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OPERATION REDWING

Commander Task Group 7.3
Final Report

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March-August 1956

Pacific Proving Grounds

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Nuclear Atmospheric Tests	Radiological Safety	Ship Instllations
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Pacific Proving Ground	Search & Rescue	
Security & Safety Patrols	Aircraft Radiation Survey	
Shipboard C^3 Facilities	Scientific Support	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Operation REDWING was conducted at the Pacific Proving Ground during the spring and summer of 1956. The main effort of the Navy task group (Task Group 7.3) was concentrated at Bikini Atoll in support of large yield shots. The broad mission of Task Group 7.3 was to provide the necessary naval support, including an evacuation capability, required by Joint Task Force Seven. Task Group 7.3 carried out the following assigned tasks: 1) conduct security and safety patrols (air and surface ship); 2) provide surface ship transporation between Eniwetok and Bikini and other atolls; 3) provide shipboard command, control and communications facilities for CJTF-7 and the task groups; 4)

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Abstract (Continued)

provide shipboard facilities to accommodate elements of the Joint Task Force while afloat, including pre-shot evacuations as directed by CJTF-7 and; 5) provide support to scientific projects as requested.

FOREWORD

This report has had classified material removed in order to make the information available on an unclassified, open publication basis, to any interested parties. This effort to declassify this report has been accomplished specifically to support the Department of Defense Nuclear Test Personnel Review (NTPR) Program. The objective is to facilitate studies of the low levels of radiation received by some individuals during the atmospheric nuclear test program by making as much information as possible available to all interested parties.

The material which has been deleted is all currently classified as Restricted Data or Formerly Restricted Data under the provision of the Atomic Energy Act of 1954, (as amended) or is National Security Information.

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It is the belief of the individuals who have participated in preparing this report by deleting the classified material and of the Defense Nuclear Agency that the report accurately portrays the contents of the original and that the deleted material is of little or no significance to studies into the amounts or types of radiation received by any individuals during the atmospheric nuclear test program.

ABSTRACT

Operation REDWING, a Joint Atomic Energy Commission-Department of Defense effects test series of atomic weapons and devices, was conducted by Commander Joint Task Force SEVEN at the Pacific Proving Ground during the spring and summer of 1956. The Chief of Naval Operations was the Executive Agent of the Joint Chiefs of Staff for the conduct of the test.

There was a total of 17 weapons and devices detonated using both Eniwetok and Bikini Atolls as detonation sites. The main effort of the Navy task group (Task Group 7.3) was concentrated at Bikini Atoll in support of large yield shots. The list of shots detonated is as follows:

SHOT NAME	DATE DETONATED	ATOLL
LACROSSE	5 MAY	ENIWETOK (Ground)
CHEROKEE	21 MAY	BIKINI (Air Drop)
ZUNI	28 MAY	BIKINI (Ground)
YUMA	28 MAY	ENIWETOK (Tower)
ERIE	31 MAY	ENIWETOK (Tower)
SEMINOLE	5 JUNE	ENIWETOK (Ground)
FLATHEAD	12 JUNE	BIKINI (Barge)
BLACKFOOT	12 JUNE	ENIWETOK (Tower)
KICKAPOO	14 JUNE	ENIWETOK (Tower)
OSAGE	16 JUNE	ENIWETOK (Air Drop)
INCA	22 JUNE	ENIWETOK (Tower)
DAKOTA	26 JUNE	BIKINI (Barge)
MOHAWK	3 JULY	ENIWETOK (Tower)
APACHE	9 JULY	ENIWETOK (Barge)
NAVAJO	11 JULY	BIKINI (Barge)
TEWA	21 JULY	BIKINI (Barge)
HURON*	22 JULY	ENIWETOK (Barge)

*HURON device had failed during final countdown on 2 July at Bikini Atoll. The device was returned to Eniwetok, made ready to fire again and became the last detonation of the REDWING series on 22 July 1956.

The Navy task group build-up phase began on 1 September 1955, with the reporting of the Task Group Commander, Rear Admiral Joseph H. Wellings, U.S. Navy. The operational phase commenced on 16 January 1956 when the first units of the task group deployed to the Pacific Proving Ground.

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3. While the two destroyers assigned to Operation REDWING did valuable service weatherwise, this use was a compromise between weather requirements and availability. Four destroyers would enable more distant, and therefore more useful weather stations to be used.

3.13 AIRCRAFT RADIATION SURVEY (Project 2.64 - Fallout location and Delineation by aerial surveys).

3.13.1 PLANNING STAGE

Aerial surveys involving P2V aircraft were scheduled originally for CHEROKEE, ZUNI, FLATHEAD, HURON, NAVAJO, APACHE and TEWA. Four P2V aircraft from PatRon ONE based on Kwajalein had the following special project equipment installed:

"Top Hat" detector (installed in after tail section over the camera hatch).

Control assembly and strip chart recorder.

Telemeter tape recorders.

Power supply.

ART-13 transmitter.

Original plan called for flights to originate from Kwajalein and instruments to be serviced and calibrated on Eniwetok. During the period D-7 to D-1 prior to each shot, each aircraft in rotation was to land at Eniwetok Island during daylight hours so that repairs and calibration could be undertaken. This command recommended, in the early stages of planning, that the calibration and repairs of project instruments be done at Kwajalein. From D Day to D+6 aircraft surveys were to be flown out to approximately 300 miles from Bikini. Two planes were to be used each day with two on standby. This aircraft utilization was planned to keep contamination levels down, so that aircraft used for later flights would be able to detect the relatively low radiation on the surface after D+2. Flight plans were based on fall-out prediction and control was maintained during each flight so that change in aircraft could be effected simply. The purpose of the flights was to determine the amount of radiation absorption experienced through various altitudes and data secured at various altitudes were to be used to develop a relationship for predicting fall-out attenuation over land. Telemeter

equipment and communication channels were installed in the Program 2 Plot on board the USS ESTES (AGC-12), to facilitate communications with and control of the aircraft directly from the fall-out plotting center.

Preoperational planning conducted by Project 2.64 could have been improved considerably from a military standpoint. The aircraft were scheduled to be operationally ready in the Pacific Proving Ground along with the other aircraft of VP-1 by 15 April 1956. Aircraft were made available for project installation in sufficient time but the equipment was not completely installed at NAS, Alameda until the latter part of February 1956, leaving little time for a thorough flight check and correction of discrepancies prior to deployment. The civilian engineers from the New York Operations Office, AEC sponsors of Project 2.64, did not have the necessary liaison with various military agencies involved. The net result was that the squadron was not sufficiently advised from the beginning to insure that adequate progress was made through military channels. Presence of a representative on the scene at Alameda to check detail and progress of equipment installations and to make arrangements for in-flight and ground checks of equipment would have detected the discrepancies later discovered in operation of the telemetering gear. The New York Operations Office requested that four electronic technicians from VP-1 be made available for a special one months' school in New York. This school was to train one man from each crew in basic maintenance and operation of project equipment. The four men were made available in November 1955, approximately three months prior to deployment of the squadron, but the school was not set up by the New York Operations Office. The school was finally set up in February 1956. In view of the lateness of the convening date and the fact that the squadron was under going an Operational Readiness Inspection and simultaneously preparing for deployment, the Commanding Officer, VP-1 requested that the school be set up in Alameda rather than in New York City. This request was not formally acknowledged by the New York Operations Office, but a representative was sent to Alameda and the crews received limited instructions prior to deployment. Pilots involved received no check-out in

special equipment prior to deployment.

