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A9-4(2) MONTHLY STATUS REPORT
PROJECT 2.2

HRE-0841

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MONTHLY STATUS REPORT

COVER SHEET

When sepe... from Inclosures this sheet may be downgraded to UNCLASSIFIED.

Date 1 February 1958

FINAL STATUS REPORT, No. 9

Project No. 2.2

Title of Project Shipboard Contamination Ingress (U)

Report for Period January 1st to February 1st, 1958

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Inclosures:*

X A—Experimental Plan
X B—Personnel and Housing Requirements
X C—Office Requirements
D—Communications Requirements
X Part 1—Communications, Telemetering and Radar Requirements
X Part 2—Timing Signal and Voice Count Down Requirements
X E—Vehicle Requirements
F—Sample Return Requirements
X Part 1—EPG to ZI
N/A Part 2—Inter Atoll
N/A G—Trailer Movement in EPG
X H—Photographic Requirements
X I—A Cargo Requirements
X Part 1—B Air Trans. Requirements
X Part 2—Surface Trans. Requirements
X J—Personnel and Clearance Data
X K—Shipboard Facilities
N/A L—Off-Atoll Requirements
X M—Rad Safe Re-entry Requirements
N/A N—Meteorological Requirements
N/A O—Technical Aircraft Requirements
X P—Rad Safe Monitors
N/A Q—Construction Changes Report
X R—Equipment Purchased with AFSWP Funds

*Indicate one of the following:

X—Inclosure submitted
NC—No change—means that inclosure remains the same as in previous report and is therefore not included
N/A—Inclosure are not applicable to project

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Project Officer's Signature Michael M. Bigger Date 7 Feb. 1958

Program Director's Signature ____________ Date ________

Director, Test Division ____________ Date ________

Comment of Program Director, and/or Director, Test Division, if any, will be attached following this page.

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INCLOSURE A
EXPERIMENTAL PLANNING SECTION

1. Experimental Plan.

A. Objectives.

To obtain data in selected interior compartments of one destroyer located within the dynamic radiological environment following two underwater nuclear detonations from which it may be possible:

(1) To estimate the external gamma radiation dose or dose rate in these compartments due to the ingress of contaminants;

(2) To determine whether an inhalation hazard exists in these compartments due to the ingress of contaminants via ventilation or combustion air systems;

(3) by means of measurements of particle-size distribution in several size ranges and activity associated with these size ranges:

(a) to attempt correlation between biological dosimetry (primary measurements for objective (2) above) and physical measurements;

and (b) to provide specific activity information for use in objective (1) above.

B. Background and Theory

Two underwater nuclear detonations were scheduled by the Navy to obtain data from which safe stand off distances for a weapon delivery ship (a destroyer) could be determined. Among the effects which must be considered in such a determination are the potential radiological hazards which may result from the ingress of contamination into the interior of a ship via ventilation and combustion air systems. While the scope of this project is too limited to provide information applicable to the complete region of interest, the data obtained may serve to indicate whether further contamination ingress studies are required.

A weapon delivery ship may be enveloped in the base surge or fallout following underwater detonation of the weapon. In this situation the ship is exposed to radiation from these external sources; and in addition the ingress of contamination (via ventilation and combustion air systems) may increase radiation intensities and create an inhalation hazard at some locations within the ship. The magnitude of these potential hazards is a function of (1) the mechanism of transport and deposition of airborne radioactive particles and (2) the physical, chemical and radiological properties of the particles. Quantative information is lacking on many of the parameters necessary to evaluate the magnitude of these potential hazards.

BuShips has had the requirement for a number of years to determine the need for countermeasures and to develop countermeasures if required.

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"This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The

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Studies made on the ventilation system for the after engine room of the USS Crittenden eighteen months after the Baker explosion at Operation CROSSROADS resulted in the conclusion that the ventilation system would have drawn in enough radioactive aerosol, with its associated beta and gamma radiation to immobilize and kill the occupants (Reference 1).

Based upon these conclusions further tests were conducted aboard the (CL-144) USS Worcester using a non-radioactive tracer (cobalt chloride) to: (1) trace an aerosol assumed to simulate that generated by a deep underwater explosion; and (2) determine the deposition characteristic of this tracer through an average boiler combustion air system and fireroom ventilation system (Reference 2). Similar laboratory tests (Reference 3) were conducted at USNRDL using models of typical ventilation air and boiler combustion air systems. It was found from these studies that large amounts of tracer were detected along the walls of the duct and at obstructions within the system.

Estimates of the radiation hazard associated with boiler operations on mobile ships exposed to the radioactive aerosol of an underwater atomic burst have been made (Reference 4). In this analysis which was primarily a theoretical study, an assumption was made that the amount of activity deposited along the combustion air ducts was negligible. One of the conclusions stated that external hazards will markedly increase if radioactive material is deposited in the combustion air passages.

Theoretical estimates were also made of the radiation hazard from a contaminated aerosol entering a ship's ventilation system (Reference 5). It was concluded that the degree of hazard varies with the condition of ventilation blowers (on or off) and with the amount of deposition of the aerosol. The condition of blowers off may lessen the external gamma dose but the potential contact beta hazard was considered to be a significant hazard in the ventilated space, in addition to the inconvenience presented by a contaminated room below deck. It was stated that if adoption of any countermeasures are considered they must be effective in counteracting the contact-beta hazard.

For ships at great ranges but nevertheless subjected to the fallout from the surface megaton shots at Operation CASTLE, tests were conducted on the ventilation and boiler air systems in an attempt to determine:

(1) the efficacy of countermeasures against the ingress of contaminants into the interior of the ships;

(2) the deposition characteristics of radioactive materials in the test systems;

(3) the existence of significant gamma radiation fields originating from ventilation and boiler air ducts.

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It was determined at Operation CASTLE that, for the specialized conditions studied, an average airborne activity concentration in the unprotected ventilation cubicles was on the order of 0.02 percent of the average weatherside concentration (Reference 6). The paper filter and the electrostatic precipitator ventilation protective devices reduced this value still further. It must be stated that the contaminating events encountered were basically different from the CROSSROADS BAKER Shot.

