371. That as of 15 September 1967 estimates have not been received for the replacement costs of the equipments and systems under the cognizance of the Naval Air Systems Command Headquarters.

372. That the total of all known estimated costs as of 15 September 1967 is $72,203,000.

373. That personnel claims for reimbursement for property lost or damaged is unknown.

OPINIONS

1. That the fire on 29 July 1967 aboard FORRESTAL was caused by the accidental firing of one ZUNI rocket from the port TER-7 on external stores station 2 of F-4B #110, VF-11, then spotted on the extreme starboard quarter of the flight deck. The above mentioned ZUNI rocket struck A-4 #405, rupturing its fuel tank, igniting the fuel and initiating the fire.

2. That material failures of aircraft and armament components of F-4B #110 and its loaded ordnance stores, were the proximate cause of the accident.

3. That poor and outdated doctrinal and technical documentation of ordnance and aircraft equipment and procedures, evident at all levels of command, was a contributing cause of the accidental rocket firing.

4. That no improper acts of commission or omission by personnel embarked in FORRESTAL directly contributed to the inadvertent firing of the ZUNI rocket from F-4 #110.

5. That a single ZUNI rocket was fired from the port inboard station of F-4 #110 at 10-51-21H due to the simultaneous malfunctioning of the following components:

a. CA42282 pylon electrical disconnect.

b. Safety switch of the TER-7.

c. LAU-10/A shorting device.

6. That, assuming the possible malfunctions described in Opinion 5 above:

a. LCDR B-6 may have triggered the firing of the ZUNI when he switched from external to internal electrical power by superimposing enough transient voltage upon existing stray voltage to fire the ZUNI.

b. B-6 or B-6 may have triggered the firing of the ZUNI by moving the TER electrical safety pin far enough to arm the TER-7 safety switch while checking the pin to ascertain that it was securely in place.

c. B-6 may have triggered the firing of the ZUNI by mistakenly "stepping" rather than "homing" the TER-7 after the LAU-10/A launchers had been plugged in, if a faulty LAU-10/A shorting device were present on the second or third LAU-10/A in the firing sequence rather than the first.

7. That the CA42282 pylon electrical disconnect is of defective design in that it is susceptible to shorting by moisture.

8. That the Naval Air Systems Command erred in:

a. Changing the wiring of the TER-7 mod -527 so that the safety switch is shorted to ground in the "SAFE" position rather than open as in models -505 and -521.

b. Issuing the TER-7 mod -527 to the fleet without promulgating a complete description of the equipment and procedures for conducting circuit testing and checking based on the new circuitry.

c. Changing direction of throw of the HOME-STEP switch in the TER-7 mod -527 from that of the TER-7 mod -505 and -521 (see enclosure (368)).

9. That the electrical safety pin for the TER-7 is poorly designed in that the ordnance pins which are used in the AERO-7 Sparrow Launcher and the LAU-17/A pylon, and which will not reliably actuate the TER-7 safety switch, can be mistakenly inserted in the TER-7 pylon.

10. That the existence of ordnance safety pins which are physically interchangeable but not functionally interchangeable creates a potentially dangerous situation.

11. That the LAU-10/A shorting device is of inherently poor design for the following reasons:

a. There is no positive "safe" position into which the device locks.

b. This device may be placed in any intermediate position between the extremes of "safe" and "arm" where its actual arm/safe condition cannot be determined by visual inspection. That a very small movement of the slide from "safe" toward "arm" may in fact arm the LAU-10/A, though still appearing to be on "safe". See photographs, enclosure (370).

c. A bent, short or damaged pin in the 5 pin receptacle of the LAU-10/A may prevent the device from grounding, thereby leaving it armed though appearing to be safe.

d. That the sliding arm of the device allows interference with the LAU-10/A suspension lug; hence, personnel frequently either cant the device by partially unscrewing it or bend the slide of the device to allow it to clear the lug.

12. That the above inadequacies of the LAU-10/A shorting device constitute an inherently dangerous situation which should be corrected as a matter of urgency.

13. That the transient voltage induced when switching aircraft power of F-4 #110 from "external" to "internal" would not have been sufficient in itself to cause inadvertent firing of the ZUNI rocket. However, it would have been additive to any stray voltage induced through the CA42282 pylon electrical disconnect and could have acted as a trigger if the simultaneous malfunctions had occurred, as previously described in Opinion 5.

14. That the effects of high energy radiation on the LAU-10/A's from the ALQ-51, installed in A-4s in close proximity to F-4 #110, were not known, but are considered not to be the proximate cause of firing the ZUNI.

