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Bureau of Ships Project TRANSIT

BLUE BOOK

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TRANSIT

OPERATION PLAN

PROJECT 6.4, OPERATION CASTLE

Third Draft
23 December 1953

Joint Task Force Seven
Task Group 7.1
Task Unit 13

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LIST OF ANNEXES

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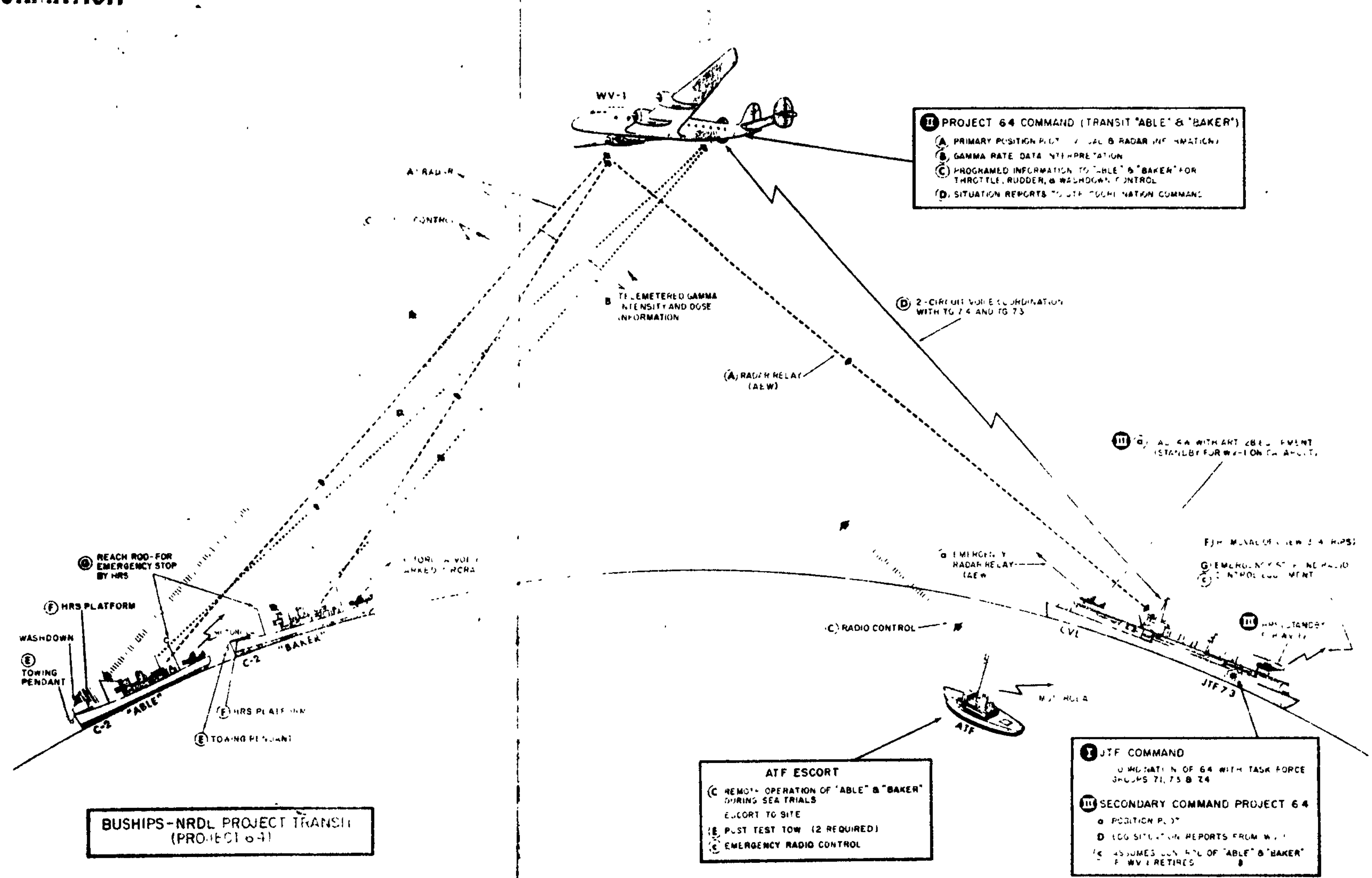

BUSHIPS-NRDL PROJECT TRANSIT (PROJECT 64)

ST. LOUIS FRC

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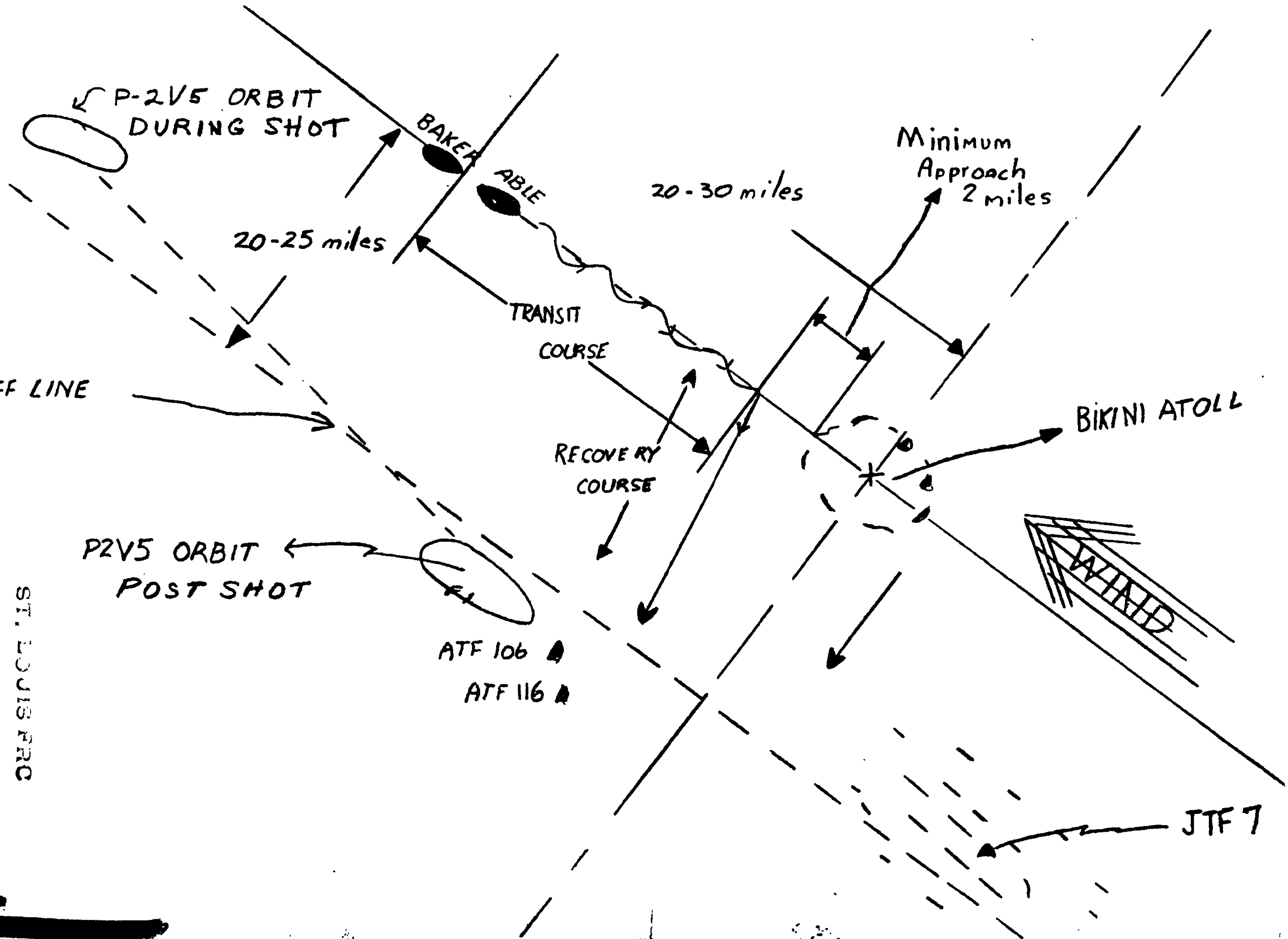

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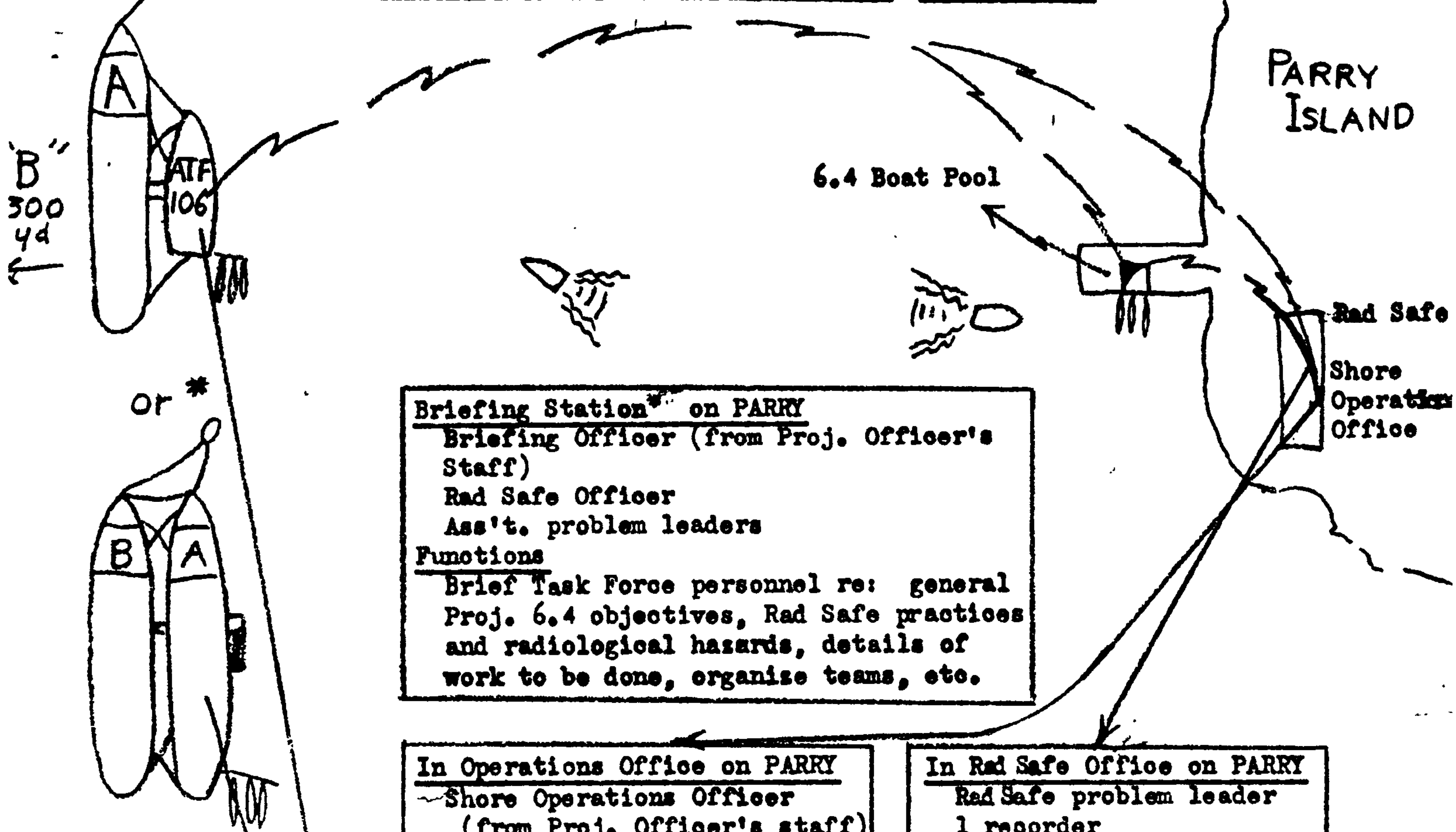
6.4 Operations Plan - Ship to Shore Parry Island



Briefing Station* on PARRY
- Briefing Officer (from Proj. Officer's Staff)
- Rad Safe Officer
- Ass't. problem leaders

Functions
- Brief Task Force personnel re: general Proj. 6.4 objectives, Rad Safe practices and radiological hazards, details of work to be done, organize teams, etc.

In Operations Office on PARRY
- Shore Operations Officer (from Proj. Officer's staff)
- Ass't. problem leaders
- 2 yeomen
- 1 runner

Functions
- Team make-up
- Operations briefing
- Equipment issue
- Boarding pass issue
- Ship to shore communications (Motorola Circuit)

In Rad Safe Office on PARRY
- Rad Safe problem leader
- 1 recorder
- 4 dressers and clothing issuers

Functions
- Rad Safe briefing
- Clothing issue and change

In MOLALA or Able**

Personnel in Tech Control Point
- Boarding Officer (from Proj. Officer's staff)
- Problem Leaders
- 2 runners
- 1 recorder

Functions
- Final Pre-Boarding check
- Pre and Post Operations Briefing
- Communications Ship to Shore on "Motorola Circuit"

Personnel in Rad Safe Control Point
- Rad Safe Ass't. Problem Leader
- 3 dressers
- 1 recorder

Functions
- Final pre-boarding Rad Safe check
- Clothing removal (post-operations)
- Preliminary pers. decontamination

In Boat Pool Office on pier

Boat Pool Officer
Ship to shore radio (Motorola Circuit)

*Briefings for succeeding day's operations

**When operations move from Able to Baker, 6.4 personnel and equipment will move onto Able from MOLALA and Able will move alongside Baker.

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TRANSIT BLUE BOOK

1. GENERAL SITUATION

1.1 General

This plan is a directive plan of operations for the conduct of CASTLE Project 6.4. It defines the purpose and scope of the project, the assumptions which guide and justify the project, and the general operations which are necessary for accomplishment. Because Project 6.4 is a quasi-naval operation, this plan is prepared in the format recommended by the Naval Manual of Operational Planning, 1948 Edition. Detailed planning for the technical and scientific work on Project 6.4 is contained in a series of annexes to this plan. The annexes are in the same format as the basic plan and are supported in detail by tabs which reflect the current status of planning and accomplishment. It is intended that this plan, together with annexes and tabs, will be sufficiently complete to form a basis for command decisions and preparation of on-site reports.

1.2 Nature and Scope of Operations

1.2.1 Nature of Operation

Project 6.4 is a proof test of shipboard countermeasures, damage control, and industrial rehabilitation procedures against radiological contamination effects in atomic warfare. For purposes of ship activation and operation control, Project 6.4 has been identified by the unclassified Bureau of Ships code name "Project Transit". Project TRANSIT is composed of two specially altered and instrumented drone LIBERTY ships, a control P2V5 aircraft, two fleet tugs for escort, tow and decontamination operations, and an operations base on Parry Island (ELMER), Eniwetok Atoll. One ship will be equipped with candidate AW protective devices and will be fully instrumented; this ship will be identified as TRANSIT ABLE. The second ship designated as TRANSIT BAKER, will be unprotected, but will be instrumented the same as TRANSIT ABLE. TRANSIT BAKER will also incorporate special ventilation tests. The drone ships will not be manned during the experiments but will be maneuvered by radio control from an aircraft. The ships will be steamed into an area of high fall-out activity subsequent to each event participated in. After each test, it is planned to board the protected ship (TRANSIT ABLE) and steam her to Eniwetok, radiation levels permitting. In event of excessive radiation levels, both ships will be recovered by tugs after each shot participated in and towed to Eniwetok for post-test operations. Post-test operations will consist of:

(a) detailed radiological survey of each ship, both above and below decks.

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(b) instrument and record recovery.

(c) removal of test aircraft and test panels for survey purposes and decontamination studies.

(d) tactical decontamination of each ship, both above and below decks.

(e) final preparation of each ship for participation in the next test.

The diagrams on page V and VI form a schematic concept of the basic operating situation during the event. The diagram on page VII illustrates the basic operating situation after reboarding.

1.2.2 Scope of Operations

This operation will involve the accomplishment of a number of scientific and technical field studies on: ship countermeasures; aircraft and limited surface test panels; the preparation, movement and control of the test ships; the provision of supporting ships and aircraft; and the basing of test personnel on Parry and Eniwetok Islands. For planning purposes, participation will be limited to three shots: Shots 1, 3, and 5. Changes and additions to this schedule may come about if adequate contamination is not obtained on any run or if experimental work following a run prevents turnaround in time to participate as scheduled.

Organizations participating are the Bureau of Ships, the U. S. Naval Radiological Defense Laboratory, the Bureau of Supplies and Accounts, the Army Corps of Engineers, and the Army Chemical Corps. The Army studies are identified in Task Group 7.1 as Project 6.5 and will be included in the 6.4 operation plan as one of the ten test problems to be conducted aboard the TRANSIT ships. Personnel required include approximately 50 technical personnel and 165 naval personnel that comprise the crews of the two drone ships, the control plane, and the fleet tugs. Project 7.3 will provide a working party of 500-1000 men.

1.3 Purpose of TRANSIT BLUE BOOK

1.3.1 To provide data on the operational and logistical requirements of CASTLE Project 6.4 and 6.5.

1.3.2 To provide a firm basis for scheduling and instructing project personnel.

1.3.3 To initiate the preparation and implementation of supplementary technical annexes.

1.4 Shot Schedules for Project 6.4 Participation

1.4.1 Operations are planned for shots 1, 3, 5 and possibly 7. Shots 2 and 6 are regarded as alternates in the event of failure to contaminate the TRANSIT ships on any run.

1.4.2 The following table lists shot information pertinent to this Project:

Code	Code Name	Shot No.	Yield	Location	Date
(Unclassified)	(Unclassified)[1]	(Confidential)[2]	(Secret)	(Secret)	(Secret)
B	Bravo	1 1	4-8 MT	Reef SW Charlie	1 Mar 54
U	Union	4 2	4-6 MT	South of Dog (barge)	11 Mar 54
Y	Yankee	5 3	6-10 MT	South of Dog (barge)	22 Mar 54
E	Echo	4	125 KT	Ruby	29 Mar 54
N	Nectar	6 5	1-2.5 MT	South of Dog (barge)	5 Apr 54
R	Romeo	2 6	2-4 MT	South of Dog (barge)	15 Apr 54
K	Koon	3 7	1 MT	Tare	22 Apr 54

1.4.3 On the basis of the above schedule, participation is planned on 1 March, 22 March, and 5 April, 1954. Turnaround time between runs will be three weeks and two weeks, respectively.

1.4.4 Annex M includes a discussion of the radiological effects expected from the above listed yeilds and shot locations.

1.5 Project 6.4 Composition and Relation with TASK FORCE SEVEN

1.5.1 Project TRANSIT is organized and implemented for the purpose of conducting ten (10) associated investigations, all of which are coordinated with the fall-out distribution studies of Project 2.5. Project 6.4 is actively comprised of the two drone ships TRANSIT "ABLE" and "BAKER", a control aircraft, an auxiliary support vessel (ATF) and part-time

Note (1) Use for telephone or low-classified messages.
(2) Do not use for reference purposes.

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use of a second support vessel (ATF). Shore headquarters are based in the RadSafe building on Parry Island, Eniwetok, and consist of a small full-time administrative staff, a RadSafe organization conducted in conjunction with TU-7, and an instrument repair facility.

1.5.2 Water transportation is provided by the drone ship's boats. Communication with all units of Project 6.4 is provided by a short range voice network. During the shot operations, a secondary control station is maintained aboard BAIROKO for maintaining a position plot of the drone ships and providing for their emergency radio control by helicopter.

1.5.3 BuShips Project TRANSIT being a proof-test of AW Countermeasures was assigned to Program 6 "Tests of service equipment and operations" and was designated Project 6.4. Program 6 is one of several Department of Defense Effects Programs being conducted in CASTLE. This group of programs has been assigned to Task Unit 13. This Task Unit is under the operational control of CTG 7.1 for planning and coordination during non-operational phases and under full operational control during the shot operational phase at the test site. Technical direction of the DOD programs is exercised by the AFSWP through CT/G 7.1. All official communications with other project agencies and headquarters in connection with CASTLE from Project 6.4 are directed to the Headquarters, Task Unit 13.

1.5.4 The work of other than Project 6.4 personnel is indicated as follows. Pre-test ship conversion and installation of equipment on the test ships will be done by Mare Island Naval Shipyard and San Francisco Naval Shipyard. At the test site, removal and reloading of equipment will be done by personnel from the support ships. Aircraft, test panels, and test plates will be moved to and from the beach decontamination area by personnel of J6, Task Group 7.1. Ship decontamination will be carried out by Task Force personnel under the direction of 6.4 problem leaders. For survey monitoring and sample recovery, ten personnel will be provided from the ships' companies and additional monitors will be drawn from Task Force personnel, to be trained and supervised by 6.4 personnel. The decontamination of protective equipment will be arranged with the Holmes and Narver laundry facility. Assistance at the Personnel Decontamination Center will be given by Task Group 7. Photographic film to be used in 6.4 will be stored and processed by the Task Force Photographic Unit. Basic information on the physical and chemical nature of contaminant will be supplied by Program 2, Project 2.5. Project 6.5 personnel will aid in ship decontamination and ventilation studies.

1.5.5 The chart in Annex K show, diagrammatically, the relationship of Project 6.4 with Joint Task Force Seven. Annex "K" includes a complete organizational outline for Project 6.4.

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1.6 Technical Assumptions and Limitations

1.6.1 Participation of Project 6.4 in Operation CASTLE will provide an opportunity to proof-test ship countermeasures from the point of view of radiological hazard reduction for certain AW attack situations of importance to the Navy. Within the technical limitations set forth in this paragraph, participation in CASTLE will result in information directly applicable to the military situation involving the detonation of super-weapons in harbors during amphibious operations and in shallow coastal waters. The information may also be applicable, by suitable extrapolation, to the following situations:

(1) Surface or shallow water attacks with moderate yeild fission weapons.

(2) Certain offensive uses of fission weapons involving surface ship delivery.

1.6.2 It is desirable not only to test the performance of existing protective equipment and systems, but also to establish firmly the military need for additional ship countermeasures which appear to be required.

1.6.3 The nature of the conditions of interest and the countermeasures to be tested makes it necessary that steam-driven vessels be exposed to the contaminating event.

1.6.4 The nature of the event is such that these vessels must be exposed to contamination in the region of military interest rather than on the periphery of the event. The region of interest is that area beyond immobilizing shock ranges and where incapacitating or serious radiation hazards exist. This requirement makes radio-controlled operation of the test vessels necessary.

1.6.5 Although the primary interest of the experiment is the modern combatant ship, radio-controlled operation of such vessels is virtually impossible. It is assumed the measurements made on the modified LIBERTY ship can be successfully applied to combatant ships.

1.6.6 A technical limitation on the interpretation of the effectiveness of some countermeasures may be the presence of an atypical contaminant. For shots fired from land composed primarily of calcium deposits (i.e. atolls or reefs), the contaminant may be composed primarily of calcium hydroxide ($Ca(OH)_2$) and calcium carbonate ($CaCO_3$). It was shown at Operation Ivy that such material, in the presence of sea water, forms particularly tenacious bonds with surfaces. Since most land of interest to the military is not composed of calcium deposits, results based on such tenacious deposits must be extrapolated to more representative contaminants. This may require laboratory correlations with field data.

1.6.7 The line along which the ships travel during the time they are being contaminated represents only a small fraction of the contaminated area of military interest. Data from the tests will therefore be directly applicable to the unique set of conditions existing along the line of travel during the contaminating event. Use of this data to describe countermeasure effectiveness in other areas of military interest will thus be necessarily limited by the lack of knowledge as to how the variation of contaminating conditions would affect countermeasures. A close working relationship with Projects 2.5a and 2.6a has been set up to mitigate this problem.

1.6.8 Estimations for combat ships on the basis of results obtained on the Liberty ships will be limited by differences between the two types with respect to construction and operating speeds. Construction will affect drainage and thus affect decontamination. Construction differences will also affect shielding measurements. Differences in operating speeds may affect the effectiveness of the washdown system. Modifications have been made on the TRANSIT ships to simulate combat vessel construction. Washdown delivery conditions will be measured to assist in extrapolation.

1.6.9 The usefulness of some countermeasure data will be limited when used to estimate effectivenesses at earlier times than when data was collected. During the period before the ships can be reboarded and studies undertaken, changes in the initial conditions will occur from redistribution of contaminant by weather, from changes in the nature of bonds between surfaces and contaminant, and from changes in energy of radiation due to radioactive decay.

2. MISSION

To proof-test existing and proposed radiological countermeasures for naval ships and aircraft (not in flight) against surface and subsurface atomic attack; to gain sufficient basic knowledge of the radiological situation on ships and aircraft (not in flight) to permit proper countermeasure development; and to gain such information for harbor targets as is appropriate within test conditions and without jeopardizing the primary objectives of the mission.

3. TASKS OF SUBORDINATE UNITS

3.1 Organization

3.1.1 Annex J illustrates the Organization of Project 6.4 and includes personnel listings, both alphabetically and by sub-project.

3.2 Project Officer

3.2.1 The Project Officer 6.4, is designated by the Chief, Bureau of Ships and ordered to report to Commander, Task Group 7.1 through

Commander, Task Unit 13, for operational and administrative control on all matters relating to the DOD Weapons Effects Program, Operation CASTLE. He has been authorized to act in the name of the Chief of the Bureau of Ships in matters relating to Project 6.4.

3.3 Deputy Project Officer

3.3.1 With the approval of the Director, U. S. Naval Radiological Defense Laboratory, a Deputy Project Officer has been designated by the Project Officer 6.4, from the Technical Developments Branch, U. S. Naval Radiological Defense Laboratory.

3.3.2 He is authorized to act for the Project Officer in all technical matters concerning the laboratory's participation in Project 6.4.

3.3.3 He is responsible for the coordination of the experimental effort aboard the TRANSIT ships and will report directly to the Project Officer on matters concerning the conduct of all sub-projects.

3.4 Operations Officer and Assistants

3.4.1 Operations Officer

3.4.1.1 The Operations Officer is designated from the sponsoring agency, the Bureau of Ships, by the Project Officer 6.4.

3.4.1.2 The Operations Officer is authorized to act for the Project Officer in matters concerned with the activation, outfitting, special alterations, and preparations of the test ships, TRANSIT ABLE and BAKER.

3.4.1.3 He reports directly to the Project Officer and is responsible for the ships' operational readiness.

3.4.1.4 During test operations, he will be stationed aboard ATF-106 and will represent the Project Officer on all recovery operations on TRANSIT ABLE and BAKER.

3.4.2 Assistants for Electronics and Assistant for Machinery

3.4.2.1 With the approval of the Commander, Mare Island Naval Shipyard, Assistants for Electronics and an Assistant for Machinery have been designated from the Design Division, Mare Island Naval Shipyard, to assist the Operations Officer.

3.5 Tests Coordinator and JTF Liaison

3.5.1 The Test Coordinator is designated by the Project Officer 6.4 from the sponsoring agency, the Bureau of Ships.

3.5.2 He will assist the Project Officer in Operational Planning and Task Force matters conducted through the Program 6 Director.

3.5.3 He will establish liaison on a working level with elements of other task groups of the Joint Task Force.

3.5.4 During the shot phase of test operations he will represent the Project Officer in the Project 6.4 Command Station aboard the carrier for operational matters.

