

Board of Inquiry (REPORT)

Loss of SS Atlantic Conveyor

Board of Inquiry
Furse House
37-41 Queens Gate Terrace
South Kensington
London SW7

21 Jul 82

Sir

1. We have the honour to report the findings of our inquiry into the loss of SS ATLANTIC CONVEYOR (AGO) as directed in your 00520/6.X dated 11 Jun 82.
2. The Board convened 21 Jun and dispersed 21 Jul 82. XXXXXXXXXXXX XXXXXXXXXXXXXXXX
XX were present throughout the examination of witnesses. 544,540
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3. The Board heard the evidence of 34 selected survivors (19 Royal Navy, 10 Cunard, 1 Royal Marine, 3 RAF, 1 STO(N)) and from DNOT, DGA(N). The valuable ship's investigation report dated 3 Jun 82 and statements from other survivors were available to the Board. A written survival questionnaire was also completed by all survivors.
4. We visited Northwood for briefings on 5 Jul and toured SS ATLANTIC CROWN in Liverpool 6 Jul 82.
5. A working level liaison was maintained with HMS SHEFFIELD's Board of Inquiry on non-warfare matters.

6. SS ATLANTIC CONVEYOR, a twelve year old ACL Container/Vehicle Transporter was taken up from trade 14 Apr 82. The ship was modified and stored in Devonport 16-25 Apr, sailing punctually for the South Atlantic after embarking 5 Chinook and 6 Wessex V and carrying out first of class flying (fixed and rotary wing) and RAS(L) trials.

7. ACO arrived off Ascension on 5 May and embarked 8 Sea Harriers and 6 GR3 Harriers. Then, in company with the Amphibious Group, ACO proceeded south arriving in the Total Exclusion Zone 19 May with 25 aircraft on board. The Harriers were disembarked to HM ships HERMES and INVINCIBLE 19-21 May and ACO remained with the Carrier Battle Group as HDS Ship. She was due to go into the Assault Operations Area on the night of 25/26 May to disembark her helicopters and associated stores, but at 1942 25 May she was hit in very quick succession by two air-launched Exocet missiles (AM39) which penetrated her main cargo deck port side aft causing explosions and a fireball.

9. The rapid spread of fire, the presence of hazardous cargo forward (kerosene and cluster bombs), and the onset of darkness prompted the timely decision to abandon ship.

ABANDONMENT AND SURVIVAL

10. The ship was abandoned in a calm and orderly manner. Twenty-two personnel were taken off by helicopter from the forward flight deck, four jumped overboard, the rest climbed down one of the three starboard jumping ladders aft. Being exhausted, wet and cold, many found entry into the 25-man RN liferafts difficult.

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12. Final rescue from liferafts was well conducted by HM Ships BRILLIANT and ALACRITY assisted by helicopters from the two CVS.

FINAL LOSS

13. After burning for another day during which she was photographed from a helicopter, the bow section containing kerosene and cluster bombs blew away. Listing and settling, the burnt-out midships and stern section finally sank under tow at 0350Z 28 May.

ADEQUACY OF MATERIAL

14. ACO was subject to Lloyds Register of Shipping continuous surveys of Hull and Machinery. Following a period of nine months laid-up in Liverpool, during which the Engineering Department had progressed machinery maintenance, the outstanding surveys were cleared and the ship raised steam with only a few minor problems.

15. An "on hire" survey was carried out jointly by surveyors representing ACL and the Ministry of Defence before sailing for Devonport and this only revealed a variety of minor defects in the cargo spaces and weather deck.

16. An intensive period in Devonport for conversion to aircraft ferry gave the opportunity for outstanding defects to be rectified and ACO sailed for the South Atlantic in a sound material condition. Three Cunard officers remarked that she was operating better at the time of her loss than at any time in recent years.

b. There were errors of judgement in not closing the ventilation flaps to cargo spaces in the first instance after the attack and failing to inject CO2 early enough and in sufficient quantities bearing in mind the hazardous nature of the cargo. However, given the design characteristics of the fixed firefighting system, it is considered highly unlikely that they could have controlled the very rapid spread of fire caused by two Exocet impacting close to inflammable cargo.

HONOURS AND AWARDS

22. The Board fully endorsed the Senior Naval Officers proposals passed to you before the Board convened. A separate citation for XXXXXXXXXXXXXXXX xxxxx Royal Navy was despatched to your Chief of Staff on 13 Jul.

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CONCLUSIONS AND RECOMMENDATIONS

23. Conclusions and recommendations on the many and varying aspects of this inquiry are included, where appropriate, in Annexes A-N to this report.

We have the honour to be,
Sir,
Your obedient Servants

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N/R

Lieutenant Commander, Royal Navy

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Commander, Royal Navy

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Commander. Royal Navy

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XXXX Surgeon Commander, Royal Navy

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XXX XXXXXXXXXXXXXXX

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Commodore

ANNEXES

- A. NARRATIVE
- B. MATERIAL STATE OF ATLANTIC CONVEYOR ON HER DEPARTURE FROM DEVONPORT 25 MAY 1982
- C. SHIPS CARGO LOADING
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- F. PROBLEMS ARISING FROM THE DESIGN AND LAYOUT OF THE SHIP AND HER MACHINERY AND EQUIPMENT IN FULFILLING HER ROLE, WITH PARTICULAR REGARD TO ANY HAZARDOUS MATERIALS
- G. MAJOR DEFECTS IN MACHINERY, SYSTEMS AND EQUIPMENT IMMEDIATELY BEFORE THE ATTACK
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ENCLOSURES:

