SECTION 7. FIREFIGHTING AND SAFETY EQUIPMENT

FIREFIGHTING EQUIPMENT

Thermal Imaging Camera (TIC)

7.1 Thermal Imaging Cameras (TIC) use infrared technology to identify heat sources in poor visibility. TIC can be used to identify hot spots in a fire or to search for personnel.

7.2 The hose teams in WESTRALIA used TICs on 5 May 1998.As there were only three allocated to the ship it was important that this resource was fully operational. Unfortunately there was a problem with one of the TICs which meant that the hose teams had to pass a camera from team to team. LS Mitchell described the TIC failure, saying:

> I couldn't see anything through the TIC camera: the screen was black, the lights were still on, but it was not working.[T665, 668]

7.3 The Board also heard evidence that the TICs were of very little benefit at the start of firefighting operations as the camera screens suffered from 'white out effect' due to the high ambient temperatures that prevailed in the MMS.[T668.6] Hose team leaders were unable to identify the seat of the fire with any certainty using the TIC until much of the extreme heat in the MMS had dissipated.

7.4 The Board is aware that the Director of Naval Warfare (DNW) is in the process of introducing an improved TIC to the fleet.[DNW Minute D91/3075.1 dated 7 Jul 98] Any new TIC introduced into the naval inventory should be extensively trialled. Depending on the technology available it should be capable of discriminating fire from a background of very high ambient temperatures.

Conclusions

7.5 The TIC currently in service suffers from overload in large fires and was of marginal utility in this case.

Recommendation

7.6 Thermal Imaging Cameras used by firefighting teams should be capable of determining the seat of a fire against very high background temperatures.

Waterwall

7.7 In shipboard firefighting an effective waterwall is an essential element. A waterwall provides a hose team with a shield against the heat from the fire and cools the space around them. The waterwall nozzle should supply a wide cone of water spray.

7.8 A number of personnel who were part of the hose teams have stated that the Elkhart nozzles did not provide a wide enough spray pattern to protect all the hose crew

from the high temperatures. The general view of those who came before the Board was that the older English style branch provided a wider protective spray pattern while the new Elkhart branch provided more water but the spray pattern was not as good.[T663, T664, T767, T469, T479]

7.9 The issue here is whether a wider spray pattern would have made any difference on the day. The MMS had been enclosed for some time prior to the entry of the hose teams and was filled with trapped heat and smoke. Firefighting operations would have also produced a significant quantity of steam, which would have made the conditions even more difficult for the teams. In addition the sheer size of the space allows heat to come around behind the hose teams' protective curtains and impact on personnel. The comments made suggest that the earlier style branches are more effective but testing needs to be carried out to verify if this is in fact the case.[T685, T693] RAN training tends to focus on compartments with low deckheads. The large dimensions of WESTRALIA's MMS may detract from the utility of the Elkhart branch.

Recommendations

7.10 Although the hose nozzles currently in service in the RAN are appropriate in various fire situations, further evaluation should be undertaken of the most appropriate nozzles, and particularly waterwall nozzles, for use in the whole range of situations which can be foreseen. In particular, compartments with unusual configurations, such as the exceptionally large spaces in WESTRALIA's MMS, need further study.

BREATHING APPARATUS RESOURCES

7.11 WESTRALIA is equipped with the following OCCABA and spare cylinders:

a. 28 sets in stowage around the ship

b. 2 spare sets in the NBCD store

c. 56 (approx.) spare cylinders [E419]

7.12 The number of OCCABA and spare cylinders is sufficient for one wear of all the sets and a change over of all cylinders once. This theoretically enables operations requiring respiratory protection for 30 personnel to continue for approximately two hours. This is sensible approach considering the likelihood of an emergency arising when there is limited opportunity for the ship to seek external assistance.

7.13 The RAN Damage Control Manual, ABR 5476 Vol 1, details WESTRALIA's allowance of 30 OCCABA and 30 spare cylinders. This number of spare cylinders is inadequate for a complete change of fitted cylinders. As a result of the conflicting documentation there is some confusion about how many spare cylinders should be carried in the ship.[T1338]

7.14 There was also conflicting evidence as to whether there was an adequate number of OCCABA in WESTRALIA to combat the fire.[T143, T383, T1349, T2839] There were claims that at times there were not enough OCCABA readily available for hose team members to wear.[T383] However it is also clear the WESTRALIA requested

additional breathing apparatus sets be sent from the other RAN vessels to supplement the ships resources and these were supplied.[T128, T143]

7.15 The problem of where a ship stores its OCCABA and spare cylinders is a prime consideration. The sets are not located in a common area but are dispersed throughout the ship. This makes it difficult in an emergency to ascertain if all the resources have been gathered and used.[T418]

7.16 During this emergency additional resources were readily on hand but this may not always be the case. To enable the ship to maximise the equipment that is available, the standard operating procedure in a major incident is for all the sets and cylinders to be taken to a central point. From this point a logistics officer, or someone coordinating the entry of hose teams, could monitor the availability of equipment, and allocate resources to the most important area.