3.6 Administrative Assistant

3.6.1 With the approval of the Director (USNRDL), the Project Officer has designated an assistant for administrative matters from the Scientific Department Staff, U. S. Naval Radiological Defense Laboratory.

3.6.2 He will coordinate the administrative activities and logistical requirements of the project staff and sub-project sections.

3.6.3 He will administer budget, fiscal and travel matters.

3.6.4 He will advise the Project Office on Security matters.

3.7 Military Evaluation Consultants

3.7.1 With the approval of Chief, AFSWP, two consultants have been designated by the Project Officer from Headquarters, AFSWP. With the approval of the Director, USNRDL, two consultants have been designated from the Military Evaluations Group, USNRDL.

3.7.2 They will be available for consultation on matters connected with the military application of test studies and with the review of test plans in terms of military objectives.

3.7.3 They will participate in staff planning functions for test operations and perform such staff functions as the Project Officer may desire.

3.7.4 During each test participated in, they will be stationed in the Primary Airborne Control (P2V5) and in the Secondary Control Station (BAIROKO) and provide advice on radiological matters.

3.8 Decontamination Advisor

3.8.1 With the approval of the Director, a consultant for Ship Decontamination has been designated by the Project Officer from the Chemical Technology Division, U. S. Naval Radiological Defense Laboratory.

3.8.2 He will assist the Operations Officer in planning for post-test operations and will recommend ship decontamination schedules, procedures, and materials.

3.8.3 He will report directly to the Project Officer upon the effect of each day's decontamination operations and the degree of operational readiness achieved as concerns residual radiological contamination.

3.8.4 He will participate in staff planning functions and during each test participated in he will be stationed aboard the alternate ATF-116 (assigned to TRANSIT "Baker") to represent the Project Officer.

3.9 <u>RadSafe Liaison</u>

3.9.1 The Project Officer is assisted in complying with Task Force Radiological Instructions by the provisions of paragraph 3.17, "Personnel Protection and Radiological Safety".

3.10 <u>Staff Functions</u>

3.10.1 Procure, activate, design, plan, and schedule operations for all ships, aircraft, and base facilities, and coordinate functions with other Task Force activities incident to accomplishment of mission.

3.11 <u>Washdown Problem (6.4a)</u>

3.11.1 Determine the effectiveness of the washdown system in reducing factors which may affect the gamma radiation hazard; provide information so that the degree of hazard may be determined and so that the results of the experiment may be extrapolated to other types of naval vessels in various tactical situations of interest.

3.11.2 Determine the gamma radiation dose rate and integrated dose at various times at various comparable locations on the two test ships.

3.11.3 Use the above information to determine the effectiveness of the washdown in terms of

a) the reduction in integrated gamma radiation dose
b) the reduction in the amount of contaminant remaining on the ships weathered surfaces

3.11.4 Determine the uniformity of contaminant remaining on various surface materials and configurations with respect to washdown nozzle positions.

3.11.5 Determine the limitations imposed upon the experimental data by

a) the mechanical performance of the washdown system
b) the ship's performance
c) the atmospheric conditions encountered during the test

3.11.6 Determine the effects of the washdown system on subsequent tactical and industrial decontamination operations (to be considered along with problem 6.4b).

3.11.7 Annex A outlines the objectives, procedures, and logistic requirements for the washdown group.

3.12 Ship Decontamination Problem (6.4b)

3.12.1 Obtain necessary information for determination of an optimum procedure for the tactical and industrial recovery of contaminated ships.

3.12.2 Reduce the total radiation field of each ship so that participation in subsequent shots will not be a hazard to operating personnel.

3.12.3 Annex B outlines the objectives, procedures and logistic requirements for the ships decontamination group.

3.13 Aircraft Study Problem (6.4c)

3.13.1 Obtain information necessary for the determination of the protective value and feasibility of the ships washdown system in protecting parked aircraft aboard ship and for the evaluation of selected decontamination techniques and materials on aircraft.

3.13.2 Obtain information necessary for computing the hazard to the operation and decontamination of aircraft on carriers following contamination by an atomic weapon.

3.13.3 Annex C outlines the objectives, procedures and logistic requirements for the aircraft study group.

3.14 Radiological Surveys and Photography (6.4d)

3.14.1 Obtain radiological survey data as required for the various investigations being conducted under Project 6.4. Organize and instruct survey parties and conduct surveys of the test ships and aircraft to obtain the above data. Procure, store and maintain, calibrate, and issue all portable radiological survey instruments for Project 6.4 surveys.

3.14.2 Photograph the fallout on TRANSIT Baker from the various shots in which TRANSIT Baker participates.

3.14.3 Annex D outlines the objectives, procedures, and logistic requirements for the radiological survey and photography group.

3.15 Interior Contamination Problem (6.4e)

3.15.1 Obtain information necessary to determine the radiological hazards in interior compartments at various times after burst as a result of external radiation from airborne and deposited activities in spaces and ductings.

3.15.2 Obtain information necessary to determine the radiological hazard in interior compartments as a result of the inhalation of airborne contamination in ships spaces.

3.15.3 Obtain information regarding the nature of the contaminant to which the ships are exposed in order that the observed interior hazard may be susceptible to interpretation.

3.15.4 Obtain information necessary to determine the effect of standard components of boiler and ventilation systems on the hazards listed above so that qualitative extrapolations to other systems can be made.

3.15.5 Obtain information necessary to determine the overall effectiveness of various protective devices in reducing the extent of the radiological hazard from ventilation systems.

3.15.6 Annex E outlines the objectives, procedures, and logistic requirements for the interior contamination group.

3.16 Instrumentation Problem (6.4f)

3.16.1 Design, plan, develop, specify, construct (or contract for construction), install, and operate a gamma radiation detecting and recording network on TRANSIT Able and Baker, and provide a system for automatic data reduction.

3.16.2 Annex F outlines the objectives, procedures, and logistic requirements for the instrumentation group.

3.17 Personnel Protection Problem (6.4g)

3.17.1 Provide adequate radiological safety coverage for all Project 6.4 operations, thereby minimizing the personnel hazard associated with the various phases of the test operations.

3.17.2 Evaluate existing radiological safety procedure techniques and instrumentation for their suitability under tactical decontamination conditions, and obtain information to aid in the development of new and improved radiological safety techniques, equipment, and instruments.

3.17.3 Annex G outlines the objectives, procedures, and logistic requirements for the personnel protection group.

3.18 Shielding Studies Problem (6.4h)

3.18.1 Obtain information necessary to determine the natural gamma radiation sheilding of ship structures from radioactive material enveloping the ship and from radioactive material deposited on weather surfaces.

3.18.2 Obtain information necessary to compute the hazard from these two sources to personnel within naval vessels either equipped or not equipped with washdown systems.

3.18.3 Annex H outlines the objectives, procedures, and logistic requirements for the shielding study group.

3.19 Airborne Contamination Problem (6.4i)

3.19.1 Secure information on possible future need for shipboard air monitoring systems. Attempt to find the extent of airborne concentrations of beta decay products.

3.19.2 Determine whether the present instruments designed will fulfill such needs for an adequate shipboard warning device.

3.19.3 Annex I outlines the objectives, procedures, and logistic requirements for the airborne contamination group.

3.20 Panel Studies (6.5) (6.4j)

3.20.1 Obtain information necessary to determine the contamination characteristics of various construction materials.

3.20.2 Obtain information necessary to determine the decontamination char..cteristics of various construction materials.

3.20.3 Check usefulness of beta instruments for measuring decontamination effectivenesses.

3.20.4 Annex J outlines the objectives, procedures, and logistic requirements for the panel studies group.

4. ADMINISTRATIVE AND LOGISTICAL MATTERS

The administrative and logistical matters involved in Project 6.4 are grouped as (a) test preparation, (b) roll-up of the project, and (c) logistics and support services for the test.

4.1 Test Preparation, Laboratory

The test preparation on a laboratory scale involves pre-test experimentation to determine optimum methods and procedures for obtaining the desired data; evaluation and calibration of instruments and devices; and the training of personnel for their various assignments. These operations are described briefly below, as they pertain to the individual sub-projects, and details are given in Annexes A to J.

4.1.1 Washdown

No laboratory pre-test work.

4.1.2 Ship Decontamination

Laboratory work on ship decontamination methods will be carried out in order to determine the influence of such factors as weathering, surface deposits, and repeated contamination-decontamination on the effectiveness of the proposed decontamination methods. Suitable additives will be tested, and mechanical performance of decontamination equipment will be studied.

4.1.3 Aircraft Study

For the aircraft study, a series of tests have been conducted using fluorescent simulant on aircraft sections subjected to small-scale washdown. A nozzle arrangement has been set up and tested on a dud F4U4, to determine the optimum location of each nozzle in covering the aircraft with an adequate flow of water. A pre-test study has been made of the cleaning agents to be used with the aircraft decontamination equipment, and the aircraft have also been modified for loading.

4.1.4 Survey and Photography

Test preparation for survey and photography includes evaluating the portable beta probes; testing the correlation of beta readings with directional gamma readings; testing a newly designed wipe sampler; testing the camera and synchronizer to be used to detect the fall-out on Baker; and training the enlisted personnel assigned as radiological survey monitors.

4.1.5 Interior Contamination Study

At the Laboratory, pre-test work has included: testing of different filtering elements for pressure-drop characteristics and general adequacy for use in the air sampler; construction and testing of reduced-scale boiler model and a full-scale ventilation system; preparation of prototype air samplers, particle collector, and beta-decay monitors; construction of counting chambers; and duct section design.

4.1.6 Instrumentation

A discussion of instrument procurement, design, and testing is contained in Annex F.

4.1.7 Radiological Safety

It will be necessary to properly indoctrinate Project 6.4 personnel in the radiological safety aspects of their particular problem. Special lectures and training programs will be given to those personnel available at USNRDL prior to departure for the test site. Additional training will be given by the Treasure Island Training School. Radiological safety instruments will be procured and will be tested in the Laboratory simulating expected conditions.

4.1.8 Shielding Study

Pre-test work on the shielding study has planned a simplified shielding experiment using a gamma source of known energy. The pre-test work on gamma instrumentation, dosimetric devices, and radiac sets has some bearing on the shielding study.

4.1.9 Air Monitoring

The air-monitoring study is to conduct simulated test runs at USNRDL, using Sr^{90} calibration samples, and X-ray and gamma-ray backgrounds, so as to determine the versatility of the air-monitoring instrument. Extra shielding and other adjustments as may be necessary will be added, and the instrument will be calibrated prior to shipboard installation.

4.1.10 Panel Study (6.5)

For the study of construction material panels, pre-test work is to be done at the Army Chemical Center, where representative construction materials will be selected and panels designed to house these materials. Appropriate protective coatings for the construction materials will also be selected.

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4.2 Test Preparation, Shipboard

Numerous modifications have been made of the two Liberty ships in order to approximate certain combat vessel construction. Examples of these modifications are:

a) addition of a flight deck section
b) installation of 2 - 3 in. guns (inoperative)
c) installation of forced draft intake ducts for the boilers
d) installation of typical ventilation systems
e) installation of steel sections to simulate armored deck.

Instruments and equipment to be used in the test will be installed as soon as practicable. Special test surfaces, the washdown system, and general instrumentation will be installed by Mare Island Naval Shipyard. An aircraft will be located and secured on the No. 5 hatch of each ship, and the other aircraft will be loaded on each ship for transportation to the site. Technical photographic equipment will be installed on the main deck of Baker in the deck house. During dock trials, Pitot traverses will be taken at selected points in the boiler-air and ventilation systems, and air samplers and particle collectors will be operated and tested. An air-monitoring instrument will be located and secured aboard each test ship while in the San Francisco area, with power turned on to insure correct operation. Location of construction material panels and fallout equipment will be determined, and panels and racks installed. Sampling devices and electrical service lines of Project 2.5b will be installed, and protective coatings will be applied to panels and paint frames.

Ten special monitors furnished from the crews of the YAG's 39 and 40 will be given additional specialized radiological safety training. As part of the general indoctrination of survey personnel, specific monitoring survey techniques and monitoring check points will be established to expedite the survey operations after shot.

During sea trials, the equipment and procedures for each subproject will be tested. Exhaustive tests will be made on decontamination equipment and supporting facilities. Men from crews of Able and Baker, permanently assigned to decontamination studies, will be trained in the use and operation of decontamination equipment and in decontamination techniques. The aircraft on No. 5 hatch of each ship will be checked during trials of the washdown system. Water coverage will be documented, and the washdown system will be modified if necessary. Air samplers, gamma recorders, nozzles, air monitoring instruments, portable radiation detectors, decontamination units, camera, and other test equipment will be operated and/or checked for proper performance. Personnel will rehearse the various operations to which they have been assigned. Any experimental or other work left uncompleted at the time of departure of the ships for the test site must be completed aboard ship prior to arrival at the site.

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4.3 Roll-up

After the final shot, most of the work will involve data reduction, packing of materials and equipment, shipment of samples, and the writing of the preliminary test report. All records and classified material will be cleared through the appropriate channels and prepared for transmittal to USNRDL.

Special details of roll-up operations may be required. Regarding washdown, if after the last shot, surface surveys indicate a pattern of residual activity, then a detailed check of water coverage by the washdown system on the test areas will be attempted on Transit Able. Consideration will also be given to the possible need for industrial decontamination of one or both ships before, or during, their return to the continental United States. The scope of such work and the logistics involved will be ascertained when final tactical decontamination in the field has been completed. Aviation maintenance personnel will complete any required maintenance on the aircraft and prepare them for shipment aboard Able and Baker.

Post-test work at the Laboratory will include data analysis, sample analysis, and the writing of the final report.

4.4 Logistics and Support Services

4.4.1 Equipment Required

Detailed lists of equipment required for Project 6.4 are given in the Annexes and Tabs of the sub-projects. General information is as follows: (a) Decontamination - washdown system; equipment for fire hosing, hot liquid cleaning, steam cleaning, hand scrubbing, sandblasting, Tennant machining, cutting, and flame treating; plates, racks, frames, and supplementary tools; (b) Other equipment - technical photography equipment such as camera, synchronizer, and film; particle collectors; air samplers; personnel protection equipment; auxiliary tools and parts; various laboratory models and equipment for pre-test work.

Some of this equipment will be obtained from commercial sources, and some will be fabricated or modified at the Laboratory before departure to the site. All equipment will be checked for operability and other requirements laid down by the nature of the project.

4.4.2 Instruments Required

Detailed lists of instruments required for Project 6.4 are given in the Annexes and Tabs of the sub-projects. General information is as follows: (a) Gamma measurement - about 140 fixed gamma detection instruments (gas ionization chamber detectors), installed both above and below decks on the test ships; information from these instruments to be recorded by approximately 30 recording devices per ship; various portable gamma survey meters for individual operations; (b) Beta measurement - portable beta probes; (c) Airborne contaminant measurement - prototype air-monitoring instrument installed topside on each test ship; air samplers for assessing contaminated air in ventilation and boiler-air systems; (d) Other - dosimetric devices, both fixed and carried by personnel; data reduction device; and various laboratory instruments for pretest work.

Some of these instruments will be obtained from commercial sources, and some will be fabricated or modified at the Laboratory before departure to the site. At sea trials, instruments will be further checked for operability and other requirements laid down by the nature of the project.

4.4.3 Support Services

Support services are given in detail in the Annexes and Tabs for each sub-project. General support requirements at the test site are as follows: (a) office and storage space for approximately 40 investigators; (b) workshop on each ship for maintenance and repair of equipment, with shop facilities also available ashore; (c) shore decontamination center for panels, aircraft and equipment; (d) shore change house for participating personnel; (e) on-site transportation of personnel and equipment, ship to ship, ship to shore, and transportation ashore between locations; (f) water and power supply ashore for operation of instruments and equipment; (g) transportation enroute to site, some personnel and most of the equipment travelling aboard Able and Baker, other personnel travelling by air; (h) air shipment of radioactive samples.

4.4.4 Manpower

USNRDL technical personnel will number about 39 or 40 investigators, each working about three months, for a total of 117 man-months, or about 10 man-years. Other agencies are contributing about six to ten personnel directly involved in the test, each working about three months, for a total of 18 to 30 man-months. Approximately 165 naval personnel will comprise the crews of the two drone ships, the control plane, and the fleet tugs, Project 7.3 will contribute 1000 enlisted men for working parties. Total estimated manpower: 50 technical, 165 ship personnel, 1000 workers. Supervision will be given on individual sub-projects by the problem leaders involved.

4.4.5 Costs

(Kearns)

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5. COMMAND AND COMMUNICATIONS MATTERS

5.1 General

Detonation time for each shot participated in will be designated as H-Hour for planning purposes. Operations immediately before and after shot time will be scheduled with respect to H-Hour. The illustrations on pages V and VI represent the general operating situation in connection with H-Hour. After Transit Able and Baker are returned to Eniwetok, recovery operations on board the contaminated vessels will be conducted. Reboarding time on each vessel will be designated as R-Hour. Operations immediately before and after reboarding will be scheduled with respect to R-Hour. Planning will be on the basis of a radiation field on the topside of Transit Baker of 1000 r/hr at H-Hour plus 1. Communications details (frequencies, range, etc.) will be according to Annex M.

5.2 Operations Prior to H-Hour

5.2.1 Movement of Vessels to Bikini Area

Transit Able and Baker will depart Eniwetok for shot station approximately H minus 48 hours. An operating crew of 9 men to run the ship and 4 technical personnel to start experimental equipment will be aboard each ship. These 13 men will be called the "Able (or Baker) operating party". Able and Baker will be escorted by MOLALA, (ATF106) and TAWAKONI, (ATF116). The Ships Operations Officer (Kearns) and the Task Force Radiological Safety Representative (Serviss) will be aboard MOLALA; and the Decontamination Advisor (Hawkins) and the Radiological Safety Advisor (Baietti) will be in TAWAKONI. Able and Baker will proceed so that they arrive on station at approximately H minus 3 hours. This station will be in the predicted downwind direction from shot as shown in Annex N and will be approximately 20 - 30 miles from shot.

5.2.2 Postponement of Shot

In case a shot is postponed for one day, the Transit operating parties will remain aboard and orbit Able and Baker in the general vicinity of the station; ATFs 106 and 116 will stand by Able and Baker. If the P2V5 is in flight, it will return to Kwajalein. If a shot is postponed for more than one day, the tugs and Able and Baker will prepare return to Eniwetok, upon orders of the Project Officer.

5.2.3 Transfer of Control to MOLALA and Start of Washdown Pumps

At H minus 4, MOLALA will assume radio control of Able and Baker; the operating parties will remain aboard Able and Baker. The washdown system pumps aboard Able will be operating at this time, pumping overboard.

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5.2.4 Transfer of Control to Primary Airborne Control

At H minus 3, the P2V5 will be on station above the ships and will assume radio control of Able and Baker. From H minus 3 to H minus 2, the operating parties will remain aboard. During this time, the P2V5 will test control, and proceed to its station for the Transit phase. This station will be 20 - 25 miles crosswind toward the Task Force (See illustration VI).

5.2.5 Removal of Able and Baker Operating Parties

At H minus 2, MOLALA will remove the operating party from Able, and TAWAKONI will remove the operating party from Baker. MOLALA and TAWAKONI will then proceed to a station 20 - 25 miles crosswind toward the Task Force (See illustration VI).

5.3 Emergency Measures

These emergency measures apply from the time the P2V5 assumes unguarded radio control (H minus 2) until it returns radio control to MOLALA.

5.3.1 Standby Airborne Control

If for any reason the P2V5 is forced to retire or loses radio contact or control of Able and Baker, it will communicate this information to BAIROKO (CVE 115). A helicopter with radio control equipment will proceed from BAIROKO to the P2V5's station and assume control of Able and Baker. If the P2V5 is forced to retire from its station before the arrival of the helicopter, it will place both Able and Baker on a safe crosswind course toward the Task Force, if possible. In either case, the helicopter will continue to direct the ships on the Transit phase courses and maneuvers upon assuming radio control.

5.3.2 Standby Shipboard Control

If the helicopter is forced to retire, or if it fails to arrive on station, it or the P2V5 (depending upon which has control) will vector Able and Baker on a safe course toward MOLALA. When Able and Baker arrive within radio range of MOLALA, she will assume radio control. MOLALA will not attempt to continue directing the ships on the Transit phase courses and maneuvers, but will direct them on a safe course away from the area.

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5.4 Operations from H-Hour to R-Hour

5.4.1 Transit Phase Control

The P2V5 will keep Able and Baker on or near their H minus 2 station until shot time or a stated departure time after shot time. The P2V5 will do this by dialing the ships on a course that will generally orbit the H-2 station. Departure time will either be a predetermined departure time taken from Annex M or will be determined from telemetered data received by the Project Officer (CAPT Molumphy) and the Military Evaluations Consultant (Strope) in the P2V5. At this time the washdown valve will be remotely actuated by the Project Officer, and the washdown system on Able will commence spraying. At departure time, the P2V5 will direct the ships on a course upwind into the contaminating event. At the same time the P2V5 directs Able and Baker into the contaminating event, it will dial the sinusoidal maneuver, and the automatic pilot aboard each ship will commence directing this series of course changes.

5.4.2 Ships' Location and Radiation Information

In the P2V5, the Project Officer and the Military Evaluations Advisor will maintain a continuous record of the position of the ships and the radiation intensities on each ship. Ships' locations will be determined by radar from the plane and radiation intensities will be gathered by multi-channel telemetering equipment.

5.4.3 Ship Recovery

The ships will be turned onto a course toward MOLALA either (1) when they reach a point two miles downwind from the reef of Bikini Atoll or (2) when the general radiation intensity on Baker reaches 1000 r/hr, whichever occurs first, or (3) at the discretion of the Project Officer. It is anticipated that, in the case of (1) or (2), this time will be approximately H-plus-2. As soon as the ships are clear of the contaminating event and are within range of MOLALA (from 10 to 14 miles), control will be transferred to MOLALA. The P2V5 will be in voice communication with both MOLALA and TAWAKONI at this time and will direct operations immediately subsequent to MOLALA's taking over control. If it is desired to continue the washdown on Able, based on telemetered intensity information received by the P2V5, MOLALA will direct Able on various maneuvers to ensure that all areas of the ship are wet by the washdown. When Able has been sufficiently washed, MOLALA will turn off the spraying array by remote control and the washdown pumps will pump overboard. Baker will also be controlled by MOLALA, but will not continue to maneuver. TAWAKONI will approach each ship and the Radiological Safety Adivsor will conduct a radiological survey of the ship. As a result of these surveys, one of a number of courses of action may be followed, all directed toward returning the ships to Eniwetok immediately and expeditiously.

(a) If either ship (presumably Able) is judged by the Radiological Safety Advisor and the Project Officer to be safe for continued occupancy, her operating party will board her and take over manual control. Reboarding will be accomplished underway.

(b) If either ship is judged to be safe for only limited occupancy, MOLALA will continue radio navigational control and the operating crew will board for a short period of time (commensurate with the radiological situation) in order to resume manual engineering control. When manual engineering control is resumed, the operating crew will debark to its respective ATF, leaving the ship to steam unattended for a short period of time. Depending upon the radiological situation, the crew will reboard at intervals to maintain a watch on the engineering controls.

(c) If it is determined by the initial radiological survey that it is unsafe to reboard a ship, her engineering spaces will be secured by securing the main feed valve and the main fuel pumps at the external controls provided and the appropriate ATF will take the ship in tow. This will be accomplished without boarding the ship, the tug picking up a pendant rigged on the bow of the ship. When the ships have been recovered and/or are under control of the ATFs, the P2V5 will return to Kwajalein.

5.4.4 Movement of Ships to Eniwetok

Immediately upon resumption of local or ATF control, Able and Baker will proceed toward Eniwetok. Continued radiological surveys of the ships will be conducted underway. As soon as either temporary or permanent occupancy can be granted, to the ship(s) in (b) and (c), paragraph 5.4.3, this will be carried out - toward the end of increasing the speed of the ship. Under tow, it is anticipated that a speed of 4 knots can be made under continuous or semi-continuous engineering watch, full speed, 10 knots, can be maintained. This will mean a time of return of approximately 45 hours or 18 hours respectively.

5.4.5 Determination of R-Hour and Other Radiological Safety Data

Data from the radiological surveys conducted underway will be relayed to the Project Officer who will have returned to Eniwetok with the other P2V5 personnel from Kwajalein. Based on the observed rate of decay of the activity, the intensities observed by the Radiological Safety Advisor, and the telemetered data from the P2V5, the intensities will be extrapolated forward to determine at what time intensities will reach or be below 2.5 r/hr. If either ship is running under continuous manual control by the operating party, R-hour will be the time of arrival of the ship at Eniwetok. At this same time, the Radiological Safety Advisor will install, where possible, air-monitoring devices and will transmit any data collected to the Project Officer on Parry, along with recommendations regarding special necessary radiological safety precautions such as gas masks, if an unacceptable inhalation hazard exists. For the high intensity condition, R-hour will be declared when the general topside intensity reaches 2.5 r/hr. For the condition of 1000 r/hr at one hour, this will occur at H plus 6 days.

5.4.6 Arrival at Eniwetok

Upon arrival at Eniwetok, the ships will moor to the two buoys assigned. These buoys are approximately three-quarters of a mile from the beach and are designated as ______________________________. If R-hour has not been reached on either ship, general operations will not start, but radiological surveys will be conducted as necessary.

5.5 Operations After R-Hour

5.5.1 Radiological Safety Arrangements

At or prior to R-hour, arrangements for the radiological safety of personnel of the various problems will be instituted. It is presumed that R-hour will be declared first on TRANSIT Able. MOLALA will moor alongside Able and, if necessary, will supply Able with necessary electrical power and other services. At this time, a RadSafe control point will be set up in MOLALA and the RadSafe change house will be put into operation on the beach. Personnel having duties aboard Able or MOLALA will proceed through the change house on the beach and will be outfitted there with protective clothing and dosimetry devices. They will proceed via small boat to MOLALA and thence to the Technical Control point on MOLALA. The Technical Control Point is discussed in paragraph 5.5.2. They will then proceed aboard Able and conduct their work. Upon finishing their work on Able, personnel will board MOLALA and remain in a delineated zone until monitored. They will discard booties and gloves here, into containers provided by RadSafe. RadSafe will delineate passageways for contaminated personnel by disposable rubber matting or other suitable material, and personnel will follow these paths to the Technical Control Point.

Upon release from the Technical Control Point, they will proceed by small boat to the beach and through the change house for thorough decontamination. Task Force personnel will proceed from the change house to their ships; 6.4 personnel will be released to their respective duties. As soon as Able is declared safe for continued occupancy, the RadSafe control point and Technical Control Point will be transferred from MOLALA to Able and the same rules will apply for operations on Baker. For details of the RadSafe change house and control point arrangements, see Annex G.

As soon as operations can be conducted for longer than 4 hours or the time between meals, personnel expecting to eat aboard either MOLALA or Able will bring a box lunch with them and leave it in a clean area designated by RadSafe. They will be monitored before eating, and be issued instructions by RadSafe in the proper care to take to avoid internal contamination. At the end of each working day, RadSafe will take such measures as necessary to decontaminate or otherwise control the radiological situation on MOLALA.