3.13.2 CONCLUSIONS

1. Four aircraft with special configuration is considered minimum for this type project in an operation of the scope of Operation REDWING. Number of aircraft should be increased if the scope of future operations is broadened.

2. Use of specially configured aircraft to fly security missions on availability basis is satisfactory.

3. Considerable time and effort was wasted on flight and ground check of project equipment after arrival in the Pacific Proving Ground.

4. The telemetering equipment failed to function correctly throughout the operation.

5. Training for technicians was too little and too late.

3.13.3 RECOMMENDATIONS

1. That for an operation of the scope of Operation REDWING four aircraft be employed for this type project, with the number assigned made greater as the scope of the operation increases.

2. That in future operations effective liaison should be established between project personnel and the operational assigned squadron to insure that necessary action required from military sources is undertaken in an early and effective manner.

3. That training on special equipment for military technicians be undertaken as early as possible.

4. That the training for these technicians be given, if at all possible, at the squadron's home base.

3.14 OPERATIONAL PHASE

Soon after arrival in the forward area, it became apparent that planned procedures for operation of aircraft in conducting the project were incorrect. Aircraft were based on Kwajalein and staged all their flights through Kwajalein. Project engineers were based on Parry Island, Eniwetok Atoll and performed their calibration and ground checks on Eniwetok Island,

messages and transmission time both from control center and from the aircraft.

Frequencies Assigned (HF)

3130 KCS, 6693 KCS	Aircraft Telemetering
3151 KCS, 6708 KCS	Aircraft Telemetering
3088 KCS, 6745.5 KCS	Navigation, Ship/Aircraft

3.14.4 CONCLUSIONS

1. Operations split between Kwajalein and Eniwetok Atoll are cumbersome, inefficient, and needlessly expensive.

2. Operation of aircraft can be more effectively controlled from their home base using base communication facilities.

3. Code developed by the project was unsuitable in that it was too complicated and involved transmissions of too great a length.

4. It is necessary that a naval aviator be present to supervise operations of patrol aircraft.

5. Communication frequencies were inadequate and should be critically examined.

6. Air to ship telemetering system did not function in the manner designed.

3.14.5 RECOMMENDATIONS

1. That all test and calibration of equipment be accomplished at the aircraft home base.

2. That a naval aviator, experienced in operational control of patrol aircraft, be assigned to coordinate operations of aircraft assigned to a mission of this type, and that he review all proposed control procedures critically prior to the operational phase of this project.

3. That clear telemetering and air to ship communication frequencies be requested and assigned, allowing a choice so that a day or night frequency could be chosen for best range and operation.

3.15 RADIOLOGICAL SAFETY

3.15.1 GENERAL

The mission of the radiological safety organization for Operation

REDWING was determined to be; (a) protection of personnel and equipment from radiological hazards, (b) training of personnel in radiological safety, and (c) evaluation of effectiveness of radiological safety training and equipment.

3.15.2 ORGANIZATION

The organization of Task Group 7.3 for radiological safety during Operation REDWING was based on the existing shipboard and unit Damage Control and Atomic, Biological and Chemical Defense (ABCD) organization supplemented by further training and organization in atomic defense in order to meet minimum standards for radiological safety during the operation.

Additional qualified personnel on the staff were required in order to render necessary advice, assistance, and training to all ships and units. In addition, this group developed new procedures and operational techniques in radiological safety for use by fleet units.

3.15.3 INITIAL PLANNING

The Assistant Plans and Operations Officer (Atomic Defense) was relieved in early July 1955, after Operation WIGWAM. Active planning was begun in August 1955.

At this time, planning letters detailing advice and assistance were prepared and forwarded to all ships and units assigned. All ships and units available on the West Coast were later visited to discuss their part in the operation and to further advise them concerning their RadlSafe problems. Visits were also made to other task groups and activities to discuss matters of mutual interest concerning the operation.

Modifications to ships and aircraft for radiological safety considerations and in support of other task group operations were coordinated with the activities concerned. Logistic requirements for radiological safety operations were promulgated to all ships and units, and procurement of various items was coordinated with other activities. For the most part, ships and units were required to obtain radiological safety clothing, radiac spare parts and batteries, decontamination materials, and other supplies. They were required to obtain radiological safety clothing, radiac spare parts and batteries,

decontamination materials, and other supplies. They were required to pay for these items from their quarterly operating allotments. This gave rise to several problems, such as (1) insufficient funds available to procure required supplies, especially for smaller ships, (2) lack of information available to type commanders on the special logistic requirements for an operation of this nature and the consequent need for augmentation of quarterly operating allotments, and (3) difficulties in justifying requisitions for materials which were required for the operation yet were not on allowance lists or were in excess of allowance.

To partially compensate for the above problems and to insure availability of clothing and supplies for any possible emergencies, a reserve supply of clothing, radiac spare parts and batteries, and other special materials, was obtained by the staff radiological safety officer. This gave rise to problems in procurement, stowage, issue, accounting, and roll-up, which are not normally within the province and capabilities of a small operational staff. Advance information was requested and received from the Bureau of Naval Personnel and the Bureau of Medicine and Surgery, concerning enteries to be made in service and health records of personnel exposed to ionizing radiation during the operation.

A reference library and file system was set up to facilitate solution of technical problems during the operation. Forms and information pamphlets were also devised and distributed to disseminate information, facilitate recording and reporting, and to provide check-off lists for preparations and inspections.

The Radiological Safety Annex to CTG 7.3 Operation Plan (Annex G) included, in a readily declassifiable manner, all possible information and directives concerning radiological safety which would be needed during the operation. An advance copy of Annex G was sent to all ships and units. Subsequent changes and supplementary letters were promulgated, but considerable revision of the contents of Annex G is necessary prior to use in future operations. In particular:

1. Radiological safety regulations should be more realistic and permit

a more liberal "on the spot" interpretation of maximum permissable contamination limits (MPL) by qualified personnel.

2. Preventative measures should emphasize the necessity for cleaning firemains to insure maximum water supply to washdown systems.

3. Countermeasures should detail more specific instructions concerning fall-out detection and evaluation.

In consideration of the need for increased emphasis and effort on training and indoctrination for Operation REDWING, an over-all proposal for radiological safety training was formulated and discussed with the Bureau of Naval Personnel, U.S. Naval Radiological Defense Laboratory (NRDL), and U.S. Naval Schools Command. A radiological safety training officer and chief petty officer from the Naval Schools Command, Treasure Island and a civilian consultant for radiological safety from NRDL were assigned to Task Group 7.3 staff. Arrangements were made for obtaining training films, slides, projection equipment, and other training aids. The two military personnel reported for duty at NRDL in January 1956 and commenced planning and preparations for the Task Group 7.3 training program.

