and flammable stores have a split pin fitted?		
DC&FF Equipment 1. Are the contents of FRPP lockers in accordance with BR 2170(3) and the displayed contents list, and in good condition? 2. Is the DC&FF equipment stowed adjacent to FRPPs and at dispersed positions in accordance with BR 2170(3) and in good condition? 3. Is the equipment at the Upper Deck Re-entry Fire Party Post in accordance with BR 2170(3) and in good condition? 4. Is all electrical equipment in date for electrical testing? 5. Is NBCD open line working?		

Check	✓	Reason for any Deviation
Main Machinery Space Ventilation Systems 1. Are all MMS ventilation starters identified as per BR 2170(1) Chapter 3?		

Check List Completion by Ship's Staff

Signature .... Print Name .... Rank/Rate .... Post ....

Audit by Fleet Waterfront Staff

Signature .... Print Name .... Rank .... Post ....

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ANNEX B TO CHAPTER 36

HAT (NBCD) PRE-RFSD CHECKS

HMS ....

Check	✓	Reason for any Deviation
NBCD and Identification Markings 1. Do the following openings have the correct risk, control and location markings in accordance with BR 2170(1) and the ship's Class Book? a. Doors b. Hatches c. Vent terminals and trunkings d. Scuttles and deadlights e. Opening bridge windows f. Electrical connectors, sockets and deck tubes g. Escape scuttles and hatches h. Ventilation spigots in watertight doors (CVS and T 42 only) 2. Are the following systems and fittings correctly identified in accordance with BR 2170(1) and BR 2170(3)? a. Pipe systems b. Gas boxes c. Discharge overboard valves d. Drains and discharges e. Watertight slide valves f. Trunks g. Foam tubes h. Through-bulkhead hose connections 3. Are the following marked with photoluminescent paint? a. HPSW system main isolating valves b. Machinery space fire isolation valves c. BA charging panel isolating valves d. Remote diesel engine stops e. Remote fuel stops for auxiliary boilers f. The fully closed position on Leith Cardle WT door handles g. Operating levers/handwheels on escape scuttles 4. Are valves and hydrants on the HPSW main identified in accordance with BR 2170(1) Chapter 3?		

Check	✓	Reason for any Deviation
Miscellaneous Markings 1. Are the following signs in accordance with BR 2170(1) Chapt 3? a. Other Side markings b. Sub citadel boundaries c. NBCD zone boundaries d. Compartment Contents circles e. Two clip markings f. Compartment below signs g. Shelter routes h. Upper-deck MMS boundary cooling markings.		
Incinerator Compartments 1. Is the remote fuel drain valve clearly marked? 2. Are there clear operating instructions, including clinker and ash removal? 3. Is there a SPE (AFFF) in the vicinity?		
Citadel Airlocks 1. Are the insides of both doors marked ‘CITADEL OUT’ and the outsides marked ‘CITADEL IN’ ? 2. Are light exclusion plates fitted to the viewing ports? 3. Are air bleed valves (where fitted) in good condition?		
Seat Covers and DIY Additions 1. Are all seat units fitted with removable, flame retardant covers? 2. Are seat locker lids securable? 3. Are DIY additions in messes: a. Made of flame retardant materials? b. Readily removable? c. Clear of any DC&FF arrangements?		
Ramset Tool 1. Is the holding in accordance with the allowance? 2. Is the correct set of charges held? 3. Are ear defenders and goggles included in the set? 4. Are there sufficient trained operators (completed NBCD35 course)?		
Mobile Repair Party Post 1. Are immersion suits available? 2. Are two fully stocked leak stopping bags available? 3. Is there a dedicated and functional communication line between the MRP and the MCR/SCC?		