- 1. SET OF PHOTOGRAPHS

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NARRATIVE

ANNEX A TO

AC/BI/002

DATED 21 JUL 82

14 April, Wednesday	Study/Meeting in MOD(N). Concept evolved of using ACO to carry Harriers to War Zone to replace lost aircraft in the Task Group.
15 April, Thursday	Late PM, ship sailed Liverpool.
16 April, Friday	Ship arrived Devonport.
17 April, Saturday	Decision taken to embark Naval and Victualling stores.
20 April, Tuesday	Decision taken to embark further equipment (eg Tented City).
16 - 25 April	Modification period in Devonport.
23 April, Friday	Main modification programme complete.
24 April, Saturday	ACO left Dock at 1600 and anchored in Sound.
25 April, Sunday	Bunkered with FFO, AVCAT and WATER overnight. FOCFT - WESSEX, CHINOOK (Both Decks), SEA HARRIERS (Forward Deck). Embarked five CHINOOK (18 Sqn), 6 WESSEX 5 (848 Sqn). ACO sailed Devonport late pm. RAS(L) Trial with RFA GREY ROVER. Initial DC exercises conducted (Minor/major fires Degaussing run. Emergency Station exercised (DOT rules). Sailed in company 'EUROPIC FERRY'.
2 May, Sunday	Arrived Freetown 0900.
3 May, Monday	Sailed Freetown 0600. Independent. fast passage South.
5 May, Wednesday	Arrived Ascension 0600. Offloaded 1 CHINOOK to Ascension. Victualling stores transferred to RFA STROMNESS by Vertrep from after ramp (36 hours). 80% completed. Loaded 8 SEA HARRIERS and 6 GR3 HARRIERS
6 May, Thursday	Pre-sailing briefing in FEARLESS.
7 May, Friday	ACO sailed Ascension PM. In company with Amphibious Group (TG 317.0). Continued to transfer stores. Passage to TEZ. One HARRIER at Deck Alert 20 during daylight hours in Anti-Shadower role. Armed with Sidewinder AIM9L and guns.

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Four GR3 HARRIERS and four SEA HARRIERS
disembarked to HMS HERMES.

ACO proceeded in company HMS ARDENT to rendezvous with HMS INVINCIBLE.

Four SEA HARRIERS disembarked to
HMS INVINCIBLE.

One GR3 to HERMES.

ACO rejoined main Battle Group.

Last GR3 HARRIER disembarked to HMS HERMES.

ACO remained in close company Battle Group.
Provided HDS facilities for Battle Group
(3 WX 5 and CHINOOK used).

One LYNX embarked.
Used as "Hot Spare" source for remainder BG's
LYNX.

One WESSEX 5 transferred to STROMNESS.

20 Cluster bombs transferred to HMS HERMES.

Two WESSEX 5 and personnel from 845 Sqn embarked.

Signal received from ~~XXXXXXXXXX~~ detailing ACO
to be ready in all respects to proceed,
under cover of darkness, to San Carlos
Water to disembark all helos, at first
light.

20 Cluster bombs to HERMES.

Prepositioning of Squadron stores on aft flight deck and in C deck Cathedral area (Aft).

Prepositioning of stores for disembarkation of helo sqdns completed. Personnel involved cleared A, B, C decks and went to accommodation spaces.

CHINOOK (BT) completed disengaged engine ground run.

WESSEX YD takes off from ACO for check test flight and short vertrep with HMS HERMES.

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Immediate Execute Turn port to 040°.

Emergency stations piped by xxxxxxxxxxxx xxxxx 344
Ship's siren sounded as supplementary alarm. 340
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Missile approach from RED 150 sighted by
 xx
 xxxxxxxx Also sighted by xxxxxxxxxxxxxxxxxxxxxxxxxx
 HMS BRILLIANT.

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8 people known to have been between decks (aft) at this time.

XXXXX informed on TG Tactical (UHF). 544, 540, 538

HMS INVINCIBLE fires Sea Dart.

Boilers went out. Shafts stopped.

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Sound Powered Telephones only in use.

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WESSEX YD scrambled from HMS HERMES.

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XXXXXXXXXXXXX attempts to release stbd bridge wing lifebouy. Release pin broke off in his hand. XXXXXXXXXXXXXXX releases smokefloat only (cuts line to buoy). Hits water 1000 yds from man.

Boundary cooling commenced 1 Deck.

WESSEX YD (originally from ACO, but launched from HMS HERMES) recovers man overboard. Directed to man by UHF radio from ACO.

Helo YD observes deep rooted fire through missile penetration hole in ACO port side.

Lift shaft to after end engine room reported collapsed.

Smoke reported as far fwd as fwd DC party station (For'd MG Room). No evidence of fire fwd on A Deck.

Attempts to close all fan flaps unsuccessful.

AGRs in use on after Flight Deck.

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Ammunition on After Flight Deck (grenades and 7.62 mm) being ditched overboard.

Thick black smoke reported on all, A Deck.
No heat/damage. Frd DC party moves to upper
deck.

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C02 firefighting system activated.

Ships firemain pressure lost.

HMS ALACRITY asked if ACO settling by stern. Reply negative. HMS ALACRITY (on ACO's stbd quarter) standing by to Boundary Cool from 50 yds. This was ineffective.