5.5.2 Technical Control

5.5.2.1 Technical Control Point

As soon as operations on Able start, a Technical Control Point will be set up on MOLALA. Here the various problem leaders or their representatives and representatives of the Project Officer will be located during working hours. Into this point, information will flow during working hours by means of having all personnel who do any work aboard Able and report their progress or findings to the problem leaders before leaving MOLALA for the beach. This information will be immediately available to all problem leaders and the Project Officer, thereby keeping each responsible person current with the day's progress.

5.5.2.2 Evening Planning Conference

Each evening, the Project Officer will hold a conference on Parry, in Bldg ______, for the purpose of planning the next day's operations and discussing the current day's progress and events. Present at these meetings will be the problem leaders, the Project Officer's staff, and other interested parties. It is at this meeting that regular decisions to follow or to depart from the basic plan will be made, and where news of Task Force decisions and plans will be announced. Although prior to each operation there will be a definitive and detailed operations plan regarding objectives, effort, and manpower and material requirements, it is planned that at the evening planning conference these plans will be changed as necessary in order that every bit of information available is obtained, governed by the probabilities of participation in or availability of information from subsequent shots.

5.5.2.3 Emergency Plan Changes

Each problem will proceed as planned in the previous evening's planning conference, if at all possible. If it is not possible to follow the arranged plan, or if an immediate change appears to be desirable, the problem leader will consult with other problem leaders and the Project Officer at the Technical Control Point. Clearance will be granted by the Project Officer or Deputy Project Officer if the change is considered desirable and feasible.

5.5.3 Transportation

Four personnel boats and two motor whale boats are available and will be standing by with coxwains and engineers for transporting 6.4 personnel to and from the beach and Able and Baker. Schedules and numbers available will be arranged locally.

5.5.4 Operations

MOLALA will initially moor alongside Able and the radiological survey will commence immediately after power is supplied and RadSafe is set up. This will be described in plan in Annex 6.4d. At the completion of this survey, the aircraft (Annex 6.4c) will be removed, followed by the panels (Annex 6.4j). These will be hoisted by the ship's boom and lowered onto a barge to be supplied by the Task Force. These items will be towed ashore and transported to their respective testing areas. Simultaneous with the initial survey, the records from the gamma recording instruments will be retrieved by 6.4f personnel (Annex 6.4f). Successive problems leaders will then initiate their work, governed by the radiological situation and the planning conferences. For details of the operations of various problems, see Annexes A, B, C, D, E, F, G,,H, I and J. As soon as the radiation level on Baker is sufficiently low to permit commencement of operations on her, she will be moved alongside Able, and Able will commence supplying facilities to Baker. At this time, if it is radiologically feasible, the RadSafe and Technical Control Points will be moved onto Able.

5.5.5 Preparation for Next Shot

5.5.5.1 Operational Decontamination

Depending upon the initial levels experienced on the ships, and the effectiveness of the washdown and the tactical decontamination operations conducted by Problem 6.4b, an additional thorough operational decontamination may become necessary. Plans shall be made to determine the need for this sufficiently before four days prior to shot time that it may be completed by H minus four days.

5.5.5.2 Readying for Sea

At least four days before shot time all problem personnel shall devote their efforts toward getting their particular arrangements aboard Able and Baker for the next shot completed. The airplane and panels in Annexes C and J shall be loaded, all instruments shall be checked for operational readiness and all other arrangements shall be checked and completed in order that the Deputy Project Officer can report to the Project Officer at least 12 hours before sailing time that the ship is, for experimental purposes, ready for sea.

5.5.5.3 Final Pre-Shot Conference

At least twelve hours before the ships departing Eniwetok for Bikini or other shot site, a final planning conference will be called by the Project Officer for the purpose of receiving reports from the Deputy Project Officer and the problem leaders that they are in all respects ready for the next shot participation. Final arrangements for personnel to make up the operating parties will be made at this time.

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1

TRANSIT BLUE BOOK

ANNEX "A"

WASHDOWN STUDIES

Problem 6.4a

Problem Organization

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1. General Situation

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Test

This test is to supply information which will permit determination of the effectiveness of a washdown system in reducing factors which may affect the gamma radiation hazard to shipboard personnel. On Transit ABLE this system will be installed on surfaces and configurations typical of several types of Naval vessels. Transit BAKER, which has no washdown system, will have the same surfaces and configurations as Transit ABLE and will be used as the basis for comparison. Washdown effectiveness will be determined by comparing:

(1) the integrated gamma radiation dose;
(2) the gamma radiation field attributable to surface contamination at various times and at comparable locations on the two ships. Additional determinations of relative washdown effectiveness will be made for various surface materials and juxtapositions by comparing relative contamination levels as measured by beta surveying instruments. Correlation of the achieved effectiveness with ship's operational information such as relative wind velocity, the washdown supply and drainage waterflow, etc., will be made when required. Shot participation is as stated in the basic plan.

1.3 Purpose of Annex

1.3.1 To describe in detail the experimental objectives and plan of attack on Problem 6.4a.

1.3.2 To provide detailed information on the operational and logistical requirements of Problem 6.4a.

1.4 Enemy Forces (Shot Schedule)

Same as in basic plan.

1.5 Friendly Forces

1.5.1 Same as in basic plan.

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1.5.2 Data reduction, development, installation, and maintenance of the instruments will be performed by the Instrumentation Group. (Problem 6.4f).

1.5.3 Gamma field, directional gamma, and beta surface surveys will be coordinated by the Radiological Survey Group (Problem 6.4d).

1.5.4 Arrangement, installation, and maintenance of the washdown system will be performed with the help of the Ships' Operations Officer and members of Transit ABLE's crew.

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan.

1.6.2 It is assumed that the gamma radiation field resulting from a semi-infinite enveloping contaminating medium will be identical at all weatherside detector stations on the ship, and that this gamma radiation field is not affected by the washdown.

1.6.3 It is assumed that the relative contributions to the gamma radiation field, caused by (1) the enveloping contaminating medium, and (2) the contaminant collected on the ship's weather surfaces, can be determined.

1.6.4 It is assumed that differences in the gamma radiation field observed at a given location and time on the two ships are attributable to the washdown action alone except in the vicinity of the ventilation test spaces.

1.6.5 Some extrapolation of attenuation factors may be necessary for paragraph 3.1.1 if there is a significant variation in the mean gamma radiation energy.

1.6.6 The washdown waterflow to specific areas will be estimated only by means of pressure readings and nozzle characteristics.

1.6.7 There are three types of washed protecting domes over the gamma radiation detection stations but only two of these are calibrated for the effects of contaminated water as specified in Tab A-8. The effect on the third type will be obtained by means of interpolation of the results obtained on the other two.

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1.6.8 Drainage characteristics as affected by the period and amplitude of roll, sheer, and camber will have to be determined for the test ships to see whether they are typical of combatant ships. (see Tab A-10).

2. Mission

To determine the effectiveness of the washdown system in reducing factors which may affect the gamma radiation hazard; to provide information so that the degree of hazard may be determined, and so that the results of the experiment may be extrapolated to other types of Naval vessels in various tactical situations of interest. The specific missions of Problem 6.4a are:

2.1 To determine the gamma radiation dosage rate and integrated dose at various times at various comparable locations on the two test ships.

2.2 To utilize the above information to determine the effectiveness of the washdown in terms of:

(a) the reduction in integrated gamma radiation dose;
(b) the reduction in the gamma radiation field remaining on the ship's weather surfaces.

2.3 To determine the uniformity of contaminant remaining on various surface materials and configurations with respect to washdown nozzle positions.

2.4 To determine the limitations imposed upon the experimental data by:

(a) the mechanical performance of the washdown system;
(b) the ship's performance; and
(c) the atmospheric conditions encountered during the test.

2.5 To determine the effect of the washdown system on subsequent tactical and industrial decontamination operation; (to be considered under Problem 6.4b).

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3. Tasks and Plans of Attack

3.1 Radiation Measurements

3.1.1 Determination of Gamma Radiation Field and Dose at Various Locations and Times, Attributable to the Enveloping Contaminating Medium

Since the washdown can be expected to be effective as a countermeasure only against that contaminant which has collected on the weather surfaces, it is of interest to determine the magnitude of the gamma radiation field and dose which will not be affected by the washdown. In other literature the dose resulting from the enveloping contaminating medium has been named Transit DOSE. Two adjacent gamma radiation dose increment recording stations, one of which is shielded with respect to radiation from collecting surfaces, located on top of the forward kingpost of each ship (see Station 9 and 10 in Tab A-3) will supply the information for this purpose. Attenuation factors will be obtained from the recorded data and geometry factors will be calculated. By means of the data collected and the use of simultaneous equations, the effects due to surface collection and the enveloping medium will be separated at these locations (see Tab A-4 for details and results). By means of assumption 1.6.2 the results of effect due to the enveloping medium are directly applicable to all weatherside locations. The Ship Shielding Group (Problem 6.4h) will use above results to determine the Transit Dose within the weather envelope of the ships (see Annex H).

3.1.2 Determination of the Over-all Gamma Radiation Field and Dose at Various Locations and Times

Gamma radiation dose increment recording stations at various locations on the ships (see Tab A-3 for locations) will be used to supply information on gamma fields and integrated dose attributable to all causes. (See Tab A-5 for results). The dose results will be used for the determination of: (1) washdown effectiveness in reducing over-all dosage; (2) magnitude of dose, to be used for estimations of hazard by the Military Evaluations Group. The dose rate results are starting points for supplementary calculations.

3.1.3 Determination of Gamma Radiation Field, at Various Weatherside Locations and Times, Attributable to the Deposit of Contaminant on Weatherside Surfaces

By subtracting the effect attributable to the enveloping medium (results of Tab A-4) from the effect attributable to all causes (results of Tab A-5) for all weatherside stations (See Tab A-3), the effect attributable to deposited contaminant is obtained. (See

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Tab A-6 for results). The separation of effects within the ship's weather envelope is either non-feasible or rather qualitative, and therefore will not be considered. These dose rate results will be used to determine the washdown effectiveness in reducing the gamma radiation field attributable to contaminant remaining on the ship's weather surfaces.

3.1.4 Gamma Radiation Field Survey over the Ship's Weather Surfaces after Reboarding

After reboarding the ships and prior to decontamination operations, the Radiological Survey Group (Problem 6.4d) will coordinate the measurement of gamma radiation dose rates at a height of three feet above the weather surfaces at locations specified in the sketch in Tab A-7. This will allow determination of the uniformity of the gamma radiation field resulting from surface contamination and wash-down action (see Tab A-7 for results).

3.1.5 Beta Radiation Surface Survey at Various Locations after Reboarding

After reboarding the ships and prior to decontamination operations, the Radiological Survey Group (Problem 6.4d) will coordinate a detailed beta radiation surface survey over selected areas of both ships (see Tab A-7 for details of location and results). This information will allow correlation of the relative effect of the washdown system on various surface materials and configurations with respect to nozzle position.

3.1.6 Determination of Contaminated Water Effect on Radiation Data

Because ocean water will be used to wash the protecting domes of the weatherside radiation detection stations to keep the build-up of undesirable contaminant on these stations to a minimum, it is required to establish the effect of the contaminated water on the data recorded. This will be accomplished by means of a recording gamma radiation detection station, set up in a shielded location on each ship, which will be washed intermittently. (See Tab A-8 for details and results.

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3.2 Miscellaneous Measurements for Correlation Purposes

3.2.1 Water Supply to the Washdown System

A by-pass meter will record the quantity of water being supplied to the washdown system as a whole in order to indicate the uniformity of water flow. This information will show up possible pump failures or nozzle clogging and may allow explanation of possible anomalies in the radiation data (see Tab A-9 for results, Tab A-2 for details).

3.2.2 Drainage from Test Areas

The Flight Deck, Boat Deck, and the aft end of the Top of the House are three test areas which will have a recording water meter system installed (see Tab A-2 for details) in order to measure the flow of that water which has had a chance to wash a well-defined contaminated configuration on which radiation data will be available (see Tab A-10 for results). This information may allow correlation of drain waterflow with the rate of buildup or removal of contaminant from the test surfaces.

3.2.3 Relative Wind Velocity

A recording anemometer and wind vane will be installed on a kingpost of each ship in order to measure the wind speed and direction relative to the ship (see Tab A-11 for details and results). Because the water coverage provided by the washdown system may be dependent upon the relative wind velocity, the above information is required to help explain possible anomalies in drainage and radiation data.

3.3 Utilization of the Measured Data

3.3.1 Washdown Effectiveness in Reducing the Over-All Gamma Radiation Dosage

The results of Tab A-5 will be used to calculate the relative difference in the dosage accumulated on the two ships at any given time and location. This relative difference will be used as a definition of washdown effectiveness and will be plotted as a function of time. (See Tab A-1 for Washdown System, Tab A-3 for Station locations, and Tab A-12 for results). In addition to plotting the effectiveness for each station, dosage results from stations on similar

[redacted]

[redacted]

surfaces and configurations for each ship will be averaged and used to determine an average effectiveness for various types of ships structures and configurations. (See Tab A-14 for details and results). No over-all average is contemplated because it would be meaningful only for these specific test ships.

3.3.2 Washdown Effectiveness in Reducing the Gamma Radiation Field on the Ships Weather Surfaces

The results of Tab A-6 will be used to calculate the relative difference in gamma dose rate attributable to surface contaminant on the two ships at any given time and locations. This relative difference will be used as the second definition of washdown effectiveness and will be plotted as a function of time. (See Tab A-1 for Washdown System, Tab A-3 for location, and Tab A-13 for results). In addition to determination of effectiveness at each station, an average effectiveness for various types of ships structures and configurations will be determined in a manner similar to that employed in paragraph 3.3.1. (See Tab A-14 for details and results).

3.3.3 Uniformity of Washdown Effectiveness

It is desired to estimate the uniformity of the washdown effectiveness in reducing the surface contaminant in relation to the washdown nozzle locations. Since a detailed survey with directional gamma radiation detectors is impractical, it is necessary to use the less reliable Beta radiation surface survey data of Tab A-7. Because of uncertainties in beta decay and absorption, and because there will be a significant time interval between the surveys on the two ships, absolute values of effectiveness will not be considered. However, on any one ship the measurement time differences will be negligible, therefore a common unknown decay factor could be applied to bring all readings to a common base time. If the ratio of values, from Tab A-7, for Transit ABLE with respect to Transit BAKER for each location are compared to the highest ratio found, then this ratio of ratios will have eliminated the unknown decay factor but will still include the uncertainty due to absorption. Assuming the absorption error to be minor, we have the relative values of fractions of beta-emitting contaminant remaining. These relative values will be plotted on sketches of test areas showing nozzle locations. (See Tab A-15 for results).

3.3.4 Limitations Imposed upon the Experimental Data

Results of Tab A-9, A-10, A-11 and other information on ships course and atmospheric conditions will be used to determine

[redacted]

[redacted]

whether or not the experimental data is typical. (See Tab A-16 for results).

4. Administrative and Logistical Matters
(Test preparation, Support and Roll-up)

4.1 Pre-test work at USNRDL

None.

4.2 Pre-test work on Transit ABLE and BAKER

4.2.1 Ship Conversion

Special test surfaces, the washdown system, and general instrumentation will be installed by Mare Island Naval Shipyard.

4.2.2 Sea Trials

The operation of, and the water coverage provided by, the washdown system will be checked and altered, if necessary, with the help of the Ships' Operation Officer and members of the Ship's crew during sea trials off the cost of the zone of the interior and at the test site.

4.3 Post-test work on Transit ABLE and BAKER
(See Tab A-23 for details)

4.3.1 Roll-up

4.3.2 If surface surveys indicate a pattern of residual activity, then a detailed check of water coverage by the washdown system on the test areas will be attempted on Transit ABLE.

4.4 Post-test Work at USNRDL

4.4.1 Experimental Work

None.

4.4.2 Data Reduction

Reduced data will be supplied by the Instrumentation Group (Problem 6.4f).

[redacted]

[redacted]

4.4.3 Reports

Report information will be kept current by means of tabs to this annex. A preliminary report will be written in the field. The final report will be written upon return to USNRDL.

4.5 Equipment Requirements (see Tab A-17 for details)

Tools and materials needed for alterations and maintenance of the washdown system will be incorporated into the Ships Allowance List.

4.6 Instrument Requirements (see Tab A-18 for details)

4.6.1 Recording Fixed Gamma Radiation Detection Stations (See Tab A-3, Tab A-8)

4.6.2 Recording Waterflow Meters (see Tab A-2)

4.6.3 Recording Anemometers and Windvanes (See Tab A-11)

4.7 Supporting Services Required at Site (See Tab A-19 for details)

4.7.1 Office and Storage Space

Desk and file cabinet space is only shore requirement.

4.7.2 Shop Facilities and Work Areas

Plan to use shop on Transit ABLE.

4.7.3 Utilities

No shore requirements foreseen.

4.7.4 Transportation

Ship to ship, ship to shore, and shore transportation for personnel and equipment as needed.

4.7.5 Photography

Equipment and washdown system layout and action photographs are required.

[redacted]

[redacted]

4.7.6 Special Services

None foreseen.

4.8 Manpower Requirements

See Tab A-21 for details.

4.9 Shipping and Transportation Requirements

See Tab A-19 for details.

4.10 Costs

See Tab A-20 for details.

5. Command and Communication Matters (Test Operation)

General operational matters are given in the basic plan.

5.1 Pre-Shot Preparation (see Tab A-22 for details)

The washdown system will be tested and altered if necessary. Equipment and instruments will be checked. There will be a rehearsal of operations.

5.2 Shot Test Schedule (see Tab A-21 for details)

A sequential description of operations, the number of personnel and the time required for individual jobs are included. The final scheduling will be done by the coordinating group.

5.3 Between-Shot Preparations (see Tab A-22 and Tab A-21)

These will be essentially the same as the pre-shot preparations, except that rehearsals may not be needed.

5.4 Roll-up

See Tab A-23 for details.

5.5 Communications and Timing Links

Same as in basic plan.

[redacted]

[redacted]

5.6 Report Schedule

5.6.1 A preliminary report will be written at the test site.

5.6.2 The final report will be written at USNRDL in accordance with the schedule to be set up by the Project Officer.

[redacted]

[redacted]

ANNEX "A"
LIST OF TABS

Tab No.	Paragraph Reference	Tab Contents
A-1	3.3.1, 3.3.2	Washdown System Layout
A-2	3.2.1, 3.2.2	Water Meter Systems
A-3	3.1.1, 3.1.2, 3.1.3, 3.3.1, 3.3.2	Gamma Detector Stations
A-4	3.1.1, 3.1.3	Gamma Field and Dose due to the Enveloping Medium
A-5	3.1.2, 3.1.3, 3.3.1	Over-all Gamma Field and Dose
A-6	3.1.3, 3.3.2	Gamma Field due to Surface Contamination
A-7	3.1.4, 3.1.5, 3.3.3	Radiation Surveys
A-8	1.6.7, 3.1.6	Effect of Contaminated Wash Water on the Detector Stations
A-9	3.2.1, 3.3.4	Washdown Supply Waterflow
A-10	1.6.8, 3.2.2, 3.3.4	Drainage Waterflow
A-11	3.2.3, 3.3.4	Relative Wind Velocity
A-12	3.3.1	Washdown Effectiveness in Reducing Gamma Dosage at Specific Locations
A-13	3.3.2	Washdown Effectiveness in Reducing the Gamma Radiation Field at Specific Locations

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45

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ANNEX "A"
LIST OF TABS

Tab No.	Paragraph Reference	Tab Contents
A-14	3.3.1, 3.3.2	Average Washdown Effectiveness in Reducing Gamma Dosage and Radiation Field on Various Ship Components
A-15	3.3.3	Relative Fractions of Contaminant Remaining in Relation to Nozzle Locations
A-16	3.3.4	Limitations Imposed upon Experimental Data
A-17	4.5	Equipment Requirements
A-18	4.6	Instrument Summary
A-19	4.7, 4.9	Shipping, Transportation, and Supporting Services at Site
A-20	4.10	Costs
A-21	4.8, 5.2, 5.3	Shot Schedule and Manpower Requirements
A-22	5.1, 5.3	Pre-shot and Between-shot Preparation
A-23	4.3, 5.4	Roll-up and Post-Test Work

[redacted]

[redacted]

ANNEX "B"

SHIP DECONTAMINATION STUDIES

TASK ORGANIZATION

Group Leaders - F. S. Vine
R. H. Heiskell

Teams	Manpower
A - Technical	F. S. Vine R. H. Heiskell-P.M. McConihe* R. J. Crew M. Morgenthau, CRL(ACC,Md.) W. L. Owen J. D. Sartor R. H. Black N. J. Vella
B - Supervision	LCDR C. J. Striemenski, NDCTC, NB, Philadelphia, Pa. Approx. 6 weeks at PPG CPO N.G.Biasi, NDCTC, NB, Philadelphia, Pa. Approx. 6 weeks at PPG LT(JG) R. D'Ambra, ACCS, Ft McClellan, Ala. LCDR G. C. Bell, USNSC, NS, Treasure Island, San Francisco, Calif. Approx 1 week at PPG
C - Ship Decontamination	DC1 E. Hoffman, YAG 39, Duration of Test DC1 J. Quarterman, YAG 40, Duration of Test
D - Support	274 enlisted personnel from the Task Force for decontamination

*P.M. McConihe USNRDL only.

[redacted]

[redacted]

1. General Situation

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Test

This test is designed to provide valid information on the comparative effectiveness of varioud decontamination procedures in the removal of radioactive contamination from ship's weather surfaces and interior spaces. Transit ABLE, with washdown, will have residual contamination, and Transit BAKER, without washdown, will have original contamination. Measurements will be made to determine the extent and distribution of the contaminant, the comparative effectivenesses of the decontamination procedures, and the relative effectivenesses of the individual methods constituting the procedures. All results will be recorded.

1.3 Purpose of Annex

1.3.1 To state and describe the objectives, experimental and non-experimental, of Project (Problem) 6.4b.

1.3.2 To describe in detail the plan of attack on Project (Problem) 6.4b.

1.3.3 To provide detailed information on the operational and logistical requirements of Project (Problem) 6.4b.

1.4 Enemy Forces (Shot Schedule)

1.4.1 Same as in basic plan.

1.5 Friendly Forces

1.5.1 Same as in basic plan.

1.5.2 Team B will be as shown in Task Organization.

1.5.3 Team C will be supplied from the complements of YAG 39 and YAG 40 on permanent assignment. Team D will be supplied by the Task Force in four equal groups; one group for each shot with a fourth group in reserve for emergency replacements (refer to Tab B-10). No particular ratings are required.

 [redacted]

[redacted]

1.5.4 Development, provision and maintenance of non-manned instruments will be accomplished by 6.4f.

1.5.5 Radiological surveys, provision and maintenance of manned instruments will be accomplished by 6.4d.

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan.

1.6.2 Radioactive contamination of a ship in transit through an area beyond range of disabling physical damage from an underwater atomic detonation, could conceivably constitute a major hazard for the ship's operating and fighting personnel. This appears to be particularly true where weapons in excess of 20KT are involved.

1.6.3 It is assumed that the test ships will be contaminated in the same manner and to the same extent under the test conditions as would Naval vessels in a tactical situation of similar nature.

1.6.4 Information obtained regarding contaminant distribution, contaminability, decontaminability, effectiveness of decontamination procedures, and requirements of time, manpower, materials and equipment for decontamination, will provide the basis for the development of operating procedures for the recovery of contaminated ships, tactically and industrially, and either with or without washdown.

2. Mission

2.1 Same as in basic plan.

2.2 To obtain necessary information for the determination of an optimum procedure for the tactical and industrial recovery of contaminated ships.

2.3 To reduce the total radiation field of each ship so that participation in subsequent shots will not be a hazard to operating personnel.

3. Tasks and Plan of Attack

3.1 Distribution Studies

The distribution of contamination over the weather surfaces, in the interior spaces, and through the ventilation and boiler-air

[redacted]

ducting of each ship, will be measured both with beta instruments and directional gamma instruments before any decontamination operations are undertaken. (See Tab B-1 for monitoring plan and available results). All measurements will be made by 6.4d.

3.2 Monitoring and Surveying

Measurements will be made by means of fixed gamma monitoring instruments, beta instruments, radiac instruments and directional gamma instruments to determine (1) the progressive and over-all effectiveness of each decontamination procedure, and (2) the individual effectivenesses of the steps, or methods, constituting each procedure. The measurements will be made at established locations, or stations, and a total of 138 zone surveys will be required (see Tab B-1). The number of additional surveys which may be required for the boiler air ducts, ventilation compartments and machinery spaces, is problematical. Surveys will be accomplished by 6.4d.

3.3 Effectiveness of Decontamination Procedures

Upon the completion of initial surveys and following the removal of test aircraft and test samples, decontamination procedures will be conducted on both ships.

3.3.1 Equipment to be Used

See Section 4.5.

3.3.2 Decontamination Procedures

These are described in Tab B-2.

3.3.3 Efficiency of Contamination Removal

This measurement will be used to determine the amount of residual activity removable from ABLE after washdown, and the amount of original activity removable from BAKER in the absence of washdown. Residual contamination will be measured after each step (method) of each decontamination procedure to obtain the indicated efficiency of each step and the total efficiency of the procedure. These results will be of importance in the ultimate preparation of an operational plan for the recovery of ships. Available results are given in Tab B-2.

3.3.4 Cost of Decontamination

A complete record will be maintained of the amounts

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[redacted]

of equipment, materials, and manpower expended for each operation. This record will provide information regarding the unit and total cost of ship decontamination by any or all of the procedures tested. Time and motion studies will be made to determine operating rates. These results should be useful in planning and executing large scale decontamination operations. The available record is given in Tab B-3.

3.3.5 Operational Advantages and Limitations

Particular attention will be given to the advantages, disadvantages, and limitations of the various decontamination procedures and methods with respect to typical operational capabilities and necessities aboard ship. Information gained will be used to recommend candidate methods for shipboard use. Results of these observations will be found in Tab B-3.

3.3.6 Material Damage by Decontamination

Appropriate inspections will be conducted to determine possible detrimental effects of decontamination procedures, with particular regard to those involving surface destructive techniques. See Tab B-3 for available results.

3.4 Radiation Dose to Decontamination Teams

Dosage to personnel engaged in decontamination operations aboard the test ships will be measured by means of dosimeters and film badges furnished by 6.4g. Processing of dosimeters and badges, as well as the maintenance of a record of the accumulated dose of each man, will also be accomplished by 6.4g. This record will enable exposed personnel to avoid exceeding the total permissible dose for the operation and may yield information of value regarding the total dose to personnel decontaminating a ship (1) previously protected by washdown (ABLE) or (2) unprotected by washdown (BAKER). Available results are recorded in Tab B-4.

4. Administrative and Logistical Matters (Test preparation, Support and Roll-up)

The general administrative and logistical requirements are given in the basic plan.

4.1 Pre-Test Work at NRDL

4.1.1 Evaluation of Factors Affecting Decontamination Effectiveness

Investigations will be made to determine the influence

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[redacted]

of such factors as weathering, surface deposits, and repeated contamination and decontamination, on the effectiveness of various decontamination methods. The investigation will include the selection of a suitable all-purpose chemical additive (detergent). Additional details and available results are given in Tab B-5.