Conclusions

7.17 The number of OCCABA carried by the ship was appropriate. The ship carried a greater number of spare cylinders (by a factor of almost two) than the number specified in the RAN Damage Control Manual - ABR 5476 Vol 1.

7.18 In a major incident the utilisation of breathing apparatus should be managed by one person.

Recommendations

7.19 The allocation of spare OCCABA cylinders in a ship should be equal to the number fitted to the breathing apparatus sets.

7.20 ABR 5476 should be updated to reflect the allocation of OCCABA and spare cylinders.

7.21 During any major incident, a coordinator should be designated to gather all OCCABA resources and place them in a central location.

Condition and Maintenance of OCCABA

O rings

7.22 A number of personnel have given evidence that the OCCABA O-rings failed on their set while others reported difficulty in changing cylinders.[T1349, T2524, T2539, T627] It was reported to the Board that the blowing of O-rings was a common occurrence and this happens if the cylinders are turned on too fast.[T980, T984 , T1000, T1349]

7.23 To determine what problems, if any, there are with the OCCABA, the Fire and Emergency Services Authority of Western Australia (FESA) was asked to conduct an independent assessment on a set obtained from HMAS STIRLING. In addition a quantity of O-rings were supplied with the set so that comment could be made on the density of the material used.

7.24 The O-ring test results indicated:

a. In over one hundred operations of the cylinder valves no O-rings failed. However, prior to the test all three O-rings were replaced as they were damaged.

b. The O-rings, BS 111/A90, nitrile (NSN 5330-66-121-8906) as supplied by the Navy store appeared to be correct size and composition.

c. The OCCABA set has three high pressure hand wheels that can vibrate loose in stowage. With a loose connection and the application of high pressure the O-rings can be damaged and cause leakage. A leaking O-ring reduces the maximum duration of the OCCABA.[E429]

Test Bench Interspiro Spirotest 2000 results.

7.25 The OCCABA was placed on a computerised test bench, which was set to the parameters for the non-military version of the unit. The set failed a number of tests, indicating that the complete set was in need of a full service and calibration. The result of most concern was the failure of the set to provide a positive facemask pressure on any of the three breathing rates.[E429] A negative facemask pressure can allow toxic gases to enter the facemask when the wearer inhales. The adverse affect of personnel with beards using breathing apparatus is covered in more detail at Section 3 of this report.

7.26 While this is the test result of only one OCCABA, it was selected at random and may indicate a more general problem with the servicing and maintenance of the equipment throughout the Navy.

7.27 Other matters raised by FESA technicians were:

a. The mass of the apparatus fully charged and ready for use is 19kg. This exceeds the maximum of 18kg for compressed air breathing apparatus in AS/NZS 1716:1994.

b. Breathing apparatus should be serviced as per section 8 of AS/NZS 1715:1994. Point 8.3 of section states ‘In all cases the manufacturer’s instructions should be observed when servicing self-contained breathing apparatus’.

7.28 The details for servicing WESTRALIA OCCABA are outlined in the planned maintenance schedule. This schedule details the weekly, monthly, three monthly, six monthly, twelve monthly and twenty-four monthly requirements. The twenty-four monthly requirements require the complete set to be sent away for servicing and calibration.[E102]

7.29 The manufacturer of the RAN’s OCCABA recommends that the pressure reducer valve should be serviced annually. As the pressure reducer is attached to the backplate this would suggest the complete set should be sent away for servicing annually rather than the 24 months specified in the planned maintenance schedule. No details are available for the servicing of the facemask.[E464]

7.30 A complete set is made up of a number of key components. The major components that are readily separated include the cylinder, backplate (included main valve assembly and pressure reducer) and face mask. In the WESTRALIA the cylinder and backplate are numbered but not the facemask.[T1350] The numbering of these

components would enable them to be traced to ensure they meet the requirements of the planned maintenance schedule.

7.31 To ensure all components are serviced at the appropriate intervals the facemask and backplate must be given the same number. This will overcome the problem of facemasks being interchanged onto different backplates. As not all OCCABA are serviced at the same time it is possible, by interchanging facemasks, for facemasks to miss being serviced. This increases the risk of worn or faulty facemasks being attached to a newly serviced backplate, directly affecting the effectiveness of the unit and the safety of the wearer.

7.32 To ensure all OCCABA are maintained in accordance with the planned maintenance schedule, records must be kept of the set numbers and the dates they were last serviced.