Check	✓	Reason for any Deviation
Thermal Lance Cutting Equipment 1. Is the holding of cutting equipment and oxygen cylinders in accordance with the allowance? 2. Is a regular functional test carried out? 3. Are there sufficient trained operators? 4. Is a set stowed in the superstructure, within reach of a hatch leading between decks? 5. Are the batteries recharged at least every 8 weeks? 6. Is a copy of the operating instructions included in the case? 7. Are the oxygen cylinders stowed in a correct location, as near as practicable to the set?		
Cutting and Spreading Equipment 1. Is the holding in accordance with the allowance? 2. Is a functional test of all components regularly carried out? 3. Are there sufficient trained operators? 4. Is the equipment stowage readily accessible to the MRP? 5. Is a copy of the operating instructions stowed with it? 6. Are visor/goggles and heavy duty gloves stowed with it?		
Emergency Electrical Supplies 1. Are cables and stowages correctly marked? (pre Type 23 ships) 2. Are cables and connectors in good condition? 3. Are portable transformers and fuse panels in good condition?		
HP Air/Hydraulic Hose Repair Kits 1. Is the correct outfit held in accordance with BR 2170(3)? 2. Is the stowage accessible to the MRP?		
Magazine Spray Systems 1. Are manual spray valves locked and the keys available adjacent to the valves? 2. Are automatic spray systems correctly set up in accordance with the operating instructions? 3. Are spray systems identified and operating instructions clearly displayed? (white on red)		
Petrol Stowages (excluding MM/PPs) 1. Are fuel tanks painted grey and contents identified with 25 mm red lettering? 2. Are stowages marked ‘PETROL STOWAGE NO SMOKING’ in white letters on a red background? 3. Is the remote release at least 5 m from the stowage? Is the quick-release handle clearly identified? 4. Does the mechanism appear operable? Is it in-date for functional test?		

Check	✓	Reason for any Deviation
Hangar Spray System 1. Is the spray operating valve (or pneumatic control) locked and the key available nearby? 2. Is the spray system identified and operating instructions clearly displayed? (white on red)		
SF90 Mobile Foam Unit 1. Is the holding of SF90s for the aviation facilities in accordance with the allowance? 2. Is the foam tank correctly filled with a 6% AFFF / fresh water solution? 3. Is the air cylinder charged to 123 bar?		
10 kg CO_2 Extinguisher 1. Is the holding in accordance with the allowance for the aviation facilities? 2. Are the flexible hose, extending lance and removable discharge horn in good condition? 3. Is the CO_2 cylinder fully charged?		
Flight Deck Foam Monitors 1. Are the monitors set to the automatic oscillating mode, with the nozzle centred, the correct elevation and the correct spray angle? 2. Is the system correctly set up in accordance with the operating instructions? 3. Does the tank contain 1% AFFF, to the correct level? 4. Are system valves identified and operating instructions clearly displayed? (white on red)		
Hangar Firefighting Locker 1. Are the contents of the locker in accordance with BR 2170(3)? (single spot ships)		
Fire and Repair Party Posts 1. Are the locker contents and adjacent equipment itemized on check lists? 2. Are locker drawers marked to show contents? 3. Are locker keys available in a glass-fronted keybox? 4. Are the following held at each Post? a. Personnel muster cards b. State 1 preparation check lists c. State 1 dispersal plan d. Patrol route cards e. Kill cards for compartments covered by that FRP f. Closing down cards for Yankee, Zulu, Alfa and Mike openings 5. Is the whole-ship incident board stowed securely and in accordance with its classification when not in use, but portable when rigged?		

Check	✓	Reason for any Deviation
6. Does the incident board emergency lighting work? 7. Does the incident board show personnel locations at State 1? 8. Is there a whole-ship electrical board? 9. Is there an electrical 'underground map'? 10. Is there a 'green line' to HQ1 (and Section Base) 11. Is there a clock? 12. Are there stowage arrangements for duplicate key boxes? 13. Is there a whole-ship HPSW system board? 14. Are the patrol, leakstopping and shoring bags held in accordance with BR 2170(3)?		
Machinery Space DC Equipment 1. Are the DC boxes and bags in accordance with BR 2170(3)? 2. Are the boxes properly secured, fully stocked iaw BR 2170 and the contents available for immediate use? 3. Are the shoring materials in accordance with BR 2170(3), properly secured and available for immediate use? 4. Are all eductors functional and ready for use? 5. Are all MMS manometers filled with water coloured with Methyl Orange? 6. Are signs posted at accesses detailing length of hoses required to reach extremities of compartment? 7. Are the following held in each DC box? a. State 1 preparation cards. b. Blanket search cards. c. Fire isolation cards for adjoining main machinery spaces. d. Muster list for DC box. 8. Is DC equipment available in the Tiller Flat?		
HQ2 (large ships only) 1. Is the location separated from HQ1 by at least two main transverse bulkheads? 2. Are the equipment and documentation as specified for HQ1?		
Section Bases (large ships only) 1. Are the facilities in accordance with BR 2170(1) Chapter 8?		