In addition it was decided that a manual be made available for (1) use as a text in training (2) a pamphlet for "all hands" indoctrination, and (3) a reference manual for technical personnel. The most acceptable and available publication for these purposes was a proposed revision to a NRDL manual entitled "Radiation and Contamination Control." One thousand copies of this manual were procured and distributed to all ships and units.

Participation of personnel from naval training activities in field test operations was another innovation. Such participation was requested of and approved by BuPers in order to permit instructors from the several naval activities conducting training in radiological safety and atomic defense to gain experience by witnessing test detonations and radiological safety operations, while at the same time "paying their way" by actual participation in training programs and radiological safety operations. In addition, such participation tended to promote better exchange of information and doctrine

between personnel teaching radiological safety and personnel engaged in actual radiological safety operations in the field. Although participation was limited, it was worthwhile.

3.15.4 CONCLUSIONS

1. Earlier planning and implementation of training, visits to ships and units, and other staff functions is indicated for future operations. Visits should be undertaken earlier, more frequently, and for longer durations of stay than was possible for Operation REDWING. The same conclusion holds for visits to other task groups and activities concerned in the operation. Modification to ships and aircraft at West Coast locations also require personal contacts.

2. Previous experience and continuity between operations is highly desirable in filling the billet on the staff of Assistant Plans and Operations Officer (Atomic Defense).

3. Logistic requirements for radiological safety during Operation REDWING imposed some hardships on assigned ships and units. Type commanders and supply activities concerned should be better advised on such matters to facilitate their understanding the needs of ships and units assigned. Some emergency materials and special equipment must be procured, stowed, issued, and returned on roll-up by staff action. In addition personnel and facilities should be available to accomplish the necessary stowage and issue for the field use of the equipment (see above).

4. Further revision and ultimate printing and distribution to units of Task Group 7.3 of a training, indoctrination and reference manual is highly justified for the next operation.

5. Training for future operations should be conducted earlier and be more comprehensive.

6. The participation of personnel from established ABCD training activities in test operations was very successful, although limited. Similar participation on a larger scale would be very worthwhile in future operations.

7. With exceptions as noted, radiological safety planning for Operation REDWING achieved desired results and is considered to have been adequate

and satisfactory.

3.15.5 RECOMMENDATIONS

1. That planning for future operations commence immediately after the conclusions of the preceding operation. This includes appropriate visits to ships and units assigned, and to other task groups and activities concerned.

2. That the staff billet of Assistant Plans and Operations Officer (Atomic Defense) be filled with an officer who has had experience on a previous operation.

3. That adequate provisions be made to procure and stow on an appropriate ship for issue as needed, the reserve supplies and special equipment for radiological safety operations. Custody control of these items can be detailed to this ship for issue as directed by CTG 7.3.

4. That type commanders be apprised, by letters and visits, of the materials not on allowance lists or in excess of allowance which will be required by ships and units assigned.

5. That radiological safety training for future operations be planned immediately upon the conclusion of the preceding operation. Training should commence as soon as units are assigned and be accompanied by a team of experienced and qualified instructors, temporarily assigned to Commander Task Group 7.3. All instruction should be completed before the first scheduled detonation. This instruction should be in addition to the supplement training available under regularly established courses.

6. That supply activities concerned be apprised, by letters and visits, of the materials not on allowance lists or in excess of allowance which will be required by ships and units assigned.

7. That increased participation by instructor-observers from BuPers training activities be planned and requested for future operations.

8. That two qualified radiac instrument electronic technicians be assigned to the staff at least four months prior to deployment for the operation, and that they be employed as for Operation REDWING.

3.15.6 RADIOLOGICAL SAFETY TRAINING

The purpose of the radiological safety training program of Operation REDWING was to train all personnel of Task Group 7.3 in the methods and procedures of dosage and contamination control. The training program was conceived and designed to meet two objectives: (a) to teach personnel how to protect themselves from radiological hazards and to improve the state of readiness of naval units in radiological safety, and (b) to evaluate the effectiveness of radiological safety training now being given to the fleet units and their readiness for atomic defense operations.

It was determined that this program could best be carried out by having available in the Pacific Proving Ground a radiological safety training team. The team consisted of the following personnel; one lieutenant; one chief petty officer, chief damage controlman; and one civilian, health physicist; all having a background in radiological safety training.

The first concern was to develop course curriculum, prepare and obtain training aids, and conduct unit training prior to deployment of ships to the Pacific Proving Ground in March. The manual "Radiation and Contamination Control," prepared by the Health Physics Division of NRDL, was adopted for use in the course, and served as a basic background text for lectures. A field manual for the use of Radiological Safety Officers was prepared and printed at NRDL.

Due to the shortage of time before deployment, it was possible to conduct only a limited amount of training before units departed from the West Coast. Appendix A summarized the training completed during Operation REDWING. Twenty-four sessions, involving a total of 1036 personnel, were conducted. The preparation and manufacture of training aids, such as slides, demonstration devices, and practical exercises utilized the remainder of the time before the training team boarded the flagship at San Diego on 14 March 1956.

The training team presented courses of instruction during March and April to the majority of participating units. The objective of the training was to offer a concentrated radiological safety briefing to all key personnel

on board a ship. The average class size was between 25 and 30. Personnel attending the course were generally the officers, chief and leading petty officers of the ship. Monitors and decontamination team members also attended many of the sessions. Personnel attending this course were to return to their units and give instructions to all hands. The one day course consisted of the following curriculum:

1. A resume of Nuclear Weapon Phenomena
2. Nuts and Bolts of Nucleonics
3. The Bomb, Its Effects, and You
4. Basic Radiological Safety
5. How to Monitor and the Use of Radiac Instruments
6. Principles of Radiation and Contamination Control - (An introduction to the manual)
7. General Discussion: Questions and Answers

In addition to the classroom sessions listed above, practical exercises in decontamination and monitoring were conducted on board ship. These exercises were scheduled in accordance with availability of the fleet units and involved personnel assigned to monitoring and decontamination teams.

During the shot phase, radiological safety training personnel were needed to supervise actual radiological safety operations and to assist the Radiological Safety Officer. This assistance consisted of effecting liaison and coordination with project personnel in the decontamination of test ships and barges by Task Group 7.3 personnel. Instructors were also detailed to various task group ships to act as observers and be available for technical aid as required. It was planned to continue training aboard ships during the shot phase, by conducting practical exercises. However, commitments for decontamination work and other operational matters interfered with this phase of the training program. It soon became evident that it was impractical to schedule any organized training after D-3 due to the unpredictability of ship movements. Briefings for all of the Radiological Safety Officers of Task Group 7.3 were held to discuss operational problems. The subjects covered in this briefing were as follows:

1. Introduction to Briefing
2. Weather and Fall-out
3. Decontamination Situation Report
4. Radiological Situation Report
5. M.P.E. and Clearances
6. AFSWP 99 (Dosage and Dose-Rate Curves of Residual Radioactivity).
7. Thumb Rules
8. Training Report
9. Radiological Safety Organization
10. Reports and Discussion

During the operation, service force ships rendering logistic support changed several times. It was necessary to indoctrinate the crews of these ships in the radiological hazards of the test operations, but again operational commitments prevented extensive training for these ships.