15. That the various armament safety features in the F-4B aircraft, the TER-7 and the LAU-10/A-ZUNI combination, if functioning entirely properly and properly used, provide sufficient safety for attack carrier operations. This assumes that all defects in hardware and deficiencies in procedures noted herein have been corrected.

16. That the operational and technical procedures developed by FORRESTAL and the embarked air wing for operations on Yankee Station relating to ordnance handling were poorly documented and promulgated.

17. That approved procedures should have been adhered to, even during conditions of high tempo operations. That if normal procedures were not found adequate, they should have been officially modified to fit combat operational requirements.

18. That documentation by VF-11 regarding detailed ordnance procedures was found to be inadequate.

19. That it was basically a sound decision to organize composite air wing catapult arming crews in order to reduce the numbers of personnel in the vicinity of the catapults.

20. That the organization and specific duties of each member of the composite air wing arming crews should have been detailed in writing and promulgated over the Carrier Air Wing Commander's signature.

21. That on 29 June 1967 the augmented Weapons Coordination Board discussed and made decisions concerning ordnance handling and safety procedures on board FORRESTAL. Those decisions falling within his authority should have been approved by the Commanding Officer, FORRESTAL, and promulgated in writing to all departments, divisions and squadrons concerned over his signature. Where deviations from documented safety or other procedures were involved, approval should have been specifically requested from authority higher than CO, FORRESTAL, to deviate.

22. That if rockets were to have been plugged in prior to reaching the catapults, the procedures therefor should have been approved and documented by authority higher than the CO, FORRESTAL.

23. That the minutes of the 29 June meeting should not have been informally distributed to the CVW-17 Ordnance Officer as a double-spaced rough but should instead have been officially promulgated to squadron commanding officers and ship's department heads over the Operations Officer's signature.

24. That the reply to the double-spaced rough minutes of the 29 June meeting, which reply was originated by AOC (b)-(6) should not have gone directly to the CVW-17 Ordnance Officer without having been reviewed by an appropriate officer in VF-11. The reply should have gone through the squadron chain of command for review (even though the rough minutes were informally received) and should have been forwarded over the CO, VF-11's signature.

25. That LTJG (b)-(6) by not referring the above double-spaced rough to his commanding officer, failed to keep his CO properly informed of matters relating to ordnance procedures.

26. That CDR (b)-(6) was aware of the 29 June meeting and its possible impact on squadron ordnance operations, but failed to keep himself adequately informed of the details relating thereto.

27. That the ordnancemen of VF-11 were generally competent as individuals but were poorly organized and instructed.

28. That official documentation as to when and where to conduct stray voltage checks for LAU-10/As is ambiguous and inadequate.

29. That documentation as to specifically how to conduct stray voltage checks for the F-4B/TER-7/LAU-10/A weapons system is inadequate.

30. That although there were no directives or guidance to prohibit it, leading VF-11 ordnance personnel exercised poor judgment in allowing stray voltage checks and plugging in rockets before the aircraft's electrical system had stabilized after starting, i.e., before both engines were started and the aircraft was switched to internal electrical power.

31. That B-6 action in conducting stray voltage checks on F-4 #110 before both engines had been started and the aircraft electrical power had stabilized was contrary to VF-11 squadron policy, as stated by the CO. However, this policy was not set forth in writing.

32. That B-6 and AO2 B-6 VF-11, acting on incomplete squadron instructions gave incorrect instructions to B-6 as to the time when stray voltage checks should be started.

33. That B-6 arried out the stray voltage checks on F-4 #110 on 29 July completely in accordance with the instructions which had been given him.

34. That the ordnance crew which was working on F-4 #110 was loosely organized and without adequate supervision.

35. That the testimony of B-6 is false in that he was not standing, as he testified, directly in front of the port LAU-10/As of F-4 #110 at the time the fire was initiated.

36. That the testimony of (b)(6) and (b)(6) is false in regard to their stated failure to observe the ZUNI rocket fire from #110.

37. That the sworn statement made by (b)(6) on 1 August wherein he stated that he did see the ZUNI rocket fire, is true.

38. That if (b)(6) were standing in the position he stated, he must have seen the ZUNI rocket fire and therefore his testimony is either false in regard to his location or false with regard to failure to see the ZUNI.

39. That the testimony of LCDR (b)(6) to the effect that ZUNI missile covers were intact, applies, in the opinion of the Board, to missile covers on the starboard side of the aircraft. That LCDR (b)(6) did not accurately inspect the port side ZUNI missiles.