Sunset.

Ship's firemain pressure restored.

Several explosions from aft on C Deck area.

Three men succumbed to smoke and treated in First Aid Clearing Station.

RFA SIR PERCIVALE closing port quarter.
Unable to assist due to dense smoke.
Reported flames throughout hole (port aft).

Ship's main broadcast lost. Messengers used.

Consideration given to spreading and launching a WESSEX from forward but discounted in order to keep forward spot clear for airborne helos.

Fire assessed as out of control, and risk of fire spreading forward to "magazine" area (contents cluster bombs and kerosene).

Survival suits donned - order given by XXXXX 544, 54
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Aft flight deck becoming untenable because of dense smoke.

Abandon ship ordered, stand fast fire parties. ALACRITY asked to look out for any survivors who missed the rafts and drifted aft.

Three ladders put over stbd side.
Four liferafts launched over stbd side.
(Port side untenable due to smoke).
Three liferafts stowed below racks took
some minutes to launch.

Decision taken by ~~xxx~~XXXXXXXXXXXXXXXXXXXX to
abandon ship.

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Frd and Aft DC parties informed by xxxxxxxxxxxxxxxx. S4
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WESSEX YD lands on frd and picks up 15 members of Frd/flight deck DC party. SEA KING land on immediately afterwards to pick up final seven members of Frd DC parties. Both helos recovered to HMS HERMES.

HMS ALACRITY again attempts to come alongside, stbd aft, pulled away due to difference in heights of weather decks. Two ladders chopped in the process.
Abandon ship commenced.

Liferaft case seen to strike xxxxxxxxxx who was climbing down ship's side. 544, 540
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ALACRITY fires coston gun lines over liferafts
and pulls rafts clear.

Civil twilight.

Six liferafts pulled alongside ALACRITY.

HMS ALACRITY (with rafts alongside) goes astern to clear ACO's area.

One liferaft drifts round ALACRITY's bows.
Five/six people on lifelines.

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MATERIAL STATE OF ATLANTIC CONVEYOR ON HER DEPARTURE FROM
DEVONPORT - 25 MAY 1982

1. Following a nine months laid up period in Liverpool during which considerable maintenance work in the machinery compartments was carried out, ACO raised steam with minor problems, which were soon overcome, and proceeded to Devonport for conversion to an aircraft and stores carrier.
2. On 15 April 1982 an on-hire survey was carried out jointly by surveyors representing the Owners and the Ministry of Defence. The survey which covered all cargo areas and weatherdecks was detailed and only revealed a number of defects of a very minor nature (Appendix 3). Details of conversions to ATLANTIC CONVEYOR are at Appendix 4.
3. The system of Lloyds Register of Shipping continuous quarterly survey of Hull and Machinery (Appendix 1) was updated and this, following rectification of outstanding defects undertaken concurrently with conversion, the ship was considered to be well prepared to fulfil her role as an aircraft ferry and stores carrier.
4. XXXXXXXXXXXXXXXXXXXXXXXXXXXX. ACO has stated that the standard of maintenance in the machinery compartments was high, with a clearly lower standard of husbandry and cosmetics being apparent above and below decks, as would be expected. S44
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5. XXXXXXXXXXXXXXXXXXXXXXXXXXXX. Devonport Dockyard responsible for the completion of the conversion work of ACO (Appendix 2) has commented on the generally good condition of ACO. S44
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6. In the event, the only shortcoming identified in the material state which could have, but did not influence events, was the inability to release the lifebuoy, together with its smoke float from the starboard bridge wing when 'man overboard' alarm was given shortly after the missile struck. The smoke float was released and this combined with clear instruction from ACO was sufficient for an approaching helicopter to recover the survivor after a very short period in the water.

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ANNEX C TO

AC/BI/002

DATED 21 JUL 82

SHIP'S CARGO LOADING

1. The cargo carried in ATLANTIC CONVEYOR (ACO) and its distribution around the ship is detailed at Appendix 1 to this Annex. Specific hazardous cargo concentrations are indicated by shading, but other hazards existed throughout the ship in the form of vehicles and machines with full fuel tanks, POL associated with particular Squadron equipment, and other similar stores.

2. The actual storing XX 344, 340, S38
XXXXXXXXXXXXXXXXXXXX and the factors determining xx decision on 344, 340, S38
stowage are contained in XXXXXreport at Appendix 2 to AnnexO paragraphs 2.31 to 2.38. As mentioned elsewhere in XXXXreport, the final stability figure for ACO, as measured by its GM, was 2.4 metres, which was extremely stiff compared with its normal operating GM of around 75 cms. It is relevant that the ship's stabilisers were also inoperative.

3. Just prior to the Exocet attack, some re-disposition of 848 Squadron equipment had been completed in preparation for the San Carlos operations next morning. This included a quantity of inflammable stores and POL stowed on C Deck aft of the engineroom casing.

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EXPLOSIVES ARRANGEMENTSBACKGROUND

1. Initially ATLANTIC CONVEYOR (ACO) was intended only as a ferry for Harrier reinforcements and she was taken up from trade and converted at Devonport to meet this concept. No magazine arrangements were considered necessary within this concept and, consequently, none were included in the conversion work package. The Magazine Safety Committee were not involved in STUFF.