Check	✓	Reason for any Deviation
Alternative HQ (AHQ) 1. Does the location give easy access to fresh air? 2. Is a whole-ship incident board available, with a stowage and emergency lighting? 3. Is a full set of kill cards and smoke clearance plans available? 4. Is a HPSW system board available? 5. Is an NBCD ventilation board available? 6. Is an NBCD electrical information board available? 7. Are the following communications available? a. NBCD open line to HQ1, FRPPs and Ops Room b. ‘Green line’ c. Main broadcast d. Exchange telephone e. Field telephone and cable (may be stowed in UDRFPP)		
Weapon Section Base 1. Are WSB facilities available in accordance with BR 2170(1) Chapter 8? 2. Is an alternative WSB available in accordance with BR 2170(1) Chapter 8?		
Orders and Publications 1. Is the NBCD section of Ship’s General Orders in accordance with BR 2170(1) Chapter 35? 2. Are the Ship’s NBCD Orders in accordance with BR 2170(1) Chapter 35? 3. Are Volumes 1, 2, 3 and 5 of BR 2170 held and at the latest change state? (for current change state, ring NBCD Fleet Staff Author on MoD 93825-2752) 4. Are the holding and custody of the NBCD Class Book in accordance with the CB Register? 5. Where applicable, is the holding and custody of the Ship Stability and Survivability Book in accordance with the CB Register? 6. Are the Stability Statement, Curves of Statical Stability and Hydrostatic Particulars up-to-date? 7. Are NBCD posters, selected from BR 2170(3), displayed around the ship? 8. Is ATP 45 Volume 1 held, and at the latest change state? 9. Is the BRACIS software held and available for use?		

Check	✓	Reason for any
NBCD Organisation 1. Is BR 9274 being used as a basis for NBCD training? 2. Are the HFEP and SSEP organisations in accordance with BR 2170(1) Chapter 20? 3. Are daily duty watch lists, detailing HFEP duties, displayed effectively? 4. Has a Jettison Bill been produced? 5. Are there any outstanding A&As or major defects affecting the NBCD capability? 6. Are regular HoD covered Fire exercises being conducted and recorded?		
Emergency Medical Facilities 1. Are First Aid Posts and Secondary Medical Positions provided and clearly identified? 2. Are sufficient First Aiders trained in accordance with BR 2170(1) Chapter 13?		
Citadel 1. Has a satisfactory HAT (Citadel) been completed? 2. Are all manometers filled with water, coloured with methyl orange? 3. Are all manometers marked to show the differential pressure being measured? (eg Zone 1 / atmosphere) 4. Is a portable digital manometer held? 5. Are all AFUs in-date for test and filter life?		
Collective Protection in Non-Citadel Ships 1. Are the COLPRO arrangements clearly defined in the ship's orders? (UCPS or sanctuary) 2. Are the material arrangements available and proven?		
NBC Protection Officer Facilities 1. Can the NBCPO be accommodated in or adjacent to HQ1? 2. Does the NBCPO have easy access to the following?: a. Communications to the Command Adviser b. The SIRS indicating unit c. Main broadcast 3. Is the following documentation available to the NBCPO? a. Total Dose Record Board b. Log/log graph paper c. Stay-time table d. Monitoring Route Cards in splashproof covers e. Radiological Monitoring and Decontamination Boards f. Chemical State Board g. Citadel in/out Log i. NBCPO's incident Board		

Check List Completion by Ship's Staff

Signature .... Print Name .... Rank/Rate .... Post ....

Audit by Fleet Waterfront Staff

Signature .... Print Name .... Rank .... Post ....

ANNEX C TO CHAPTER 36

HAT (NBCD) PRE-FDI CHECKS

HMS ....