The task group television network was used to present a series of radiological safety programs. The programs presented were of the general interest type, aimed at indoctrinating all hands in basic radiological safety for Operation REDWING.

During the latter part of the operation, two officers and two chief petty officers, from naval training commands, reported to the staff for 30 days temporary additional duty as technical observers. These personnel were from the Fleet Training Groups in Newport, Rhode Island; Norfolk, Virginia; and Yokosuka, Japan. They were integrated into the staff radiological safety organization and thus were able to observe several detonations and to become active in actual radiological safety operations.

3.15.7 CONCLUSIONS

1. Operational radiological safety requirements were integrated with training so that personnel could understand exactly what was required and the reason for doing it. The maximum use of operational situations was made to supplement classroom training. Full advantage was taken of the only realistic atomic defense and radiological safety situations now available to fleet units.

2. Although there was little contamination of ships during Operation REDWING, the spread of contamination aboard ships was positively controlled, and the radiological exposure of personnel was held to a minimum.

3. The participation, as observers, of personnel instructing in naval courses dealing with atomic defense and radiological safety is a valuable contribution to their background in a subject that offers few opportunities for actual participation. While with the staff, all of the observers exchanged ideas, obtained new information and developed an "espirit de corps" making them better instructors.

4. The state of readiness in radiological safety of all naval units participating was improved. The training staff was afforded an excellent opportunity to learn what is good and what is poor in the radiological safety training offered naval personnel.

5. Training during test operations is of value to increase morale of the ships. Ship's personnel felt that a personal concern was being shown for their individual safety. During periods between shots radiological safety training provided a worthwhile subject which interested all participants since they were all involved.

3.15.8 RECOMMENDATIONS

1. That the radiological safety training program, as established for Operation REDWING, be continued for future operations held at the Pacific Proving Ground.

2. That the scope of radiological training be increased. All units should receive unit training from a staff training team before their deployment to the Pacific Proving Ground. Training at the Pacific Proving Ground should consist of briefing sessions and practical exercises. The hard core of training should be done while the units are in CONUS, but this training should be followed up by conducting briefings at the Pacific Proving Ground to insure a high state of readiness.

3. That, to facilitate 2 above, the training team should become active about six months prior to the operational phase.

4. That prior to the first detonation and upon the completion of formal training and briefing, an inspection and atomic defense exercise should be held by staff training personnel for each ship and unit. Deficiencies should be corrected before the first scheduled event.

5. That radiological safety training should be conducted from one central location.

6. That the potentialities of training via television warrant further development.

7. Radiac maintenance personnel should be located on the same ship with the training team if feasible to give better unity and coordination to the various staff functions.

8. That a greater number of personnel on duty at naval schools offering instruction in Atomic Defense and Radiological Safety should be ordered as technical observers to the naval task group during special weapon test operations.

3.15.9 RADIOLOGICAL SAFETY PREPARATIONS AND COUNTERMEASURES

Commander Task Group 7.3 Operation Plan No. 1-56 and directives prescribed and recommended radiological safety preparations and countermeasures to all ships and units, and field trips were made to assist units with these requirements.

"Interim" washdown systems were installed on all ships of Task Group 7.3. This system consists essentially of the installation of plastic piping with special nozzles located according to a predetermined plan designed to provide for a complete "water curtain" coverage of all topside surfaces. Aluminum quick coupling piping is used on flight decks and other locations where it is more advantageous. Salt water is utilized from the ships fire-main system using canvas firehose jumpers from selected topside fire plugs. These interim systems are presently authorized for installation on all fleet units in the near future. Actual installations were accomplished by ships' forces with material procured and funded by Bureau of Ships. Technical assistance and supervision during installations was also rendered by Bureau

of Ships representatives. All ships were required to report results of testing washdown systems by letter. Although employed only occasionally during the mild fall-outs encountered during the operation, it is considered that washdown systems were very satisfactory and are one of the best available fall-out countermeasures. Ships were given guidance in the correct employment of these systems. Only minor problems in nozzle locations and coverage were experienced. Firemain pressure, due to limited pumping capacity, was critical on many ships. The major problem with these systems is reduced flow through firemains due to stoppage by accumulated marine deposits. This also results in a radiation hazard on ships steaming in contaminated water due to a pronounced tendency for radiological contaminants to adhere to such deposits, and the contamination level builds up with time spent in contaminated water. Processes are available for cleaning firemains and other salt water systems and should be accomplished on all ships prior to deployment for future operations.

It was considered impractical to take LCU's to sea on pre-shot evacuations at Bikini, although leaving them in the lagoon might result in serious contamination of these boats and consequent nonavailability for urgent scientific recovery missions. For Operation REDWING, it was decided to test the feasibility of using a "strippable coating" to effect more rapid decontamination in such instances. Discussions with Bureau of Ships and NRDL personnel resulted in Bureau of Ships procurement, funding, and transporting to the Pacific Proving Ground of the necessary paint, strippable coating, spray application equipment, and Sellers hot salt water removal equipment. Personnel from the boat pool and all destroyer types assigned were instructed in the use of the equipment. Temporary modifications to shore steam connections were accomplished on all destroyer type ships. Surfaces were prepared and LCU's were coated prior to the first contaminating event at Bikini. No serious contamination of LCU's was experienced, but durability and strippability of the coating is very unsatisfactory. Further technical developments of this decontamination procedure is indicated.

Radiac instruments are an important consideration in nuclear test operations as well as for atomic defense purposes. In previous operations it was assumed that established allowances for ships and units were adequate and satisfactory for such purposes. This was not the case, since ships' radiac allowances do not provide for:

1. An instrument capable of evaluating the beta component or combined beta-gamma intensities greater than 5 mr/hr. Beta-gamma intensities from fall-out in the order of roentgens/hr contain beta intensities greater than that from the gamma radiation. Ratios as high as ten to one were observed after fall-out during Operation REDWING.

2. A side window GM counter or similar instrument for more rapid and efficient personnel and equipment monitoring.

3. Pocket dosimeters in sufficient quantity and satisfactory reliability to meet requirements.

4. Automatic radiation (fall-out) detection devices with associated alarms.

5. An alpha particle detector which will work under field conditions.

Additionally it was found that most ships and units did not have complete allowances of radiacs on board, did not know where such equipment was stored, had not kept equipment in proper operating condition, did not understand proper procedures for care and use of radiacs, and did not have necessary spare parts and fresh batteries. A final consideration is that nuclear test operations are not normal situations insofar as radiac instruments are concerned and normal allowances are not adequate.