2. However, the need for further supplies of explosive stores in the Falklands operation led to the late embarkation of the following:

240 x 600lb RAF Cluster bombs
AS12 (motors and heads crated separately)
SS11 (boxed)
7.62 mm Ball Rounds, in cases.
Conventional Grenades
Phosphor Grenades
Additionally, Sidewinder missiles were embarked at Ascension Island and stowed in a container on the upper deck.

STOWAGE ARRANGEMENTS

3. All explosive stores were stowed by UN Hazard Categories as indicated on the package markings. The choice of stowages was dictated by a natural wish to keep the stores as deep as possible on steel decks and as far from accommodation areas and superstructure as possible, yet providing reasonable access. The final choice was on both side pockets of C Deck (lower forward) as indicated in Appendix 1 to Annex and was almost inevitable. The centreline container cells (forward) were considered but rejected, because of the difficulties of access once stowed and because the upper deck access cover plate was welded down in order not to interfere with flying operations.

4. Stowage XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX assisted by RNAD Ernesettle who inspected the stowage and firefighting arrangements within the magazines. No Sea Transport Officer from the Department of Trade (DOT) was available and, indeed, would undoubtedly have found the final stowages in breach of all DOT regulations.

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5. The Phosphor grenades were Shipcat 2; the Demolition Charges Shipcat 5; the remainder were Shipcat 1. The Shipcat 1 and 2 were inadvertently stowed together, which is not permitted by NMER; it may be assumed that UN Hazard Markings would also have indicated the same incompatibility. However, this error was noticed at a later date and the grenades were then stowed separately. The RE Demolitions were separated from the Shipcat 1 explosives by a pre-fabricated wooden bulkhead, which was the best possible arrangement in the circumstances and given that the RE wished to have access for practice purposes on passage.

6. The confusion in the mixing of Shipcat 1 and Shipcat 2 was undoubtedly due to the speed at which all stores were embarked in the ACO, under the control of the xxxxxxxxxxxxxxxxxx who was also the only UN Hazard Categories markings expert on board. Assistance from RN resources would have been of value, particularly as the Shipcat markings would also have been on the packages but not understood by the xxxxxxxxxxxxxxxxxx

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7. The other main concentration of hazardous cargo was 80 tons of kerosene, which was stowed on A Deck forward and hence one complete steel deck division between it and the magazines.

8. The sprinkler system was modified in the magazine areas by removing the heat-sensitive bulbs and thereby converting it to a manual system, operated from the Sprinkler Room.

SAFETY ARRANGEMENTS AND ASSOCIATED INFORMATION

9. The ship was cleared by ASWE for any Radhaz from own radars. However, the ship did not carry BR 2924 (Radhaz) nor Confidential Addendum (CB 4986), and therefore would not have known what hazards might have existed from other radar transmissions from ships or aircraft in company.

10. BR 862(79) (NMERS) was also not carried on board and the normal magazine checks, such as daily temperature records, were not completed. However, hourly fire and safety rounds were instituted to cover the whole ship, including magazine areas.

11. No information on the specific hazards presented by the individual explosive stores, from fire or spontaneous explosions, was available to the ship. BR 862(79) Article 2612 gives some details of certain naval air-launched weapons and would have only given a guide to the behaviour of these particular stores in their worst possible hazard state. The hazards presented by the Army and RAF explosives stores, particularly the cluster bombs, were not known to the ship and the information was not provided. This information, which might have been available, was not asked for nor was it offered. An appreciation of the actual hazards presented by the explosive stores, as far as known to the Explosives Training School, HMS COLLINGWOOD, is at Appendix 1 to this Annex.

12. An accurate appreciation of the exact nature of the explosive hazards would undoubtedly have been of inestimable value to xx in their decision on how soon, if at all, to abandon ship in the face of an apparently uncontrollable fire.

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EXPLOSIVES ORGANISATION

13. No trained Explosives Safety or Responsible Officers (ESO or ERO) were borne, as were no trained Officers of Quarters (OOQ). Consequently, the normal HM ship organisation for ensuring explosives safety was not instituted, nor was the possible need appreciated. As stated above, NMERS were also not carried to act as a guide.

14. It is understood that the [XXXXXXXXXXXXXXXXXXXXXXXXXXXX] raised the question of setting up the normal RN organisation in STUFT transporting explosive stores. but was firmly informed by the [XXXXXXXXXXXXXXXXXXXXXXXXXXXX] that such ships were covered by the rules contained in the Inter Governmental Maritime Consultative Organisation (IMCO) book - the 'Blue Book' - and that this gave sufficient advice to Masters of merchant ships to manage their embarkation and stowage. S44 S40 S38

15. In fact, information on the transportation of explosives in merchant ships is contained in two books:

- a. Department of Trade (DOT) - 'Blue Book'
- b. IMCO - 'International Maritime Dangerous Goods Code Volume 1'

They deal in general with classes of explosives, but do not define specific military weapons in terms of Classification Codes or Compatibility Groups, ie the hazards associated with a given weapon and whether it may be stowed with another. There is only general advice on stowage arrangements, precautions relating to electrical fittings in magazines, electronic emissions, fire precautions, and fire fighting. They give no directives on magazine rounds, temperatures and the other normal routines and precautions in force in HM Ships. Clearly, such are not normally practised in merchant ships which treat explosives as pure cargo.

16. By RN standards, therefore, the information available in these publications is imprecise and inadequate. Also, to the average naval-trained ERO or ESO, they would be nearly impossible to interpret and use.