Check	✓	**Reason for any Deviation**
TV and VDU Protection 1. Do all TVs and VDUs have protective coverings/bags?		
Prewetting 1. Is the system identified by ‘PREWET’ tape? 2. Are operating valves marked by ‘PREWET’ tape either side of the valves? 3. Are all operating and drain valves locked shut? 4. Are low level nozzles fitted on the flight deck? 5. Has a satisfactory prewetting trial been completed?		
Cleansing Stations 1. Is the entry door marked ‘CLEANSING STATION’ on the outside in orange letters? 2. Does the final exit door bear an M control marking? 3. Do air bleed valves give a purging flow from the citadel, diagonally across all areas, to atmosphere? 4. Are the paintwork, fittings and equipment in good condition and in accordance with BR 2170(2) Chapter 14? 5. Are all areas of the cleansing station clear of extraneous items, unless specifically authorised by the Command?		
Cleansing Posts 1. Are Cleansing Posts sited in accordance with the Class Book? 2. Are they marked ‘CLEANSING POST’ in orange letters? 3. Are the cleansing lockers stocked in accordance with BR 2170(2) Chapter 14?		
CAM 1. Are holdings of CAM in accordance with the allowance? 2. Are CAMs, which are not vacuum packed, run up weekly? 3. Are the CAM, battery and protective nozzle within their shelf lives? (iaw BR2170(3))		
NAIAD 1. Are the holdings of NAIAD in accordance with the allowance? 2. Are the reagent module and enzyme pad within their shelf lives? (iaw BR 2170(3))		

Check	✓	Reason for any Deviation
SICS 1. Is the system serviceable and an onboard test kit held? 2. Are the filter paddle assembly and replenishment kit within their shelf lives? (iaw BR 2170(3))		
RVD 1. Are the holdings of RVD in accordance with the allowance? 2. Is the RVD training aid held? 3. Are the reagents within their shelf lives? (iaw BR 2170(3))		
Chemical Detector Papers 1. Are holdings of 1-colour and 3-colour detector papers in accordance with the allowance?		
Water Test Kit (Biological and Chemical) 1. Is the kit held, complete with consumables? 2. Is there a trained operator?		
Radiac Instruments 1. Are the holdings of the following instruments held in accordance with the allowance? a. Quartz Fibre Dosimeter and Charging Unit b. General Purpose Beta/Gamma Monitor ADM 300A(V1A) c. Potable Water Contamination Monitor MK25 NRM 2. Is the SIRS serviceable and regularly tested?		
NBC and Decontamination Suits 1. Are the holdings of IPE in accordance with the allowances and within their shelf lives? (iaw BR 2170(3)) 2. Are the holdings of Decontamination Suits in accordance with the allowance?		
NBC Respirators 1. Are all personal respirators within the 20-year life, in-date for test and held onboard? 2. Are fibre discs fixed to respirators and haversacks, giving personal details? 3. Are the haversack contents in accordance with BR 2170(2) Chapter 12? 4. Are stocks of both types and all sizes of NBC respirator, and spare canisters held? (iaw BR 2170(3)) 5. Are all stock and personal spare respirator canisters within their shelf lives? (iaw BR 2170(3)) 6. Have corrective lenses been issued, where needed?		

Check	✓	**Reason for any Deviation**
Air Filtration Units 1. Do the gas filters have a practicable in-service life remaining? 2. Where this is less than 12 months, has a suitable maintenance period been identified for changing filters?		
NBC Contamination Control Stores 1. Are the holdings of the following in accordance with the allowances? a. DAP2 b. CAD c. Citric acid d. Fuller's earth e. Conwed sorbent rug f. DKP1 and DKP2 g. Combopen and NAPS (in MO's custody) h. Combopen training device i. NBC casualty bag 2. Are there sufficient stocks of the following? a. GP detergent, scrubbers, etc for decontamination b. Paper/plastic bags and paper towels for cleansing stations c. Trigene disinfectant for respirator facepieces		
NBCD Radioactive Sources 1. Are the following items correctly stored and accounted for in the Radioactive Source Register? a. CAM b. Check source for MK 25 NRM Potable Water Monitor c. SIRS heads d. SICS Mk 10 drift tube		

Check List Completion by Ship's Staff

Signature .... Print Name .... Rank/Rate .... Post ....

Audit by Fleet Waterfront Staff

Signature .... Print Name .... Rank .... Post ....

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