For Operation REDWING the known shortages in allowance were requested of all assigned ships, and arrangements were made to assemble instruments to fill such shortages at NRDL, along with a pool of instruments for supplementary issue at the Pacific Proving Ground. Authority was received from

BuShips to issue radiac instruments to ships on permanent custody to fill shortages in authorized allowances. All the foregoing instruments were shipped to NRDL, by BuShips radiac issuing activities, where they were inspected, tested, and calibrated by staff electronics technicians prior to loading aboard the USS BADOENG STRAIT (CVE-116) for transportation to the Pacific Proving Ground.

The "workhorse" instrument for the operation was the AN/PDR-27F with the AN/PDR-18A available for use in higher radiation fields. These instruments were very satisfactory and gave essentially trouble free service throughout the operation. By relying principally on these instruments, the logistics of spare parts, tubes, batteries, and maintenance was greatly simplified. Instruments were issued and repaired by staff electronic technicians on the BADOENG STRAIT. For planning purposes in future operations, the repairs accomplished during Operation REDWING after the initial work at NRDL are described in Appendix B. Ships and units were required to effect all radiac repairs within their capacity.

The requirement for procurement of a pool of radiac spare parts, tubes, batteries, and tools was placed on the BADOENG STRAIT with funding to be done by BuShips. This worked out satisfactorily, although some materials were not received until late in the operation. All ships and units were advised to procure 200 percent spare tubes and 300 percent spare batteries, and to keep these batteries in cool storage (approximately 40°F). The electronic supply office was alerted on these abnormal requirements and fresh batteries were made available at West Coast issuing activities.

Radiac instrument allowances for the operation were established by request to BuShips for HMR-363 and Patrol Squadron ONE, and instruments were shipped directly to these units. In view of their remote location at Kwajalein during the operation, Patrol Squadron ONE was advised to be as self-sufficient as possible, and that qualified radiac repair electronic technicians should be trained at the U.S. Naval Schools Command. This recommendation was also made to all large ships.

Special instruments to supplement available Navy standard types were provided. Twenty Berkeley side window GM counters were obtained on loan from NRDL, for issue and use as personnel monitoring instruments. Twenty Cutie-Pies were ordered from ELTRONICS, funded by Commander Joint Task Force SEVEN, and issued for use in monitoring and evaluating high beta-gamma intensities. These latter instruments were not received until late in the operation and many were defective upon receipt from the manufacture. Seventy-five Bendix O-5r dosimeters and one charger were borrowed from Task Unit 7 (Radiological Safety Task Unit of TG 7.1) for use of Patrol Squadron ONE and for decontamination operations. Standard Navy dosimeters (IM-9/PD, IM-19/PD, IM-94/PD and the PP-354C charger) were used.

Radiation sources for instrument calibration and for training purposes were obtained from BuShips. These sources were received without calibration information and without individual containers for convenient use. Calibration was effected and lead "pigs" were fabricated in the forward area, but were not available in time to be used extensively. The use of actual sources, under close supervision, for monitoring drills appeared to be very effective. A seven curie Cesuim 137 source was also obtained on loan from NRDL for instrument calibration.

Casualty Range dosimeters (DT-60/PD) and the CP-95/PD readers were provided for all units. The issue of DT-60's to all personnel of Task Group 7.3 was recommended and accomplished. The initial reading, recording, and issue of these dosimeters presented no problems. Since no dosages in the casualty range were experienced during Operation REDWING, no further evaluation of their use was made.

The film badge dosimetry program for Joint Task Force SEVEN was a primary function of Task Unit 7 of Task Group 7.1. Film badges and associated record cards were obtained from Task Unit 7 and distributed to all ships and units of Task Group 7.3 together with instructions concerning issue, wearing, and executing record cards. Completed "Individual Exposure Record Cards" and "Film Envelopes" were collected and returned to Task Unit 7 to establish

central records. All personnel of Task Group 7.3 were issued "permanent" film badges. Completed serialized film badge cards were retained by the Radiological Safety Officer as a check on the complete return of all badges issued. New badges and serialized cards were issued about midway during the operation and exposed badges collected, checked and returned to Task Unit 7 for developing, evaluation, and dosage recording. Film badges were collected and processed about one week after the final shot. Accumulated dosages for all Task Group 7.3 personnel was reported by Task Unit 7 for forwarding to individual units of Task Group 7.3. Close supervision of film badge issue, accounting, and collection was time consuming but very necesary, due to numerous instances of improperly executed cards, lost film badges, transfer of personnel, and movements of ships. Film badges were also furnished to transient ships where indicated.

The established maximum permissable exposure (MPE) for Operation REDWING was 3.9r for any 13 week period. Dosage control was thus very critical, especially for HMR-363, boat pool, PATRON ONE, and personnel engaged in YAG and YFNB decontamination. "Mission" film badges were obtained from Task Unit 7 for such personnel using a "charge-a-plate" system. Accumulative dosage records were kept by all units to prevent overexposure of personnel. Dosage control records were also maintained by Task Unit 7. Reports of all exposures over 2.0r were made by Task Unit 7. To date, only one HMR-363, one YAG-40 and three boat pool enlisted men have radiation exposures in excess of 2.0r (all less than 2.5r), and one X-Ray technician from the BADOENG STRAIT has accumulated a dosage of about 5.0r from faulty X-Ray equipment.

3.15.10 CONCLUSIONS

1. Available radiological safety preparations and countermeasures are not generally well understood and should be emphasized to units assigned by all possible means.

2. Coveralls, caps, and cotton or canvas gloves are satisfactory protective clothing for use in hot humid climates. Hooded rain jackets, trousers, rubber gloves, plastic face shields, and boots or overshoes are

satisfactory for wet decontamination work in such climate.

3. Washdown systems are a required countermeasure for all ships participating in nuclear test operations and can be very effective if properly employed.

4. Thorough cleaning of firemains and other salt water systems on ships operating in contaminated water would greatly reduce residual radiation hazards upon leaving contaminated areas. Periodic cleaning of firemains is mandatory if washdown systems are to operate effectively.

5. The AN/PDR-27F and AN/PDR-18A radiac instruments were very reliable and satisfactory for most needs, and should be extensively employed. Ship's radiac instrument allowance, however, do not have a suitable medium range beta-gamma instrument. Numbers of radiacs available to most ships are not adequate for nuclear test operations.

6. Procurement of radiac spares and batteries was satisfactory. Adequate supplies of fresh batteries prevented many of the instrument problems experienced on previous operations.

7. Small radiation sources are required for instrument calibration and training purposes aboard ships. Monitoring drills using actual sources appear to be very worthwhile.

8. The procedures followed in obtaining distributing, wearing, and collecting film badges for all personnel in Task Group 7.3, and the recording and reporting of their accumulated dosages were satisfactory. Close supervision of this program is necessary if dosage records are to be complete and accurate, and such supervision is very time consuming. Dosage control procedures were very successful. More frequent reissue and reading of film badges is desirable since the high humidity resulted in water marking of all badges to a density equivalent to several hundred milli-roentgens. Reporting all dosages received on "permanent" badges during the operation, as well as for "mission" badges would provide for better dosage control.