40. That the CO, VF-11, displayed poor judgment in eliminating the requirement for an ordnance safety petty officer during stray voltage check and rocket plug-in while aircraft were spotted in the pack.

41. That ordnancemen should not conduct stray voltage checks or plug in rockets without the pilot's specific knowledge. Hence, CO, VF-11 erred in abolishing a hand signal exchange in the pack with the pilot that such ordnance functions were being conducted.

42. That the preflight briefing given by CDR (b)(6) to LCDR (b)(6) was inadequate in that more attention should have been directed to flight deck inspection procedures relating to the LAU-10/A ZUNI combination which LCDR (b)(6) had not previously employed.

43. That VF-11 preflight procedures are deficient in that they should have required the pilot (and RIO) to check the position of the LAU-10/A shorting device prior to manning the aircraft.

44. That NATOPS procedures are deficient in that they do not require that the pilot check the position of the Armament Override Switch during pre-starting cockpit check.

45. That the act of actuating the Home-Step switch on the TER-7 after the LAU-10/As had been plugged in was a potentially dangerous action in that if he stepped rather than homed the switch, he might have fired a LAU-10/A if certain malfunctions (Opinion 5) existed in the firing circuit. There were, however, no written or verbal prohibitions to this action in effect on 29 July.

46. That the situation described in the preceding opinion is further aggravated by reversal of the direction of throw of the Home-Step switch with the issuance of the -527 model TER-7.

47. That the personnel assigned to the Weapons Branch of VF-11 were adequate in both numbers and experience levels, and lack of personnel or experience level was not a contributing cause of the accident.

48. That VF-11 had sufficient time and opportunity since transitioning to F-4 aircraft in July 1966 to develop operational proficiency in the F-4. The squadron's administrative and organizational progress is unimpressive.

49. That the loose ordnance organization and poor procedures of VF-11 as described in previous statements of opinion were not known to the Air Wing Commander, the Air Wing Ordnance Officer, the Ship's Operations Officer or CO, FORRESTAL.

50. That inconsistencies and improper procedures evident in VF-11 ordnance operations should have been discerned by ship and air wing personnel and corrected.

51. That, at least a part of the poor organization and procedures, mentioned above, and the failure to uncover them can be attributed to the short period during which the squadron had been operating on Yankee Station.

52. That despite the short interval between the ship's overhaul and deployment to WESTPAC and despite the relatively short period since commissioning of CVW-17, FORRESTAL arrived on Yankee Station with a comparatively high degree of personnel and material readiness.

53. That Navy personnel policies should have permitted the stabilization of the ship's personnel at the beginning of refresher training and thus have enabled FORRESTAL to retain, for deployment, those personnel who received refresher training.

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54. That FORRESTAL's material readiness for fire fighting and damage control were at acceptable standards at the time of the fire.

55. That the magnitude of the fire and the resultant heavy damage was due to the concentration on the flight deck of aircraft loaded with aviation ordnance stores and huge quantities of aviation fuel; a condition characteristic of present day combat carrier operations.

56. That with existing installed fire fighting equipment, the fire could not have been extinguished prior to the explosion of major ordnance (94 seconds after initiation of the fire) regardless of the aggressiveness, readiness, response and expertise of personnel and readiness of equipment.

57. That extensive fire fighting efforts were underway on the flight deck at the instant of the first major explosion.

58. That effective fire fighting of this large fire could not have been conducted during the period of the major explosions (approximately five minutes) and was properly suspended for this period until after major explosions had subsided.

59. That the design and operating procedures of fire fighting equipment currently available in attack carriers is totally inadequate to the needs generated by modern combat operations and the concentrations of very large quantities of ordnance and fuel on jet aircraft.

60. That because of the tremendous quantities of fuel carried by jet aircraft, which may be expected to spill to the deck in casualties of this type, methods and devices must be developed to rapidly jettison or drain over the side large quantities of fuel which may flow onto the deck.

61. That, though not a significant factor to the spread of the fire in this instance, difficulty was experienced in jettisoning ordnance stores and aircraft. The RA-5C was particularly difficult to jettison because of its size and weight.

62. That the fire in FORRESTAL might have been confined to a few aircraft had proper equipment and techniques been available to either rapidly jettison ordnance stores on burning aircraft, or, to cool the stores while the fire was being extinguished.

63. That the concentration during combat operations of exposed ordnance stores on the hangar and flight decks in so-called "bomb farms" which have neither special fire fighting protection nor high capacity emergency jettison facilities creates a dangerous situation.