Correlation of results obtained from Operation CASTLE, Operation HARDTACK, or Operation CROSSROADS (BAKER) will be difficult because of the nature of the contaminating events.

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During the final decontamination phases of the YAGs 39 and 40 at SFNS after Operation CASTLE, it was noted that large amounts of contamination were located along the inner surfaces of the mushroom type ventilation openings. By the inherent nature of the basic design of these ventilation openings, particulate matter was centrifuged from the air streams. However, the magnitude of this effect is unknown. This effect might also be anticipated to exist at all types of air intakes where deposition may take place due to directional changes in air flow; e.g., air lift ventilation intakes and louvered boiler air intake openings.

While there is little doubt that acute biological injury resulting from exposure to airborne contamination from a nuclear detonation is predominantly due to external whole body irradiation, the internal radiation hazard associated with the accumulation of fission products within the body can be important in individuals that survive the initial period.

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Characterization of an inhalation hazard in terms of the physical properties of an aerosol alone does not allow for a biological interpretation of the data. For this reason and because of the difficulty in characterizing completely an aerosol in terms of its physical-chemical properties, the use of biological samplers in the form of small animals are used to provide an empirical method for assessing the inhalation hazard to man. Expressing the internal radiation hazard from inhaled particulate fallout in terms of airborne concentrations and exposure time does not indicate the internal radiation dose to the lungs and other tissues since only a fraction is retained by the respiratory system and this fraction varies in magnitude and in site of deposition with size and other physical-chemical properties of the inhaled particles. The ratio of effective tissue dose received by the respiratory system to the concentration of contaminant in inhaled air for man can be obtained by extrapolation from data collected on guinea pigs. For example, the same relation between atmospheric particulate concentration and deposition of particles has been found in the alveolar tissue of the lungs of both man and guinea pigs for particles of about 1 micron in diameter (Reference 7). This particle size is the most favorable for alveolar deposition in both man and guinea pig (approximately 50 percent deposition in both).

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The lack of complete physical characterization of the field situation makes the simulation of field conditions in the laboratory very difficult. The data required for laboratory inhalation hazard studies in any given situation include accurate measurement of the particle size, concentration, nature and spectrum of radioactivity of the fallout material. There are several field

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studies reported which attempted to delineate the internal radiation hazards from inhalation of fallout from nuclear detonations. (References 8, 9 and 10). In all these studies, the fallout was dry and largely insoluble. Further, in these situations, little or no physical characterization of the fallout material was performed.

In general, in these studies and in a theoretical calculation((Reference 11), it was found that the inhalation hazard was small compared with the concomitant external radiation hazard. There is no field data on the possible inhalation hazard associated with an underwater detonation as planned in this test operation. In the event of an underwater detonation, the inhalation hazard may be considerably greater because of the fluid nature of the contaminated water, base surge or fallout. Laboratory experiments indicate that moist particles are deposited in the respiratory tract and retained by the body to a greater extent than the same material when dry (Reference 12).

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The ingress contamination studies will be conducted aboard the USS Howorth, DD-592, which will be moored downwind from S.Z. Presently planned distances and 5500' for Wahoo and 3600' for Umbrella.

Ventilation systems normally supply large quantities of air to the interior of a ship but under battle conditions many vent fans are secured. The Navy has adopted the policy of stopping all vent fans under atomic attack conditions as a countermeasure to minimize the ingress of contamination. However, securing the fans in engine room and fireroom ventilation systems for any length of time can seriously impair habitability in these spaces due to high ambient temperatures.

In shipboard tests with fans stopped a variable and intermittent induced air flow ranging from 0 to 17 percent of normal air flow has been measured. This reduced air flow with correspondingly reduced velocities should decrease the quantity and particle sizes of the aerosol which the air streams can transport.

The ventilation systems and spaces that were instrumented on the DD 592 were selected as representative of the range of complexity and size of systems to be found aboard a destroyer and included vital machinery spaces and associated vent systems. In order to obtain a maximum and known air flow test condition simulating the "fans off" condition an exhaust fan was installed in each of the ventilation systems under test to induce 20 percent of normal air flow.

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No countermeasure has been adopted by the Navy to reduce the ingress of contamination via boiler combustion air systems. Boiler combustion air is confined to closed air passages and, except for boiler casing leakage, should not present an immediate inhalation hazard. However it might be necessary to enter the forced draft blower room, a section of the air passage, to perform maintenance checks on the blower. Because large volumes of air are involved, it is possible that contamination could be deposited along the air path in sufficient quantity to constitute a radiation hazard to personnel in the firerooms or adjacent compartments. On a weapon delivery ship it is probable that full power would be required and combustion air flow rates would be near maximum. Since the test ship was to be moored this condition could not be achieved during test.

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Instead full power air flow will be maintained through an unfired boiler. This test condition provides a suitable air flow rate but does not include normal heating and combustion effects along the air path. Air and surface temperatures will be lower than normal from the air entrance to the burner air registers. Beyond this point where combustion normally occurs the test conditions will be significantly different than in a fired boiler with respect to particulate transport and deposition.

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4. USNRDL Report TR-16. Personnel Radiation Hazards Incident to Ship Boiler Operation Following an Underwater Atomic Attack by J. D. Teresi, R. W. Shnider and H. P. Rinnert.

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12. Studies on the Metabolism of Inhaled Aerosols of Strontium and Lanthanum. S. H. Cohn, W. B. Lane, J. K. Gong, L. Weisbecker and W. L. Milne. USNRDL-TR-175, May 1957.

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14. USNRDL-TR-77. Uptake, Distribution and Retention of Fission Products in Tissues of Mice Exposed to a Simulant of Fallout from a Nuclear Detonation. I. Simulant of Fallout from a Detonation Under Sea Water. S. H. Cohn, W. B. Lane, et al.

15. USNRDL-TR-118. Radiotoxicity Resulting from Exposure to Fallout Simulant. S. H. Cohn, W. B. Lane, J. K. Gong, R. K. Fuller and W. L. Milne.

C. Theory.

Specific activity as determined by air sampling measurements will be applied to compartment and air passage volume to estimate their relative contributions to the total gamma field as measured by the GITR's in the test compartments. A similar application will be made using surface samples and compartment surface areas.