4.1.2 Analysis of Decontamination Methods

The wet decontamination methods will be analyzed to establish working specifications for temperature, pressure and time (rate) of application. Available results are given in Tab B-5.

4.1.3 Engineering Evaluation of Decontamination Methods

The results of the analyses described in 4.1.2 will be further evaluated with full-scale decontamination equipment. Refer to Tab B-5 for results.

4.1.4 Protective Coatings

Investigations will be made to determine the effectiveness of various coatings in protecting typical shipboard weather surfaces against radioactive contamination. Details of these tests are presented in Tab B-5.

4.1.5 Miscellaneous

4.1.5.1 A practical system for operational intercommunication will be selected and tested.

4.1.5.2 Modifications of equipment will be made, if required, and necessary accessories will be fabricated.

4.2 Pre-test work on Transit ABLE at NRDL

4.2.1 Tests during Sea Trials

Exhaustive tests of decontamination equipment and supporting facilities will be made aboard Transit ABLE prior to departure for the test site. Any necessary modifications will be made during this period.

4.2.2 Personnel Training

One man each from the crews of ABLE and BAKER,

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permanently assigned to decontamination studies, will be trained in the use and operation of decontamination equipment and in decontamination techniques, work schedules permitting.

4.3 Post-Test Work on Transit ABLE and Transit BAKER

4.3.1 Industrial Decontamination

The possible need for industrial decontamination of one or both ships before, and the continuation of such work after, their return to the continental United States, is recognized. The scope of such work and the logistics involved cannot be ascertained until final tactical decontamination in the field has been completed. See Tab B-6.

4.3.2 Roll-Up

See Section 5.5.

4.4 Post Test Work at NRDL

4.4.1 Post-Test Experimental Work

None.

4.4.2 Preparation of Report

Data and information will be compiled and currently maintained by means of tabs to this Annex. A preliminary report will be prepared at the test site. The final report will be written following return to USNRDL and will comply with the schedule published by the Project Officer.

4.5 Equipment Requirements

These constitute the equipment, supplies, and materials which will be required for the decontamination of both ships. Tools for the maintenance and repair of equipment are included. Detailed lists are given in Tab B-7.

4.6 Instrument Requirements

4.6.1 Gamma detection instruments with continuous recorders, as installed in fixed locations on both ships by 6.4f. See Tab B-8 for location details.

4.6.2 Survey instrument and directional gamma probe needs

[redacted]

will be determined by 6.4d to meet survey and monitoring requirements. See Tab B-8.

4.7 Supporting Services Required at Site

4.7.1 Office and Storage Space

See Tab B-9.

4.7.2 Shop Facilities and Work Areas

See Tab B-9.

4.7.3 Utilities

See Tab B-9.

4.7.4 Transportation

See Tab B-9.

4.7.5 Photography

See Tab B-9.

4.7.6 Special Services

See Tab B-9.

4.8 Manpower Requirements

See Tab B-10 for personnel lists and schedules.

4.9 Shipping and Transportation Requirements

Sea and air transportation and shipping requirements for personnel, equipment, supplies, and materials are shown in Tab B-11.

4.10 Costs

See Tab B-12 for breakdown of budget and record of expenditures.

5. Command and Communications Matters

General operational matters are as given in the basic plan. H-hour is shot time. R-hour is reboarding time on a particular ship.

[redacted]

5.1 Pre-Shot Preparation (See Tab B-13 for details and schedule)

5.1.1 Equipment and Facilities Check

All firehose and hot liquid jet decontamination equipment will be given full-capacity tests aboard Transit ABLE. Final changes and modifications will be made if required.

5.1.2 Off-Load Equipment

Deck-stowed and other equipment will be off-loaded and placed ashore in storage area.

5.1.3 Painting of Ships

Selected areas of both test ships will be coated with a special strippable paint prior to the first shot. Assuming satisfactory performance will be obtained with this material, the same or larger areas of both ships will be protected with this material prior to subsequent shots.

5.2 Dry Runs and Shot Rehearsals (See Tab B-13)

5.2.1 Boarding of Ship

The boarding of Transit ABLE will be rehearsed by selected personnel from Teams B and C and, when available, from Team D. The starting of the washdown system pumps will be accomplished and the lighting off of one boiler will be simulated.

5.2.2 Decontamination

After the boarding of Transit ABLE, the monitors will practice their initial monitoring while the set-up crews move the decontamination equipment into position, connect firehoses and steam lines and otherwise prepare for the scheduled decontamination procedures which will then be simulated step-by-step. This will include intermediate monitoring.

5.2.3 Positioning of Transit BAKER

The ATF will bring Transit BAKER alongside of Transit ABLE. Camels will be placed between the vessels if the water is rough. Decontamination equipment will be transferred from ABLE to BAKER. Firehose and steam lines will be strung from ABLE to BAKER. Supporting

[redacted]

cables will be provided, if necessary. Simulation of step-wise decontamination will not be repeated.

5.3 Typical Shot Schedule

5.3.1 Operations Prior to H-Hour

None.

5.3.2 Operations Between H and R Hours (See Tab B-13 for Schedule)

5.3.2.1 Organize decontamination crews. Complete training and briefing.

5.3.2.2 Verify arrangements for instruments and services with 6.4d, 6.4f and 6.4g.

5.3.2.3 Check arrangements for transport of personnel from personnel decontamination center to test ship and return.

5.3.3 Operations After R-Hour (See Tab B-13 for schedule)

5.3.3.1 Assemble monitors and decontamination teams and transport to test ship ABLE in accordance with schedule.

5.3.3.2 Board ABLE and proceed with decontamination as planned.

5.3.3.3 When decontamination of ABLE has been completed, bring BAKER alongside and decontaminate in accordance with plan.

5.4 Between-Shot Preparation (See Tab B-14 for schedule)

5.4.1 After decontamination operations have been completed, all equipment will be monitored, decontaminated, checked and repaired as necessary.

5.4.2 Upon receipt of the monitoring data after the first shot, these will be analyzed to determine the adequacy and efficiency of the decontamination procedures, the individual methods and their manner of application. Any indicated changes and improvements will be made wherever possible. Hot spots will be located and reduced if they

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constitute hazards.

5.4.3 The responsible officer will be advised regarding personnel requirements (Team D) and schedule for the forthcoming shot.

5.5 Roll-Up Schedule (See basic plan and Tab B-15 for schedule)

5.5.1 Industrial Decontamination of Test Ships

The need for and scope of such industrial decontamination as may be required for the return of the ships to the continental United States will be determined. It will also be decided if the conduct of this work at the test site is feasible, or if the vessels must be moved to a shipyard.

5.5.2 When all decontamination is completed, the equipment and tools will be cleaned and repaired as necessary, and packed for shipment. Surplus materials and supplies will be assembled and packed.

5.5.3 All records and classified material will be processed through the proper channels and prepared for transmittal to USNRDL.

5.6 Communication and Timing Links

5.6.1 General requirements same as in basic plan.

5.6.2 Additional facilities will be supplied by 6.4b.

5.7 Report Schedule

5.7.1 A preliminary report will be issued at the test site.

5.7.2 The final report will be prepared at USNRDL, with completion in accordance with the Project Officer's schedule.

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LIST OF TABS
ANNEX "B"

Tab No.	Paragraph Reference	Contents of Tab
B-1	3.1, 3.2	Plan for shipboard monitoring, distribution; available results
B-2	3.3.2, 3.3.3	Decontamination procedures and available results
B-3	3.3.4, 3.3.5, 3.3.6	Cost of decontamination and observations of operational advantages, limitations, material damage
B-4	3.4	Doses to decontamination crews; available results
B-5	4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.5	Pre-test laboratory investigations at NRDL
B-6	4.3.1	Post-test industrial decontamination
B-7	4.5	Equipment requirements
B-8	4.6	Instrument requirements
B-9	4.7.1, 4.7.2, 4.7.3, 4.7.4, 4.7.5, 4.7.6	Requirements for supporting services at test site
B-10	1.5.3, 4.8	Manpower requirements
B-11	4.9	Shipping requirements
B-12	4.10	Cost breakdown
B-13	5.1, 5.2, 5.3.2, 5.3.3	Time schedule for operations
B-14	5.4	Between-shot schedule
B-15	5.5	Roll-up schedule

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58

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TRANSIT BLUE BOOK
ANNEX "C"
AIRCRAFT STUDIES

TASK ORGANIZATION

Group Leader - J. E. Howell

Teams	Manpower
A - Technical	J. E. Howell, Leader W. S. Kehrer F. W. Heilman
B - A/C Handling	Two Aviation Mechanics 2/c permanently assigned
C - Support	6 enlisted personnel from Task Force for A/C handling and decontamination

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1. GENERAL SITUATION

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Test

This test will be conducted to provide information on the effectiveness of a washdown system in preventing the contamination of carrier-based aircraft. Two F4U4 aircraft will be used in each test (total of 6). One aircraft will be placed on Transit ABLE and will be washed by a washdown system designed particularly for the purpose of delivering water to all exposed surfaces of the aircraft. An identical aircraft on Transit BAKER will not be protected. Continuous measurements will be made of the dose rates in and around both airplanes. After transit, both planes will be removed from the ships at Eniwetok. A detailed monitoring will be conducted to determine the extent and distribution of the contaminant on both aircraft. Various decontamination methods and equipment will be employed on the aircraft and the results documented. Nine (9) one (1) foot square aluminum plates will be installed on the #5 hatch of each ship before each test. The plates will be removed and transported to Eniwetok Island with the aircraft. The sequences of operations outlined in Tab C-6 for the three shots will be employed after each shot to decontaminate these plates. The results of these tests should indicate whether the decontamination efficiency of the method is dependent on the contaminating material. Doses to pilot and crewmen in the operational situation will be estimated and possible damage to the aircraft or aircraft components by the salt water washdown and other decontamination materials and methods, will be assessed.

1.3 Purpose of Annex

1.3.1 To describe in detail the experimental objectives and plan of attack on Project 6.4c.

1.3.2 To provide detailed information on the operational and logistic requirements of Project 6.4c.

1.4 Enemy Forces (Shot Schedule)

Same as in basic plan.

1.5 Friendly Forces

1.5.1 Same as in basic plan.

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1.5.2 Experimental aircraft are F4U4 type supplied by BAMR, West Coast. They will be designated by code name of drone ship carrier and shot to which exposed. Code names and Bureau Numbers are:

ABLE UNION	Bureau No. 81624
BAKER "	" " 81724
ABLE KOON	" " 81777
BAKER "	" " 81859
ABLE YANKEE	" " 82022
BAKER "	" " 97119

1.5.3 The operation of removing these aircraft from the test ships, and reloading onto the ships will be done with the aid of personnel from the support ships. Transport of aircraft to and from beach decontamination area will be done by J6, Task Group 7.1.

1.5.4 Team B will be supplied from the special ratings assigned as part of the complement of YAG's 39 and 40. Team C will be supplied by the Task Force, with a separate group of 6 men supplied for each shot. Three of these men must be rated men preferably from an Air Department or deck division. No particular trade is required, nor any particular rating. The other three may be non-rated deck personnel.

1.5.5 Development, provision and maintenance of non-manned instruments will be accomplished by Project 6.4f.

1.5.6 Provision and maintenance of manned radiac instruments will be accomplished by Project 6.4d.

1.5.7 Basic information regarding physical and chemical nature of the contaminants will be supplied by Program 2, of Task Unit 13.

1.5.8 Monitoring services.

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan.

1.6.2 Contamination of aircraft aboard a ship beyond the region of immobilizing damage to the aircraft from an underwater atomic attack will probably present a hazardous situation, both to the pilot and to the handling crew. A theoretical analysis, based on Bikini data, has shown this to be the case for weapons from 20 KT to 160 KT if a contaminating event similar to Bikini Baker occurs.

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1.6.3 It is assumed that the test aircraft will be contaminated (at the location aboard the test ship) in the same manner and to the same extent in this operation that they would at any location on the flight deck of an aircraft carrier.

1.6.4 The dose to the pilot of the aircraft, as measured on the two ships, will have two contributors; dose from the aircraft and dose from the ship's surfaces (deck, etc.). It is assumed that it will be possible to separate the contributions of each of these sources, so that the situation existing with many aircraft and a wider deck can be computed.

1.6.5 Information gained at this test regarding the contaminability, distribution of contamination, decontaminability, effect of decontamination methods and materials, and requirements during decontamination of manpower, materials and time can be used in planning for the recovery of contaminated aircraft afloat and ashore.

1.6.6 It is presently extremely difficult to calculate the shielding afforded either the pilot or the crewmen by the airplanes structure. An attempt will be made to compute this shielding value, but if it is not computable, any multiplication of dose rates as in 1.6.4 will be of limited accuracy.

2. <u>MISSION</u>

2.1 To obtain information necessary to determine the protective value and feasibility of the ships washdown system in protecting parked aircraft aboard ship, and to evaluate selected decontamination techniques and materials.

2.2 To obtain information necessary to compute the hazards to operation of aircraft on carriers following contamination by an atomic weapon.

3. <u>TASKS AND PLAN OF ATTACK</u>

3.1 <u>Radiation in and Around Each Aircraft Aboard Ship</u>

The test aircraft will be placed aboard ABLE and BAKER in identical locations on the #5 cargo hatch cover. At three locations: (1) in the cockpit; (2) above the deck in front of the aircraft, and (3) in a location similar to (2) on #4 hatch, will be placed spherical-geometry ionization chambers attached to continuous recording mechanisms.

[redacted]

[redacted]

These instruments will record dose-increments as a function of time and the records will be processed to yield (a) dose rate from H hour to time of reboarding ship (maximum 100 hours) and (b) total dose during this period. (The instruments and processing equipment are described in Annex F.) The readings will give information on dose rate and dose to (1) the pilot while the aircraft is on deck, (2) the crewman in a typical deck location near the aircraft, and (3) a background reading which will be subtracted from (2) to give the contribution of the aircraft to the crewman's radiation exposure. (See Tab C-1 for detailed location plans and Tab C-2 for retrieving schedule and available results.)

3.2 Radiation In and Around Each Aircraft on Eniwetok

With the aircraft on Eniwetok in a non-contaminated area, instruments (1) and (2) in 3.1 above will be set into operation in identical orientation. Processed data from instrument (1) will yield information regarding radiation exposure to the pilot in flight (no radiation source other than the aircraft); data from instrument (2) will yield the crewman's radiation exposure from a contaminated aircraft situated on a non-contaminated surface. Tab C-2 gives operating schedule and available results.

3.3 Effectiveness of Washdown System in Decontaminating Aircraft Aboard Ship

To determine how effective the washdown system has been a number of studies will be conducted:

3.3.1 Over-all Monitoring of Aircraft Aboard Ship

Before the aircraft are moved, a spot-check monitoring, according to a predetermined plan, will be conducted aboard each ship. This monitoring will be conducted to obtain information regarding the radiation field around the aircraft. (See Tab C-3 for monitoring plans and available results.) The two sets of readings (ABLE vs. BAKER) will be compared and any difference will be assigned as a decrease due to washdown, unless known extraneous factors interfere.

3.3.2 Distribution Studies

The distribution of contamination over the surface of each aircraft will be measured both by beta instruments and directional gamma instruments after the airplane has been moved to the beach and before any additional decontamination operations are begun. This will be an indication of (1) possible preferential washing action by the washdown system as installed (ABLE plane); (2) possible selective retention of contaminant by various locales on the aircraft surface, and will indicate either a need for relocation of the aircraft washdown system,

[redacted]

[redacted]

or that the system, as installed, was adequate. (See Tab C-4 for monitoring plan and available results.)

3.3.3 Material Damage by Washdown System

After the aircraft are removed from the ships, they will be inspected in as much detail as possible (governed by the radiological situation) to determine any physical or strutural damage that can be attributed to the effects of either the contaminant or the washdown system. Various circuits will be tested, and, unless the radiological situation precludes it, the engine will be run. Results of this inspection and test will be used to predict useability of aircraft after washdown and, if the effects are deleterious, will be used (1) to design countermeasures against these effects, or (2) to remove the causes of these effects. (See Tab C-5 for inspection schedule and available results.)

3.4 Effectiveness of Manual Decontamination Methods and Equipment

After the two planes have been removed from the ships, and the foregoing tests and studies have been conducted, manual decontamination procedures will be carried out. These will be tested on both planes.

3.4.1 Equipment to be Used

See Section 4.5.

3.4.2 Methods and Procedures to be Used

An outline of these is included in Tab C-6.

3.4.3 Efficiency of Contamination Removal

This measurement will be used to indicate the amount of residual activity removable after washdown (ABLE plane) and the amount of original activity removable (BAKER plane) by the various decontamination methods. Residual contamination will be measured, giving the efficiency of each method and the total of all methods or combinations of methods. Available results are given in Tab C-6.

3.4.4 Cost of Decontamination

A complete record will be maintained of the amounts of materials and manpower expended during each operation. An analysis of this record will yield information regarding the material unit cost of decontaminating fighter aircraft. Rates of operation will be recorded.

[redacted]

[redacted]

These figures can be used in planning large scale decontamination operations. The available record is given in Tab C-7.

3.4.5 Operational Advantages

Observation will be made of the advantages and disadvantages of the various decontamination methods used with respect to typical operation capabilities and necessities aboard an aircraft carrier. Information gained will be used to recommend candidate methods aboard ship. Results of these observations are given in Tab C-7.

3.4.6 Material Damage by Decontamination

The same type of inspections and tests will be conducted as in 3.3.3. These inspections and tests will be conducted after each decontamination operation ashore. (See Tab C-5 for inspection schedule and available results.)

3.5 Decontamination of Test Plates

The nine (9) test plates will be removed from the ship and transported to Eniwetok Island for decontamination. The group of nine (9) plates will be divided into three (3) sub-groups of three (3) plates each. The decontamination sequences for shots 2, 4, 6 will be employed on these plates, using one (1) sub-group of plates for each decontamination sequence, after each shot. These tests will provide information which can be used to determine the dependence of each decontamination sequence on the contaminating material. Portable gamma instruments will be used to monitor these plates. See Tab C-6 for further information.

3.6 Doses to Decontamination Crews

The crews that decontaminate the aircraft ashore will wear a special set of dosimeters furnished by Project 6.4g. This set of dosimeters will be worn by the men only while they are actually decontaminating the aircraft or engaged in operations concerning this decontamination process. At all other times the dosimeters will be stored in a location with as low a background as possible until they are delivered to 6.4g for processing.

Results of this investigation will yield information regarding total dose to personnel in an otherwise non-radioactive field from decontaminating (1) an aircraft washed down previously (ABLE aircraft), and (2) an unprotected aircraft (BAKER aircraft), and are recorded in Tab C-8.

[redacted]

4. ADMINISTRATIVE AND LOGISTICAL MATTERS (Test Preparation, Support and Roll-up)

4.1 Pre-Test Work at USNRDL

4.1.1 Washdown System Design

In order to predict the probable pattern of residual contaminant after washdown, a series of tests were conducted at NRDL to determine the effectiveness of a film of water flowing over a surface in removing a fluorescent simulant. A manifold of spray nozzles was installed in the decontamination tank on the YFNX-16 and aircraft sections were subjected to this water spray. These test sections were contaminated with the fluorescent material (1) with the washdown system turned off, and (2) with the washdown system operating. (See Tab C-9 for details of this experiment and the results obtained.)

Subsequently, in order to obtain information required for the proper design of the washdown system around a complete aircraft, a nozzle arrangement was set up and tested at USNRDL. A dud F4U4 was procured from NAS Alameda in September 1953 and delivered to USNRDL for test purposes. The preliminary nozzle arrangement was set up around the aircraft and tests were run to determine the number of nozzles required and the optimum location of each nozzle. (See Tab C-9 for a detailed description of the equipment used, the washdown system and available results of system tests.)

4.1.2 Equipment Tests

The ACC is lending USNRDL a cleaning unit which provides facilities for hot liquid cleaning, steam cleaning, and pressure washing. When the cleaning unit arrives at USNRDL, Team A will check it for proper performance along with other equipment such as the portable pumps, Sellers units, etc. These equipment tests will serve as a training period for Team A.

4.1.3 Laboratory Investigation of Cleaning Agents

Personnel of Applied Research Branch, Chemical Technology Division, USNRDL, are conducting tests to determine the relative decontamination efficiencies of a large number of cleaning materials on a semi-micro scale. Team A will determine which of these methods will be tested on full-scale air foil and cowling surfaces of typical Naval aircraft. These tests will form a basis for selecting the particular methods and equipment to be used in the field. (See Tab C-10 for available results.)

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4.1.4 Modification of Aircraft for Loading

The lifting gear will be permanently installed on the forward part of the aircraft, to avoid having to remove the access plate in the engine cowling after contamination. Holes will be drilled in the plate, the cable attached to the lifting pads, and bloomers installed around the cables to prevent contamination from getting into the engine accessory section. Rigging will be made up for each aircraft. The cowling modification and fabrication of rigging will be accomplished at NAS Alameda. (See Tab C-11 for modification plans.)

4.1.5 Instruments

Fixed gamma recording instruments are being developed by the NRDL Laboratory Instrumentation Branch. A directional gamma probe is being developed to supplement the existing USNRDL beta probes. See Annex E for details. Standard radiac sets will be used for survey purposes.

4.2 Pre-Test Work on Transit ABLE and BAKER at USNRDL

4.2.1 Location and Securing of Test Aircraft

An aircraft will be installed on #5 hatch on each ship during sea trials in the San Francisco area. Loading and securing arrangements for both sea shipment and test operations will be determined during these trials. Three aircraft will be loaded on each ship for transport to the test area. See Tab C-1 for details. Procedure for loading and unloading the aircraft will be checked out. These two aircraft will be installed at NAS Alameda by the NAS Alameda Supply Department. (See Tab C-1 for details.)

4.2.2 Tests During Sea Trials

A final check of the washdown system will be made with the aircraft on #5 hatch. The water coverage will be documented and the system will be modified if the water coverage needs improvement. The location, connection and operation of three four-pi instruments will be checked at this time with personnel of Project 6.4f.

4.3 Post-Test Work on Transit ABLE and BAKER

See rollup.

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4.4 Post-Test Work at USNRDL

4.4.1 Post-Test Experimental Work

None.

4.4.2 Data Reduction

The data obtained from the gamma recording instruments will be reduced by Project 6.4f. Some of these data will be reduced at test site.

4.4.3 Report Writing

Report information will be kept current by means of tabs to this annex. Preliminary report will be written in field from this information. Final report will be written upon return to USNRDL to fit schedule laid down by Project Officer.

4.5 Equipment Requirements

These requirements consist of equipment necessary to decontaminate the aircraft on Eniwetok Island and tools required to maintain and repair the equipment and aircraft. (See Tab C-12 for a detailed list.)

4.6 Instrument Requirements

4.6.1 Three fixed gamma four-pi ionization chambers and continuous recorders will be installed by 6.4f on board each ship. (See Tab C-1 for details of location.)

4.6.2 Survey instrument and directional probe requirements are given in Tab C-13.

4.7 Supporting Services Required at Site

4.7.1 Office and Storage Space

See Tab C-14.

4.7.2 Shop Facilities and Work Areas

See Tab C-14.

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4.7.3 Utilities

See Tab C-14.

4.7.4 Ground and Water Transportation and Equipment Movement

See Tab C-14.

4.7.5 Photography

See Tab C-14.

4.7.6 Special Services

See Tab C-14.

4.8 Manpower Requirements

See Tab C-15 for personnel lists and schedules.

4.9 Shipping and Transportation Requirements

Sea and air shipment requirements for materials, test samples and personnel to and from test area are shown in Tab C-16.

4.10 Costs

See Tab C-17 for breakdown of budget and record of expenditures.

5. COMMAND AND COMMUNICATIONS MATTERS (Test Operations)

General operational matters are as given in the basic plan. H-hour is shot-time. R-hour is reboarding time on a particular ship.

5.1 Pre-Shot Preparation (See Tab C-18 for details and schedule)

5.1.1 On-Site Equipment Check and Calibration

Water lines will be connected to the cleaning unit and sufficient operation of the unit will be conducted to determine its performance. Booster pumps will be added as necessary to give the required water pressure. Other items of equipment including water hoses and pumps will be tested for proper performance. The aircraft engines will be run up periodically. The radio equipment will be checked for proper operation after the aircraft has been loaded on the ship.

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5.1.2 Off-Load Extra Test Aircraft

Two test aircraft will be off-loaded from both Transit ABLE and BAKER and transported to Eniwetok for stowage. (See Tab C-19 for aircraft off-loading plan.) The aircraft which is installed on #5 hatch will be left on the ship for the first test.

5.2 Dry Runs and Shot Rehearsals (See Tab C-18 for schedule)

5.2.1 Off Loading of Aircraft

The procedure for off-loading the aircraft after R-hour will be checked out. (See Tab C-19.)

5.2.2 Decontamination of Aircraft

Using a test aircraft spotted in the proper location in the decontamination strip, the monitors will practice their initial monitoring operation. Decontamination equipment will be moved into position and the stepwise decontamination operation will be simulated. These operations will be used to train Team C when they are available.

5.3 Typical Shot Schedule

5.3.1 Operations Prior to H-Hour

None.

5.3.2 Operations Between H and R Hour (See Tab C-18 for Schedule.)

5.3.2.1 Make final check on all equipment.

5.3.2.2 Organize decontamination crews and complete training.

5.3.2.3 Contact 6.4d, 6.4f and 6.4g and complete arrangements for instruments and services.

5.3.2.4 Check arrangements with J6 for equipment and personnel to off-load the aircraft, transport it to the freight pier and tow it to the decontamination strip.

5.3.2.5 6.4c representative proceed to Transit ABLE and BAKER with barge for the off-loading of aircraft.

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5.3.3 Operations after R-Hour (See Tab C-18 for schedule.)

5.3.3.1 Off-load aircraft from transit ship to LSU using winch and boom on ATF-106. Remove gamma detector from cockpit and #5 hatch (as in 4.7.6). Scheduled time of off-loading after R-Hour to be coordinated with Project 6.4i and J6.

5.3.3.2 LSU with aircraft proceed to freight dock at Eniwetok with aircraft. Unload aircraft and attach towing gear. Tow the aircraft to the decontamination strip. (Operations performed by J6.)

5.3.3.3 Set up gamma detectors in cockpit and immediately forward of the wing. Proceed with monitoring, inspections and stepwise decontamination. Monitors will be required (as noted in 4.7.6), equipped with beta, gamma, directional gamma instruments and wipe sampling equipment.

5.4 Between-Shot Preparation (See Tab C-18 for schedule)

5.4.1 After the decontamination operations have been completed, all equipment will be checked and repaired as necessary.

5.4.2 When processed monitoring data is available from the first shot, it will be studied to determine its adequacy and the efficiency of the washdown system. Hot spots will be located and the washdown system will be modified if the washing action can be improved. Pipe available from the ship's stores will be used for this work and it will be accomplished in conjunction with Project 6.4a.

5.4.3 Two test aircraft for next shot will be transported from Eniwetok Island to Transit ABLE and BAKER and loaded on #5 hatch. (See Tab C-19 for details.)

5.4.4 All operations and procedures will be carefully checked and improved where possible.

5.5 Roll-Up Schedule (See basic plan and Tab C-18 for schedule)

5.5.1 Packing

When all decontamination is completed, the equipment and tools will be cleaned and repaired as necessary and packed for shipment.