64. That on the forenoon of 29 July 1967, when large quantities of ordnance stores were exposed above the second deck, the manning of only four HCFF generating stations on the second deck was insufficient to provide required protection against fire.

65. That personnel not familiar with the functions of damage control during general quarters, improperly initiated many actions, such as opening and closing hangar bay doors without informing Damage Control Central.

66. That concentrations of armed aircraft on the flight deck generate high hazard conditions for the flight deck as well as for the 03, 02, 01 and hangar deck areas beneath. In such circumstances, concentrations of personnel on decks below the affected part of the flight deck are highly hazarded.

67. That cook-off times of ordnance stores in use were not available to FORRESTAL and that considerable injury and loss of life can be attributed to the cook-off of installed ordnance stores at a time earlier than expected.

68. That the present HCFF hose stations in FORRESTAL lack standard configuration and invite confusion, and therefore constitute a potentially hazardous situation.

69. That the technique for perforating a deck or bulkhead in order to insert a fire hose into a compartment that is otherwise unreachable has great merit. However, the directional characteristics of currently available hose nozzles, which cannot be manipulated through the hole to cover all areas within a compartment, limit the effectiveness of this technique.

70. That key personnel of the damage control organization, including key repair party members, were not distinctively marked and could not be readily identified. In some instances this created confusion concerning leadership, control or even the presence of damage control personnel.

71. That FORRESTAL's allowance of OBA cannisters and fog foam was sufficient to support only the initial fire fighting efforts. It was insufficient to support the sustained effort required by this major fire.

72. That without the continuing replenishment of OBA cannisters and fog foam from assisting ships, FORRESTAL would probably not have been able to extinguish all fires but could probably have contained them until they burned out.

73. That, although FORRESTAL was 25 OBAs and 50 cans of fog foam short of allowance at initiation of the fire the shortage of these items did not inhibit initial damage control and fire fighting efforts.

74. That although at allowance, insufficient numbers of eductors and portable blowers (red devils) were on hand to adequately cope with clean up operations during the terminal periods of the emergency.

75. That FORRESTAL's fire fighting operations required the rapid uncoupling and recoupling of fire hoses. Presently available couplings and fittings are too cumbersome for the instantaneous response now required.

76. That aircrewmen are not adequately trained in the considerations and techniques for abandoning static aircraft engulfed in flames.

77. That current fire fighting exercises do not provide adequate training for the type and scope of fire experienced by FORRESTAL 29 July.

78. That the 1MC ship's general announcing system as presently installed in FORRESTAL is inadequate for passing the word effectively on the hangar deck.

79. That the 750 gallons of liquid oxygen stored in compartment 1-192-2-E adjacent to hangar bay 3 constituted a high hazard for a prolonged period (approximately one hour) while the liquid oxygen was being drained over the side through a small hose.

80. That the weather was not a contributing factor to the casualty although the high ambient temperature may have reduced the cook-off time of ordnance stores. The hot decks made the spilled JP-5 fuel more volatile and could have been an additional factor in the rapid spreading of the fire.

81. That the divisional doors between hangar bays 2 and 3 were closed and the sprinkler system in hangar bay 3 actuated early enough to effectively prevent the spread of fire forward in hangar bay 3 where ten aircraft were spotted.

82. That fire boundaries on the flight deck and below were initially established at the optimum locations considering prevailing conditions.

83. That some hatches and doors along casualty routes for injured personnel properly remained open during condition ZEBRA to enhance the movement of injured personnel.

84. That the status and loading of each magazine in the ship is vital information for effective damage control. This information should be continuously available in Central Control.

85. That records were not properly maintained and preserved in Central Control and Damage Control Central relating to significant events that occurred during the casualty.

86. That the FORRESTAL electrical systems were managed in a highly satisfactory manner throughout the entire period of the emergency.

87. That during the fire, various untrained individuals took well-intentioned but ill-advised actions because they were unaware that damage control personnel were at the scene and were executing a considered plan of action.

88. That air wing personnel require considerably more basic training in fire fighting and damage control.

89. That good judgment was exercised in sounding general quarters at 1053H, 29 July 1967, as soon as the magnitude of the fire became apparent.

90. That the Commanding Officer FORRESTAL consistently demonstrated a personal interest in the material condition and training of his ship's company in fire fighting and damage control.

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91. That Captain performed satisfactorily his assigned duties as Commanding Officer, USS FORRESTAL (CVA-59), and that no blame attaches to Captain in connection with the fire that occurred in FORRESTAL on 29 July 1967.