A check on these estimates will be made by comparing GITR measurements in closed compartments with those in ventilated compartments. Particle size distribution of the contaminated aerosol which enters the test systems and compartments is another physical measurement to be taken in order to assess the transport and deposition characteristics of the radioactive particulate matter.

This information should indicate the relative effectiveness of the systems under test to exclude contaminants in various particle size ranges and provide correlative information on the concentration of radioactive material available in the particle size range for inhalation.

Whether an inhalation hazard sufficient to warrant further study exists, can be approximated by measuring the uptake and retention of airborne radioactivity by the respiratory system of small animals. Assessment of the inhalation hazard from physical measurements alone is extremely difficult and requires knowledge of the biological factors involved.

While the evaluation of the internal radiation dose from inhaled radioactive contaminant, with any degree of precision is difficult, an approximation based on experimental data obtained from animal studies is feasible. (References 13, 14, 15). The dose delivered to the tissues by beta emitting fission products is estimated from the tissue concentration of the isotope mixture. In this study the gamma emitting fission products are used as a tracer for estimating the tissue concentration of the beta emitting fission products. Since the range of beta particles in tissue is confined largely to the organ containing the contaminant, calculation of the beta dose is essentially an estimate of the energy made available by the decay of a quantity of the isotope per gram tissue.

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The isotope concentration divided by an appropriate constant permits direct conversion to a unit of dose. The calculation of the dose is based on several assumptions. First, that the gamma activity of the contaminant per gram of tissue is assumed to reflect the beta activity when corrected for the ratio of beta particles to gamma photons in the fission product mixture at the time of the study. Secondly, it is assumed that the radioactive contaminant is evenly distributed in the organs. Calculation of the dose is also based on the assumption that the energy emitted in an organ is completely absorbed in that organ. The dimensions of the organs of guinea pigs are actually such that a considerable fraction of the more energetic beta particles may not be stopped in the organ. The organs in man, on the other hand, have dimensions sufficiently large as compared to the range of the beta particles to make valid the assumption of the equivalence of energy emission and absorption. Thus, by extrapolating the values of concentration and distribution as observed in the guinea pigs used in this study (based on the assumption of similar organ distribution and similar ratio of organ sizes in guinea pig and man) an estimate of the dose from inhaled material may be made in man.

An approximation of the dose rate to individual tissues can thus be determined by use of the following formula:

$$I_t = K \frac{Q}{W} E_B$$

where I_t = dose rate in rad/hr.

E_B = average energy of beta particles[14]

Q = Beta activity of each tissue in dpm (gamma activity will be measured and converted to beta activity on the basis of the ratio of gamma photons to beta particles at 1-4 days).[14]

W = weight of tissue in grams

K = constant factor converting Mev to ergs, erg/gm to rad, min to hrs, and gamma photons to beta particles, i.e.,
$= 1.15 \times 10^{-6}$

If the activity per gram of tissue is plotted as a function of time after exposure, the total dose received by each tissue during any time interval (for comparable energies) is proportional to the area under its curve.

D. Operations

Installation and final checks of all shipboard instrumentation on DD-592 will be made between WAHOO - 25 days until WAHOO - 4 days. Laboratory facilities on Parry Island will be setup for counting and animal dissecting work prior to WAHOO - 3 days.

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Two round trips daily from Parry Island to the DD-592 will be required for a maximum of ten men between WAHOO - 25 days until the target ship is moved to its final position in the target array. Regular scheduled boat runs (TG 7.3's transportation) will be utilized whenever feasible while the ship (DD-592) is moored off Parry Island. When the ship is moved to the target array, regular boat runs of the LSD and LCM will be used for the final placement of animals.

On WAHOO - 2 or 3 days, three Task Group personnel and two project men will be transported to the test ship using scheduled boat and ship runs for a familiarization course for sample recovery operations. These same three men should be permanently assigned to Project 2.2 for all sample recovery work.

Whenever radiological and daylight conditions permits, transportation from the LSD to the target ship is required for sample recovery. Total weight of samples is estimated at 1000# and a maximum of 6 test personnel and 3 Task Group personnel will recover these samples. The exposed animals must be sheltered from green seas while they are being returned to Parry Island.

In order to keep the radiation dosage of test personnel required to be aboard DD-592 prior to the second shot (UMBRELLA) for preparatory work, at a minimum, the target ship must be decontaminated between the period of WAHOO plus 1 or 2 days and UMBRELLA - 8 days.

While the test ship is being decontaminated by the Task Group, all samples from WAHOO will be processed and analyzed at Parry Island. Some samples and **live, highly** contaminated animals will be shipped to NRDL for chemical and decay studies.

On or about UMBRELLA - 8 days, the test personnel will begin preparing for the second shot by reinstalling and recalibrating all test equipment. The operational requirement for UMBRELLA will be similar to WAHOO.

E. Shot Participation

Participation is planned for the two Navy underwater shots, WAHOO and UMBRELLA, as this project part of the Navy program to determine safe standoff distances for weapon delivery ships for shots of this type. It is required that the target destroyer, DD 592, on which this projects operation are based, be moved within the region of dynamic radiological environments.

F. Instrumentation

(1) GITR (Gamma Intensity Time Recorder), (see Project 2.1 for details) will be installed in the test compartments and in similar compartments which are closed (non-ventilated) of the test destroyer. A GITR is a portable self-contained battery powered gamma radiation recorder. It consists of two packages; a recorder unit, and a detector unit which will be connected by a suitable cable so that the detector may be located at some distance from the recorder if desired.

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Each detector unit will consist of two concentric ionization chambers filtered to provide a nominally flat roentgen response in the 0.1 to 2 MEV gamma energy region. The nominal dose rate range for the detector units will be 15 mr/hr to 150,000 r/hr.

The pulses are recorded on magnetic tape and the recording time interval of 12 hrs will be provided by 900 ft of tape on standard 5 inch reels. The recorder shuts itself off automatically when the end of the tape is reached.

Figure 1 shows the location of GITR's in areas where nominal 20 percent of rated air flow passes through the ventilation systems. It also shows the GITR location in the AFTER FIREROOM.