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5.5.2 Aircraft

The aviation maintenance personnel will complete any required maintenance and prepare the aircraft for shipment. The off-loading procedures will be reversed and the aircraft put aboard Transit ABLE and BAKER.

5.5.3 Records and Classified Material

All records and classified material will be cleared through the appropriate channels and prepared for transmittal to USNRDL.

5.6 Communication and Timing Links

As in basic plan. No special requirements for this group not covered by Annex F.

5.7 Report Schedule

The final report should be completed three months after personnel return to USNRDL.

[redacted]

ANNEX "C"
LIST OF TABS

Tab No.	Paragraph Reference	Tab Contents
C-1	3.1, 4.2.1, 4.6	Detailed location and securing plans of aircraft and instruments on ABLE & BAKER
C-2	3.1, 3.2	Four-pi instrument data-retrieving plan & available data
C-3	3.3.1	Shipboard aircraft monitoring plan & available results
C-4	3.3.2	Plan for distribution studies on aircraft at Eniwetok before manual decontamination and available results
C-5	3.3.3, 3.4.6	Material damage inspection plan, and available results
C-6	3.4.2, 3.4.3	Decontamination methods and procedures, and available results
C-7	3.4.4, 3.4.5	Cost of decontamination and observations of operational advantages, available results
C-8	3.5	Doses to decontamination crews, available data
C-9	4.1.1	Washdown system design and available results of system tests
C-10	4.1.3	Laboratory investigation of cleaning agents, history and available results
C-11	4.1.4	Modification plan of aircraft for loading and handling
C-12	4.5	Equipment requirements
C-13	4.6.2	Requirements for instruments to be supplied by Project 6.4d
C-14	4.7.1, 4.7.2,4.7.3 4.7.4, 4.7.5,4.7.6	Requirements for supporting services
C-15	4.8	Manpower requirements
C-16	4.9	Shipping and transportation requirements
C-17	4.10	Cost breakdown

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ANNEX "C"
LIST OF TABS

Tab No.	Paragraph Reference	Tab Contents
C-18	5.1, 5.2, 5.3.2, 5.3.3, 5.4, 5.5	Time schedule for operations
C-19	5.1.2,5.2.1,5.4.3	Aircraft handling plan at Eniwetok

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TRANSIT BLUE BOOK
ANNEX "D"
SURVEY AND PHOTOGRAPHY

TASK ORGANIZATION

Group Leader - R. C. Barry

Teams	Manpower
A - Technical	R. C. Barry, Leader H. Lee
B - Monitors	10 enlisted personnel from ship's company 100 enlisted personnel from Task Force
C - Support	1 instrument repairman from NRDL or T. I.

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CYRL-RDS-(54) 197

Rad 2-RDS-35

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1. GENERAL SITUATION

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Work

To plan, organize and instruct survey parties and conduct detailed initial radiological surveys on test ships, both above and below decks. To obtain such survey data as are required for various investigations being conducted under Project 6.4. These include the Washdown Group (6.4a), Ship Decontamination Group (6.4b), Aircraft Studies Group (6.4c), Interior Contamination Group (6.4e), and the Shielding Studies Group (6.4h). To photograph the fall-out on Transit BAKER. To procure, calibrate, store, maintain and issue special radiological survey instruments for Project 6.4.

1.3 Purpose of Annex

1.3.1 To describe in detail the support functions and plan of attack on Project 6.4d.

1.3.2 To provide detailed information on the operational and logistic requirements of Project 6.4d.

1.4 Enemy Forces (Shot Schedule)

Same as in basic plan.

1.5 Friendly Forces

1.5.1 Same as in basic plan.

1.5.2 Portable and laboratory type instruments will be procured from the following sources:

Gamma survey (radiac) instruments from USNRDL stock
Directional beta and gamma instruments from Instruments Branch, USNRDL
Laboratory counting equipment from USNRDL stock
Additional radiacs (if necessary) from Task Force Rad Safe or Project 6.4g.

1.5.3 Ten permanently assigned survey enlisted personnel will be obtained from the 6.4 ships' company. One hundred additional

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enlisted personnel will be obtained as needed from the Task Force for radiological survey.

1.5.4 Maintenance and calibration of portable gamma survey instruments is to be accomplished by Task Force Rad Safe.

1.5.5 Maintenance and calibration of the directional beta and gamma instruments and the laboratory counting equipment will be accomplished by Project 6.4f, or by USNRDL personnel or by an electronic technician from T. I.

1.5.6 Survey data will be shared with Project 6.4g so that there will be no useless duplication of radiological surveys.

1.5.7 Photographic film will be stored and processed by the Task Force Photographic Unit.

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan.

1.6.2 Same as Annex A, B, C, E, and H.

1.6.3 The gamma survey instruments (radiacs) will be used for measuring gross gamma fields only. It is assumed that these instruments will not detect beta radiation.

1.6.4 The directional gamma probe will be used for measuring gamma radiation with a 60° cone. This will be roughly a 36" circle at 30" from the surface. Direct beta radiation will not be readily detected by this instrument because of the 30" working distance, and the thick window in the GM tube detector.

1.6.5 The directional beta probe will be used for measuring only beta radiation emitted from 100 sq. centimeters directly under the probe window. Gamma radiation will be electronically cancelled from all readings. The instrument will be held 1/4" from the contaminated surface. This instrument will only be used to measure localized contamination on non-porous surfaces, or surfaces not covered with some material which would absorb significant amounts of beta radiation. It is assumed that there will be a definite ratio, at any one time, between beta and gamma radiation so that beta readings may be roughly converted to localized gamma readings.

1.6.6 Removable contamination presumably constitutes a hazard to personnel even in low radiation fields. Therefore, wipe

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samples will be taken from surfaces undergoing decontamination, to determine the relationship between the reduction in radiation fields and reduction in amount of removable contamination.

1.6.7 It is assumed that there will be some visible phenomenon associated with the fall-out on Transit ABLE and BAKER. The fall-out should be in the form of a mist or rain which may be photographed with proper lighting and suitable optical equipment.

2. MISSION

2.1 To coordinate the procurement of radiological survey data as required for the various investigations being conducted under Project 6.4. To organize and instruct survey parties [illegible] and conduct surveys of the test ships and aircraft to obtain the above data.

2.2 To photograph the fall-out on Transit BAKER.

3. TASKS AND PLAN OF ATTACK

3.1 Portable Instrument Storage and Issue

All portable radiological survey instruments will be stored, maintained, and issued from a single location. The Rad Safe building will be used for this facility. Dry-box storage will be provided for the Beta Probes and the indicating instruments for the Directional Gamma Probe.

3.1.1 Before-Use Instrument Check

Before issue, each portable instrument will be checked for battery condition and calibrated against a single source. Before each group of tests, each instrument will be calibrated against a group of standards (beta probes) or on a cobalt range (gamma instruments). Beta probes will be placed in plastic bags before issue.

3.1.2 After-Use Instrument Check

After a portable instrument has been in the field, it will be returned to the instrument pool by the using monitor. At this time the instrument will be decontaminated, if necessary, and checked for proper operation and calibration. The instruments will then be stored under proper conditions so as to be ready for re-issue.

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3.2 Radiological Surveys

Radiological surveys will be conducted in accordance with the requirements of the various 6.4 problems. Insofar as possible, fixed survey stations will be established on the ships and aircraft. This will involve painting suitable marks and symbols at the survey points to indicate to the radiological monitor the number of the survey point (station) and the type of measurements to be taken (beta, gamma or wipe sample). This will materially aid the semi-skilled monitor in taking proper measurements for "before" and "after" data. (See Tab. D-1 for radiological survey station markings).

3.2.1 Radiological Surveys for Washdown Group (6.4a)

Required surveys for 6.4a are listed in Tab D-2.

3.2.2 Radiological Surveys for Ship Decontamination Group (6.4b)

Required surveys for 6.4b are listed in Tab D-3.

3.2.3 Radiological Surveys for Aircraft Studies Group (6.4c)

Required surveys for 6.4c are listed in Tab D-4.

3.2.4 Radiological Surveys for the Interior Contamination Group (6.4e)

Required surveys for 6.4e are listed in Tab D-5.

3.2.5 Radiological Surveys for the Shielding Studies Group (6.4h)

Required surveys for 6.4h are listed in Tab D-6.

3.2.6 Consolidated Requirements for Shipboard Radiological Surveys

The requirements of groups 6.4a, 6.4b, 6.4e, and 6.4h will be consolidated into one shipboard radiological survey. This will be done to minimize duplication of measurements, and reduce the manpower and dosage requirements of 6.4d. (See Tab D-7 master plan). (See Tab D-8 for survey data sheets.)

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3.3 Radiological Survey Rough-Data Handling

All radiological survey data sheets will be turned into Group 6.4d so that proper calibration, decay and other factors may be applied to the rough data. The finished data will be supplied to the group requesting the surveys, and an additional copy will be posted for all interested groups to inspect. (See Tab D-9 for the correction factors required for various instruments and measurements.)

3.4 Instruction of Radiological Survey Monitors

3.4.1 Enlisted Personnel from 6.4 Ships

The enlisted personnel which will be assigned as radiological survey monitors from Transits ABLE, BAKER or the 6.4 Tug will act as a nucleus or cadre of monitors. They will receive training in basic concepts of nuclear radiation, the operation of the various survey instruments, and data taking. Training will commence as soon as the men are designated. (See Tab D-10 for training program).

3.4.2 Enlisted Personnel from Task Force Ships

The bulk of the radiological survey monitors will be obtained from the Task Force. These men will have little or no background in nuclear radiation or radiological survey. These men will receive only practical training in the use of the particular instruments they will be using, and proper techniques for recording data. The cadre from 6.4 ships (3.4.1) will aid in instructing the Task Force personnel. (See Tab D-10 for Training Program.)

3.5 Technical Photography

One camera station on Transit BAKER will be remotely operated to take sequence photographs of the fall-out. The object will be to determine, qualitatively, whether the fall-out was composed of a mist, a fine spray, or large droplets. A clock will be included in the field of view to establish the time of arrival of the various phases of the fall-out.

3.5.1 Description of Equipment

The camera station will consist of a Bell & Howell 16 mm magazine movie camera with 3" lens single framed at two frames per minutes. The camera will be placed in a lead shield to minimize film fogging. A 90° prism will direct the light into the camera lens.

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The camera assembly will be placed inside the deck house on the main deck and will view a target on or near the bulwark through porthole in the deck house bulkhead. The target will be illuminated by a Heiland electronic flash unit (Stobonar III) synchronized to the camera shutter. This lamp will be placed close enough to the target so that its light will determine the exposure of the film regardless of ambient light conditions. A timer clock will be used to turn the camera on at H hour and turn the camera off at H + 4 (480 frames being exposed). (See Tab D-11 for a layout of equipment.)

3.5.2 Loading and Adjusting Camera and Lights

About H-12, the camera will be wound and loaded with film, the lights adjusted and checked, and the time clock started. The porthole and prism will be cleaned of all dust and dirt. The flash lamp will be placed in plastic bags, set in position and checked for proper operating condition. The target will be cleaned and adjusted, if necessary. The timer clock will be adjusted to turn the camera and lights on at H hour and off at H + 4. (See Tab D-12 for details operating equipment.)

3.5.3 Recovery of Film and Securing of Camera Station

At about R + 1, one man will board the ship, and secure the camera station. The porthole will be covered and the flash lamp disconnected and removed from the ship for decontamination and storage. As soon as the interior of the ship may be entered, the camera will be unloaded and the film removed from the ship for processing. (See Tab D-12 for recovery and securing details.)

3.5.4 Processing Films and Reading Results

The exposed and recovered film will be processed as soon as possible by the Lookout Mountain Laboratories. As soon as they are processed, the negative films will be previewed with a 16 mm projector. This will show gross changes in the appearance of the target as well as suspended large drops or particles. Detailed inspection of the films will be delayed until return to NRDL.

4. ADMINISTRATION AND LOGISTICAL MATTERS (Test Preparation, Support and Roll-up)

4.1 Pre-Test Work at USNRDL

4.1.1 Evaluation of the Portable Beta Probes

A prototype beta probe will be tested to determine the

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following: mechanical operating characteristics of instrument; durability and ease of maintenance; linearity over single ranges and between ranges; temperature and humidity dependence; gamma field dependence-discrimination against gammas of various energies and intensities; geometry of the probe. (See Tab D-13 for details of testing program.)

4.1.2 Reliability of Measuring Beta Radiation in the Field

A series of laboratory tests will be conducted to determine whether beta readings may be correlated to directional gamma readings. A series of test panels made of "shipboard" surfaces will be contaminated with mixed fission products. Porous and non-porous surfaces will be used as well as samples with crevices. The contamination will be mixed with various salt concentrations of sea water to obtain various amounts of salt incrustation on the test panels. The ratio of beta to gamma readings will be determined for each of the test panels. The directional beta probe will be used for measuring the beta radiation. (See Tab D-14 for details of the testing program.)

4.1.3 Wipe Sampling Techniques

The newly designed wipe sampler will be tested to determine its efficiency on various surfaces. A standardized procedure will be established for wipe sampling which will include the proper use of the sampler, placement of filter paper wipe samples into bags, and reading the wipe samples with a laboratory type scaler and rate meter.

4.1.4 Technical Photography

Developmental tests will be conducted to determine the best film to use in the 16 mm shielded camera, the best lighting technique to use and the best target or background to use to detect the fallout on Transit BAKER. The present camera and synchronizer will be checked for smoothness of operation and resolving power of the optical system. (Tab D-15 includes test details.)

4.1.5 Training of Enlisted Personnel for Radiological Survey Monitors

If possible, the enlisted personnel from the 6.4 ship assigned as radiological survey monitors will be given training at USNRDL or at the Damage Control School, T. I., before leaving for the test site. (See Tab D-10 for Training Program.)

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4.2 <u>Pre-Test Work on Transit ABLE and BAKER at USNRDL</u>

4.2.1 <u>Installation of Technical Photographic Equipment</u>

The lead camera shield and porthole will be installed on the main deck of Transit BAKER in the deck house. Lamp brackets and an electrical connector will be installed above the porthole. Provisions will be made for securing the target or background board to the bulwark opposite the porthole. (See Tab D-16 for drawings.)

4.2.2 <u>Testing of Photographic Equipment Aboard Transit BAKER</u>

The photographic equipment will be installed and tested aboard Transit BAKER under simulated test site conditions. Operational reliability of the apparatus will be checked. The test film will be processed and inspected for readability.

4.3 <u>Post-Test Work on Transit ABLE and BAKER</u>

See roll-up.

4.4 <u>Post-Test Work at USNRDL</u>

4.4.1 <u>Post-Test Experimental Work</u>

None.

4.4.2 <u>Data Reduction</u>

All field data will be recopied on clean data sheets. Where applicable, instrument calibration factors will be applied to the data before delivery to the requesting investigator.

4.4.3 <u>Report Writing</u>

Report information will be kept current by means of tabs to this annex. Preliminary report will be written in field from this information. Final report will be written upon return to USNRDL to fit schedule laid down by Project Officer.

4.5 <u>Equipment Requirements</u>

These requirements consist of electrical instruments and

[redacted]

[redacted]

special dry-box storage facilities to check and maintain survey instruments and components of the camera station. (See Tab D-17 for a detailed list.)

4.6 Instrument Requirements

4.6.1 Required will be gamma survey meters (radiacs), directional beta probes, directional gamma probes, wipe samplers and laboratory counting equipment. Spare parts and batteries will be included for all instruments. Calibration sources will be available for the directional beta and gamma instruments. (See Tab D-18 for a detailed list.)

4.6.2 Components of the camera station on Transit BAKER will be required. Required will be a camera, lead shield, prism, lights, target, timers and film.

4.7 Supporting Services Required at Site

4.7.1 Office and Storage Space

See Tab D-19.

4.7.2 Shop Facilities and Work Areas

See Tab D-20.

4.7.3 Utilities

See Tab D-21.

4.7.4 Ground and Water Transportation and Equipment Movement

See Tab D-21.

4.7.5 Photography

See Tab D-21.

4.7.6 Special Services

See Tab D-21.

4.8 Manpower Requirements

See Tab D-22 for personnel lists and schedules.

[redacted]

[redacted]

4.9 Shipping and Transportation Requirements

Sea and air shipment requirements for materials, test samples and personnel to and from test area are shown in Tab D-23.

4.10 Costs

See Tab D-24 for breakdown of budget and record of expenditures.

5. COMMAND AND COMMUNICATIONS MATTERS (Test Operation)

General operational matters are as given in the basic plan. H-hour is shot time. R-hour is reboarding time on a particular ship.

5.1 Pre-Shot Preparation

5.1.1 Marking of Radiological Survey Stations

Radiological survey stations will be painted on Transits ABLE and BAKER in accordance with Tabs D-1 and D-7. Group 6.4c will mark the radiological survey stations on the aircraft.

5.1.2 Assembly of Photographic Station

The photographic equipment will be installed and assembled on Transit BAKER according to Tab D-11.

5.2 Dry Runs and Shot Rehearsals (See Tab D-25 for schedule)

5.2.1 Photographic Station

The camera station will be operated for four hours under actual shot lighting conditions. The film will be processed prior to the first shot and inspected. Any changes in camera or lamp settings will be made, and a repeat dry run will be made.

5.3 Typical Shot Schedule

5.3.1 Operations Prior to H-Hour

About H-12, the camera will be wound and loaded with film, the lights adjusted and checked, and the timer clock started. The porthole and prism will be cleaned of all dust and dirt. The flash lamp will be covered with plastic bags, placed in position and checked for

[redacted]

[redacted]

proper operation. The target will be cleaned and adjusted if necessary. The timer clock will be set to turn the camera and lights on at H hour and off at H + 4. (See Tab D-12 for operating details.)

5.3.2 <u>Operations Between H and R Hour</u>

5.3.2.1 Make final check on all instruments.

5.3.2.2 Organize survey teams and continue training.

5.3.3 <u>Operations After R-Hour</u> (See Tab D-25 for schedule)

5.3.3.1 The first radiological survey will be initiated aboard Transits ABLE and BAKER in accordance with Tab D-7.

5.3.3.2 At about R + 1, one man will have the task of recovering the film and securing the camera station on Transit BAKER. (See Tab D-12 for recovery and securing details.)

5.3.3.3 Required radiological surveys for the aircraft Studies Group, 6.4c, will be initiated as outlined in Tabs D-4 and D-7.

5.4 <u>Between-Shot Preparation</u> (See Tab D-25 for schedule)

5.4.1 Check condition of markings at Radiological Survey Stations and repaint where necessary.

5.4.2 Check and calibrate all instruments.

5.4.3 Continue training of monitors (Tab D-10).

5.4.4 Recheck operation of camera station according to Tab D-12.

5.4.5 Rough data will be corrected for instrument calibration, decay and other factors. (See Tab D-9 for details.)

5.5 <u>Roll-up Schedule</u> (See basic plan and Tab D-25 for schedule)

5.5.1 <u>Packing</u>

When all radiological survey operations have been completed, the instruments, parts and equipment will be packed for shipment. The camera station will be disassembled after the last shot and the components packed.

[redacted]

[redacted]

5.5.2 Records and Classified Material

All records and classified material will be cleared through the appropriate channels and prepared for transmittal to USNRDL.

5.6 Communication and Timing Links

As in basic plan. No special requirements for this group not covered by Annex F.

5.7 Report Schedule

The final report should be completed three months after personnel return to USNRDL.

[redacted]

[redacted]

LIST OF TABS
ANNEX "D"

Tab No.	Paragraph Reference	Tab Contents
D-1	3.2, 5.1	Radiological survey station markings
D-2	3.2.1	Radiological surveys for Washdown Group 6.4a
D-3	3.2.2	Radiological surveys for Ship Decon Group 6.4b
D-4	3.2.3, 5.3.3.3	Radiological surveys for Aircraft Studies Group 6.4c
D-5	3.2.4	Radiological surveys for the Interior Contamination Group 6.4e
D-6	3.2.5	Radiological surveys for the shielding Studies Group 6.4h
D-7	3.2.6, 5.1.1, 5.3.3.1, 5.3.3.3	Consolidation requirements for shipboard radiological surveys
D-8	3.2.6	Radiological survey data sheets
D-9	3.3, 5.4.5	Data correction factors for survey instruments
D-10	3.4.1, 3.4.2, 4.1.5, 5.4.3	Radiological survey monitor training
D-11	3.5.1, 5.1.2	Shipboard camera station layout
D-12	3.5.2, 3.5.3, 5.3.1, 5.3.3.2, 5.4.4	Shipboard camera station instruction for operating, recovering film and securing camera station after shots
D-13	4.1.1	Evaluation and testing of the directional beta probe at USNRDL
D-14	4.1.2	Laboratory tests to establish the reliability of measuring beta radiation in the field
D-15	4.1.4	Technical photography development tests

[redacted]

[redacted]

LIST OF TABS
ANNEX "D"

Tab No.	Paragraph Reference	Tab Contents
D-16	4.2.1	Installation of technical photographic equipment
D-17	4.5	Equipment requirements
D-18	4.6.1	Instrument requirements
D-19	4.7.1	Office and storage space
D-20	4.7.2	Shop facilities and work areas
D-21	4.7.3, 4.7.4, 4.7.6	Utilities required, ground and water transportation and equipment movement, photography and special services
D-22	4.8	Manpower requirements
D-23	4.9	Shipping and transportation requirements
D-24	4.10	Budget and record of expenditures
D-25	5.4, 5.5	Between-shot schedule, roll-up schedule

[redacted]

[redacted]

ANNEX E

Interior Contamination Annex

Task Organization

Group Leader - N. R. Wallace

Team A - Data and Sample Retrieving - 99 men from Task Force
- 6-10 men from Project 6.4 test ships

Team B - Radiological Survey - See Annex D

Team C - Decontamination - See Annex C

Team D - Test Setup - 5 men (USNRDL)
N. R. Wallace
F. K. Kawahara
J. C. Sherwin
J. V. Zaccor
H. B. Johnston
R. E. Rexroad (ACC) loan from Project 6.5

1. General Situation

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Test

Measurements will be made within below-deck and top-side compartments of the test ships to provide information relative to the personnel hazard created inside the ship by the intake of contaminated air through boiler-air and ventilation systems. An attempt will be made to evaluate the protection afforded by several devices installed in, or by special operation of, ventilation air systems. The work will be done primarily on TRANSIT BAKER.

1.3 Purpose of Annex

1.3.1 To describe in detail the experimental objectives and plan of attack on Project 6.4e.

[redacted]

[redacted]

1.3.2 To provide detailed information on the operational and logistical requirements on Project 6.4e.

1.4 Enemy Forces

Same as in basic plan

1.5 Friendly Forces

1.5.1 Same as in basic plan.

1.5.2 Team C will be provided by and under control of Project 6.4b.

1.5.3 Development, provision, and maintenance of gamma-time intensity instruments will be accomplished by Project 6.4f.

1.5.4 Basic information on physical and chemical nature of contaminant will be available from Program 2, Project 2.5.

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan.

1.6.2 Contamination of interior compartments of ships beyond the region of immobilization from underwater atomic attack may present a personnel hazard of military significance.

1.6.3 Major avenues of ingress of contamination are the ventilation and combustion-air systems.

1.6.4 The total hazard to personnel in interior compartments is caused by gamma radiation through bulkheads and decks, by active deposits on surfaces of compartments and ductwork, and by active material contained in the air. These factors can be measured independently.

1.6.5 Areas of interest in this investigation are firerooms, boilers, boiler air ducts, ventilation ducts, and ventilation compartments.

1.6.6 Information gained from observations of the boiler, boiler-air ducts, and firerooms on the test ships can be usefully applied or extrapolated to boiler systems in various naval vessels of interest.

1.6.7 Information gained from observations of limited numbers of typical ventilation systems and devices can be usefully applied or extrapolated to ventilation systems in various naval vessels of interest.

2. Mission

2.1 To obtain information necessary to determine the radiological hazards in interior compartments at various times after burst as a result of external radiation from airborne and deposited activity in spaces and ducting.

[redacted]

[redacted]

2.2 To obtain information necessary to determine the radiological hazards in interior compartments as a result of the inhalation of air-borne contamination in ship spaces.

2.3 To obtain information regarding the nature of the contaminant to which the ships are exposed in order that the observed interior hazards may be susceptible to interpretation.

2.4 To obtain information necessary to determine the effects of standard components of boiler and ventilation systems on the hazards listed above, so that qualitative extrapolations to other systems can be made.

2.5 To obtain information necessary to determine the over-all effectiveness of various protective devices in reducing the extent of the radiological hazards from ventilation systems.

3. Tasks and Plan of Attack

3.1 Radiation from Ventilation and Boiler Air Ducts

Existing firerooms and modified boiler air systems on TRANSIT ABLE and TRANSIT BAKER will be documented with measuring devices. Typical ventilation systems and devices will be installed and instrumented in No. 3 Hold of each ship as shown in Tab F-1. Six systems (Conditions I through VI) will be installed on TRANSIT BAKER. Condition II only will be installed on TRANSIT ABLE to measure the effect of the washdown countermeasure on an operating ventilation system. Arrangements are as shown in Tab F-1 and detailed working plans listed therein.

3.1.1 Distribution of Deposited Radioactive Material Throughout Ducts

Information desired is:

a. Representation of activity as a function of position and distance in ducts.

b. Absolute magnitude of activity deposited on inside walls of ducts.

Item a will be obtained on R+1-day by means of a survey of exterior surfaces of ducts with beta and gamma survey instruments. Item b will be obtained by installing small rectangular sampling surfaces over rectangular holes cut from the ducts in various locations prior to test. These sampling surfaces will be removed on R+1-day for counting, decay measurements, and readiochemical analysis. The proper location of these sampling surfaces will be determined by pre-test experimental work at USNRDL using a 1/6-scale boiler system and a full-scale ventilation system.

 [redacted]

[redacted]

3.1.2 Time-rate of Arrival of Active Aerosols

Information desired is:

a. Rate of increase of activity level of the air moving in the ducts.

b. Time at which the activity per unit volume in the ducts is at a maximum.

c. Proportionality of increase and decrease of activity per unit volume at each sampling station within the same duct.

d. Presence or absence, and amount of redistribution, of activity once deposited on duct walls.

e. Variation of gamma intensity with time as measured outside the exhaust and intake stack.

Items a, b, c and d will be obtained by installing a series of air samplers at various locations in the boiler and ventilation ductwork as shown in Tab F-2. The air-sampler head is a long diverging tube protruding through a duct elbow and extending sufficiently far upstream of the elbow that the latter will not influence the air stream at the opening of the tube. Duct air will be drawn iso-kinetically into the tube, slowed by the divergence of the tube and pulled through a continuously moving strip of filter paper by a positive displacement pump. The diameter of the tube will be small compared to the diameter of the duct. Since the pump will displace a constant number of cubic feet per minute and since the filter paper will move from one roll to another at a constant speed, the activity on the paper should be directly proportional to the activity per unit volume of air traveling through the duct at any time.

The filter paper rolls will be shipped to USNRDL for counting. They will be driven through a counter attached to a recording rate meter producing a record of count-rate against time. Parts of the filter may be analyzed radiochemically to obtain the proportions of the major isotopes contributing to the observed count-rate; whereupon, the count-rate data may be calibrated against a standard filter impregnated with known amounts of the predominantly occurring isotopes in the correct proportions.