92. That Commander performed satisfactorily his assigned duties as Engineering Officer, USS FORRESTAL (CVA-59), and that no blame attaches to Commander in connection with the fire that occurred in FORRESTAL on 29 July 1967.

93. That Lieutenant Commander performed satisfactorily his assigned duties as Damage Control Assistant, USS FORRESTAL (CVA-59), and that no blame attaches to Lieutenant Commander n connection with the fire that occurred in FORRESTAL on 29 July 1967.

94. That Commander performed satisfactorily his assigned duties as Air Officer, USS FORRESTAL (CVA-59), and that no blame attaches to Commander in connection with the fire that occurred in FORRESTAL on 29 July 1967.

95. That Lieutenant Commander performed satisfactorily his assigned duties as Hangar Deck Officer, USS FORRESTAL (CVA-59), before and after the fire. Lieutenant Commander as not on board FORRESTAL 29 July during the fire. No blame attaches to Lieutenant Commander in connection with the fire that occurred in FORRESTAL on 29 July 1967.

96. That Lieutenant performed satisfactorily his assigned duties as Flight Deck Officer, USS FORRESTAL (CVA-59), and that no blame attaches to Lieutenant n connection with the fire that occurred in FORRESTAL on 29 July 1967.

All redactions are B-6

97. That Chief Warrant Officer performed satisfactorily his assigned duties as Fire Marshall, USS FORRESTAL (CVA-59), and that no blame attaches to Chief Warrant Officer in connection with the fire that occurred in FORRESTAL on 29 July 1967.

98. That Warrant Officer performed satisfactorily his assigned duties as Air Ordnance Gunner, USS FORRESTAL (CVA-59), and that no blame attaches to Warrant Officer in connection with the fire that occurred in FORRESTAL on 29 July 1967.

99. That Commander , Jr., performed satisfactorily his assigned duties as Commander, CVW-17 and that no blame attaches to CDR in connection with the fire that occurred in FORRESTAL on 29 July 1967.

100. That Lieutenant Commander performed satisfactorily his assigned duties as pilot of VF-11 aircraft #110 and that no blame attaches to Lieutenant Commander in connection with the fire that occurred in FORRESTAL on 29 July 1967.

101. That because of overall inherent weaknesses in the development and documentation of ordnance operations, procedures and safety measures, Lieutenant , CVW Ordnance Officer, was unable to carry out all of his responsibilities relating to safety and ordnance handling operations in an efficient manner, however, no blame attaches to Lieutenant in connection with the fire that occurred in FORRESTAL on 29 July 1967.

102. That CDR demonstrated poor judgment and lack of supervision in the following areas:

a. Eliminating the "hands off" signal and safety petty officer during ordnance evolutions in the pack.

b. Permitting loose organization and operational procedures to continue in the Weapons Branch of VF-11.

c. Allowing squadron instructions and organization manual to become outdated.

All redactions are B-6

However, no blame attaches to CDR in connection with the fire that occurred in FORRESTAL on 29 July 1967.

103. That Lieutenant Commander performed satisfactorily his assigned duties as Maintenance Officer, VF-11, and that no blame attaches to Lieutenant Commander n connection with the fire that occurred in FORRESTAL on 29 July 1967.

104. That Lieutenant performed satisfactorily his assigned duties as Avionics/Weapons Officer, VF-11, and that no blame attaches to Lieutenant in connection with the fire that occurred in FORRESTAL on 29 July 1967.

105. That Lieutenant (junior grade) did not exercise the required close degree of supervision and control over personnel in the ordnance branch of VF-11, however, no blame attaches to Lieutenant (junior grade) n connection with the fire that occurred in FORRESTAL on 29 July 1967.

106. That Warrant Officer performed satisfactorily his assigned duties as Assistant Avionics/Weapons Officer, VF-11, and that no blame attaches to Warrant Officer n connection with the fire that occurred in FORRESTAL on 29 July 1967.

107. That AOC satisfactorily performed his duties as Aviation Ordnance Supervisor, VF-11, and no blame attaches to AOC in connection with the fire that occurred in FORRESTAL on 29 July 1967.

108. That AO1 performed satisfactorily his assigned duties as aviation ordnance team leader, VF-11, and that no blame attaches to AO. in connection with the fire that occurred in FORRESTAL on 29 July 1967.

109. That AO2 VF-11, satisfactorily performed the ordnance evolutions assigned him at F-4 #110 and that no blame attaches to AO2 nnection with the fire that occurred in FORRESTAL on 29 July 1967.