Conclusions

7.33 The Board has serious concerns regarding the servicing of OCCABA sets, the unacceptable number of equipment failures and the monitoring of the servicing. The Board also notes that the OCCABA sets exceed the weight recommended by the AS/NZS 1716:1994.

7.34 RAN OCCABA sets have three high-pressure hand wheels. If these are not fully tightened damage to O-rings can result. As there are three high pressure connections rather than the one found on BA generally, there is a three-fold risk of failure.

Recommendations

7.35 The Navy should review its policy on the servicing of OCCABA to ensure it meets the highest standards and meets the manufacturer's instructions.

7.36 A Navy instruction should be distributed outlining the following:

- **The type and part number of the O-ring to be fitted to OCCABA.**
- **Cylinder servicing - outlining care and maintenance procedures for O-rings.**

7.37 All facemasks should be numbered and matched to a backplate.

7.38 A system should be implemented in ships to record OCCABA set numbers and dates serviced.

7.39 Standard operating procedures should be reviewed to ensure high-pressure hand wheels are tight before cylinders are opened (part of the donning procedure).

7.40 The Navy should investigate the purchase of new breathing apparatus that has fewer hand wheels and complies with the Australian Standard.

Breathing Apparatus Ancillary Equipment

7.41 The vast majority of professional fire services today fit distress signal units (DSU) on to their breathing apparatus. The DSU is a self-activated detector which emits a loud piercing beep if the BA wearer stops moving. Should a BA wearer be injured or become unconscious the DSU will activate, alert other people to a problem and guide rescuers to the person by listening to where the noise is coming from.

7.42 Attached to the key that activates the DSU is a BA tag that is utilised to record the name of the wearer and cylinder pressure. The BA tag is given to the board marker on entry. Therefore before entry the key is removed with the BA tag and the DSU is activated. The BA tag slips onto the BA control board and is the record of entry for the wearer. The board marker calculates the time due out and includes other details as required. On exiting the scene the tag is taken off the BA board by the maker and given back to the wearer to deactivate the DSU.

7.43 This approach assists the BA board marker keep the entry control records correct. The board maker does not have to try and recognise the name of the wearer on entry and when the person exits they must get the tag from the marker to turn off the DSU. If they do not collect the tag, the DSU normally goes off to remind them they are still logged in on the BA control board. This method of entry control may have alleviated the problem of LS Nunn's name not being removed from the control board. Had he been missing, as the board marker thought, and was either lost or unconscious within the MMS, the DSU would have assisted the searchers to locate him.[T1336]

Conclusions

7.44 BA control tags are available to assist board markers maintain entry control.

7.45 Distress signal units are an additional safety device that can be fitted to OCCABA.

Recommendations

7.46 The Navy should fit DSUs and BA control tags, if they are acceptable for marine use, to all OCCABA.

Bauer Compressors

7.47 During firefighting operations the crew members of the WESTRALIA were concerned they would run out of fuel for the Bauer and called for additional supplies from other navy ships.[T738, T385] The fuel from the other ships arrived and fuel was taken from one of WESTRALIA's cargo tanks, which ensured there was no interruption to the process of charging cylinders. However the call for supplies highlights the need to store spare fuel away from the MMS so that the Bauer can be topped up during emergencies.

Conclusion

7.48 The ship had no spare fuel supplies for the forward Bauer compressor.

Recommendation

7.49 Fuel should be stored in a convenient position to re-supply the Bauer compressor.

ANCILLARY FIREFIGHTING EQUIPMENT

Communication with hose teams

7.50 Portable communications equipment (Maxons) although initially serviceable were not reliable or trusted.[T449, T544, T627, T630 T667, T1385, T1531] A significant number of people came before the Board and told of the problems that occurred with the Maxon radios. They got wet during firefighting operations and failed: this may be a result of a failure to use the waterproof bag provided for each unit. They did not work when some hose teams were within the MMS. The wrong buttons can be depressed when trying to transmit messages – compounded by the wearing of anti-flash gloves.[T627, T654 T784] The problems were mainly associated with communications between the hose teams and the scene leader.[T633]

7.51 As the Maxon was the only direct link between the hose teams and Aft DC Section Base and they did not always work, both parties had to rely on the use of runners to relay the information.[T640, T669] With teams working in dangerous situations where there was high risk of injury or the need for assistance, reliable radio communications are an operational necessity.

7.52 To overcome the communications problems often experienced between operational hose teams and command, a number of companies now produce a variety of systems for use with BA. They can come as compact microphone/loudspeaker units designed to be installed in the BA facemask, others fit in the helmet and some are also voice operated for hands free operation.