17. The future policy on explosives organisation in STUFT needs to be determined. If STUFT are to be considered as merchant ships throughout their period in naval service, then MOD(N) will need to satisfy itself that the present regulations contained in Department of Trade and other publications are adequate. On the other hand, if STUFT are to be subject to naval standards and procedures with explosives embarked, then the necessary publications and any other information will need to be issued and trained manpower provided.

CONCLUSIONS

STOWAGE AND SAFETY ARRANGEMENTS

18. The stowage of explosives stores in STUFT is bound to be a compromise between the sometimes conflicting demands of choosing obvious magazine sites for their security, access, firefighting arrangements, distance from accommodation areas and other hazardous cargo, stability and a number of other allied factors which may be pertinent at the time. Unless STUFT are to be previously ear-marked and specific arrangements built into them to accommodate the possible range of explosive stores likely to be carried, the final stowage will have to be the decision of the storing officers, [XXXXXXXXXXXXXXXXXXXXXXXXXXXX] at the time. Their over-riding priority is bound to be to ensure the safety of the ship as best they may; this may not always accord with military requirements. S44 S40 S38

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19. It is probable that the information contained in DQT and IMCO publications and in NMER, coupled with the explosives package markings, will be sufficient to guide storing officers on the optimum stowage arrangements for the different categories of explosives stores. However, further information may be required from military sources and this will need to be co-ordinated, probably by CINCFLEET.

20. Firefighting and other safety arrangements in the magazine areas will necessarily be ad hoc measures and will have to be accepted. However, to ensure that the best possible measures are taken, expert advice will need to be available to assist ships officers. Once again, this will need co-ordinating, probably by CINCFLEET. The alternative would be for STUFT to be ear-marked and shipping companies compensated for installing the necessary magazine arrangements at the build stage. In either event, it would be for CINCFLEET to be satisfied that STUFT sail with explosives embarked in a basically safe condition.

ORGANISATION AND INFORMATION

21. A policy decision is required that STUFT are to be subject to RN rules of organisation for ensuring explosives safety once such stores are embarked, in accordance with NMERs. Merchant Navy regulations do not include such an organisation, treating explosive stores as pure cargo. This is considered unacceptable, given the variety of explosives and their likely movements for military requirements. A firm control is required.

22. Such a decision would require a trained ERO to be borne, but for STUFT other than pure ammunition ships, where an RNAD Officer would be embarked, a dual appointment should prove sufficient. The most likely candidates would be STO(N) officers who are also dormant appointees for STUFT and an acquaint course at HMS COLLINGWOOD, with a regular refresher course at certain intervals, should prove sufficient.

23. A full range of explosives safety publications will need to be available for issue, ie BR 862(79), BR 2924 and CB 4986. Additionally, CINCFLEET will need to ensure that information not normally available, giving details of the hazards associated with the specific explosives stores, individually and collectively, are provided to STUFT. The lack of this information, particularly in the case of the RAF cluster bombs, undoubtedly constrained the judgement of the Senior Naval Officer in his decision to abandon the ship.

24. It is understood, however, that the provision of such information is entirely dependent on whether explosives stores have been subjected to the full range of tests required for use in the Naval environment. At present, there is no requirement for non-RN stores to be so tested, therefore information on their behaviour in fires being known to the Ordnance Board is currently a matter of chance. In view of the wide range of explosives stores likely to be embarked in STUFT, or warships, in an emergency, it is strongly recommended that all Service Staff Requirements include a proviso for individual stores to undergo the range of trials required for the Naval environment. The results would then be available to the Ordnance Board for promulgation.

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~~CONFIDENTIAL~~RECOMMENDATIONS

25. The following recommendations are made:

- a. That CINCFLEET co-ordinates all the information required by storing officers to assist in the safe stowage of explosive stores in STUFT.
- b. That CINCFLEET ensure that magazine arrangements in STUFT are in a basically safe condition, given the prevailing circumstances.
- c. That CINCFLEET provides information to STUFT on the hazards relating to all the explosives stores embarked.
- d. That the full range of explosives safety publications be issued to STUFT.
- e. That STUFT be subject to RN explosives regulations as laid down in BR 862(79) and that a trained ERO be appointed, preferably as a dual appointment.
- f. That all Service Staff Requirements for explosive stores include a proviso for those stores to undergo the trials required for use in the Naval environment.

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FIXED FIREFIGHTING SYSTEMSFIREMAIN SYSTEM

1. A fixed system serving hydrants on Port and Starboard sides of the ship from tank top level (F Deck) through to the Navigational Bridge level of the superstructure. Additional fire hydrants together with fixed in-line foam inductors were fitted to the upper deck in the vicinity of the Forward and After flight deck spots as part of the conversion.
2. The firemain system, unlike RN practice, provides pressure to hydrants only. The MN practice is to maintain a dry system in normal circumstances with manual pump operation when circumstances demand. The system is supplied by 2 in NO 120 tons/hour pumps, one situated in the Engine Room, the other in the Stabiliser Compartment (Starboard).
3. In ACO's role as an aircraft carrier, the MN SOP was adapted to one whereby a fire pump was started whenever the ship went to flying stations. It was soon realised that with no hydrant take-off, that fire pump damage would occur through churning in the pump casing and so the procedure was further adapted to have a bleed off from one hydrant to avoid pump damage. In the event, this proved unsatisfactory as aircraft parked forward and aft were being sprayed by the whipped up outlet from the hydrant and damage did occur to the Engine Room pump when the hydrant was inadvertently shut off, resulting in total write off of the pump. Thereafter, with only one fire pump available, the MN practice was reverted to maintaining a primed system and starting the pump whenever required.
4. The upper deck conversion providing additional hydrants forward and aft was of the RN instantaneous connection type, whereas the remainder of the fit above and below this level were of the bayonet connection type resulting in non-compatibility so that foam branch pipes could only be led and fed from the upper deck.