An EG and G radio signal will actuate these GITR's.

(2) Incremental Air Samplers.

A total of 15 Incremental Air Samplers will be located on the target ship, DD-592 (see figure 1 for locations). An incremental air sampler consists of 3 major components. These are:

(a) One 1.5 cfm constant flow suction unit comprising of a GAST rotary vacuum pump Model 0321-V3-G18X, flow control valve, protective filter and trap, suction and control vacuum gages and a Minicorder suction recorder.

(b) Ledex solenoid operated indexing head which consists of a solenoid operated selector switch, manifolds and ten sampling ports.

(c) Ten Andersen sampler heads which consists of a series of four similar stages through which the aerosol sample is drawn. Each stage contains an impaction plate upon which the aerosol particles are collected by means of direct impingement. Immediately above the collection plate is a metal plate perforated with 340 equi-diameter holes through which the particle laden air is drawn producing jets of air against the collecting media where the particles may be deposited depending on their size, density and velocity. The air then passes over the edge of the collection media and into the next stage and so on through the other three stages. The diameter of the holes is constant for each stage, but decreases with each succeeding stage; as a result, the jet velocity from the one stage to the next increases accordingly. The increasing jet velocities produce a cascading effect which causes the particles to be collected on the various stages according to their size and density.

A Millipore filter has been added as the fifth stage to collect any particle which may slip past the four stages.

The ten heads are used to collect for various time increments in order to cover a total of 79 minutes. The first head samples for 14 minutes; the next 5 heads sample for 2 minute increments; the next head samples for 5 minutes, the next succeeding two heads sample for 10 minutes each and the last head samples for 30 minutes.

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Wall losses within the sampling head have been determined in laboratory tests to be approximately 4 percent of the total activity passing through the sampling head.

The suction unit and the Ledex Selector head is mounted on a shock mounted three tiered rack while the ten Andersen sampler heads are mounted on the top of the three tiered rack. The sampling heads only will be recovered after exposure.

In order to operate these sampling mechanisms as an incremental air sampling system, two timers, which have multi-cams operating from one synchronous motor, latching relays and power relay are installed in one control panel which remotely operates these 15 air samplers.

A flowrator and wet test meter is used to calibrate the air flow through the suction unit. One cfm through the Andersen sampler head must be the required flow rate in order that the data obtained can be compared with existing data.

An EG and G radio signal at H-15 for both shots will close the relay contacts which start the timers. Closing of a cam in the second timer at H+64 minute will unlatch the latching relay and stop the timers, which then stops the air samplers.

(3) Total Air Sampler Type A - This instrument utilizes the USNRDL 10 cfm constant Flow Suction Unit which was developed in Operation CASTLE and a sampling head. The sampling head will consist of an 8 inch diameter pre filter which will be either a Hollingsworth and Vose No. 70 filter or Mine Safety Appliance No. 1106 filter and an 8 inch diameter Millipore Membrane filter. An E.G. and G radio signal at H-15 min will start the timers and the timers will start these samplers at H-14 minutes and will operate continuously until H + 65 minutes. The timing mechanism used for the incremental air sampling system will operate the total air Sampler Type A for the 79 minute sampling period.

This instrument will be used to sample air at a higher rate than the Incremental Air Samplers and has been included in these tests as a backup in the event that the amount of activity detected by the Incremental Air Samplers is below the lower limit of the counting equipment. In the event that the Incremental Air Sampler heads show detectable amounts of activity and the samples from the four total Air Samplers are highly contaminated, these samples from the 10 cfm total Air Samplers will be shipped to NRDL for chemical analysis.

The 10 cfm suction units are located as shown in figure 1 with the sampling heads located near each animal station. One inch pipe connects the suction unit from the sampling head and 10 cfm flow rate through the sampling head will be regulated using an Air flow rate meter and the adjustable valve of the suction unit.

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(4) Total Air Sampler Type B - This will be a portable, 6 V battery powered GAST Model AD440 air sampler. A Zenith Process Recycling Timer which has a cycle of 15 minutes on 45 minutes off, will be utilized to operate this total Air Sampler to extend the battery capabilities for a longer period. A second latching relay connected to the unlatching side of the latching relay use for the Incremental Air Sampler will start the Zenith timer through its recycling operation. This sampler will start at H + 66 minutes and will sample air for 15 min periods each hour until the battery is expired or until recovery.

The collecting head will be a Millipore Membrane filter with a pre-filter of either HV-70 or MSA 1106 filter. It will be operated at 12 liters per minute. Data collected by this sampler and the total air sampler No. 1 will be processed to yield an average air concentration for two sampling periods which will cover the time period of H-14 minutes until recovered or until the battery will have expired. The fresh battery life under these operating conditions is approximately 24 hrs. Correlation of animal data will be attempted with the combined data of all three air samplers.

(5) Surface Samples

Salt water sensitive films will be placed on plates which can be removed from accessible locations of test compartments and will be used to determine activity per unit area. Material deposited on these films will be analyzed for activity per unit area and for sizing of the particle. Activity relationship with particle size will be attempted utilizing radioautograph films.

(6) Counting Apparatus

(a) Gamma Ray Spectrometer and a scintillation well counter - Model 1820 Nuclear Chicago Co. consists of a Model D35-5 scintillation detector (well counter), Nuclear Chicago and a recording spectrometer which consists of a radiation analyzer, Model 1820 Nuclear Chicago, a Model 1820 ratemeter, Nuclear Chicago and a Bristol Model 1 PH 560-51 Dynamaster recorder. This gamma ray spectrometer and scintillation detector will be located in the counting room of the Eniwetok Marine and Biology Laboratory, Parry Island. It will be calibrated using 3 sources, Cs^{137}, Sn^{113}, and Ce^{141}, each less than one (1) microcurie.

(b) Four Pi Ion Chamber - A 4 pi ionization chamber which utilizes a vibrating reed electrometer.

(c) Radiac Set AN/UDR-9 which consists of a radiac - computer indicator (CP-79/UD) radiac compute indicator (CP-71/UD) and a radiac detector (DT-40/UD).