9. The use of "strippable" coating to facilitate rapid decontamination of LCU's was unsuccessful due to technical problems in durability and

and strippability of the coating.

3.15.11 RECOMMENDATIONS

1. That continued emphasis be placed on radiological safety preparedness and available countermeasures for future operations.

2. That coveralls, cotton or canvas gloves, and utility caps be adopted as standard radiological safety protective clothing. That hooded rain jackets, trousers, boots or overshoes, rubber gloves, and plastic face shields be adopted as standard clothing for wet decontamination.

3. That washdown systems be required on all ships for nuclear test operations and for atomic defense, and that such systems should be further developed to provide permanent systems with an internal central control.

4. That firemain and other salt water systems be thoroughly cleaned on all ships prior to reporting for nuclear test operations, and that periodic cleaning be required on all ships as an atomic defense measure.

5. That procedures utilized for procurement, distribution, and maintenance of radiac instruments during Operation REDWING be followed for future operations.

6. That utilization of radiac types AN/PDR-27 and AN/PDR-18 as basic field instruments be continued.

7. That further development of standard Navy radiac instruments, particularly for alpha and beta detection and for personnel monitoring, be vigorously prosecuted.

8. That small radiation sources (such as several Cobalt 60 sources in the 5-100 millicurie range) be procured for instrument calibration and training aboard ships assigned to future operations.

9. That close supervision of the film badge program be required in future operations. That film badges be renewed at least monthly in hot, humid climates, or that more effective protection of film from heat and moisture be developed. That reports of accumulated dosage for all personnel be made available to units as frequently as possible during future operations.

10. That "strippable" coating not be used for future operations until durability and strippability is improved.

3.15.12 RADIOLOGICAL SAFETY OPERATIONS

During all major events, all ships were deployed at a distance of about 30 miles from shot site. This distance afforded complete protection from blast and shock, initial radiation, and thermal effects. No special clothing at shot time was required.

The only remaining shot time hazard was from the initial flash. Positive control of all personnel was established to insure that no one looked directly at the detonation during the first few seconds. Personnel of all ships and units were repeatedly indoctrinated in safe procedures for viewing the phenomena. Six hundred pair of high density (NX 5) goggles, having an optical density of 4.25, were obtained and distributed to all units. Despite these precautions two or three isolated instances of possible temporary eye injuries due to flash were reported where goggles were not worn. Safety and morale considerations indicate that a greater number of these goggles should be made available.

Countermeasures, including monitoring and decontamination operations aboard all ships were conducted during fall-out. These measures insured that only minimum exposures of personnel were incurred, even in the case of the only significant contamination on ships other than the fall-out collection group, on CURTISS, AINSWORTH, and KNUDSON when these ships were sent to Eniwetok after TEWA for possible evacuation. This, which included "hot spots" as high as 300 mr on CURTISS, was brought within tolerable limits by use of washdown scrubbing. No delay in operational clearance was required of any ship because of contamination. Monitoring and decontamination of P2V-5 aircraft and HRS-3 helicopters was accomplished on numerous occasions of moderate contamination. A commercial cleaning compound "Keolite" was very effective for cleaning aircraft engines. A canvas "bathtub" was successfully used on the BADOENG STRAIT to control the spread of contamination during helicopter decontamination. Contamination control, insofar as entrance and exit to the gas tight envelop of ships is concerned, prevented the spread of contamination into ship interiors.

For all of the later events at Bikini, the Radiological Safety Officer for Joint Task Force SEVEN remained at Eniwetok and the radiological situation,

from aircraft and helicopter surveys was furnished to CTG 7.3 and also relayed to CJTF-7 headquarters at Eniwetok by telephone, teletype, and radio. This procedure appears to have worked out very well.

Reentry into the lagoon was usually made at about H/2½ hours. No samples of lagoon water prior to reentry were taken by survey helicopters or considered necessary. All ships were directed to take lagoon water samples at their anchorages for radiochemical analysis. Only slight contamination of the lagoon in the anchorage area was encountered during the operation. Boating and contamination of ship's hulls and salt water systems were not a problem although some salt water systems were contaminated on ships operating and anchoring near shot sites. It was not necessary to secure ships evaporators while at sea or in the Enyu anchorage area, although some ships did so as a precautionary measure. All ships were carefully advised on precautions to be taken when distilling potable water in contaminated areas and were instructed to have radiochemical analysis made periodically of potable water samples. Lagoon contamination made it necessary to prohibit swimming at Camp Blandy for several days following detonations at Bikini and finally for the remainder of the operation. This decision was based on the philosophy that exposure to radiological hazards should be kept to a minimum in the absence of reliable exposure criteria. Swimming was prohibited when radiation levels at one foot above the surface were greater than background or when contaminants were present in amounts greater than about 1 times 10 to the minus 5 microcuries per millileter, depending upon the age of the contaminants. It is probable that swimming could have been permitted more often if reliable criteria had been established by competent authority. Additional information on lagoon contamination was received from Scripps Institution of Oceanography personnel during the operation.

Personnel from the USS ESTES (AGC-12), USS BADOENG STRAIT (CVE-116) and USS CURTISS (AV-4) were detailed as decontamination temas in the decontamination of YAG-39, YAG-40, and LST-611 at Eniwetok following several Bikini shots. This required considerable coordination with ships concerned, Task Unit 7 and

and personnel from Projects 2.8, 2.9, and 2.10B of Program 2, including "on the spot" supervision by staff radiological personnel. Briefly the procedure was to send the required working parties and staff personnel from Bikini to Eniwetok on D/1 day, brief the working parties on D/2, and commence decontamination operations on D/3 using hosing and scrubbing and other special techniques. Although moderate contamination was experienced, these operations were successful in effecting required turn-around of ships for the next event. It is felt that participating personnel received valuable training and experience during these operations, and the above ships were encouraged to rotate their key damage control personnel in this assignment. Dosage received by decontamination party personnel averaged about 0.5r for each operation.

Decontamination of YFNB-13 and YFNB-29 was required after several of the Bikini events and was successfully accomplished by the fleet tugs, USS ABNAKE (ATF-96), USS LIPAN (ATF-85), and USS CHICKASAW (ATF-83). This requirement was not submitted to Task Group 7.3 until about the time of the first Bikini detonation, and inspection of the barges revealed unacceptable conditions of contamination susceptability. As a temporary expedient the ABNAKI cleared topsides of loose gear, welded over topside holes and cut drain holes in the deck house on both barges. Additionally, a modified washdown system was installed on both barges. These washdown systems were inoperable for several events due to pump and generator failures. Later in the operation it became apparent that effective decontamination, of the order required to meet turn-around dates for the next scheduled shot, might not be feasible in view of the tenacious nature of "wet" contaminants experienced from barge shots on rusty topside surfaces. These were cleaned and painted by ships personnel.