SPRINKLER SYSTEM

5. Supply by one 120 tons/hour electrically driven pump situated in the Engine Room. The system is a heat sensitive automatic operation system employing a quartzoid bulb at each sprinkler head. The system embraced a pneumatically pressurised header tank, whose pressure provides the initial discharge to a fractured bulb resulting in the pump being started by pressure switch as the header tank pressure decays.
6. Manual starting of the pump could be achieved at the Control Room and local position.
7. A batch of section control valves situated in the Sprinkler Room on the upper deck gave the facility to isolate sections not required, in the event of a fire and thus concentrate the sprinkling effect on the section involved. The practice adopted in ATLANTIC CONVEYOR was to isolate Sections 1 and 2 on C Deck where the cluster bombs were stowed and break the quartzoid bulbs in those sections, thus providing manual control. In the event, when these sections were required there is no evidence that the sprinkler pump operated after the initial pressure was released.

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8. In the event of failure of this pump, the firemain could be bridged to the sprinkler system through upper deck hydrant hose connected to a sprinkler system hydrant normally used when taking a supply from shore. This connection was not made in ATLANTIC CONVEYOR.

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CO2 FIRE EXTINGUISHING SYSTEM

9. ATLANTIC CONVEYOR (ACO) was equipped with a combined detection and extinguishing system designed to monitor and give protection to 45 locations in the general cargo spaces on A, B, C, D, E Decks and tank top level, Port and Starboard Bow Thruster compartments with additional cover for Engine/Boiler Room, Diesel Generator compartment and Steering compartment.
10. The system comprised a gas bottle stowage right aft on A Deck level with access from the mooring deck. 515 x 47 kg bottles of CO2 were stored, ganged up in banks of 12 bottles with a single release lever for each bank. The bottles discharged to a common ring main manifold which was then led by piping to the Safety Room which contained a series of identified location 3-way valves. From this point, the system became a detection/extinguishing one whereby the same piping led to each outlet was used for continual and simultaneous monitoring. Extraction fans mounted in the superstructure drew samples of air from each protected space and passed them through a viewing chamber. The chamber had direct lighting so arranged that although it was normally quite dark, the light illuminated strongly any smoke emanating from the ends of the sampling pipes. The pipe ends were labelled so that the source of smoke could be immediately located. On leaving the viewing chamber, all samples passed through an automatic detector which sounded an audible alarm when the optical density exceeded a pre-determined level.
11. The action to be taken in the event of the alarm sounding was to go immediately to the viewing chamber in the safety room, identify the location of the source of the smoke, concurrently all ventilation fans would be crash stopped and ventilation flaps closed by hydraulic action. Having identified a genuine presence of smoke and located its source, the operator would then operate the appropriate number of 3-way valves to the section(s) involved, effectively isolating the detection equipment from the piping and allowing a direct passage from the discharge manifold to the source of the fire. The operator would then consult a comprehensive chart, giving details of the recommended number of cylinders of CO2 to be released to the section involved.
12. It should be emphasised that the system was so designed to have an "initial" discharge level to each protected area, which should contain a normal cargo fire, thereafter and at set intervals, lesser "delayed" discharge levels are employed to prevent re-ignition and help cool the source of the fire.
13. Having ascertained the amount of gas to be released, the operator would then go to the storage room and release the appropriate number of cylinders to effect an initial discharge. At later intervals, the operator would revert the 3-way valves back to the monitoring position to assess whether the discharge had been effective by the presence of smoke in the viewing chamber.

NARRATIVE

14. Within one minute of the missile hit, thick black smoke was seen to issue from the after fan housings and this rapidly spread to the fan housings forward of the superstructure, the audible alarm sounded on the bridge. 'XXXXXXXXXXXXXXXXXXXX crash stopped all ventilation fans to the cargo spaces and went to investigate the extent of damage. XX'purposely did not shut the ventilation flaps, hoping this would help the smoke below to clear.

S44, S40, S38

S44, S40, S38

15. There are reports that on closing up at emergency stations, the after fire party checked the viewing chamber and saw evidence of smoke coming from 'numerous' sources.

16. Seven minutes after the missiles hit, attempts to close the fan flaps to the ventilation houses were unsuccessful. Twelve minutes after the missiles hit, the 3-way valves for the introduction of CO2 to A, B and C decks (Aft) were set, one minute later a delayed discharge of 57 bottles was released to these areas. (An initial discharge calls for the release of 336 cylinders which has a complete discharge time of 15 minutes). A later attempt to release greater quantities of CO2 to the cargo areas were beaten off by a combination of dense smoke, intense heat and difficulty experienced by the operator to gain access through a manhole whilst wearing breathing equipment.

DISCUSSION

17. Discussions with representatives of the Walter Kidde Company have established that the system was designed, in the worst case, to contain a deep seated fire in a high risk cargo such as baled cotton, probably caused by spontaneous ignition. The effectiveness of the system would depend on total and rapid sealing of the hold followed by very early introduction of an initial discharge of gas to catch the fire in its incipency. Thereafter, smaller amounts of CO2 would be introduced at set intervals and the hold would remain totally sealed in this condition until the ship reached harbour.