All redactions are B-6.

110. That AOAA VF-11, performed satisfactorily his assigned duties as stray voltage checker in accordance with instructions given him and that no blame attaches to AOAN in connection with the fire that occurred in FORRESTAL on 29 July 1967.

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111. That the major cause of injuries were wounds caused by shrapnel, flying objects and burns.

112. That the major causes of death were concussions from the bombs, suffocation, burns, and wounds caused by shrapnel and flying debris.

113. That all personnel injured during the fire on board FORRESTAL on 29 July 1967 were injured in the line of duty and not due to their own misconduct.

114. That the deaths and injuries resulting from the fire aboard FORRESTAL on 29 July 1967 were not caused by the intent of any person or persons in the naval service or connected therewith.

115. That the deaths and injuries resulting from the fire aboard FORRESTAL on 29 July 1967 were not caused by the intent, fault, negligence, or inefficiency of any person or persons embarked in FORRESTAL.

116.

B5

RECOMMENDATIONS

1. That the LAU-10/A launcher not be used on F-4 aircraft until:

   a. A redesigned shorting device is available.

   b. Deficiencies in CA42282 pylon electrical disconnect are corrected.

   c. Wiring of the -527 TER safety switch is corrected.

   d. Adequate procedures are promulgated to check for stray voltage in the rocket firing circuits of the F-4.

2. That the LAU-10/A be provided, as a matter of urgency, with a shorting device which acts positively, assuring that it can be placed only in "safe" or "arm" with no intermediate positions.

3. That the above LAU-10/A shorting device be so designed that it does not interfere with the LAU-10/A suspension lug.

4. That positive effective action be instituted to correct electrical shorting discrepancies in the CA42282 pylon electrical disconnect of F-4 aircraft, as a matter of urgency.

5. That the wiring of the safety switch in the -527 TER be changed so that it opens or severs the firing circuit when in the "SAFE" position (as in the -505 and -521 TERs), rather than be shunted to ground.

6. That a stray voltage test receptacle be incorporated in the TER-7 in order to eliminate the requirement for home-made adapter cables in checking for stray voltage in the rocket firing circuits.

7. That procedures for conducting firing circuit continuity checks on the TER-7 MOD-527 be immediately modified to prevent damage to rocket firing circuitry.

8. That care be taken during the design of new or modified equipment to insure that the direction of actuation of the same control, or of controls which perform the same function, is not changed. Enclosure (368) shows, as an example, the change in direction of actuation of the HOME-STEP switch on the TER-7 between models -505 and -521 and, model -527.

9. That directives from appropriate authority be issued specifically stating when and where rocket firing circuit stray voltage checks and rocket launcher plug-ins will be accomplished under the various conditions of operation; (land based, carrier based) considering various weapon system combinations.

10. That directives from appropriate authority be issued which specifically state the precise procedures for conducting rocket firing circuit stray voltage checks prior to rocket plug-in.

11. That an immediate technical review of all aircraft/rocket systems, including the ZUNI, be made to verify and correct procedures and documentation for their use, and that existing supporting documentation be corrected and issued as a matter of urgency.

12. That each USN aircraft weapon system (the basic aircraft and its combinations of ordnance equipments and ordnance stores) be thoroughly reviewed by competent experts to develop, verify or correct all pertinent procedures and safety precautions. That the results thereof be appropriately issued.

13. That electronic equipment which will add to the electronic environment of carriers not be sent to the fleet until its RADHAZ effects have been analyzed and tested with all ordnance currently in use.

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14. That operational procedures developed by attack carrier forces during S. E. Asia operations be fully documented and distributed by CNO to all commands concerned.

15. That any procedures so developed which are in conflict with standard Navy safety precautions be given the closest possible scrutiny by experts so that a decision can be made as to whether the advantages to be gained are in fact worth any added risks involved.

16. That added emphasis be placed on adherence to approved procedures, even under conditions of high tempo combat operations.

17. That if approved procedures are not found adequate for combat situations, the affected command initiate immediate recommendations for specific modification of procedures to appropriate higher authority.

18. That the CNO establish a single series of publications similiar to or a part of the NWP (Naval Warfare Publication) series which will serve as a single source of documentation for all operational and technical procedures related to the operation of aircraft and appertaining systems. This series of aircraft operational and technical procedures (as differentiated from maintenance (3M) publications) should be kept under continual review by knowledgeable experts.