Decontamination of the YFNB's by fleet tugs was effective in reducing initial intensities in the order of 500 mr/hr (on D/2) to fields in the order of 50 mr/hr, with no "removable" contamination remaining. Exposure of tug personnel was held to a maximum of 0.5r per event. On the basis of this experience the following three step shipboard decontamination procedures are

recommended:

1. Fire hosing, using $1\frac{1}{2}$" hoses on solid stream with two men per hose.

2. Scrubbing and salt water flushing. A mixture of detergent and fresh water (or salt water detergent and salt water) together with vigorous scrubbing action should be used. As much lather as possible should be worked up. After scrubbing with the above, flush with salt water ($1\frac{1}{2}$" hose on "fog" position) and use vigorous scrubbing action to move the residue overboard, working with the drainage of the deck. (A team consisting of two men with brushes and one man with a hose worked out very satisfactorily for the flushing operation). The men with the brushes, should work ahead of the man with the hose. If the contamination is very tenacious, boiler compound and lye may be added to the detergent mixture and the resulting solution will actually remove the paint. This may be necessary for contamination that is "wet" and of small particle size.

3. Fire hosing, using $1\frac{1}{2}$" hose on solid stream with two men per hose.

The above procedures should be applicable for all ships. Foul weather gear should be used as protective clothing. Complete dress-out should be used during steps 1 and 3. Boots, gloves, and trousers are sufficient for the scrubbing and flushing of step 2. Contamination that is not removed by the above procedures will require vigorous surface removal techniques (wet-sand blasting, etc.) if isolation and natural decay are not operationally acceptable. Such surface removal techniques are normally construed as a shipyard operation. However, it is believed that the above listed procedures can be successfully implemented by any ship's crew, and that proper application of these procedures should enable a ship to reduce any commonly encountered radiation levels to a degree that will permit it to carry out its mission without excessive radiological exposure of personnel.

The feasibility of an early radiological survey by fixed wing aircraft to provide a plot of radiation fields was investigated with P2V

aircraft on several of the later shots. Experience to date indicates that a fixed wing aircraft, flying at about 500 feet altitude, can obtain accurate and early information on the radiological situation. Only portable field type radiacs and a simple means of determining positions on a grid chart are required. A survey of the entire atoll and adjacent areas can be started immediately after local fall-out has ceased and can be completed with less than two hours flight time. This includes a complete mapping of radiation intensities from which iso-intensity contours for the entire atoll area may be determined. This would appear to be considerably more accurate, timely and complete than present surveys by helicopters, and consideration of this procedure for future operations is recommended.

All transient ships qualified for and were granted final clearances in accordance with NavMed P-1325. Most ships and aircraft qualified for a final clearance. Some ships were mildly contaminated and were granted an operational clearance. In such instances, every effort was made to spell out the extent of the residual contamination, the nature of the hazards to personnel involved, and recommended procedures for obtaining a final clearance. Letter or message reports were made to ships, type commanders, and other interested activities. In this connection, it is considered that NavMed P-1325 does not stipulate realistic criteria for such clearances and that a more workable set of numbers is needed for future clearance decisions.

3.15.13 CONCLUSIONS

1. All hands should be thoroughly indoctrinated in the precautions to take at shot time to protect them from the hazard of flash blindness.

2. Ships should set up positive procedures to be used by shipboard monitoring teams. The need for this and other fall-out countermeasures was apparent during Operation REDWING.

3. Canvas bathtubs assist in contamination control during helicopter decontamination, but are not essential. Use of hoses to provide a cover of water over the flight deck and an adequate deck drainage system will also control contamination during such decontamination operations. This procedure

is more readily available to all ships.

4. Decontamination procedures developed during Operation REDWING are considered to be practical and effective. They are adaptable to all shipboard contamination situations.

5. The Task Group 7.3 Radiological Safety Officer can coordinate the collection, evaluation, and dissemination of radiological safety information for Bikini events and keep CTG 7.3 and JTF-7 headquarters at Eniwetok adequately informed.

6. Procedures for taking salt and fresh water samples, with means available for analyzing contamination content of water, are required.

7. Ships can anchor and operate in the lagoon during conditions of moderate contamination. Boating in the lagoon is also feasible under these circumstances. Potable water can be made and used if simple precautions are taken and frequent checks are made. Contamination of ships salt water systems and ground tackle will occur and realistic countermeasures must be used.

8. Sufficient information and criteria are not available to properly evaluate the health hazard to personnel swimming in contaminated water. Swimming is an important recreation activity and should be permitted whenever possible.

9. Decontamination of ships and barges participating in the fall-out collection program can be successfully accomplished by personnel from the task force. This work provides excellent practical experience for the personnel involved.

10. Early radiological surveys of atoll and lagoon areas can be made using fixed wing aircraft (P2V-5) and standard field radiacs (AN/PDR-27 and AN/PDR-18). Intensities measured in the aircraft can be plotted on a simple grid reference chart and contaminated areas delineated.

11. To properly evaluate radiological hazards during the operation and to be able to properly assess action taken by participating units, reports are needed by the Staff Radiological Safety Officer.

12. The present directive governing radiological "clearances" for

ships and aircraft upon departure from the PPG (NavMed P-1325) is not realistic or workable. A proposed revision to NavMed P-1325, which has been in process for some time, is needed for future operations.

3.15.14 RECOMMENDATIONS

1. That ships be advised of the action recommended to protect personnel from shot time hazards. In this connection a greater quantity of high density goggles are required for issue to ships.

2. That monitoring teams be given indoctrination to insure use of standard monitoring techniques. That other radiological safety techniques and countermeasures developed during Operation REDWING be adopted for future operations.

3. That adequate drainage to provide contamination control during decontamination of aircraft on carriers be provided. The use of a canvas bathtub may prove useful in accomplishing this objective, but is not considered to be essential.

4. That a radiochemcial laboratory be provided to analyze water samples.

5. That a study be made by responsible agencies of the allowable contamination permissable for swimming in sea water.

6. That ships use regularly assigned decontamination teams to decontaminate any special target or test vessels during future operations.

7. That ship decontamination procedures developed during Operation REDWING be adopted as standard procedures.

8. That a study be made regarding the use of fixed wing aircraft for early lagoon radiological surveys and the plotting of iso-intensity lines, and that this capability be utilized in future operations.

9. That more realistic and workable criteria and procedures for radiological "clearance" to ships and aircraft be worked out with activities concerned and adopted for future operations.