18. Given the situation which obtained in ATLANTIC CONVEYOR, viz:

- a. A large opening in the ships side (8' x 10').
- b. A deep seated fire in the vicinity of missile entry (seen by helo aircrew).
- c. All ventilation flaps to the hold open and a 6' x 4' cargo hatch on the upper deck open.
- d. Liberal quantities of POL and paint in vicinity of impact.
- e. Probable rapid spread of the fire to other stores in the area including oxy-acetylene welding/burning equipment, this being sustained by the continued burning of the missile propellant, then - the limiting conditions which the system was designed to contain had been greatly exceeded in every conceivable way.

~~COMMERCIAL IN CONFIDENCE~~

19. It is of note that the CO2 extinguishing system and the water sprinkler system are not compatible due to the absorption of CO2 by water.

CONCLUSIONS

20. The decision to operate the CO2 extinguishing system was delayed for the following reasons:

a. The possibility that survivors were trapped below in the area
of the missile entry because stores had been moved to that area throughout
the day xxxxxxxxxxxxxxxxXXXXXXXXXXXXXXXXXXXXXXX S44, S40, S38

b. The after fire party were attempting entry to determine the extent and exact location of the fire.

21. When the decision was eventually taken, the amount of gas introduced was far too little too little to have had any effect at all.

S44
S40
S38

22. Notwithstanding the foregoing remarks, it is considered that even if all the correct procedures open to ACO's crew had been taken immediately after impact, it is inconceivable that CO2 smothering would have contained the spread of the intense fire to the wide range of combustible stores carried between decks.

23. Furthermore, once the initial opportunity to release the gas was lost, the subsequent opportunity to do so diminished, as each cylinder has a safety bursting disc designed to release the pressure to atmosphere when the cylinder reached 130°F. xxxxxxxxxxxxxxxxxxxxxxx evidence refers to the deck of the compartment becoming very hot, and the likelihood is that as the fire took hold, the bottles would have started to lift their safety valves.

PROBLEMS ARISING FROM THE DESIGN AND LAYOUT OF THE SHIP AND HER MACHINERY AND EQUIPMENT IN FULFILLING HER ROLE, WITH PARTICULAR REGARD TO ANY HAZARDOUS MATERIALS

1. The decision to take ATLANTIC CONVEYOR (ACO) from her laid up state at Liverpool and convert her to an aircraft and stores ferry initiated a project of considerable detail. Clearly a great deal of thought went into the requirements of such a conversion and with an extremely tight timescale for its implementation, those involved at Devonport Dockyard, DGA, DG Ships, together with ships staff are to be congratulated that it was accomplished in such a timely and professional manner. (Details of conversion at Appendix 4 to Annex B).

2. As a result of the adoption of ACO for this task, it is possible to comment on the problems and shortcomings experienced during the operation.

2.1. LACK OF SUB-DIVISION

With no longitudinal or transverse bulkheads above the water line and the vast cavernous hold of the ship sub-divided in the main only by light wooden vehicle decks, ACO was extremely vulnerable to uncontrollable flooding if damaged at or below the water line. The lack of sub-division resulted in the inability to contain the fire and dense smoke following the two missile hits.

CONCLUSIONS

2.1.1. The Board were surprised that ATLANTIC CONVEYOR line do not have fire curtains fitted in their ships. MN personnel have commented on the difficulty experienced in getting to the seat of a relatively small between deck fire when dense smoke accompanies the fire and the cargo is packed in very tightly.

2.1.2 The light wooden decks on A and B decks midships section, normally used for the stowage of vehicles had, over the years sustained a degree of oil impregnation. These decks must have added to the fire hazard in that section.

2.2 STOWAGE OF EXPLOSIVES AND OTHER HAZARDOUS MATERIALS

The lack of properly controlled stowage for explosives, gas bottles, kerosene, paint and general POL substances was one which had a very direct bearing on the decision to abandon ship. In the event, the command team selected what is considered to have been the most suitable area for the stowage of cluster bombs and kerosene, well forward away from the accommodation area in "pockets" outboard of the container hold on C deck. These pockets had good access for ease of movement of the stores, whereas the container hold became isolated by the introduction of the forward flight deck. Commendable attempts were made to minimise the hazard in those areas by isolating the sprinkler valves to those sections and breaking the quartzoid bulbs, thereby enabling the cargo to be manually sprayed as a precautionary measure and not as a direct result of heat. Regular rounds of these stowages were maintained throughout the operations and additional hoses were rigged in the vicinity.

~~COMMERCIAL IN CONFIDENCE~~

2.3 COMMUNICATIONS

Internal communications in the ship were rudimentary. The main broadcast system did not cover cargo deck areas, recreation areas or the bridge. The alarm system only covered living spaces. The internal ship telephone, being unhardened was lost at the outset leaving very limited communication by sound powered telephones.

CONCLUSIONS

As a result of the unsatisfactory communications, at least six people were below decks when the missile struck, completely unaware that the ship was at emergency stations.

2.4 MACHINERY CONTROLS AND MANNING

The machinery of ACL ships like most MN ships is designed and the ships manned for complete remote control and the minimum of manoeuvring whilst on passage. The machinery and control system is not designed for operation in an action environment, being unhardened. In the event, complete failure of the control system followed missile impact. Operation of the machinery by hand could have been achieved in slow time if circumstances had permitted. However, ship staff were completely inadequate numerically for prolonged operation in this mode.