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(7) Relative humidity and temperature measuring instruments. These are Bendix Friez Hygrothermo graphs which are capable of measuring temperatures from 10 - 110°F, 0 - 100 percent relative humidity. They will be located near all 4 animal stations and the data will be utilized to determine whether the animals, if dead, perished due to heat or excessive humidity conditions during the test run.

G. Description of Data to be Obtained During the Experiment.

This project will obtain the following data:

(1) Gamma intensity versus time recorded on tape (both dose and dose rate versus time) with its predicted reliability of 20 percent (See Project 2.1's status report). The data will be collected in ventilated compartments and in similar non ventilated compartments of the same ship. The data reduction equipment will be furnished and maintained by Project 2.3 and GITR maintenance and calibration by Project 2.1. This data from ventilated compartments is to be compared with data collected in non ventilated similar compartments in the same ship in an attempt to indicate whether the ingress of contaminated air causes an appreciable increase in gamma radiation.

(2) Air sampling data will be collected by radioactive assay of all filtering media and collection impaction plates of the Andersen sampler head. All the air samplers will be calibrated prior to sampling with respect to sampling rate and the total volume of air to be sampled per filter or collection head will be calculated with pre-determine time data. The total activity by this total volume of air sampled will yield the activity concentration at the time of counting. This value will have to be corrected for counting efficiencies and coincidence. The corrected value will then be corrected for decay to the mid time of sampling and to a common time base. The decay correction factor will be determined either by the theoretical decay formula or samples will be continuously assayed to obtain this decay correction factor. Decay factors obtained by any other project will also be considered. Once the samples are all converted to < common time base, comparison will be made for each compartment, location and with animal data.

Comparison will be made with the animal data in an attempt to correlate the data obtained from the mechanical samplers. The data will further be reduced by this project at NRDL to determine the chemical nature of the filtered or collected material and to determine the activity association with the collected particles.

Project 2.3's air filtration instrument (AF1) and located out of the washdown area above the Gun Director on the DD 592 will provide data of airborne contaminated debris around the test destroyer to aid in the interpretation of the contamination Ingress data by Project 2.2.

A randomly selected number of the collection plates of the Andersen Sampler head will be shipped to NRDL for further photo micrographic studies.

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MONTHLY STATUS REPORT
INCLOSURE A (Cont'd)
EXPERIMENTAL PLANNING SECTION

(3) Various tissues of the small animals (guinea pigs and mice) will be counted with a scintillation detector, radiation analyzer and ratemeter and the data will recorded on a single pen Bristol Dynamaster recorder.

The data obtained on the animal tissues will be applied as described in Section C, Theory, in an attempt to determine the dose to the individual tissues following an inhalation exposure. Mortality examination for pathology, hematological studies of tissues will be made.

In the event of significant internal deposition, some of the animals will be returned to NRDL for further observations.

In the event that all the animals perish during the shot, several items would have caused this. Some of these causes are excessive temperature and humidity, shock, thermal, etc. Shock and thermal effects data from other projects on the DD-592 will then be required to study these conditions. A temperature and humidity recorder located near each animal station will yield data from which it may be possible to deduce whether the small animals died from excessive temperature or humidity.

2. Present Status

A. Experimental and Theoretical Preparation of Test or Equipment.

Preliminary laboratory tests have been conducted to improve the sampling retention capabilities of the Andersen Sampler head. In modifying existing 4 stage Andersen Samplers which were utilized in bacterial aerosol studies, it was determined that the insertion of a Millipore filter after the 4th stage improves the sampling retention capacity. Wall losses within the sampler were kept to within 4 percent of the total activity detected with the improved Five stage Andersen sampler. The Sampling bias of the Andersen sampler in introducing the activity in the aerosol surrounding the sampler has not been studied due to the limited time prior to the tests.

The incremental air sampling system was tested for reproducibility of the time increments during any particular test run. It was determined that the sampling system did not vary more than 1 percent of the total sampling time.

Pressure drops through each Andersen Sampler as determined by laboratory tests vary significantly. Since the air flow through the Andersen Sampler must be maintained at 1 cfm in order to produce comparable data, this pressure variation was minimized by purchasing a suction unit which is designed to automatically regulate the air flow rate over a wide range of pressure change. The A.C. Schmidt 1.5 constant flow suction unit, which is essentially the same design as the USNRDL 10 cfm constant flow suction unit, except for the size and capacity has been installed ahead of the sampling head to maintain a instant 1 cfm regardless of the change in pressure drop caused by the Andersen Sampler and the Ledex solenoid selector head. Tests will have to be conducted on the suction units prior to the field installation.

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MONTHLY STATUS REPORT
INCLOSURE A (Cont'd)
EXPERIMENTAL PLANNING SECTION

B. Submission of Construction Requirements.

The animal dissecting work will be conducted at the Eniwetok Marine and Biology Laboratory. Permission for use of this space by the project has been received. Animal tissue counting will also be performed in the Eniwetok Marine and Biology Laboratory.

The two animal housing facilities must be located adjacent to the Eniwetok Marine and Biology Laboratory. Power requirements for the two animal housing facilities are 110 VAC for lighting and 208 VAC, 3 phase for the air conditioner. Each air conditioner draws 65 amperes on starting and the normal load is 14 amperes. A Russell and Stoll No. 8418 plug at the end of a 75' cable will be attached to each transportainer. The refrigerant used by these air conditioners is Freon 12.

The project will install all other counting equipment in Room 3, Building 465. In addition, bench space in this room will be utilized for maintaining the electrical components of the air samplers.

Tent No. 355 will be utilized as the Project's storage and workshop for the mechanical components of the air samplers.

C. Special Contract Negotiations, Manufacture and Delivery Schedules.

Two standard instrument shelters are being converted into animal housing facilities. One of the shelters will be a pre-exposure animal holding facility and the second shelter will be used to house exposed animals prior to sacrificing. The housings were completed on 17 January 1958 and the air conditioners were tested for one week.

The 17 1.5 cfm constant flow suction units were received. Tests have been started on these units and will be completed prior to 5 February 1958. Installation of these units at Long Beach Naval Shipyard on the DD-592 is scheduled for the first 2 weeks in February 1958.