APPENDIX A

RADIOLOGICAL SAFETY TRAINING

SHIP OR UNIT	DATE	NUMBER ATTENDEES	COURSE PRESENTED ON/AT
YAG-39, YAG-40, LST-611	2/8-9	95	Naval Radiological Defense Laboratory
Patrol Squadron ONE	2/27 to 3/2	322	U.S. Naval Air Station Whidbey Island, Washington
USS ESTES (AGC-12)	3/19 to 3/21	20	USS ESTES (AGC-12)
Staff CTG 7.3 & Officers USS ESTES (AGC-12)	3/26 to 3/30	30	USS ESTES (AGC-12)
USS LIPAN (ATF-85)	4/4 to 4/5	15	ENIWETOK (FRED)
USS CHICKASAW (ATF-83)	4/4 to 4/5	19	ENIWETOK (FRED)
USNS T-LST-306	4/10	20	USNS T-LST-306
Marine Helicopter Transport Squadron 363	4/16	42	USS BADOENG STRAIT (CVE-116)
USS KNUDSON (APD-101)	4/17	30	USS BADOENG STRAIT (CVE-116)
USS BADOENG STRAIT (CVE-116)	4/18 & 4/21	48	USS BADOENG STRAIT (CVE-116)
USS SILVERSTEIN (DE-534) USS MC GINTY (DE-365)	4/19	17 16	USS BADOENG STRAIT (CVE-116)
CTG 7.3 BOAT POOL BIKINI	4/20	34	USS BADOENG STRAIT (CVE-116)
USS SIOUX (ATF-75)	4/23	15	USS BADOENG STRAIT (CVE-116)
USS CHICKASAW (ATF-83)	4/23	10	USS BADOENG STRAIT (CVE-116)
USS CATAMOUNT (LSD-17)	4/24	36	USS BADOENG STRAIT (CVE-116)
USS ABNAKI (ATF-96)	4/26	16	USS BADOENG STRAIT (CVE-116)
USS SILVERSTEIN (DE-534)	4/26	19	USS BADOENG STRAIT (CVE-116)
USS CURTISS (AV-4)	4/30	35	USS CURTISS (AV-4)
Marine Helicopter Transport Squadron 363	5/3	18	USS BADOENG STRAIT (CVE-116)
USS BADOENG STRAIT (CVE-116)	5/3	21	USS BADOENG STRAIT (CVE-116)
USNS FRED C. AINSWORTH (T-AP-181)	5/4 & 5/7	28	USNS FRED C. AINSWORTH (T-AP-181)
USS SHELTON (DD-790)	5/8 & 5/15	25	USNS FRED C. AINSWORTH (T-AP-181)
USS JAMES E. KYES (DD-787)	6/28 & 6/29	30	U.S. Naval Station, KWAJALEIN
U.S. NAVAL STATION KWAJALEIN	7/5 & 7/6	55	U.S. Naval Station, KWAJALEIN
		Total 1036	

APPENDIX B

REQUIRED RADIAC REPAIRS

TYPE	SHIP	TROUBLE	CURE
AN/PDR-27C	LIPAN	No meter reading	Replaced C-101 and V-103
AN/PDR-27C	ESTES	No meter reading	Replaced C-101, C-107, C-108, and V-103
AN/PDR-27C	ESTES	No meter reading	Replaced batteries, V-103, and V-101
AN/PDR-27C	ESTES	Meter pegs to right Audio note in headset	Replaced C-107, C-105, C-104, C-106, C-101, CR-101, batteries
AN/PDR-27C	ESTES	Calibration	Calibrated
AN PDR-27C	ESTES	Calibration	Calibrated
AN/PDR-27C	ESTES	Calibration	Calibrated
AN/PDR-27C	ESTES	No meter reading	Replaced C-107, C-108
AN/PDR-27C	ESTES	Meter pegs to right	Replaced batteries, cleaned battery box
AN/PDR-27C	LIPAN	No meter reading	Replaced C-101
AN/PDR-27C	ESTES	No meter reading	Replaced C-101, C-107, V-101, V-103
AN/PDR-27C	LIPAN	No meter reading	Meter movement open, no spares available
AN/PDR-27E	BADOENG STRAIT	No reading on .5 & 5 mr/hr scale	Replaced batteries, V-102, V-103
AN/PDR-27E	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27E	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27E	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27E	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27F	HMR-363	No meter reading	Replaced V-103, V-101, batteries
AN/PDR-27F	ABNAKI	No meter reading	Broken battery clip on BT-107
AN/PDR-27F	Boat Pool	No meter reading	Replaced V-101, V-103
AN/PDR-27F	HMR-363	No meter reading	Replaced V-103, batteries

APPENDIX B (CONT'D)

TYPE	SHIP	TROUBLE	CURE
AN/PDR-27F	T-LST-618	No meter reading	Replaced batteries
AN/PDR-27F	BADOENG STRAIT	No reading on low scales	Probe wire open - no replacement port
AN/PDR-27F	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27F	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27F	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27F	KNUDSON	No reading on low scales	Replaced V-102
AN/PDR-27F	BADOENG STRAIT	Calibration	Calibrated
AN PDR-27F	T-LST-618	No reading on low scales	Replaced batteries, V-102
AN/PDR-27F	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27F	BOAT POOL	Meter will not ZERO	Adjusted mechanical ZERO on meter
AN/PDR-27F	BOAT POOL	No reading	Replaced batteries
AN/PDR-27F	BADOENG STRAIT	Calibration	Calibrated
AN/PDR-27F	ESTES	Calibration	Calibrated
AN/PDR-18A	HMR-363	Meter pegs to right	Replaced E-104, V-101, V-102
AN/PDR-18A	BOAT POOL	Will not ZERO	Replaced V-101, V-102
AN/PDR-18A	LCU-974	Mo meter reading	Replaced V-102
AN/PDR-18A	LCU-974	No meter reading	Replaced V-101, V-102, batteries
AN/PDR-18A	ABNAKI	Will not calibrate	Adjusted high voltage
CP-95/PD	T-LST-618	Will not calibrate	Adjusted internal calibrate control
CP-3D/PD	ESTES	No meter reading	Replaced broken probe and electrometer tube
AN/PDR-10B	ESTES	Meter pegs to right	Chamber arcing - could not repair

APPENDIX B (CONT'D)

TYPE	SHIP	TROUBLE	CURE
AN/PDR-10D	LIPAN	No meter reading	Replaced C-105, C-106, C-101
BERKLEY	SHELTON	No meter reading	Replaced batteries
AN/PDR-8B	MC GINTY	No reading on low scales	Replaced BS-101 tube
AN/PDR-8B	LIPAN	No meter reading	Replaced 1U5
AN/PDR-8B	LIPAN	No meter reading	Replaced 1U5, 3A5, BS-2
IM-4/PD	ESTES	Eratic - broken window	Replaced window, cleaned instrument
IM-4/PD	ESTES	Eratic	Cleaned instrument
IM-4/PD	ESTES	Eratic - broken window	Replaced window, cleaned instrument
IM-4/PD	ESTES	Eratic	Cleaned instrument

NOTE: 1. All instruments were calibrated after repairs.

2. This does not include numerous replacements of battery clips.

3. Failure of condensers C-101, C-107, and C-108 was the most frequent trouble with AN/PDR-27F instruments.

4. This listing does not include work on dosimeters and special instruments such as Cutie-Pies, which were received with defective wiring and meters.