CONCLUSIONS

It is considered that STUFF ships with remote controls should have their engineering department complemented by the addition of RN personnel to help cope with the variety of contingencies which might arise in an action environment. This is particularly relevant in the case of the Chief Electrician whose duties covered maintenance of all electrical equipment with no assistance complemented.

2.5 FLYING OPERATIONS

Flying operations were carried out with a remarkable degree of success, the forward constructed flight deck after clearance of fan houses gave a platform suitable for the operation of Sea Harrier GR3, Chinook and Wessex 5 helicopters. On the after flight deck, the height of the stern ramp in the stowed position, together with parked helos had a limiting effect upon the operation of Chinook helos and made night flying of Wessex helos an extremely hazardous operation.

2.6 CONTAINER SHIP FREEBOARD AND HULL SHAPE

The very considerable freeboard (circa 40 feet) together with water line hull form in the most suitable area for life raft stowage and launching, ie, abreast the superstructure, created many problems during the abandonment of ACO. The rounded hull form, which created a very strong push/pull effect on swimmers and liferafts as the ship rose and fell, had a very tiring effect on survivors in the water and most probably contributed to the number of casualties.

MAJOR DEFECTS IN MACHINERY, SYSTEMS AND EQUIPMENT IMMEDIATELY BEFORE THE ATTACK

1. The following major defects were known before the attack:

- a. BOW THRUSTERS, INOPERATIVE SINCE LEAVING UK
- b. STABILISERS, INOPERATIVE SINCE LEAVING UK
- c. ENGINE ROOM FIRE PUMP WHICH BECAME DEFECTIVE ON THE PASSAGE SOUTH

2. The lack of bow thrusters had no effect on performance related to the incident. The lack of stabilisation did not prevent all flying operations being successfully carried out in the reasonable weather conditions experienced. However, this did increase the likelihood of the ship rolling in a turn which together with the much increased GM as a result of cargo loading, meant that the rate of turn had to be judged carefully, particularly at high speed.

3. The third defect clearly had a more direct bearing on the ships fire-fighting capability after the attack. The loss of this pump left the ship with only two pumps, the forward fire pump, which fed the firemain generally and the sprinkler pump which was kept for its prime purpose. It was fortuitous that, if a fire pump had to be inoperative, it was the engine room pump because the power supplies to that pump, after the T/As stopped, were from the diesel generator and could only be supplied via interconnecting breakers in the Safety Room and Control Room. The latter very quickly became inaccessible due to dense smoke. The forward firepump was fed from the diesel generator switchboard in the Safety Room and was included in the 'last ditch' services supplied from it. Hence the firemain service was maintained. The possibility of isolating the firemain into forward and after sections in the RN manner was considered. Even if all pumps had been available, no advantage could be found for departing from the MN practice of leaving the system de-isolated except when a breach occurred. The principal reason being that the fire pumps did not have the necessary integrity, ie. a lack of alternative supply in the event of loss of normal supply.

DAMAGE CONTROLBACKGROUND

1. ATLANTIC CONVEYOR (ACO) was taken up from trade on 16 April 1982 at Liverpool. She was converted at Devonport for her ferry carrier role, and sailed south on 25 April to transfer these aircraft to the carriers. She embarked a large amount of other stores (see Annex - ATLANTIC CONVEYOR - SHIP'S CARGO LOADING), much of it of a hazardous and/or inflammable nature. The risks associated with the cargo, distributed throughout the ship, were well appreciated, as were the problems of firefighting and damage control given the large, open plan cargo deck spaces with little or no watertight integrity between decks and the use of wooden (WORKHAUS) decks in certain areas. Risks associated with flying operations from each of the ship's two flight decks were also appreciated and required special measures.
2. The ship underwent a large number of modifications to equip her for her role and those for damage control included:
 - a. Upper deck firemain system for RN firefighting equipment, for aircraft emergencies (details included at Annex B).
 - b. Additions to the internal communications systems to link proposed damage control bases (Appendix 1 to this Annex).
 - c. The automatic spray system in the magazine areas was converted to a manual system.

The ship also embarked a large amount of extra RN firefighting equipment, both for flight deck emergencies and for normal ship damage control purposes, based on a frigate's normal outfit.

3. Initially, on sailing from Devonport, the firefighting and damage control (DC) organisation was based on Merchant Navy (MN) procedures. This was mainly because the 31 Merchant Navy officers and ratings formed the only possible organisation in the time available. They also had the ship knowledge, not yet shared by the some 120 service personnel who had joined during the previous week. However, soon after sailing, the organisation was changed to follow recognised RN procedures and practice. Additionally, hourly fire and security rounds throughout the ship were instigated.

DAMAGE CONTROL ARRANGEMENTSSHIP SYSTEMS

4. The ship's fixed firefighting systems are described in Annex E.

Internal Communications

5. The ship's normal internal communications consisted of:
 - a. A comprehensive internal ship's telephone system, serving much of the ship. It's main design shortcoming was that the individual receivers were insecurely mounted and liable to fall off even in heavy weather; once more than about three receivers were off their cradles, in these circumstances, the whole system failed on overload.
 - b. Limited SP telephones as shown in Appendix 1 to this Annex.