Item e will be obtained by use of gamma time-intensity recorders described in Annex F. By proper location and selective shielding, these instruments will be used to determine the magnitude of gamma radiation as a function of time, emitted by specific arrangements such as boiler air intake and boiler. Results will be compared with those of unshielded gamma intensity-time recorders installed in spaces to measure the intensity of the total gamma field as a function of time at the point of measurement.

[redacted]

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3.2 Deposited Material in Compartments

A survey of each ventilated compartment will be made under the supervision of Program 6.4d subsequent to recovery of samples. It is intended that specific points be measured during this survey and that these points be delineated by some suitable marking prior to the actual test. If each point is measured at the same distance from the surface, then the relative distribution of active material throughout each compartment could be plotted as a function of position in the compartment.

In addition, the surface distribution of the Condition II compartment will be supplemented by a material balance between the last air sampler in the intake duct and the air sampler in the exhaust duct. Presumably, the difference between the total activities recorded by these two samplers would represent the amount of activity lost to the room, provided the quantity of activity deposited inside the intervening ductwork is observed to be negligible.

3.3 Airborne Activity in Compartments

In the ventilated compartments information relating to the airborne activity will stem from two sources--particle collectors (Tab E-6) mounted in each compartment and air samplers (Tab E-5) located in the exhaust ducts from each compartment.

Millipore filters obtained from the particle collectors will be radioautographed and the active particles will be measured to obtain an estimate of the particle size available for inhalation and ingestion.

Total gamma and beta activity per unit volume of air exhausted from the room as a function of time will be estimated from a count of the activity on the filter paper removed from the exhaust duct air samplers.

3.4 Nature of Active Material in Ducts and Spaces

See Tab E-11.

4. ADMINISTRATIVE AND LOGISTICAL MATTERS (Test Preparation, Support & Rollup)

4.1 Pretest Work at USNRDL

4.1.1 Filter Paper Investigations

A number of different filtering elements have been tested for pressure drop characteristics and general adequacy for use in the air sampler. Results of these tests are given in Tab E-3.

4.1.2 Model Construction and Testing

Air flow characteristics and deposition sites have been investigated by means of a reduced-scale boiler model and a full-scale

[redacted]

ventilation system. The purpose was to establish the proper location of air sampling devices and duct sampling surfaces. Details and available results are in Tab E-4.

4.1.3 Preparation of Prototype Air Samplers

Drawings are in Tab E-5.

4.1.4 Preparation of Prototype Particle Collector

Details and drawings are in Tab E-6.

4.1.5 Preparation of Prototype Beta-Decay Monitors

See Tab E-7 for details.

4.1.6 Construction of Counting Chambers

Available results are in Tab E-8.

4.1.7 Duct Section Design

See Tab E-4

4.2 Pre-test Work on TRANSIT ABLE and TRANSIT BAKER

4.2.1 Experimental

4.2.1.1 Pitot traverses will be taken at selected points in the boiler air system aboard each vessel during dock trials, sea trials, and, if necessary, enroute to the site. The data obtained from these traverses will be used to:

a. Calibrate static taps for use with differential flow recorders.

b. Determine air flow patterns at air sampler stations.

4.2.1.2 Pitot traverses will be made in the ventilation systems with the same objectives as described for the boiler air systems. The majority of ventilation measurements will take place aboard TRANSIT BAKER. For details, see Tab E-9.

4.2.1.3 One or more air samplers and one or more particle collectors will be operated during dockside trials or sea trials to determine the amount of background "dirt" picked up by the collecting surfaces.

4.2.1.4 One air sampler will be operated in the wash-down spray of TRANSIT ABLE during a sea trial to determine the resistance of the instrument to such abuse.

4.2.1.5 All the instruments associated with Project 6.4e will be operated at once for a minimum of eight hours during a sea trial. Afterwards each instrument will be examined, and its mechanical performance during the test will be assessed. Under these conditions, mechanical weaknesses should be disclosed and corrected.

4.2.1.6 Any experimental work left uncompleted at the time of departure of the ships for the site must be completed by Project 6.4e personnel aboard the ships prior to arrival at the test site.

4.2.1.7 Additional details will be available in Tab E-9.

4.2.2 Operational

4.2.2.1 Shipyard workers from San Francisco Naval Shipyard will be required to install instruments aboard the ships. Once installed, air samplers will receive final adjustments from Project 6.4e personnel. Except for a few cases, none of the instruments need be moved from their initial installation points. The exceptions include several air samplers in the boiler air system and several clock-wound recording instruments.

4.2.2.2 Practice recovery operations will be attempted on all instruments and duct sections. Their recoveries will be timed in order that close estimates may be made of:

a. How many teams are needed for recovery operations after each shot.

b. How many samples each time should recover and how many discrite operations must be performed by each team.

c. How much time each team will require to complete its recovery. For results and details, see Tab E-10.

4.2.3 Instrument Check-out and Maintenance

See Tab E-9.

4.3 Post Test Work at USNRDL

4.3.1 For Project 2.6a analyses of samples, see Tab E-11.

4.3.2 On the basis of the results from radiochemical analyses of duct sections, standards will be prepared to calibrate the counting results of the air samplers and duct sections in terms of disintegrations per minute. See Tab E-11.

4.4 Equipment Requirements

Equipment will include spare parts for all instruments installed by 6.4e, hand tools, testing equipment, and miscellaneous items included

[redacted]

in the ship's allowance. As these items are compiled or anticipated they will be included in Tab E-12.

4.5 Instrument Requirements

See Tab E-12 for list of instruments. Survey requirements are given in Tab E-13.

4.6 Supporting Services Required

4.6.1 Lab and Shop Facilities

One workshop has been provided aboard each ship for maintenance and repair operations. One shop exists aboard TRANSIT BAKER and a machine shop will be available at Parry Island if the shipboard installation is inadequate. Storage space will be necessary at Eniwetok Island for sample return boxes.

4.6.2 Power Requirements

Power will be required for most of the instruments during the test. See Tab E-12 for list of power requirements per unit. In addition, lights will be required for all the test compartments and the firerooms during recovery, decontamination, survey and maintenance operations.

4.6.3 Billets

See basic plan.

(see continuation sheet)

4.6.4 Radiological Surveys

See Tab E-13.

4.6.5 Project 2.6a Analyses at USNRDL

See paragraph 4.3.1.

4.6.6 Miscellaneous Requirements from the Task Force

See Tab E-14.

4.6.7 Decontamination

See Annex C.

4.6.8 Gamma Time Intensity Results

See Tab E-15 and Annex F.

[redacted]

4.6.9 Miscellaneous Information from other Programs

See Tab E-16.

4.7 Manpower Requirements

4.7.1 Pre-test Stateside

See Tab E-17.

4.7.2 On-site Technical

See Tab E-17.

4.7.3 On-site Military

See Tab E-17.

4.7.4 Post-test Stateside

See Tab E-17.

4.8 Shipping and Transportation

4.8.1 Shipment to Site

All instruments and equipment associated with program 6.4e will be shipped to the site aboard ABLE and BAKER, with most of the equipment on BAKER in proportion to the number of instruments thereon.

4.8.2 Personnel to and from Site

Part of the personnel will accompany the transits to the site, and the remainder will go by air. All personnel will return by air. See Tab E-17 for details.

4.8.3 Active Sample Air Shipment

See schedule in Tab E-18.

4.8.4 Rollup Shipment

All equipment other than active samples previously shipped by air will return on ABLE and BAKER.

4.9 Costs

See Tab E-19.

[redacted]

5. Command and Communications Matters

(Test Operations)

General operational matters are as given in the basic plan. H-hour is shot-time. R-hour is reboarding-time.

5.1 Pre-shot Preparation Schedule

5.1.1 On-site equipment checks and preparation

See paragraph 4.2.3

5.1.2 Dry runs and shot rehearsals

Air samplers will not participate in shot rehearsals. Particle collectors and recording instruments will be operated during dry runs.

5.2 Typical Shot Schedule

5.2.1 Operations prior to H-hour

5.2.1.1 At about two hours prior to shot time, three project members will board BAKER and two will board ABLE. One man on each ship will throw all switches to start the instruments. (All switches will be located in the corridor between the ventilated compartments on each ship.)

5.2.1.2 On BAKER, one person will check the operation of instruments in the boiler system and fireroom, one person will check the stock instruments and instruments mounted on the superstructure, and the last person (switch-thrower) will check the instruments in the ventilated compartments.

5.2.1.3 On ABLE, one person will check instruments in the ventilated compartments and fireroom, and one person will check the instruments mounted in the masthead and superstructure.

5.2.1.4 When necessary, instrument checkers will wind clock drive mechanisms essential to the operation of instruments which they are inspecting.

5.2.1.5 At no later than boarding time plus forty-five minutes, all five persons will be evacuated from the ships (about H-1 hour 15 minutes).

5.2.2 Operations between H-hour and R-hour

5.2.2.1 Final instructions will be given the recovery teams and survey teams.

[redacted]

5.2.2.2 Preparations will be made to ship the recovered samples to USNRDL.

5.2.2.3 Instruments in need of extensive repair and which previously have been removed from the ship will suffer maintenance.

5.2.3 Operations after R-hour

See Tab E-10.

5.3 Between Shop Preparation Schedule

5.3.1 Maintenance and Repair

Instruments will be serviced and repaired as the need arises. If the repair facilities aboard ABLE and BAKER are not sufficient, machine shop work will be done at Parry Island.

5.3.2 Operational Decontamination Requirements

5.3.2.1 The precipitator in condition IV must be washed (washing system contained within the precipitator), and the Farr filter of condition V and the Chemical Corps filter of condition VI must be replaced. If the mushroom heads of the ventilation system cannot be adequately decontaminated, then they must be removed and stored until just prior to the following shot.

5.3.2.2 Decontamination of the ventilation ducts, ventilated compartments, fireroom and boiler air systems is described in Annex C.

5.3.3 Replenishment of Instruments

Instruments will not be replenished since there are no complete spare units. If an instrument is damaged beyond normal repair, then it will either be left in position not operating or it will be replaced by an instrument from another location on the ship depending on the importance of the instrument from the standpoint of gathering information.

5.3.4 Shot Rehearsal Operation

See general plan and paragraph 5.1.2.

5.4 Roll-up Schedule and Report Schedule

The roll-up schedule and report schedule will be determined by the Project Officer.

5.5 Communication and Timing Links

See Tab E-20.

[redacted]

LIST OF TABS

Tab No.	Paragraph Ref.	Tab Contents
E-1		Drawings of boiler and ventilation systems.
E-2		Instrument and duct section locations.
E-3		Filter paper studies.
E-4		Model construction and testing.
E-5		Air sampler design and performance.
E-6		Particle collector design and performance.
E-7		Beta decay design and performance.
E-8		Counting chambers.
E-9		Pretest work on Able and Baker.
E-10		Recovery operations.
E-11		2.6a analyses.
E-12		Instrument and equipment list.
E-13		Survey requirements.
E-14		Misc. requirements from task force.
E-15		Gamma time intensity measurements.
E-16		Misc. information from other programs.
E-17		Manpower requirements.
E-18		Sample Shipment.
E-19		Costs.
E-20		Communication and timing links.

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TRANSIT BLUE BOOK

ANNEX "F"

INSTRUMENTATION

PROJECT 6.4

PROBLEM ORGANIZATION

Leader - H. S. Bright

1. SITUATION

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Work

Sixty five gamma detection stations will be installed on Transit ABLE, seventy-two on Transit BAKER, both weatherside and below. Five stations will be used during aircraft decontamination operations (land based), and three on island stations for data normalization with Project 2.5a. These instruments will operate during the passage of the ships through the event. The data obtained are recorded as a function of time on strip chart operation recorders. The information recorded is a timed count of known dose increments. Records will be retrieved as soon as the ships can be boarded after each event. The data will be reduced by a computer to give plots of gamma dose rate and cumulative dose as functions of time. The number and location of the fixed gamma recording stations has been determined by the information needs of the various problems in Project 6.4.

1.3 Purpose of Annex

1.3.1 To describe in detail the functions and plan of attack of Problem 6.4f.

1.3.2 To provide detailed information on the operational and logistic requirements of Problem 6.4f.

1.4 Shot Schedule

Same as in basic plan.

[redacted]

[redacted]

1.5 Friendly Forces

1.5.1 Same as in basic plan.

1.5.2 Four electronic technicians who will be assigned from the complements of Transit ABLE and BAKER for the purpose of maintenance and calibration of instruments and the collection of the recorded data.

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan. Assumptions and limitations which form the basis for the number and location of instruments are found in Annexes A, B, C, E and H.

1.6.2 A continuous unattended record is required from shot time to approximately four days after shot time.

1.6.3 Individual records will be required for each of 137 shipboard stations, and for 8 land based stations.

1.6.4 The quantity of information to be handled is so massive that automatic data reduction is required.

1.6.5 The probability of loss of all raw data must be made very small.

1.6.6 It will be necessary to present the reduced data, in both linear and logarithmic plot form, at relatively early times after recovery of data.

2. MISSION

To plan, install, and operate a gamma radiation detection and recording network on Transit ABLE and BAKER and to provide a system for automatic data reduction.

3. TASKS AND PLAN OF ATTACK

3.1 Design of Prototype Instrument and Recorder

3.1.1 General Approach

It is proposed to record the serial occurrence of known dose increments on a linear time base rather than the traditional recording of logarithm of dosage rate versus time. Each increment of dose is to be indicated in an "all parallel data" system as a single mark on a constant speed record chart. Thus, the raw data are dis-

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[redacted]

continuous analog information, and amenable to automatic data reduction. Cumulative dose in roentgens may be plotted by summing the number of dose increments and plotting the running total, using appropriate scale factors. Dosage rate in roentgens per hour may be plotted by computing, for each time interval between individual increment marks, the quotient of unit dose by time interval. In practice, this will be done by plotting normalized reciprocal time intervals.

3.1.2 Detection

Gas ionization chamber detectors will be used. The assumptions of the basic plan indicate that records will be required over a dynamic range of as much as eight decades of dose rate. For the basic region of eight decades, four two decade ranges (A, B, C and D) will be used. Modified stations will be provided by elimination of decade ranges A or D where no significant information is expected in these ranges. All ranges will record simultaneously and continuously. Chamber designs are such that above 95 per cent collection occurs to the limiting intensity for each chamber. Output indication continues at a fixed rate, independent of dose rate so long as the latter remains higher than 30 per cent above the nominal upper limit. Simultaneous data collection is believed to be in this case a more reliable and simple method than an automatic range changing scheme. The cost per channel of recording apparatus of the kind proposed is small in comparison with that of detector range changing means which have been considered. The ion chambers are of coaxial design using from 2 to 10 atmospheres of nitrogen for the various ranges in volumes of 1.8 to 3000 cubic centimeters. Integration capacitances range from 15 micromicrofarads to 0.01 microfarads. Chambers are hermetically sealed using "O" rings and teflon feed through insulators. Gas cans are spun aluminum.

3.1.3 Electrometry

The function of the electrometer circuits is to provide one closure of a pair of relay contacts each time each ion chamber integrating capacitor discharges through a fixed voltage difference. This is provided for by using a conventional space charge grid electrometer tube in the inverted electrode arrangement. Output current is taken from the space charge grid which is operated at constant voltage, (modified by a compensating circuit for correction of filament temperature effect on calibration) and ion chamber signal is put on the control grid. The output current, as it rises through a chosen bias value, reverses the coil current in a moving coil, magnetic contact relay which serves as a discriminator and operates the output relay. The conventional plate of the electrometer tube is used as a gating control electrode over-riding the control grid to provide a fixed delay of about seven

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seconds before another relay operation can occur, thus setting a ceiling on the dose rate range of each channel. The delay is provided by an RC circuit and clamping diode, and is initiated by a separate contact on the charging relay.

3.2 Recording System

The output from the detector stations will be recorded at a central recording room located in hold number four on the port side of the shaft alley. The roof of the recorder room is a slab of concrete approximately 12 inches thick. The recording devices consist of approximately 60 per ship, 20 pen Esterline-Angus operation recorders. See Tab F-1 for a diagram of the detection and recording system.

3.3 Data Reduction System

See Tab F-2 for block diagrams.

3.3.1 General Approach

Automatic data reduction is provided. Input to the system is the set of strip charts removed from the operation recorders after each event. The product of the system is a set of plots on strip charts against time and logarithm of time of the following: total dose, logarithm of dose, dose rate, and logarithm of dose rate. Linear plots of the dependent variables are discontinuous at decade points with the scale identified by margin marks.

3.3.2 Automatic Data Reader

Four units for data reading are provided. Strip charts are fed by an operation recorder chart drive between a miniature surgical lamp and a phototube. The phototube pulses, produced by the dose increment marks on the chart, are delivered through an output cathode follower as approximately 70 millisecond pulses of about 1 volt amplitude. Chart drive is synchronized to power frequency.

3.3.3 Channel Identification Section

A line synchronized digital time base feeds, in parallel, two gated relays at different points of the time base. The gated relays drive a bi-directional rotary stepping switch in opposite directions. The time base is triggered by incoming reader pulses which may arrive direct or via a scale-of-ten, determined by alternate steps of the bi-directional switch. The gated relays and the time base sort the pulse train into one of three pulse separation time categories:

lower than, between, or greater than the above mentioned time base points. If lower, the bi-directional switch is stepped "up" a decade (which may be a scale-of-ten division of the upper decade of a channel or a change of channel). If greater, the bi-directional switch is switched "down" a decade. If between, no action occurs.

3.3.4 Dose Rate Computer

This section receives a channeled pulse train from the channel Identification Section. A scale-of-two chain driven in line synchronization is started by each pulse after a fixed time delay, and is stopped by the succeeding pulse. The binary pattern then has stored a count of timing oscillator cycles and adds to a divider (by relaying) a pattern of parallel resistors proportional to the binary count, so that the bottom conductance of the divider is proportional to the whole pulse separation time. The divider then presents to a potentiometer recorder a voltage proportional to inverse pulse separation time and thus to dose rate. The recorder chronograph pen is signalled by the channel Identification Section at decade changes and indicates by chart margin markings the scale factor. A similar relay bank sets up another divider net which presents to another recorder a voltage proportional to the mantissa of the logarithm of dose rate with characteristics obtained from the Channel Identification Section.

3.3.5 Dose Computer

The Dose Computer employs four banks of telephone minor switches: a 10-switch cascade counting bank, a 6-switch transfer bank, a 3-switch linear readout bank, and a 5-switch logarithmic readout bank. The counting bank is fed on switches 1, 3, 5 and 7 by data readers reading channels A, B, C and D and thus sums dose as a count of Channel A base increments. The transfer bank selects decade scale factor so as to confine the dose summation to the pen range of the dose recorder. The linear readout bank accepts the dose summation from a level of the counting bank determined by the current level of the transfer bank; the whole bank is in turn stepped up as required by the readout bank. The readout bank sets up a resistance divider which feeds a voltage to the linear dose recorder proportional to the count on the readout bank and so to the appropriately scaled total dose. Three significant figures are available. The logarithmic readout bank accepts dose summation in the same way as the linear, but sets up a logarithmic divider which presents a voltage to the recorder proportional over any five decades of data to the logarithm of total dose.

3.3.6 Function Recorder Time Base Drive

One operation recorder has been converted to serve as a logarithmic time plotter. A linear digital time base running in power

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frequency synchronism drives a potentiometer whose voltage output is proportional to logarithm of time. The time input of a function plotter is driven from this voltage. Three decades to 100 hours are available.

Sections 4 and 5 are forthcoming.

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TRANSIT BLUE BOOK

ANNEX G

PERSONNEL PROTECTION STUDIES AND RADIOLOGICAL SAFETY

Task Organization

Group Leader - A. L. Baietti

(See Tab G-1)

1. GENERAL SITUATION

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Test

This group is responsible for all Project 6.4 personnel protection and general radiological safety problems involved in carrying out the Project 6.4 program. This includes:

a. Performing the necessary radiological monitoring surveys so as to properly evaluate the radiological hazards associated with the various operations planned by project personnel

b. Evaluating and advising project personnel on the radiological safety aspects of any operation

c. Indoctrinating and training of project personnel in the radiological safety aspects of their particular operation

d. Maintaining and evaluating integrated radiation dosage of all project personnel

e. Providing for and supervising the monitoring and decontamination of project personnel at other places

f. Providing, issuing and maintaining radiological safety equipment and instruments for Project 6.4 requirements.

In addition this group is responsible for maintaining the necessary liaison with TG-7 on radiological safety matters and advising the Project Officer on personnel protection and radiological safety matters. Existing radiological safety procedures, techniques and instrumentation will be evaluated for their suitability under tactical decontamination conditions and to aid in the development of new and improved radiological safety techniques.

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Studies will be made on the effectiveness of various types of personnel dosimetry in controlling excessive radiation dosage to operating personnel. Correlation will be made between field radiation measurements and integrated personnel dosage as indicated by various personnel dosimetry devices. Studies will be made on the degree of personnel contamination and the effectiveness of various items of protective equipment in minimizing such contamination. Personnel decontamination procedures and general "Change House" procedures will be evaluated in terms of efficiency and effectiveness of general contamination control. Various types of radiological survey techniques involving different types of radiation detection devices will be made in an attempt to optimize monitoring techniques and establish basic instrumentation requirements. Measurements of airborne contamination in and around decontamination work areas will be made in an attempt to correlate the airborne contamination associated with various types of decontamination techniques. Additional measurements will be made to determine the degree of contamination redistribution at some distances from the actual decontamination operations per se.

1.3 Purpose of Annex.

1.3.1 To describe in detail the experimental objectives and plan of attack on Project 6.4g.

1.3.2 To provide detailed information on the operational and logistic requirements of Project 6.4g.

1.4 Enemy Forces (Shot Schedule).

Same as basic plan.

1.5 Friendly Forces

1.5.1 Same as in basic plan.

1.5.2 It will be necessary to coordinate the efforts of Project 6.4g with various representatives of TG-7. Arrangements for the decontamination of protective equipment must be made with the Holmes & Narver laundry facility. Assistance in the operation of the Personnel Decontamination Center, the maintenance and calibration of radiological safety instrumentation, and the processing of personnel dosimetry devices will be provided by TG-7 personnel (See Tab G-2).

1.5.3 The radiological monitoring operations of Project 6.4g will be supplemented by and coordinated with the monitoring surveys of Project 6.4d. This will facilitate the preparation and completeness of radiological situation maps for the test ships.

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1.5.4 Additional dose rate information, particularly at early times, will be available from the instrumentation of Project 6.4f.

1.5.5 Special air sampling instrumentation will be provided by Project 6.4o. Several of the Project 6.4o test installations will be used by Project 6.4g during decontamination operations to correlate and expand the air sampling information collected by Project 6.4g. The data collected will be processed at NRDL using Project 6.4o's data processing equipment and techniques.

1.5.6 Ten special monitors will be supplied from the personnel of YAG 39 and 40. These men will be given special training and indoctrination in rad safe procedures and operations. (See Tab G-1).

1.5.7 Additional monitors will be supplied by the Task Force as the occasion demands. (See Tab G-1).

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan.

1.6.2 It is assumed that the YAG's 39 and 40 will be contaminated such that the radiological conditions observed will be similar to conditions that would exist under actual "contaminating attack" conditions.

1.6.3 It is hoped that the information and data obtained under a maximum allowable dosage (MAD) of 3.9r can be extrapolated to formalize procedures and techniques for higher dose rates and MAD.

1.6.4 A distinction is to be made between "tactical situation" and "industrial decontamination".

1.6.5 The chronic effects of radiological exposure are not to affect "tactical" procedures.

2. MISSION

2.1 To provide adequate radiological safety coverage for all Project 6.4 operations, thereby minimizing the personnel hazard associated with the various phases of the test operations.

2.2 To evaluate existing radiological safety procedures, techniques and instrumentation for their suitability under tactical decontamination conditions; and to obtain information to aid in the development of new and improved radiological safety techniques and instruments.

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3. TASKS AND PLAN OF ATTACK

3.1 Radiological Surveys

Prior to any test operations, assessment of the radiological hazards will have to be made. Such assessment will include preliminary monitoring surveys to determine the magnitude of the radiological safety problem and supplementary surveys made during the course of the test operations to obtain additional detailed information on the radiological safety situation. Since the test operations themselves are designed to reduce the radiological hazards, it will be necessary to make periodic checks on the radiological situation in order to maintain a complete and up-to-date radiological situation map of the test ships. The results of the radiological surveys will be useful in planning and coordinating the day-to-day-test operations of Project 6.4.

Various types of surveys will be made. In addition, to direct radiation measurements of beta-gamma dose rates, checks will be made on removable contamination, concentration of airborne radioactive material, personnel and clothing contamination, etc. Periodic monitoring checks will be made in non-radiological areas adjacent to the test area to assure that the contamination is kept under control at all times. Continuous recording monitoring instruments will be used to detect any significant use in the general background in certain critical areas such as the Radiological Safety Building itself. (See Tab G-3 for details).

3.2 Personnel Dosimetry

In order to control excessive radiation dosage and to collect useful dosage information on Project 6.4 personnel, it will be necessary to set up a very detailed personnel dosimetry program.

In addition to the standard TU-7 film badge, various types of personnel dosimetry devices will be worn by Project 6.4 personnel. These devices will be processed more frequently than the TU-7 film badge and will generally provide more detailed radiation dosage information. Studies will be made on the correlation between monitoring survey dose rate information and integrated radiation dosage, as shown by the personnel dosimetry devices. It is planned to collect information on the shielding effect of the human body on personnel dosimetry devices and the optimum amount of dosage information required to control excessive radiation dosage of operational personnel. Additional information is desired on the distinction between dosage information required to control decontamination operations and that required to effect an integrated radiation dosage record for personnel medical records. (See Tab G-4).

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3.3 Personnel Decontamination Facility

One of the more important radiological safety problems is to minimize and control personnel contamination. This can best be accomplished by setting up a Personnel Decontamination Facility. All Project 6.4 test personnel must pass through this station whenever they enter or leave the radiological zone. Various types of protective equipment, personnel dosimetry devices and radiation dose rate measuring instruments will be available in the station. All personnel and clothing will be checked for contamination prior to release from the decontamination station. Facilities will be available for decontaminating personnel, clothing and equipment. Special monitoring devices such as "hand and foot" counters will be available to facilitate personnel monitoring. No person will be released from the decontamination station until personnel contamination has been reduced to an acceptable level. Various rules and procedures governing the operation of the station will be available and all test personnel must be thoroughly indoctrinated in the following of these procedures.

Data and information collected on the operation of the personnel decontamination facility for Project 6.4 will be used to formalize basic change station prododures and determine optimum size, types, and quantities of material and equipment required to provide sufficient radiological safety coverage for various types of operations in a radiological zone. (See Tab G-5).

3.4 Radiological Safety Equipment and Instrumentation

In order to minimize the radiological hazards associated with the field operations of Project 6.4, it will be necessary to have available certain items of protective equipment, radiological safety instrumentation and other devices to aid in contamination control. These items will be maintained and made available to all Project 6.4 personnel as the need arises. (See Tab G-6).