D. Due to the late delivery of many items required, the final shipboard installation of the air sampling system and checkout of instruments will be accomplished during the final two week availability period during February.

3. Special Items.

The project requires 3 Task Group personnel for assistance in recovering all samples on D day or D+1 day following WAHOO and UMBRELLA.

It is requested that 10 gallons of fresh water, two crates of oranges and one crate of lettuce be made available at Hickam Field for the animals which are being air shipped to EPG. An animal keeper will accompany the animals to the test site. Periodic supply of fresh lettuce and oranges for the animal will be required at the EPG. This type food will be used to supplement the vitamin C requirement of animals.

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MONTHLY STATUS REPORT
INCLOSURE A (Cont'd)
EXPERIMENTAL PLANNING SECTION

Care in shipping the transportainer will be required since the evaporator unit is over hanging and the unit protrudes approximately 3 ft over the top of the standard instrument shelter.

Assistance in checking out the air conditioning units attached to the two animal housing units will be required at the EPG. The project intends to bring spare part but any damage to the basic units in transit will have to be repaired by the contractor at EPG.

Certification of monitors by USNRDL will be submitted by separate correspondence following the training period scheduled to start 17 March 1958. Since the last status report comments disclosed that this project would have only one 3/4 ton truck instead of the two previously indicated, the project has shipped one (1) 1/4 ton jeep to Elmer for project use. It is required that maintenance for this jeep be made available at Elmer during the period of 6 April through 12 July 1958.

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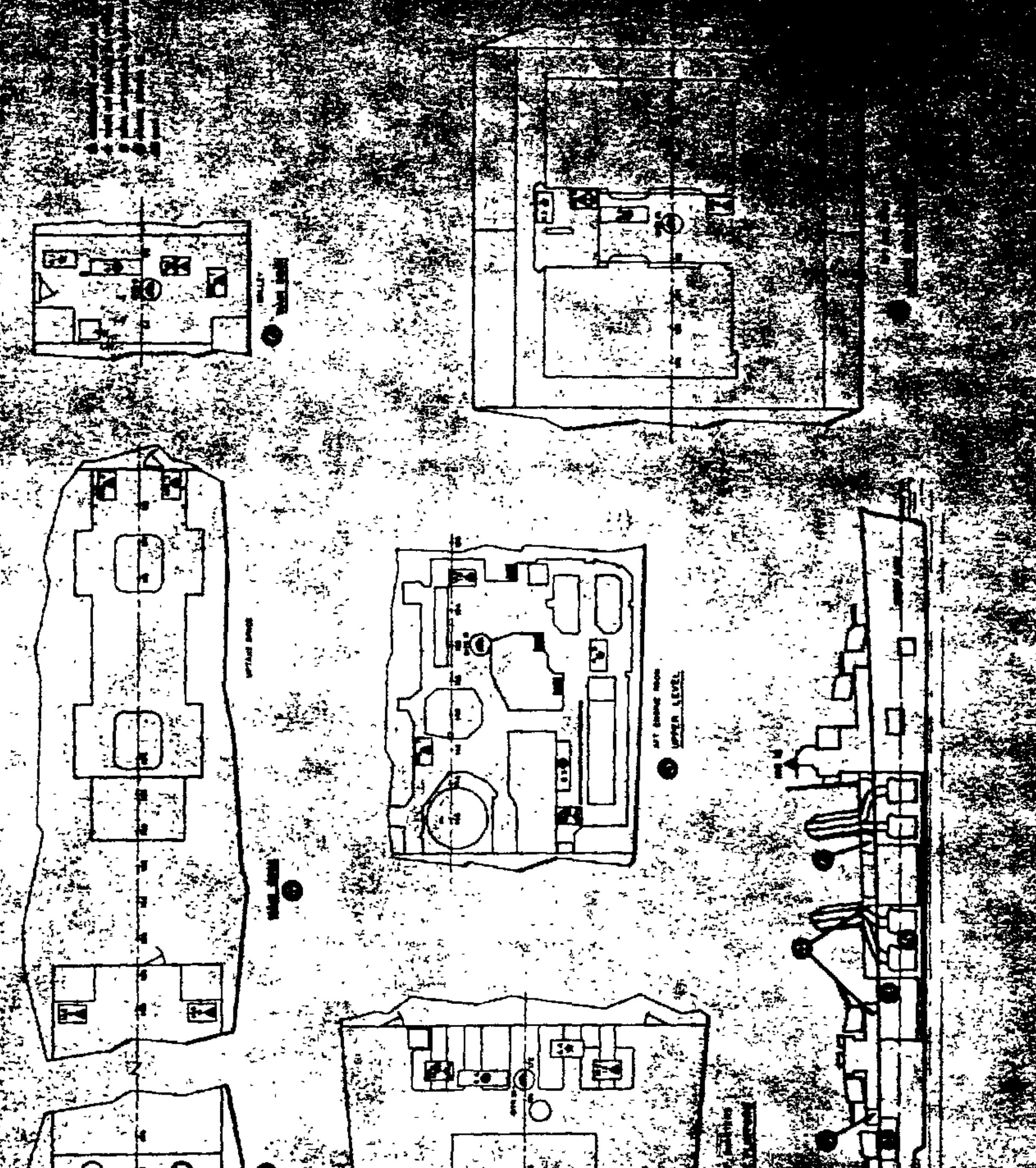
FIG. 1



ANNEX (1) TO INCL. A, PROJ. 2.2

STATUS REPORT NO. 9

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14. VERIFIED BY: Michael M. Bigger
Signature of Project Officer