7.53 In an MMS environment where there may be noise and in situations where team members may not have free hands to operate a radio, these new systems would significantly improve the safety and effectiveness of hose team operations. The Board is aware that the RAN does have some hands free microphones attached to the Maxon for use by hose team leaders. None was used in WESTRALIA during the fire.[T626, T639-640, T771] The usefulness and allocation to ships of currently available systems as well as systems available on the market should be further investigated.

Conclusion

7.54 The Maxon radios did not work effectively on the day and communications with the hose teams failed on occasions.

Recommendation

7.55 The Navy should determine whether more effective and reliable portable radio communication systems than the Maxon are available for use within the ship.

7.56 A voice activated radio communication device should be fitted to a number of OCCABA in each ship.

Emergency Fire Pump

7.57 As the MMS fire pumps were unavailable for use, the forward emergency fire pump was started to charge the fire main for firefighting operations. When WO Bottomley checked the gauge in the MCR a pressure of approximately 110psi was being supplied to the main.[T57] The pump provided an adequate fire main pressure throughout the day to sustain the lines of hose in operation. There was some concern that the pump was going to run out of fuel.[T400]

7.58 WESTRALIA requested incoming personnel from the other ships to bring fuel for the fire pump [T1139]. By the time the fuel arrived on WESTRALIA members of the crew had already used containers tied to ropes and dropped into the cargo tanks to extract fuel for the forward pump [T434]. While this approach was successful, personnel should not have had to rely on such primitive and potentially dangerous methods to keep the pump running.

7.59 The wordings of the Lloyds and SOLAS regulation on fuel supplies are virtually identical. The Lloyds regulation states 'Any service fuel tank is to contain sufficient fuel to enable the pump to run on full load for at least 3 hours and sufficient reserves of fuel shall be available outside the MMS to enable the pump to be run on full load for an additional 15 hours'. Nobody on board knew of these requirements and the WESTRALIA did not have such an emergency fuel reserve.

Conclusions

7.60 There were no reserve supplies of diesel fuel for the emergency fire pump.

7.61 Current Lloyds and SOLAS regulations state 15 hours reserve fuel must be available outside the MMS.

7.62 Regardless of the Lloyds or SOLAS requirements, the endurance of the fire pump should have been known by the command team and spare fuel should have been kept in an accessible place outside the MMS.

Recommendation

7.63 HMAS WESTRALIA should comply with the Lloyds and SOLAS requirements for emergency fire pump fuel supplies.

SAFETY EQUIPMENT

Torches

7.64 Whilst no personnel came before the Board and complained of lack of torches it appears there were either not a lot available in the ship, or the resources that were available were not fully utilised. Evidence given indicates that personnel were conducting

operations within the MMS and the after pump room sharing one torch or with no torch at all [T2279, T659]. As these areas were either very dark or smoke logged, this practice was dangerous and could have caused a serious accident. Comment was also made that the battle lanterns were awkward to use [T768].

Recommendations

7.65 Navy should conduct an evaluation on the battle lanterns to determine their suitability.

7.66 An inventory should be undertaken to determine if there are enough torches on board WESTRALIA.

Helmets

7.67 Some of hose team members made reference to the need for helmets. They described how hot water or dripping plastic fell on their heads and burnt them through their antiflash gear.[T768, T516, T544] Although no serious injury was sustained, the hot material probably added to the stress experienced by the hose teams.

7.68 In any firefighting scenario there is always the chance of a hose team member sustaining a head injury. Modern firefighting helmets produced to the Australian Standard provide head, neck and face protection.

Conclusion

7.69 The hose teams had inadequate head protection.

Recommendation

7.70 Helmets should be introduced for hose team members.

ELSRD

7.71 An Emergency Life Support Respiratory Device (ELSRD) is composed of a fire resistant hood with a clear face piece attached to an air bottle with eight minutes supply of compressed air. They are designed for escape from compartments containing hazards such as toxic gases and smoke.

7.72 Six ELSRDs are located in WESTRALIA's MMS. They can be used by personnel in need of an emergency air supply to evacuate the area. The ELSRDs are positioned on the bottom plates each side of the catwalk near the ladder leading to the middle plates.

7.73 At the start of the fire there were eight people in the MMS and they were located on different levels. When the fire started the majority of personnel moved rapidly to leave the area or fight the fire. PO Francis and PO Smith ran past the ELSRDs stored on the bottom plates but neither grabbed and put on the device. PO Francis later tried,

unsuccessfully, to find an ELSRD.[T1462.1] There is no evidence to suggest that anybody else in the space tried to locate and put on an ELSRD.

Conclusion

7.74 The number of ELSRDs within the MMS was insufficient and confined to the bottom plates.

Recommendation

7.75 The number of ELSRDs in the MMS should be increased from six to at least six on each level and placed on or near the escape routes, clearly identified and readily accessible.