3.5 Radiological Safety Indoctrination and Training of Project 6.4 Personnel.

In view of the radiological aspects of Project 6.4 operations, it will be necessary to properly indoctrinate project personnel in the radiological safety aspects of their particular problem. This will be done by lectures and training given prior to work at the test site as well as specific "on the spot" advice in terms of how to best minimize the radiological hazards involved.

Special emphasis will be placed on the radiological safety aspects of the test operations during the various "dry runs" and pretest preparations. The ten "special monitors" furnished Project 6.4g from the crews of the YAG's 39 and 40 will be given specialized radiological safety training in order to enable them to carry out their particular part of Project 6.4g's program. (See Tab G-7).

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4. ADMINISTRATIVE AND LOGISTICAL MATTERS. (Test preparation, support and roll up).

4.1 Pre-Test work at USNRDL

4.1.1 Training and Indoctrination Program

In view of the radiological aspects of Project 6.4 operations, it will be necessary/properly indoctrinate Project 6.4 personnel in the radiological safety aspects of their particular problem. Special lectures and training programs will be gigen to those personnel who are available at NRDL prior to departure for the test site. Additional training will be given by the T.I. Training School to insure maximum indoctrination of personnel in the radiological safety aspects of the test operation. (See Tab G-7). Task Force personnel will be given both general and specific Rad Safe briefings.

4.1.2 Compilation and Procurement of Radiological Safety Equipment and Instruments.

The nature of Project 6.4's operation will require assessment, delineation and control of many radiological problems. Such operations will require special radiological safety equipment and instruments. In view of the remoteness of the test site, careful and complete planning and procurement of these items is necessary. (See Tab G-6).

4.1.3 Testing Radiological Safety Instruments

To assure instrument operation under expected climatic conditions at the test site, all radiological safety instrumentation will be tested at NRDL in the Laboratory's "climatic simulator".

4.1.4 Preparation of Special Charts, Graphs, etc.

In order to effectively and efficiently carry out the responsibilities of Project 6.4g, various decay curves, data sheets, dosimetry records cards, over-lay maps, etc. will be required. (See Tab G-8).

4.1.5 Program Planning with TU-7 Representatives

Since the carrying out of Project 6.4g's program involves close interaction with TU-7 personnel, planning and scheduling meetings with TU-7 personnel prior to their departure for the test site will be held at NRDL during the latter part of December to clarify the specific responsibilities and "modus operandi" of the two groups. (See Tab G-2).

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4.2 Pre-Test Work on Transit Able and Baker at USNRDL

4.2.1 Training and Indoctrination of Personnel

The ten "special monitors" furnished Project 6.4g from the crews of the YAG's 39 and 40 will be given additional specialized radiological safety training in order to enable them to carry out their particular part of Project 6.4's program. (See Tab G-7).

4.2.2 Familiarization and Preparation of Monitoring Maps for Radiological Surveys

As part of the general indoctrination of Project 6.4g personnel, specific monitoring survey techniques and monitoring check points will be established to facilitate and expedite the radiological survey operations of Project 6.4g. (See Tab G-3).

4.3 Post-Test Work on Transit Able and Baker

4.3.1 Special Radiological Surveys

In order to determine when and how the YAG's 39 and 40 are to be returned to the states for additional decontamination studies, it will be necessary to make a special radiological survey of each test ship at the conclusion of Operation Transit in order to determine if any radiological hazards are present that require special precaution to be taken. (See Tab G-9).

4.3.2 Special Radiological Safety Instructions

On the basis of the radiological surveys mentioned in 4.3.1, it may be necessary to establish special rules and procedures for the protection of the operating crews of the YAG's 39 and 40 during the return of the test ships to the states. Adequate protective equipment, instrumentation and specific rules and procedures will be provided to assure the safety of the operating crews. Appropriate Project 6.4g personnel will be available at all times to handle any special radiological safety problems that may arise during the return voyage. (See Tab G-9).

4.4 Post-Test Work at USNRDL

4.4.1 Post-Test Experimental Work

None

4.4.2 Data Reduction

The samples collected using the air sampling instruments supplied by Project 6.4c will be processed using Project 6.4c's data processing equipment and techniques. All pertinent radiological safety data, such as dosimetry records, protective equipment critiques, radiological survey information, etc. will be summarized and tabulated for the final report.

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4.4.3 Report Writing

Report information will be kept current by means of tabs to this annex. A preliminary report will be written in the field from this information. The final report will be written upon return to USNRDL to fit schedule laid down by Project Officer.

4.5 Equipment Requirements

These requirements consist of radiological safety equipment necessary to minimize personnel exposure to contamination and control the spread of contamination from the radiological zone. (See Tab G-6).

4.6 Instrument Requirements

These requirements consist of radiation detection and measurements devices to measure and detect radiation fields and radioactive contamination. (See Tab G-6).

4.7 Supporting Services Required at Site

4.7.1 Office and Storage Space (See Tab G-10).

4.7.2 Shop Facilities and Work Areas. (See Tab G-10).

4.7.3 Utilities (See Tab G-10).

4.7.4 Ground and Water Transportation and Equipment Movement (See Tab G-10)

4.7.5 Photography (See Tab G-10).

4.7.6 Special Services (See Tab G-10).

4.8 Manpower Requirements

See Tab G-1 for personnel lists and schedules.

4.9 Shipping and Transportation Requirements

Sea and air shipment requirements for materials, test samples and personnel to and from test area are shown in Tab G-11.

4.10 Costs

See Tab G-12 for breakdown of budget and record of expenditures.

5. COMMAND AND COMMUNICATIONS MATTERS (Test Operation).

General operational matters are as given in the basic plan. H-hour is shot time. R-hour is reboarding time on a particular ship.

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5.1 Pre-Shot Preparation (See Tab G-13 for details and schedule).

5.1.1 On-Site Equipment Check and Instrument Calibration

To assure that all radiological safety equipment and instrumentation are ready for use, it will be necessary to check these items and calibrate the instrumentation in accordance with the radiation field to be measured. (See Tab G-6).

5.1.2 Formalization of Personnel Dosimetry Operations

In view of the magnitude and importance of this operation, it will be necessary to check out the film processing and record keeping systems in order to be certain that a minimum of confusion will result when the actual test operations begin. (See Tab G-4).

5.1.3 Inspection and Readiness of Personnel Decontamination Facility

It will be necessary to properly stow and arrange for the issue and return of the various items of protective equipment prior to the test operations. (See Tab G-5).

5.1.4 Establish relations with TU-7

Due to the close interaction between Project 6.4g operations and TU-7, it will be necessary to formalize the field contacting procedures to minimize confusion and misunderstanding. (See Tab G-2).

5.2 Dry Runs and Shot Rehearsals (See Tab G-13 for schedule).

5.2.1 Training and Indoctrination of Personnel

Final and detailed training of Project 6.4 personnel in the radiological safety aspects of their particular operation will be conducted during the dry runs and shot rehearsals. (See Tab G-7).

5.2.2 Formalize Radiological Monitoring Survey Techniques.

During the dry runs and shot rehearsals, Project 6.4g personnel will formalize the operational details of the various radiological monitoring surveys and the interaction with other Project 6.4 personnel. (See Tab G-3).

5.2.3 Personnel Dosimetry Operations

To minimize confusion of exposure records, dry runs will be made on the issue, collection, processing and recording of dosimetry devices and dosages during the dry runs and shot rehearsals. (See Tab G-4

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5.2.4 Personnel Decontamination Facility Operation

To minimize confusion during actual test operations, test personnel will be processed through the personnel decontamination center in order to assure proper indoctrination in the rules and procedures established for its operation, including the return and issue of protective equipment, personnel decontamination and monitoring procedures, etc. (see Tab G-5).

5.3 Typical Shot Schedule (See Tab G-13) for schedule.

5.3.1 Operations Prior to H-Hour

Arrangements will be made for appropriate Project 6.4g personnel to be on board the tugs designated to retrieve the YAG's 39 and 40. The necessary radiological safety instrumentation and protective equipment will be taken on board the tugs in order to facilitate the radiological surveys required to evaluate the personnel hazards associated with the retrievement of the YAG's.

5.3.2 Operations between H and R Hour

5.3.2.1 Initial Radiological Surveys of YAG's 39 and 40

Radiological surveys will be made on the two test ships to determine the degree of contamination. In view of the time required to maneuver the test ships from the exposure area to the decontamination station (2 - 3 days), it may be feasible to conduct the radiological assessment operation while the ships are in transit. The completeness of such assessment will be determined by the degree of initial contamination.

In order to obtain a maximum amount of information on the factor involved in towing or boarding a disabled contaminated ship, radiological survey data should be collected to determine the correlation between the radiation measurements obtainable from the tug with the radiological situation on board the contaminated ship. Such information will enable boarding and recovery procedures to be prepared in such a way as to minimize the radiological exposure of recovery personnel. Radiation intensity measurements will be made at various positions around the contaminated ship and this information will be correlated with radiation intensities measured on board the ship itself. Checks will also be made on the degree noticeable and possible airborne contamination associated with the radiation intensities. (See Tab G-3).

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On the basis of the above assessment, final detailed plans can be made for the berthing and initial boarding of the test ships. A radiological situation map for each test ship will be made and kept up-to-date.

5.3.2.2 Determination of R Hour

On the basis of the radiological information collected above, the determination of R hour for each ship will be made by the Project 6.4 Officer, after consultation with appropriate 6.4 personnel. (See Tab G-14).

5.3.3 Operations after R Hour

5.3.3.1 Preliminary Monitoring Survey and Initial Decontamination

In accordance with the operation plan of Project 6.4b, initial decontamination work will be done on the test ships to permit the removal of the air craft, special test samples and equipment and other preliminary operations that must be performed prior to the actual full scale decontamination tests. (See Tab G-3).

5.3.3.2 Removal of Aircraft and Special Test Samples and Equipment

In accordance with the operation plans of Project 6.4c, 6.4e, 6.4f and 6.4i, Project 6.4g will provide the necessary radiological safety support to minimize the personnel hazard involved and the uncontrolled spread of contamination during the removal of the aircraft and special test samples and equipment. (See Annex C, E, F and I.)

5.3.3.3 General Radiological Safety Support

As appropriate, radiological surveys will be made in order to keep the project officer and appropriate test personnel informed as to the radiological situation of the test ships and adjacent areas. Interaction with Project 6.4d will be carried out to minimize duplication of effort by Project 6.4g personnel.

Radiological Safety equipment and instrumentation, as indicated in Tab G-6, will be provided. Dosimetry device and dosage information will be available as outlined in Tab G-4. In order to facilitate the Rad Safe operational control of the field work, it is planned to establish a secondary control station on board the tug during the initial operations. Suitable personnel from Project 6.4g will man this station in order to be readily accessible to the work being carried out on board the ships. All personnel boarding or leaving the ship will be checked by Project 6.4g personnel. Personnel planning to board the ship will be checked for adequate protective clothing, dosimetry devices and validity of work area assignment. Personnel leaving the ship will be checked for contamination. Preliminary decontamination, such as removal of certain articles of contaminated clothing, may be required prior to release of personnel for processing through the personnel decontamination facility on Elmer. Detailed procedures of these operations are outlined in Tab G-5.

As the test operation progresses and the Able Ship is used as a work station for the Baker ship, the secondary control station will be moved from the tug to the Able Ship. Area delineations will be made to control the flow of traffic and a responsible representative of Project 6.4g will be available at all times to handle any emergency Rad Safe situation that might occur during the decontamination operations on board the ships. Specific operational plans will be made the night before each work-day to enable Project 6.4g personnel to provide adequate coverage for the scheduled test operations on board the ships. Specific attention should be paid to arrangements for removing any instruments, equipment or samples from the test ships in order to facilitate contamination control. Proper arrangements for messing will also have to be made in accordance with the daily operation plan.

5.4 Between Shot Preparation

At the conclusion of Project 6.4 operation, all radiological safety equipment and instruments will be checked and repaired as necessary. The personnel decontamination facility will be carefully checked for possible unknown contamination and readied for the next phase of the test operation. Stocks will be replenished and modification to procedures will be made in accordance with the experience gained during the previous operation. Radiological survey techniques and dosimetry operations will be reviewed and modified as deemed advisable.

5.5 Roll-Up Schedule (See basic plan and Tab G-15 for schedule).

5.5.1 Packing

When all test operations are completed, the equipment and instruments will be cleaned and repaired as necessary and packed for stowage or shipment.

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5.5.2 Final Radiological Survey of Test Ships.

See 4.3

5.5.3 Records and Classified Material.

All records and classified material will be cleared through the appropriate channels and prepared for transmittal to USNRDL.

5.5.4 Radiological Safety Monitoring Support for Packing and Shipping Operation.

In accordance with established radiological safety regulations, all contaminated equipment and material should be checked by Proj. 6.4g personnel and marked accordingly. Where appropriate, contaminated equipment should be decontaminated in order to minimize unpacking, handling, and stowage problems. All contaminated equipment and material should be properly marked and tagged as to the type and amount of contamination and/or radiation levels. All radioactive test samples should be monitored and tagged prior to shipment. (See Tab G-16).

5.6 Communication and Timing Links.

As in basic plan. No special requirements for this group not covered by Annex L.

5.7 Report Scheduling.

The final report should be completed three months after personnel return to USNRDL.

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LIST OF TABS

Tab No.	Paragraph References	Tab Contents
G-1	Task Organization, 1.5.6, 1.5.7, 4.8	Manpower requirements
G-2	1.5.2, 4.1.5, 5.1.4	Interaction w/TU-7
G-3	3.1, 4.2.2, 5.2.2, 5.3.3.1	Radiological Survey Details
G-4	3.2, 5.1.2, 5.2.3, 5.3.3.3	Personnel Dosimetry Details
G-5	3.3, 5.1.3, 5.2.4, 5.3.3.3	Personnel Decontamination Facility Details
G-6	3.4, 4.1.2, 4.5, 4.6, 5.1.1, 5.3.3.3	RadSafe Equipment and Instrumentation
G-7	3.5, 4.1.1, 4.2.1, 5.2.1	RadSafe Indoctrination and Training
G-8	4.1.4	Rad Safe Data Sheets
G-9	4.3.1, 4.3.2	Rad Safe Aspects of Return of YAG's 39 and 40 to States
G-10	4.7.1, 4.7.2, 4.7.3, 4.7.4, 4.7.5, 4.7.6	Requirements for Supporting Services
G-11	4.9	Shipping and Transportation requirements
G-12	4.10	Cost Breakdown
G-13	5.1, 5.2, 5.3	Time Schedule for Operations
G-14	5.3.2.2	Determination of R Hour
G-15	5.5	Roll-up Schedule
G-16	5.5.4	Rad Safe Packing and Shipping Instructions

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ANNEX H

SHIELDING STUDIES

Task Organization

C. F. Ksanda, group leader
W. E. Strope

1. GENERAL SITUATION

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Test

This study will be conducted to provide information on the effectiveness of a ship's structure in reducing the gamma radiation hazard from radioactive material which is enveloping the ship and which has been deposited on the weather surfaces. Measurements will be made of the dose rate as a function of time in locations below the weather deck and in superstructure compartments. Integrated doses will also be measured. Detailed monitoring will be conducted to determine the variation of dose rate within a given compartment. Dose-rate measurements will also be made within a series of pipes of various thicknesses on deck to provide a means of estimating the effective photon energy of the radiation as a function of time.

1.3 Purpose of Annex

1.3.1 To describe in detail the objectives and plan of attack on Project 6.4h.

1.3.2 To provide detailed information on the operational and logistic requirements of Project 6.4h.

1.4 Enemy Forces

Same as in basic plan.

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1.5 Friendly Forces

1.5.1 Same as in basic plan.

1.5.2 Experimental ships are TRANSIT ABLE AND BAKER. On TRANSIT BAKER only, two steel plates, 2 in. and 4 in. thick, have been added to give additional shielding information for extrapolation to vessels having armored decks.

1.5.3 Continuous time histories of gamma radiation will be provided by Project 6.4f, which will develop, provide, and maintain the required instruments and recording equipment.

1.5.4 Surveys of the dose rates within compartments will be accomplished by Project 6.4d, which will provide and maintain manned radiac instruments.

1.5.5 Total integrated doses will be measured, using film badges and/or other dosimetric devices.

1.5.6 Measurements of the gamma radiation field from airborne activity, as a function of time, and basic information regarding physical and chemical nature of the radioactive material will be supplied by Project 6.4a and by Program 2, Task Unit 13.

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan.

1.6.2 A general requirement exists to evaluate the relative external gamma radiation hazard to personnel at principal operating stations in ships either equipped or not equipped with washdown systems. Measurements will be aimed at obtaining information which cannot be obtained by theoretical or computational methods or by controlled non-weapon test experiments.

1.6.3 Shielding data derived from this test can be used as check points for theoretical calculations and idealized non-weapon test experiments, providing a basis for predicting the shielding of various classes of naval vessels.

1.6.4 The shielding against airborne radioactivity can be separated from that against deposited radioactivity, so that the overall reduction in hazard from these two sources can subsequently be evaluated for a variety of conditions provided the unshielded dose from these two sources is known.

1.6.5 A comparison of computed values for idealized ships with monitor data from several Bikini target vessels indicates that the shielding factor in locations below the weather deck can be adequately predicted, for the case of deposited contamination. However, the Bikini data are of

[redacted]

[redacted]

low reliability, and these measurements should provide a better check on the computations. Furthermore, data are lacking for cumulative deck thicknesses greater than about 2 inches. Measurements beneath added thicknesses of 2 inches and 4 inches of steel will provide a check on calculations for ships with armored decks. Superstructure data will aid in the formulation of methods for predicting shielding factors in superstructure compartments.

1.6.6 Bikini data are inadequate for checking the validity of computations for the shielding from airborne activity. These measurements should provide such a check, for locations below the weather deck and in superstructure compartments.

1.6.7 Since the photon energy may change appreciably with time, affecting the transmission of radiation to interior compartments, the effective energies for transmission through steel can be estimated, as a function of time, by plotting absorption curves from continuous radiation-time measurements inside a series of steel pipes of various thicknesses mounted on deck. Since preferential removal of certain isotopes by the washdown system could affect the energies, these measurements will be made in the same way on both ships.

2. MISSION

2.1 To obtain information necessary to determine the natural gamma radiation shielding of ships' structures from radioactive material enveloping the ship and from radioactive material deposited on weather surfaces.

2.2 To obtain information necessary to compute the hazard from these two sources to personnel within naval vessels either equipped or not equipped with washdown systems.

3. TASKS AND PLAN OF ATTACK

3.1 Radiation-Time Measurements

Continuous dose rate measurements will be made at exposed locations on various decks in connection with Project 6.4a. These measurements give the total dose rate from all sources at unshielded locations. In addition, an estimate of the dose rate from airborne material surrounding the ships during the contaminating event will be made using detectors mounted at the top of a mast. From these measurements, the unshielded dose rate from airborne activity and from deposited activity can be evaluated, as a function of time, for both TRANSIT ABLE and BAKER. (Details are given in Annex A.)

Continuous dose-rate measurements will be made inside various compartments at locations shown in Tab A. In addition, to provide data for larger deck thicknesses than are available on these vessels, two five foot square steel plates have been mounted on TRANSIT BAKER, as shown in Tab A, of 2 inch and 4 inch thickness. After the vessels have emerged from the contaminating event, the ratio of these dose rates to those

[redacted]

topside give the shielding factor for deposited contamination. Extrapolation of this factor to earlier times will give an estimate of the shielding factor for deposited contamination during the event--and hence of the dose rate in shielded locations due to contamination. The difference between this value and that actually recorded gives the estimated dose rate from airborne activity. The ratio of the shielded dose rate for airborne activity to the unshielded value then gives the shielding factor for airborne activity.

Continuous dose-rate measurements will be made on deck inside a series of 8 pipes of varying thicknesses. Details are given in Tab B. From these data, absorption curves can be made for any time after activity has arrived at the ship, to give an estimate of the effective photon energy for transmission through steel. This information will be used in correlating computed with experimental values.

3.2 Total Dose Measurements

As a check on integrated doses, simple integrating dosimeters of the film badge type will be installed at the same locations. Ratios of total doses at shielded locations to those at unshielded locations will give an overall shielding factor. However, this factor is applicable only to the particular conditions of the test.

3.3 Gamma Field Surveys

Gamma field surveys topside will be made in connection with Project 6.4a. In addition, similar surveys will be made in interior compartments for two reasons. First, compartments where instruments are located will be surveyed to determine the magnitude and nature of variation in the radiation field. Second, to check on the recorded dose rates and to extend decay-rate data, dose rates will be measured as soon as possible at the locations of the recording instruments, and thereafter at intervals for as long as is practicable.

4. ADMINISTRATIVE AND LOGISTICAL MATTERS (Test Preparation, Support and Rollup)

4.1 Pre-Test Work at USNRDL

4.1.1 Ship Shielding Characteristics

For correlation with the test results, a simplified shielding experiment using a source of known energy will be conducted at USNRDL. For details of this experiment see Tab C by the Nucleonics Division.

4.1.2 Instruments

Fixed gamma recording instruments are being developed by the NRDL Laboratory Instrumentation Branch. Standard dosimetric devices and radiac sets will be used for the total dose and survey measurements.

[redacted]

4.2 Pre-Test Work on Transit Able and Baker at USNRDL

None

4.3 Post-Test Work on Transit Able and Baker

None

4.4 Post-Test Work at USNRDL

4.4.1 Post-Test Experimental Work

None

4.4.2 Data Reduction

The data obtained from the gamma recording instruments will be presented as a log-log plot by Project 6.4f. Some of the data will be reduced at test site.

4.4.3 Report Writing

Report information will be kept current by means of tabs to this annex. Preliminary report will be written in field from this information. Final report will be written upon return to USNRDL.

4.5 Equipment Requirements

None

4.6 Instrument Requirements

4.6.1 See Tab H1 for details of location and instrument requirements for ionization chambers with continuous recorders.

4.6.2 See Tab H1 for details of location and instrument requirements for integrating dosimeters.

4.6.3 See Tab H2 for details of radiation field surveys.

4.7 Supporting Services Required at Site

See Tab H4.

4.8 Manpower Requirements

See Tab H5.

4.9 Shipping and Transportatioh Requirements

None.

 [redacted]

[redacted]

4.10 Costs

See Tab H5.

5. COMMAND AND COMMUNICATIONS MATTERS (Test Operations)

General operational matters are as given in the basic plan. H-hour is shot time. R-hour is reboarding time on a particular ship.

5.1 Pre-Shot Preparation

None

5.2 Dry Runs and Shot Rehearsals

None

5.3 Typical Shot Schedules

5.3.1 Operations Prior to H-Hour

None

5.3.2 Operations Between H and R-Hour

5.3.2.1 Contact 6.4 a, d, f, and g and complete arrangements for instruments and services.

5.3.3 Operations After R-Hour

Retrieve dosimeters. Proceed with monitoring.

5.4 Between Shot Preparation

Install dosimeters as late as possible to minimize dosage from residual contamination.

5.5 Roll-up Schedule

5.5.1 All records and classified material will be cleared through the appropriate channels and prepared for transmittal to USNRDL.

5.6 Communications and Timing Links

As in basic plan. No special requirements not covered by Annex F.

5.7 Report Schedule

The final report should be completed within six months after personnel return to USNRDL.

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ANNEX I

AIR MONITORING STUDIES

Task Organization

Group Leader - B. M. Carder

Teams	Manpower
A - Technical	B. M. Carder
B - Support	One enlisted man (standby) for possible duty in removing air monitoring data.

1. GENERAL SITUATION

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Test

This test will be conducted to provide information on possible concentrations of airborne beta decay products that would create shipboard inhalation problems. A prototype instrument that is expected to fit design specifications of a possible future shipboard air monitoring unit will be placed on each TRANSIT ABLE and TRANSIT BAKER in an effort to answer questions concerning the necessity for an air monitoring system and the effectiveness of the prototype instruments in providing such warning as may be needed. In other words, does an actual airborne hazard exist, and will these instruments adequately record such hazard and give warning in time for realistic countermeasures to be taken?

1.3 Purpose of Annex

1.3.1 To describe in detail the experimental objectives and plan of attack on Problem 6.4i.

1.3.2 To provide detailed information on the operational and logistic requirements of Problem 6.4i.

1.4 Enemy Forces

Same as basic plan.

1.5 Friendly Forces

1.5.1 Same as basic plan.

[redacted]

[redacted]

1.5.2 Air monitoring equipment with appropriate connectors to power leads will be furnished by problem 6.4i.

1.5.3 Power leads aboard ABLE and BAKER to the instrument site will be installed by the Mare Island Naval Shipyard. Leads are two conductor, rated at 20 amps., furnishing 115v., 60cy. power. Leads to be terminated in waterproof Amphenol plugs furnished by problem 6.4i.

1.5.4 Instruments to be located and secured aboard Able and Baker prior to west coast departure date.

1.5.5 Data removal will be accomplished by 6.4i. In case of overdose to 6.4i personnel, standby man from support group will remove data.

1.6 Assumptions and Limitations

1.6.1 Same as basic plan.

1.6.2 Assumptions

1.6.2.1 Airborne inhalation hazards may exist and are independent of gamma background levels.

1.6.2.2 Such hazards can be "magnified" in the internal spaces of a ship as a result of the ventilation system.

1.6.2.3 Adequate countermeasures (stoppage of ship blowers, wearing respirators) can be effective only while the hazard exists, indicating the necessity for a quick response warning system.

1.6.3 Limitations

1.6.3.1 The air monitor will be designed to give warning within a minute if more than 0.3 microcuries of beta-emitting particles are present on the dust per cubic meter of air surrounding a ship. It is expected that this time lag is small enough to provide ample warning should a high concentration present itself.

1.6.3.2 The instrument is designed to record the presence of airborne beta contaminants in the presence of a fairly high gamma background (10 r/hr; 200 kev gamma should give less than 10 percent full-scale reading). Above some critical level the instrument will be made inoperative, but the immediate danger from bodily gamma exposure will then require effective countermeasures exceeding those necessary for the beta inhalation problem.

1.6.3.3 The instruments will be semi-portable in nature, weighing about 50 lb, so that they can be moved about a ship and plugged in an a.c. outlet. In this test, however, they will be tied to a specific location.

[redacted]

[redacted]

2. MISSION

2.1 To secure information on possible future need for shipboard air monitoring systems; an attempt to find the extent of airborne concentrations of beta decay products.

2.2 To determine if the present instrument design will fulfill such need for an adequate shipboard warning device.

3. TASKS AND PLAN OF ATTACK

3.1 Airborne Beta Level

3.1.1 Air monitor installations will be placed on forward mast platform (Able) and above radio shack (Baker).

3.1.2 Instruments will record beta level buildup, changing filter paper at preset intervals. Should recording rate meter reach full scale within an interval, filter paper will automatically change. Should change occur within a minute of previous change, alarm circuit will be thrown. (In this test the alarm circuit will be connected to a light bulb.)

3.1.3 Records will be processed to obtain figures for beta concentration per cubic meter of sampled air at any given time.

3.2 Instrument Design

3.2.1 Instruments will be checked after each operation to assure that all automatic features have been properly functioning.

3.2.2 Records will be scrutinized to determine if background levels, sampling methods, rate meter circuitry, etc. are of adequate design for future air monitoring problems. Necessary design changes as well as possible future problems will be indicated.