MONTHLY STATUS REPORT

INCLOSURE J

PERSONNEL AND CLEARANCE DATA

Project No. 2.2
Report No. 9
Date 1 February 1958

1	2	3	4			5	6	7	8				9	10		11
			MILITARY CLEARANCE						Badge Information							
LINE No.	COMPLETE NAME LAST, FIRST AND MIDDLE. Use (NMN) for no middle name and (IO) for initial only.	MILITARY: Grade and Service No. CIVILIAN: GS No. or Contractor	DEGREE	DATE GRANTED	HQ GRANTING CLEARANCE	DATE OF BIRTH	PLACE OF BIRTH	U. S. CITIZEN	OFFICIAL PHOTOGRAPHER	PHOTO HANDLER	BINOCULARS REQUIRED	ACCESS AREA No.	SIGMA CAT	INCLUSIVE DATES THE PERSON WILL BE PRESENT AT THE ENIWETOK PROVING GROUNDS	Travis	Planned Date of Departure by MATS From Hickam
1	Bigger, Michael Motter (PROJECT OFFICER)	Civilian GS-13	S	6 Jun 50	USNRDL	9 Nov 11	Sp. Garden Township, Pa	yes				Areas 2 and 3 for all personnel.	4	4/12-7/12	4/8	4/10
2	Brownell, Malcolm Herbert	Civilian GS-11 eq.	S	29 Jun 52	USNRDL	14 Jun 16	New Bedford, Mass.	yes					4	4/27-7/12	4/23	4/25
3	Chan, James Bruce	Civilian GS-11 eq.	S	15 Jan 57	USNRDL	9 Aug 26	Denver, Colo.	yes					4	4/20-7/12	4/16	4/18
4	Dabney, Robert Faulkner	HM-3, USN 481-24-61	S	2 Dec 57	USNRDL	13 Nov 37	San Antonio, Texas	yes					4	4/29-7/12	4/27	4/28
5	Fuller, Ross Kennedy	Civilian GS-11	S	31 Oct 51	USNRDL	17 Mar 28	San Louis Obispo, Cal.	yes	x	x			4	4/20-7/12	4/16	4/18
6	Gong, Joseph Kwock (DEPUTY PROJ OFCR FOR ANIMAL DOSIMETRY)	Civilian GS-11	S	29 Sep 52	USNRDL	13 Dec 25	San Francisco, Calif.	yes					4	4/27-7/12	4/23	4/25
7	Guay, Alfred John	Civilian GS-9 eq.	S	30 Nov 50	USNRDL	15 Sep 16	Butte, Mont.	yes					4	4/20-7/12	4/16	4/18
8	Hawkins, Myron B (IO)	Civilian GS-14	TS	1 Apr 54	USNRDL	8 May 20	Indianapolis Indiana	yes					4	5/11-7/7	5/7	5/9
9	Jenks, Albert LeRoy, Jr.	LT USN 521565	S	25 Jul 57	USNRDL	27 Jun 26	Chicago, Ill.	yes					4	5/7- 7/12	5/3	5/5

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14. VERIFIED BY: Michael M. Biggel (Signature of Project Officer)

MONTHLY STATUS REPORT

INCLOSURE J

PERSONNEL AND CLEARANCE DATA

(Continued)

Project No. 2.2
Report No. 9
Date 1 February 1958

1	2	3	4			5	6	7	8				9	10		11
			MILITARY CLEARANCE						Badge Information							
LINE No.	COMPLETE NAME LAST, FIRST AND MIDDLE. Use (NMN) for no middle name and (IO) for initial only.	MILITARY: Grade and Service No. CIVILIAN: GS No. or Contractor	DEGREE	DATE GRANTED	HQ GRANTING CLEARANCE	DATE OF BIRTH	PLACE OF BIRTH	U.S. CITIZEN	OFFICIAL PHOTOGRAPHER	PHOTO HANDLER	BINOCULARS REQUIRED	ACCESS AREA No.	SIGMA CAT	INCLUSIVE DATES THE PERSON WILL BE PRESENT AT THE ENIWETOK PROVING GROUNDS	Travis	Planned Date of Departure by MATS From Hickam
10	Kawahara, Francis Kanji (ASST PROJ OFCR)	Civilian GS-11	S	16 Apr 51	USNRDL	3 Dec 21	Palo Alto, Calif.	yes				Areas 2 and 3 for all personnel.	4	4/20-7/..	4/16	4/18
11	Milne, Walter Leroy	Civilian GS-11	S	26 Jun 52	USNRDL	29 Aug 25	Santa Rosa, Calif.	yes					4	4/27-7/1	4/23	4/25
12	Tompkins, Edward Raymond (NRDL MGMT BILLET)*	Civilian GS-15	TS	1 Apr 54	USNRDL	7 Apr 08	Winterset, Iowa	yes			x		1,4	5/14-6/..	5/10	5/12
13	Will, Robert Campbell	LCDR USN 230123	S	23 May 57	USNRDL	1 July 15	Hillsboro, Oregon	yes					4	4/27-7/1.	4/23	4/25
	Emergency Alternates															
14	Abramo, Antone Joseph	Civilian GS-10 eq.	S	4 Oct 51	USNRDL	6 Apr 20	Augusta, Sicily, Italy	yes					4	- -	-	-
15	Vandivert, Verl Vane	Civilian GS-12	S	9 Jan 50	USNRDL	30 Sep 21	Bethany, Mo.	yes					4	- -	-	-

11. MAXIMUM NUMBER OF PERSONNEL TO BE AT THE SITE AT ONE TIME

OFFICER 2
ENLISTED MEN 1
CIVILIAN 10
TOTAL 13

12. I HEREBY CERTIFY THAT THOSE PERSONNEL LISTED IN SECTION "A" OF THIS REPORT AS HAVING BEEN GRANTED MILITARY CLEARANCES AS INDICATED REQUIRE ACCESS TO RESTRICTED DATA IN THE PERFORMANCE OF THEIR RESPECTIVE OFFICIAL DUTIES AND THAT THEIR ACCESS TO RESTRICTED DATA WILL NOT ENDANGER THE NATIONAL SECURITY.

R. E. HARRIS
Tech-Admin. Dir.
By direction

R. E. Harris

13. I HEREBY CERTIFY THAT THE C... ANCE INFORMATION LISTED IN THIS DOCUMENT FOR THE ABOVE LISTED PERSONNEL ... URRENT AND CORRECT.

M. K. Romann
(Signature of Security Officer)

* For further information see NRDL ltr 901-686 of 9 Jan 1958 to FC, AFSWP

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Project No. 2.2
Report No. 9
Date: 1 February 1958

MONTHLY STATUS REPORT
ENCLOSURE K

SHIPBOARD FACILITIES

1. Summary of Requirements:

Middle Destroyer (DD-592) of Target Array for Wahoo and Umbrella.