19. That the above series of publications be promulgated by a single coordinating office to assure the completeness, standardization, continuity and interface of the aircraft publications.

20. That the above series of publications incorporate a system for frequent periodic review and updating, incorporating recommendations from the operating forces as well as from the technical commands.

21. That CO FORRESTAL develop and use a standardized procedure for preparing and documenting all operational and technical procedures not adequately covered by other official publications.

22. That each squadron of CVW-17 provide the Air Wing Commander in writing with the precise procedures and safety measures the squadron will follow in all actions related to weapons and ordnance.

23. That the Air Wing Commander coordinate, standardize and recommend improvements to the procedures submitted in accordance with the preceding paragraph. When satisfied that the procedures are safe, efficient and in compliance with directives, and following the ship CO's approval, when embarked, he then give written approval of the specific procedures.

24. That CO, VF-11, immediately prepare and issue appropriate instructions as to the organization, and, ordnance operating and safety procedures for the squadron.

25. That COMCVW-17 set out in writing the organization, function and duties of all composite air wing organizations such as the composite catapult arming crew.

26. That CO, VF-11 issue appropriate directives specifically stating the requirement that an air ordnance safety petty officer be designated to supervise personnel at all times that live ordnance is being handled.

27. That, in recognition of the special importance of safety in ordnance handling evolutions, VF-11 squadron organizational instructions be revised to require the Weapons Officer to report directly to the Commanding Officer for matters relating to ordnance handling safety.

28. That VF-11 ordnance teams be composed of personnel who are specifically designated by name; that such teams should invariably train and operate as integral units; that the senior petty officer of each team be designated as the team leader; and that the team leader remain with the team, actively supervising operations in progress. If the team must be broken up into smaller units, then the senior petty officer of each unit must function as the unit leader, remaining with the unit and actively supervising operations in progress.

29. That after a pilot has preflighted and manned his aircraft, the aircraft should not thereafter be touched without informing the pilot, by appropriate hand signals, of the nature of the function intended to be accomplished and when such function has been completed.

30. That increased emphasis be exerted by the Chief of Naval Personnel to minimize the detachment of trained personnel from ships and squadrons in the last few months prior to deployment.

31. That a study be initiated to develop revolutionary new fire fighting equipment and procedures which are responsive to existing requirements of instantaneous reaction.

32. That carrier commanding officers use extraordinary measures and ingenuity in pre-positioning and readying available fire fighting resources, both equipment and personnel, to obtain the quickest, most effective fire fighting capability that is practicable.

33. That an immediate study be instituted to recommend modifications to existing carrier fire fighting systems to increase response and effectiveness, including the following:

a. Deck edge HCFF monitors served by existing risers.

b. HCFF stations to be individually actuated either remotely from Pri Fly or from the catwalk.

c. A system of water curtains or sprinklers to rapidly wash large quantities of aircraft fuel off the deck and over the side.

d. A system of scuppers and drains capable of draining off large volumes of water and fuel. These scuppers and drains should be so designed as to minimize spreading of fuel and fire to lower decks, sponsons and fantail.

e. HCFF and salt water monitors on the island, capable of issuing large volumes of foam and water.

f. Current HCFF generators be re-engineered to provide foam to the flight and hangar deck in less than five seconds, if practicable.

34. That a more effective method of storing HCFF and salt water fire hose on the flight deck be devised to facilitate leading out hose and eliminate tangling and fouling.

35. That controls for HCFF hose stations be of a standard configuration, with distinctive markings, isolated from other fittings which might be confusing. The stations' location should be highly visible and unmistakably identifiable from the flight and hangar deck by a standard method which readily attracts attention and is not obscured by aircraft spotted nearby.

36. That key personnel, particularly key repair party members, be issued and wear more distinctive badge/hat/brassard which is readily discernible to promote better on-the-scene control and identification.

37. That Central Control in FORRESTAL maintain daily records as to the status and loading of each magazine.

38. That FORRESTAL allowance of fire fighting equipment be modified as follows:

ITEM	CURRENT ALLOWANCE	RECOMMENDED ALLOWANCE
Fog foam (5 gal)	1220	2500
OBA	550	620
OBA cannisters	3300	8000

39. That deficiencies in the 1MC carrier's general announcing system be corrected to provide intelligible transmission of messages to personnel in the hangar bays.

40. That when practicable fire lanes be created in the pack by leaving space between aircraft in order to assist in isolating fires and to allow hoses and equipment to be moved with greater facility.