4. ADMINISTRATIVE AND LOGISTICAL MATTERS (Test Preparation, Support, and Rollup)

4.1 Pre-Test Work at USNRDL

4.1.1 Similated test runs at USNRDL using Sr^{90} calibration samples and X-ray and gamma ray backgrounds will indicate the versatility of the instrument. Extra shielding and other adjustments as may be necessary will be added.

4.1.2 Instruments will be calibrated prior to shipboard installation.

4.2 Pre-Test Work on Transit Able and Baker at USNRDL

Instruments are to be located and secured aboard Able and Baker in the San Francisco area. Power will be turned on to insure correct operation.

 [redacted]

4.3 Post-Test Work on Transit Able and Baker

See rollup.

4.4 Post-Test Work at USNRDL

4.4.1 Post-Test Experimental Work

Instrument design will be reviewed, and further tests will be made if needed to improve and complete the final instrument model.

4.4.2 Data Reduction

Preliminary airborne beta concentration information will be divulged at test site. Completed reduction will take place at USNRDL.

4.4.3 Report Writing

This annex will be kept current by means of supplementary tabs. Preliminary report will be written in the field. Final report is to be written on return to USNRDL.

4.5 Equipment Requirements

Consists of spare and replacement parts and tools necessary to maintain and repair instruments aboard Able and Baker.

4.6 Instrument Requirements

A shipboard air monitor, Esterline-Angus recorder and a Solavolt voltage regulator will be located aboard each ship.

4.7 Supporting Services Required at Site

See Tab I-7

4.7.1 Office and storage space.

4.7.2 Shop facilities and work area.

4.7.3 Misc. services (utilities, transportation, etc.)

4.8 Manpower Requirements

See Tab I-8

4.9 Shipping and Transportation Requirements

Sea and air shipment requirements for materials and personnel to and from test area are shown in tab I-9.

[redacted]

4.10 Costs

See Tab I-10

5. COMMAND AND COMMUNICATIONS MATTERS (Test Operations)

See Basic Plan.

5.1 Pre-Shot Preparation

See Tab I-11 for details and schedule. Instruments aboard Able and Baker will be given a final calibration and operational test at test site.

5.2 Dry Runs and Shot Rehearsals

See Tab I-12 for details and schedule.

5.3 Typical Shot Schedule See Tab I-12

5.3.1 Operations Prior to H-Hour

Final check of instruments; turn switches on.

5.3.2 Operations Between H and R Hour

None

5.3.3 Operations After R-Hour

5.3.3.1 Recovery of Data

5.3.3.2 Preliminary processing of data.

5.3.3.3 Dissemination of preliminary data.

5.4 Between Shot Preparation

See Tab I-11. Instruments to be given operational tests, "reloaded" with filter and graph paper, and recalibrated.

5.5 Roll-Up Schedule

See basic plan and Tab I-13 for schedule.

5.5.1 Packing

When all decontamination is completed, equipment and tools will be made ready for shipment.

[redacted]

5.5.2 Records and Classified Material

All records and classified material will be cleared through appropriate channels and prepared for transmittal to USNRDL.

5.6 <u>Communication and Timing Links</u> (See basic plan)

5.7 <u>Report Schedule</u>

The final report should be completed three months after personnel return to USNRDL.

[redacted]

LIST OF TABS

[redacted]

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TRANSIT BLUE BOOK

ANNEX J

PANEL STUDIES
Project 6.5

Task Organization

Group Leader - J. C. Maloney
Corps of Engineers Representative - E. H. Dhein
Chemical Corps Representative - M. Morgenthau
R. E. Roxroad
U. S. Naval Radiological Defense Laboratory Representatives -
D. Kellogg (Major, CE)
R. K. Laurino

1. GENERAL SITUATION

1.1 General

Same as in basic plan.

1.2 Nature and Scope of Test

The contamination and decontamination characteristics of several construction material surfaces and protective coatings will be tested. Surfaces will be contaminated by placing them on weather surfaces of drone ships where they will be exposed to the fallout from the thermonuclear explosions. After the contaminating event, surfaces will be transferred from the drone ships to a clean-land area where contamination-decontamination measurements can be made free from excessive radiation background. Several decontamination methods—suitable for large scale reclamation of land and sea targets—will be applied to test surfaces.

1.3 Purpose of Annex

1.3.1 To describe in detail the experimental objectives and plan of attack on Project 6.5.

1.3.2 To provide detailed information on the operational and logistical requirements of Project 6.5.

1.4 Enemy Forces

Same as in basic plan.

[redacted]

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1.5 Friendly Forces

1.5.1 Same as basic plan.

1.5.2 Removal of test panels from drone ships after contaminating event will be carried out with the aid of Project 6.4.

1.5.3 Transfer of test panels to and from the beach decontamination area will be done by J6, Task Group 7.1.

1.5.4 Personnel from 6.5 will aid Project 6.4 in operational shipboard decontamination and ventilation studies.

1.6 Assumptions and Limitations

1.6.1 Same as in basic plan.

1.6.2 Contamination of the weather surfaces of land installations and ships may present a severe hazard to personnel beyond the range of severe physical damage.

1.6.3 Surfaces to be tested are representative of those found on land installations and ships.

1.6.4 Methods of decontamination are representative of those that can be used on land installations and ships.

1.6.5 The type contaminant is representative of some type that may be found on land installations and ships, but is not representative of the contaminant expected in a harbor explosion.

2. MISSION

2.1 To obtain information necessary to determine the contamination characteristics of various construction materials.

2.2 To obtain information necessary to determine the decontamination characteristics of various construction materials.

2.3 To check usefulness of beta instruments for measuring decontamination effectiveness.

2.4 To valuate the contaminability-decontaminability (..-D) of protective coatings.

[redacted]

[redacted]

3. TASKS AND PLAN OF ATTACK

C-D characteristics will be determined by making beta and gamma measurements on each panel before and after decontamination. All measurements will be made after panels have been transferred to the land area where the decontamination equipment is set up. Beta and gamma readings will be made in identical positions on test panels so that decontamination effectiveness measurements of the two instruments can be compared. Sequence of operations on panels is given in Tab J-1.

4. ADMINISTRATIVE AND LOGISTICAL MATTERS

4.1 Pre-Test Work at Army Chemical Center

4.1.1 Select representative construction materials and design panels to house materials. Materials are given in Tab I-2; panels and racks are shown in Tab J-3. About 3 man-weeks are required for this work. Completion date 1 June 1953.

4.1.2 Select appropriate protective coatings for construction materials. Protective coatings are indicated in Tab J-2. About 1 man-week is required. Completion date 1 June 1953.

4.2 Pre-Test Work on Transit Able and Baker

4.2.1 Inspect Transit Able and Baker to determine panel and fall-out equipment locations. Locations are shown in Tab J-4.

4.2.2 Fabricate panels and racks and install on shipboard. About 100 man-weeks of shop effort required. Completion date for this work is 1 Nov 1953.

4.2.3 Apply protective coatings to panels and paint frames. About 1 man-week of effort required. Completion date is 1 Dec 1953.

4.3 Post-Test Work at Army Chemical Center

ST. LOUIS

4.3.1 Data on C-D properties will be collected and analyzed. From the results of the analysis, a final report will be written. The final report should be completed within three months after personnel return to ACC.

[redacted]

[redacted]

4.4 Equipment Requirements

Vapor Sellers Cleaning unit (available at CRL)
Two (2) Engineer water pumps (available at CRL)
Four (4) sets of Panels (By BuShips)
Two (2) sets of panel handling equipment
Two (2) shipboard mounting racks (by BuShips)

4.5 Instrument Requirements

Two (2) NRDL beta detectors
Four (4) AN-PDR/TIB gamma detectors

4.6 Supporting Services Required

4.6.1 Laboratory Facilities

Decontamination site on Parry Island - 1/2 acre
See Tab J-5 for site location

4.6.2 Shop Facilities

Service for beta and gamma instruments (Proj. 6.4)
Maintenance tent and frame (Task Group 7.1)

4.6.3 Water, Power, etc.

5,000 gallons of fresh water per shot

4.6.4 Billets, offices, storage

Office space in Project 6.4 area for 6 men.
Storage space in 6.4 area for panels and associated equipment. (Section 4.4)
Quarters on each ATF during pre-test and test operations.

4.7 Manpower Requirements

4.7.1 Pre-test stateside

Planning the operation will require 12 man-months effort with use of 2 investigators.

4.7.2 On-site technical manpower

Technical investigators will decontaminate panels, make measurements, and supervise movement of panels. These duties will require 12 man-months effort with 4 investigators. Phasing of duties is given in Tab J-6.

[redacted]

[redacted]

4.7.3 On-site military manpower

Crews of enlisted personnel will be supplied by Project 6.4 for movement of panels and racks. These duties require 1 man-month effort with about 4 enlisted personnel. Time periods during which crews are needed are given in Tab J-6.

4.7.4 Post-Test Manpower

Analysis of data and writing of final report will require 3 man-months effort with 2 investigators.

4.8 Shipping and Transportation

4.8.1 Shipment to site

All equipment and supplies will be loaded aboard Transit Able by 31 December 1953. Equipment and supplies will be unloaded at Eniwetok by 31 January 1954.

4.8.2 Schedule of Personnel to and from Site. See Tab J-7.

4.8.3 Air shipment of supplies or samples.
None
Roll-up shipment

4.9

5. COMMAND AND COMMUNICATION MATTERS (TEST OPERATIONS)

General operational matters are as given in the basic plan. H-hour is shot time. R-hour is reboarding time.

5.1 Pre-Shot Preparation Schedule (Time Schedule in Tab J-9)

5.1.1 On-site equipment checks will consist of calibration of radiac instruments, setting up of decontamination equipment ashore and checking its operation, and inspecting of panels and racks.

5.1.2 Dry runs of operations will be needed to assure that techniques are sufficiently developed to permit successful operation when the actual contaminating event occurs. When the equipment is set up and checked, personnel will run through the various decontamination techniques with the panels in place and also make dummy measurements. It will also be important to practice transferring the panel racks from the ship to the shore decontamination center to assure smooth operation. If initial dry runs for transfer show that panels are subject to excessive vibration and shock, modifications of procedure may be needed to prevent loss of contaminant from panels during the transfer after the event.

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5.1.3 Shot rehearsal operations for this project will be carried out as part of the JTF rehearsal and also as part of other Project 6.4 exercises. Details of operation are same as presented in Section 5.2.

5.2 Typical Shot Schedule

5.2.1 Shot operations prior to h hour will begin two days prior to the departure of drone ships from Eniwetok for test area. At this time, strippable coating will be applied to frames and backings.

At H minus 2 days, 6.5 personnel will board Transits Able and Baker to: (1) check adequacy of test panel mount fastenings, (2) check panels and coatings, retouching where needed, and (3) observe general shipboard experimental set-up.

5.2.2 After a survey of test craft has been made on R ≠ 1 day, a project 6.4 recovery team will dismount test panels and move them to the decontamination site. From R day to R plus seven, panels and racks will be processed at decontamination station.

5.3 Between-Shot Preparation Schedule

5.3.1 After decontamination, the panels will be replaced by clean ones from the storage area. Strippable coating will once again be applied to the frames and racks. Racks will be mounted on the ships and the preparation will continue as indicated in Section 5.2.1.

5.3.2 After decontamination tests, any contaminant remaining on panels, frames or racks will be removed by repeated applications of methods listed in Tab J-1. If the decontamination area shows a radiation background that will interfere with future testing, then area decontamination will be instituted.

5.3.3 Detection instruments will be returned to Project 6.4 for checking and calibration. Decontaminability agents and fresh water supplies at decontamination center will be replenished.

5.3.4 Rehearsals for subsequent shots will be same as given in Section 5.2. Any modifications of techniques indicated by experience of first shot will be incorporated in subsequent rehearsals.

5.4 Rollup Schedule

Rollup schedule will be synchronized with that of Project 6.4. Details of operations are given in Tab J-10.

[redacted]

5.5 Communication and Timing Links

5.5.1 Within Project 6.4 - none

5.5.2 Outside Project 6.4 - none

5.6 Report Schedule

In accordance with directives of Program 6.

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TRANSIT BLUE BOOK

ANNEX N

SHIP LOCATION CHARTS AND EVENT PREDICTIONS

E. A. Schuert
T. H. Shirasawa

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Encl (2) to USNRDL Sec ltr of 19 Jan 54 ser 00878 / Cat 2-RDS-35 REC-54-RDS-3

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1. SHIP LOCATION CHARTS

1.1 The forecasts of the radiation fields expected from fall-out at Operation CASTLE and the requirement that the participating radio-controlled vessels experience high levels of contamination were the determining factors in establishing the basic decisions governing the ship's course. It became evident that the operation area would have to be as close to bomb zero as possible; such factors as bomb blast over-pressure and the geographical configuration of the atoll limited to some extent the number of possibilities. It was further decided to steam the vessels upwind, thus eliminating failure of the washdown system due to undesirable wind speeds and directions relative to the vessel equipped with the countermeasure system.

1.2 Having established the above basic concepts for the operation, it was necessary to make further decisions in order to arrive at the best solution to the problem. Of the added variables to consider, some were fixed at the expense of others, while some were dependent upon the forecast of the downwind direction of the fall-out and the effective wind speed in this direction; these meteorological variables cannot be determined until shortly before shot time.

1.3 The final decisions used to establish the ship's course are as follows:

1. Ship's direction. The ships will follow a straight line course upwind toward ground zero.

2. Proximity to atoll reef. The nearest approach to the reef in all cases will be no less than 2 miles.

3. Blast pressure on ships. At the time of the detonation, the ships will be so positioned that the maximum over-pressure experienced will be no greater than 1 psi.

4. Ships' speed. Throughout the run, the ships will steam at a constant speed of either 7 or 10 knots depending on the effective wind speed.

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5. Ships' starting point. The starting position of the ships will be dependent upon the meteorological variables that establish the fallout area and its rate of propagation; however, in all cases the position will be as close to bomb zero as possible.

6. Time in fallout. The course was arranged so as to permit the ships to experience fall-out for as long a period as possible; in no case will the ships encounter fallout while not on the straight line run.

7. Wind speed. Courses were determined for wind speeds varying from 5 to 25 knots in 5-knot increments, so that the proper course can be selected when this variable is known.

1.4 Based on the above decisions, graphical layouts were constructed in order to indicate to the control aircraft the information needed. From these layouts and with the necessary meteorological information, the ships' starting location, starting time, steaming speed, steaming time, and bearing can be determined.

By observation of the layouts, it can be seen that the area around the shot points has been broken up into segments and plots made within each segment to scale the required information. The segment to be used in any case will depend on the forecast of the downwind direction of the fallout, while the course information to be used within this segment will be dictated by the forecast of the effective rate of propagation of the fallout area.

Very close liaison between the control personnel and the Task Force Weather Central will be maintained so that up-to-the-minute changes in the forecast of the direction and effective rate of propagation of the fallout area can be utilized in positioning the vessels. It is anticipated that minor shifts required because of revised weather forecasts can be compensated for up to shot time.

[redacted]

2. EVENT PREDICTIONS

2.1 The associated fallout patterns included with the course layouts in the form of overlays represent the best available estimates of the levels of fallout through which the ships will pass. It is to be emphasized that these patterns are not a forecast of what is expected but rather a picture of the maximum situation.

2.2 These fallout patterns were obtained by scaling up surface JANGLE data as modified by Mike-IVY data and are most valid for shot Bravo and shot Koon. However, scaling from this source represents, at the present time, the best approach to predicting the expected fallout for the surface water bursts.

2.3 An approximate indication of the radiation levels to be expected on the ships can be made on the basis of the following assumptions:

1. Fallout at any location will deposit over a 2 hour period.

2. The time of arrival of the fallout will be dependent upon the effective wind speed carrying the debris.

3. The fallout will deposit at a constant rate.

4. Decay of radioactive fallout will follow a curve having a slope of -1.2.

5. The ship's surface is in effect an infinite plane.

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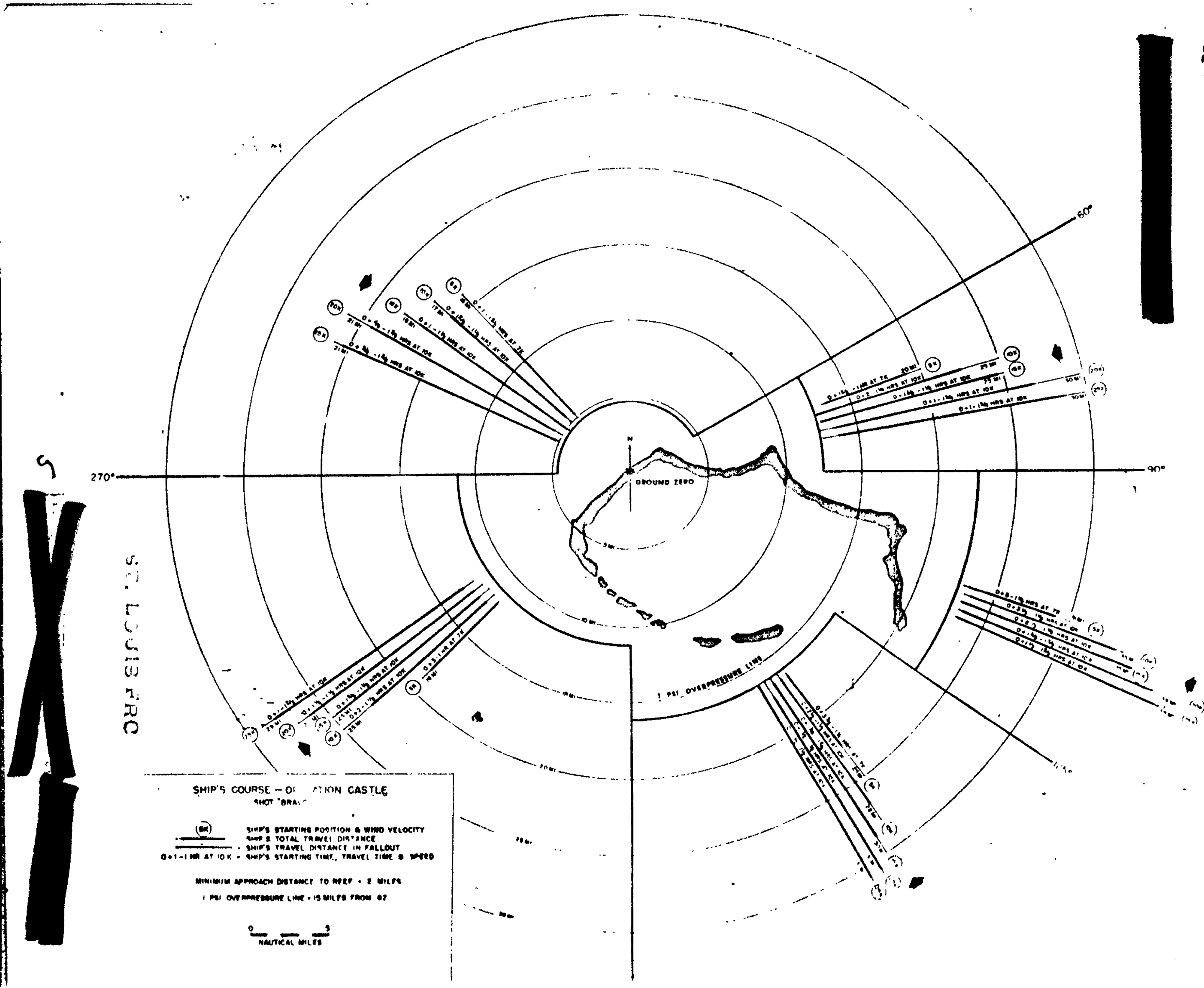

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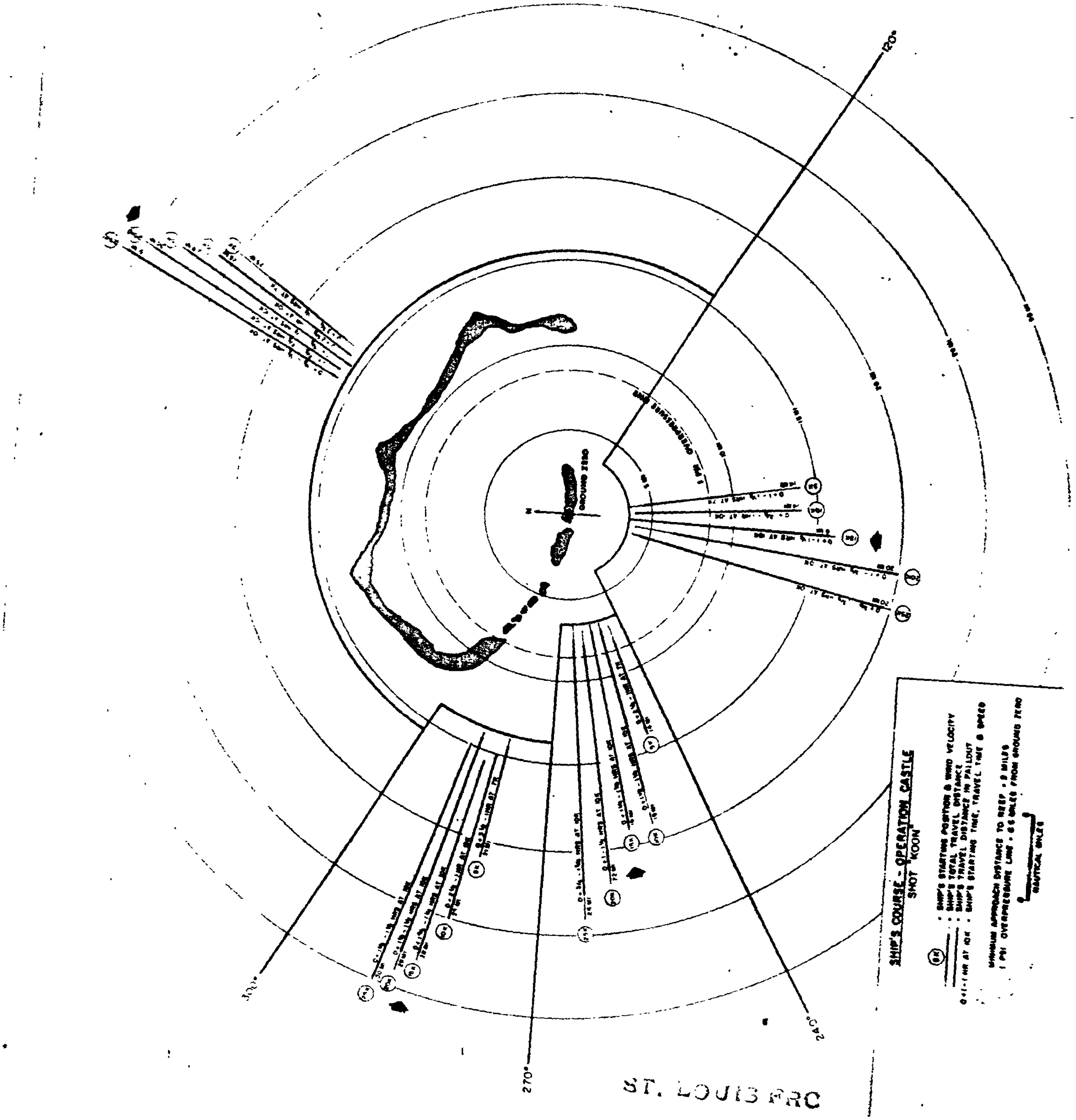

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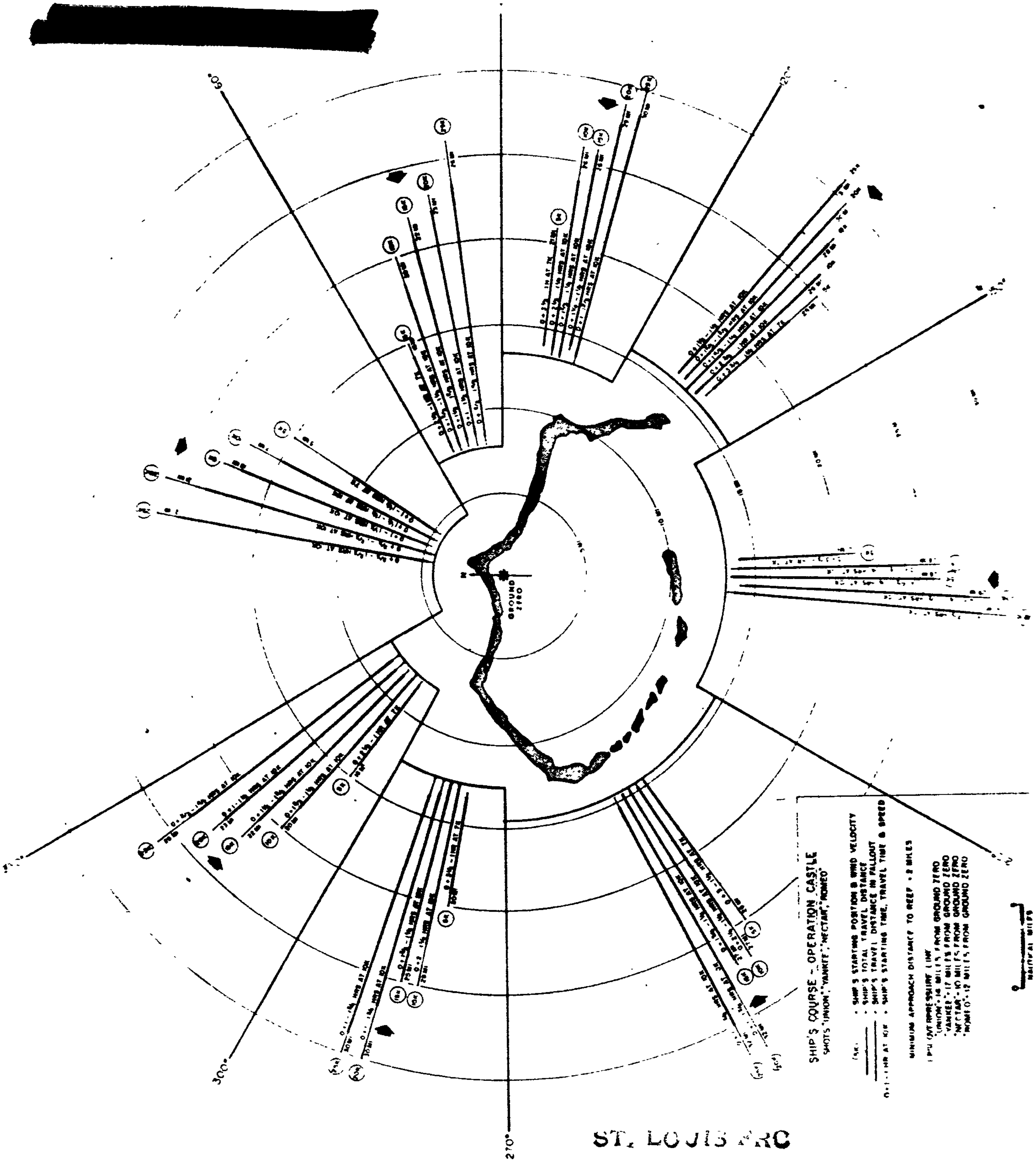

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