2. Purpose:

The Navy has assigned destroyers for these tests. Project funding limits the installation of instruments to one destroyer only, and since the DD-592 has been selected as the middle ship of the target array for both Wahoo and Umbrella, this destroyer has been specified for Project 2.2 studies. This location insures that the test ship will be in significant radiological environment and still survive the blast and thermal effects.

3. Operations Summary:

a. Shot participation. Wahoo and Umbrella.

b. Time it will be utilized. 15 April - 12 July, 1958

c. Location and movements required. DD-592 must be located near Elmer until D-2 or 3 days prior to the event for easy accessibility for installation, calibration of instruments and checking of animal cages.

4. Activity to finance installations:

BuShips' circular requirements for test ship conversion include most of the modifications required for these tests. These modifications are to be financed by BuShips. Instrument installations are to be funded by the Project with AFSWP funds.

Total funds authorized by three NPW's sent to Long Beach Naval Shipyard from NRDL is $105,845.00. Project 2.2 is chargeable for $25,000.00 of the total. The NPW's sent to Long Beach Naval Shipyard are:

62479-75-02762(75)-60258
62479-45-08197(85)-60258
62479-75-08347(85)-60258

5. Long Beach Naval Shipyard will install all project instrumentation. Final checkout and installation will be completed during the month of February 1958.

6. The Task Force will maintain and operate required services on the DD-592 while Project 2.2 will maintain all test equipment. This project will not be responsible for final rollup and rehabilitation other than the removal of test equipment.

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MONTHLY STATUS REPORT
INCLOSURE K (CONT'D)
SHIPBOARD FACILITIES

7. Maintenance Requirements

Electrical power to all test equipment must be available before and during test periods. Lighting in test compartments, laboratory spaces and corridors is required until H-12 hours. Fresh water services is required until H-12 hours. All test fans must operate before and during test periods.

The test compartments must be relatively clean at all times. It is required that the Task Force decontaminate the test compartments after the first shot in preparation for the second shot.

8. Other Specifications:

a. Power Requirements

	Estimated Wattage
(1) Power to pump and motor for instrumentation and animal cooling (110VAC, 1 HP)	800
(2) Power to 15 Incremental Air Samplers (115VAC, 1/2 HP motor each)	6000
(3) 4 total Air Samplers No. 1 (3/4 HP each, 115 VAC)	2250
(4) Timers for 4 Total Air Sampler No. 2 (110VAC)	40
(5) Power to exhaust fans from galley, aft engineroom, aft fireroom and aft crew's berthing (440V AC, 1 HP)	5000

b. Ventilation, humidity control or air conditioning requirements:

(1) Ventilation (nominal 20 percent of rated air flow) is required in the three test compartments (crew's berthing, galley and after engine room).

c. Security requirements:

(1) There are no special security requirements.

d. Utilities required othen than power:

(1) Fresh cold water outlets are required on the ship, during pre-test work.

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Project No. 2.2
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MONTHLY STATUS REPORT
ENCLOSURE K (CONT'D)

SHIPBOARD FACILITIES

9. Personnel to be aboard:

No accommodations required.

10. Radio communication from DD 592 to Building 464 is required from 20 April to 12 July 1958. Sound powered intercom system on the DD-592 must be reactivated.

A EG and G radio signal at H-15 minute is required to activate sampling equipment for the two shots, Wahoo and Umbrella.

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MONTHLY STATUS REPORT

INCLOSURE M

RAD SAFE RE-ENTRY REQUIREMENTS

Project No. 2.2
Report No. 9
Date 1 February 1958

EVENT	STATION LOCATION	TIME ENTRY	TIME DEPARTURE	No. OF PERSONNEL	WEIGHT OF EQUIPMENT	TRANSPORTATION REQUIREMENTS	REMARKS
Wahoo	DD-592 Eniwetok	W-18 hrs	W-16 hrs	3	100#	LCM	Final Placement of Animals
Umbrella	DD-592 Eniwetok	U-18 hrs	U-16 hrs	3	100"	LCM	Final Placement of Animals
Wahoo and Umbrella	DD-592 Eniwetok	H+6 hrs	H+8 hrs	9	1000"	LCM	Sample recovery. Monitor to be provided by project.

Covered LCM is suggested for more adequate protection of animals in transport from test ship to LSD.

The entry to the DD-592 at Wahoo - 18 hrs does not involve any Rad-Safe problem.

As per instruction sheets for Inclosure M, the purpose intended is to specify that a special transportation or reentry requirement exists even though no Rad-Safe problem will exist at the station.

"This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law."

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MONTHLY STATUS REPORT

INCLOSURE P

RADIOLOGICAL SAFETY MONITOR

Project No. 2.2
Report No. 9
Date 1 February 1958

1. Qualified Rad-Safety monitors recommended by project officer.

1 Name	2 Rank	3 Serial or File No.	4 Training & Experience as Monitor	5 Custodian of Medical Records

2. Personnel not qualified but desired to be trained as monitors.

Name	Rank	Serial or File No.	6 Unit & Station	7 Custodian of Medical Records
M. M. Bigger	GS-13		USNRDL	USNRDL (Attn: Code 730)
F. K. Kawahara	GS-11		"	"
R. K. Fuller	GS-11		"	"
W. L. Milne	GS-11		"	"
J. K. Gong	GS-11		"	"
A. L. Guay	GS-9		"	"
M. B Hawkins	GS-14		"	"
L. H. Brownell	GS-11		"	"
J. B. Chan	GS-9		"	"
A. L. Jonks	LT USN	5?1565	"	"
R. F. Dabney	HM-3	[illegible]	"	"
V. V. Vendivert	GS-12		"	"
A. A. Alcamo	GS-9		"	"
R. C. Will	LCDR USN	230123	"	"

NOTE: Certification of monitors by USNRDL will be submitted by separate correspondence following the training period scheduled to start 17 March 1958.

3. Project officer's estimate of total number of monitors to be required for this project 14