41. That procedures and equipment be developed for rapidly jettisoning ordnance stores that are concentrated in "bomb farms" on the hangar or flight deck preparatory to loading on aircraft.

42. That additional jettison ramps, including one located outboard of the island, be installed on carriers to facilitate jettisoning of ordnance and dangerous equipment, e.g., LOX carts.

43. That equipment and procedures be developed to rapidly jettison burning aircraft; for example, bulldozer attachments for yellow vehicles.

44. That portable aircraft jettison ramps be provided so that heavy aircraft may be pushed over the side at any location on the flight deck without hanging up in the catwalk.

45. That procedures be developed and that ordnancemen and fire fighters be trained to accomplish rapid dearming of aircraft threatened by fire.

46. That a list of the cook-off times of each appropriate ordnance store be printed on a decal to be posted at fire fighting stations and on appropriate fire fighting equipment afloat and ashore.

47. That each item of ordnance be labelled with the cook-off time for that particular store.

48. That equipment and procedures be developed to prevent cook-off of ordnance stores while fire fighting is in progress on an aircraft, for example:

a. A water fed muff or cone to cover the stores with cooling water.

b. Spray or water curtain rigs which can be rapidly applied to ordnance stores.

49. That consideration be given in future carrier modification and new designs to extending the flight deck over the stern to prevent burning fuel from engulfing the fantail.

50. That consideration be given to providing all appropriate compartments (particularly berthing, living and working) with alternate escape exits.

51. That remotely actuated, high capacity (pop-up) sprinkler systems be considered for installation to cover the entire carrier flight decks.

52. That remotely actuated high capacity spray or water curtain systems be installed on attack carriers to provide immediate fire protection in those specific areas on the hangar deck and flight deck where exposed ordnance stores may be concentrated preparatory to being loaded on aircraft.

53. That consideration be given to employing an armored fire fighting vehicle on the flight deck of attack carriers engaged in combat operations which:

a. Is capable of extinguishing aircraft fires including fuel, oxygen, and various types of explosive ordnance.

b. Is able to bulldoze burning wreckage from deck.

c. Protects operators from shrapnel and from ordnance detonations.

d. Is able to continue to operate in an environment of fire and explosions of ordnance;

e. Has two-way radio communication with Pri Fly.

54. That a special purpose omni-directional nozzle be developed and issued, possibly similar to a Butterworthing nozzle, which can be inserted through a small hole and will spray all areas within a compartment.

55. That tape recorders capable of simultaneously recording all communications with Central Control/Damage Control Central be installed on carriers, as a training aid and to assist in investigating casualties. Each sound powered circuit should be on a separate channel.

56. That specific standardized procedures be established for recording data on important events in Damage Control Central/Central Control during a casualty.

57. That Carrier Air Wing personnel receive more formal training in fire fighting and damage control with specific emphasis on:

a. Fundamentals of ship's damage control organization and operations.

b. Principles involved in controlling damage aboard ship.

c. Basic knowledge of ship's geography, including flow patterns and escape routes.

d. Fundamentals and use of basic damage control and fire fighting equipment with particular emphasis on OBA, fog foam, firemain and sprinkler systems and how to actuate and use them.

58. That specific minimum qualifications in damage control and fire fighting be established, that all personnel assigned to carriers (including air wing personnel) meet these qualifications prior to embarking, and that satisfactory completion of these qualifications be made a matter of record in each man's jacket.

59. That flight deck fire fighting exercises be developed to train personnel in fighting fires of the type experienced by FORRESTAL, taking into consideration the fire's magnitude, the live ordnance and early casualties to key personnel and equipment.

60. That techniques be developed for abandoning aircraft which are engulfed in flames, to provide aircrewmen with the most effective method of escape. Many variables should be considered such as escape time available, relative wind, possible abandonment and escape routes, size and type of fire, stores carried, whether to secure engines, taxi clear, eject, etc.

61. That the attached "Lessons Learned" be promulgated to appropriate commands at earliest concurrence by convening authority; in advance of routine routing of the record of this Board of Investigation.

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62. That no disciplinary or administrative action be taken with regard to any persons attached to USS FORRESTAL (CVA-59) or Carrier Air Wing 17 as a result of the fire which occurred on board USS FORRESTAL on 29 July 1967.

Rear Admiral, U. S. Navy

Captain, U. S. Navy

Captain, U. S. Navy

Final Entry.

Rear Admiral, U. S. Navy

Commander, U. S. Navy
Counsel for the Board

Lieutenant Commander, U. S. Navy
Assistant Counsel for the Board

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All redactions are