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POR-2032
(WT-2052)

OPERATION DOMINIC

FISH BOWL SERIES

PROJECT OFFICERS REPORT — PROJECT 2.3

ALPHA CONTAMINATION MONITORING (U)

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ABSTRACT

This project was conducted to determine the alpha hazard existing in the vicinity of the missile launch pad following the destruction of a missile-mounted warhead.

Two systems of instrumentation, one for gross alpha contamination measurement and the other for plutonium particle collection, were used to accomplish this objective. The equipment and instruments used for gross alpha contamination were: (1) broom-finished concrete pads, (2) high-volume air samplers, (3) cyclone air samplers, and (4) cellulose-acetate sticky paper. Four-stage cascade impactors and resin-coated microscope slides were used for plutonium particle collection.

Because all warhead-carrying missiles were properly launched after Project 2.3 was approved, no alpha contamination data was obtained.

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CHAPTER 1

INTRODUCTION

1.1 OBJECTIVES

The objective of the project was to determine the alpha hazard existing in the vicinity of the missile launching pad following the destruction of a missile-mounted warhead.

1.2 BACKGROUND

Although nuclear weapons are designed to prevent a nuclear yield in the event of accidental detonation, there are definite hazards associated with the component parts of the weapon. The two components of a nuclear weapon that constitute the greatest danger in case of accident are plutonium and high explosives. Other components of the warhead may produce hazards, but they are of such a nature that precautions taken against the hazards of plutonium and explosives are more than sufficient for their control.

During the Blue Gill Prime Event, a Thor missile with a nuclear warhead was destroyed on the launching pad, causing an extremely high concentration of plutonium on and immediately surrounding the launching pad (see Appendix). Because of the possibility of similar incidents occurring, Project 2.3

was initiated to determine the concentration of plutonium in the immediate vicinity after the destruction of a warhead.

As of the date of this report, no scientific experimentation has been pursued in this field. The only recorded data, as such, has been through accident monitoring which is part of normal safety procedures. This data was rendered ineffective, because the surfaces monitored were not homogeneous, and the monitoring teams were concerned only with the detection and not with the quantitative measurement of alpha radiation. Since the attenuation factors of concrete and filter paper were known, they were used during the entire project to provide accurate and valid information on alpha concentrations.

CHAPTER 2

PROCEDURE

2.1 OPERATIONS

This project was planned initially to have four arcs of samplers down-wind from the launching site to determine the amount of plutonium contamination as well as the particle size distribution. Three of these arcs were unmanned land-station types. The fourth was to be mobile sampling station consisting of two runabout boats equipped with various types of sampling equipment. However, safety considerations made the mobile sampling station unsuitable, and raft emplacements were used as the fourth down-wind arc. Six rafts were constructed and equipped with project instruments powered by 110-VAC generators. The rafts were towed approximately ½ mile down-wind of the particular launching pad and anchored securely to ensure proper orientation of the raft with the pad. Operations were then set up for the following events: Blue Gill Double Prime (Thor missile), Check Mate (X33 missile), Blue Gill Triple Prime (Thor missile), King Fish (Thor missile), and Tight Rope (Nike-Hercules missile).

2.2 INSTRUMENTATION

2.2.1 General Instrumentation. Instrumentation for all

events consisted of two systems. One system was used to measure the gross plutonium contamination, and the other was used to collect plutonium for particle-size analysis.

The system for gross plutonium contamination consisted of four industrial methods of collection. These methods and the equipment used were (1) 12- by 6-inch concrete blocks, used as monitoring pads (Figure 2.1), (2) Staplex high-volume air samplers, employed to collect gross air contamination samples, (3) cyclone air samplers, also used to collect gross air samples (Figure 2.2), and (4) cellulose-acetate sticky paper mounted on 12- by 12-inch plywood boards, employed for gross alpha contamination and particle size and frequency determinations.

The concrete blocks were to be monitored with PAC/1S alpha instruments at 12 and 24 hours subsequent to the warhead destruction. These monitoring instruments were portable, battery-operated, alpha detecting and measuring devices manufactured by the Eberline Instrument Corporation, Santa Fe, New Mexico. The detecting element, a scintillation-type probe with a sensitive area of 59 cm^2, was calibrated to yield a meter reading of the counts per minute

of alpha radiation under the probe. Four reading scales with ranges from 0 to 2,000, 0 to 20,000, 0 to 200,000, and 0 to 2,000,000 were used. Each scale was corrected for 50-percent geometry deflection for distributed plutonium-239. Provisions are made for aural monitoring. A phone jack and Clevite headset (Model BA-201) were provided with the instrument for aural monitoring.

The Staplex units used for this project were Model TFA 110 VAC, manufactured by The Staplex Company, Brooklyn, New York. These air samplers, equipped with 4-inch heads and Watman's No. 41 filter paper, allowed an air flow of 30 cfm. The filter paper, 10.5 cm in diameter, was manufactured by W. and R. Balston Ltd, England.

The cyclone air samplers, each comprised of a Leiman air pump, a cyclone sampler, and a filter holder assembly, were obtained on loan from the New York Operations Office of the U. S. Atomic Energy Commission.

For the determination of the plutonium particle size, two methods of collection were established. Casella cascade impactors, using silicon resin-coated slides as collection plates, were employed to gather and separate particles (Figure 2.3). A cascade impactor is an air sampling device consisting of high velocity jets in series,

with each jet directing the air against a collection plate at a progressively higher velocity. As a result, each stage is capable of collecting smaller particles than the preceding stage. The final stage consisted of a millipore filter, Type AA, 29 mm in diameter, with a pore size of 0.80 micron. With the filter paper following the impaction stages, all the dust in the sample could be collected, and the fraction of the dust could be determined accurately. Each impactor was operated by a 110-VAC vacuum pump, which was calibrated at an air flow of 17.5 liter/min.

Microscope slides, coated with Dow Corning 200 fluid having a viscosity of 60,000 cs, were used for passive particle collection.

All electrical equipment (Staplex units, cyclone samplers, and cascade impactors) were activated by Edgerton, Germeshausen and Grier (EG&G) time barrels at 60 seconds prior to lift-off (Figure 2.4). The four-stage cascade impactors were operated for 5 minutes after lift-off, and the Staplex units and cyclone samplers were operated for 30 minutes after lift-off.

2.2.2 Instrumentation of Thor Pads. Thor rockets were utilized to transport the warheads for the Blue Gill Double Prime, the Blue Gill Triple Prime, and the King Fish Events.

The sampling array for the Thor launching pads consisted of three land arcs and one arc of raft emplacements. The land arcs were composed of 88 concrete monitoring pads, 44 microscope slides coated with silicon resin, 4 horizontal and 4 vertical sticky-paper samplers, and 4 Staplex air samplers (Figures 2.5 and 2.6).

Six unmanned rafts, anchored approximately ½ mile downwind from the launch pad, made up the water arc (Figures 2.7 and 2.8). Each raft was equipped with one cyclone air sampler, two concrete blocks, two silicon-coated microscope slides, one Staplex air sampler, and one sticky-paper sampler (Figures 2.9 and 2.10).

2.2.3 Instrumentation of Small Rocket Launch Pads.

Two land arcs and one arc of raft emplacements comprised the sampling array for the Nike-Hercules missile (Tight Rope Event), and the XM-33 missile (Check Mate Event). The land arcs consisted of 39 concrete monitoring pads and 39 microscope slides (Figure 2.11). The same equipment as that used for the Thor missile launchings was used at the overwater sampling sites. The rafts were emplaced approximately ½ mile down wind of the launching pads (Figure 2.12).

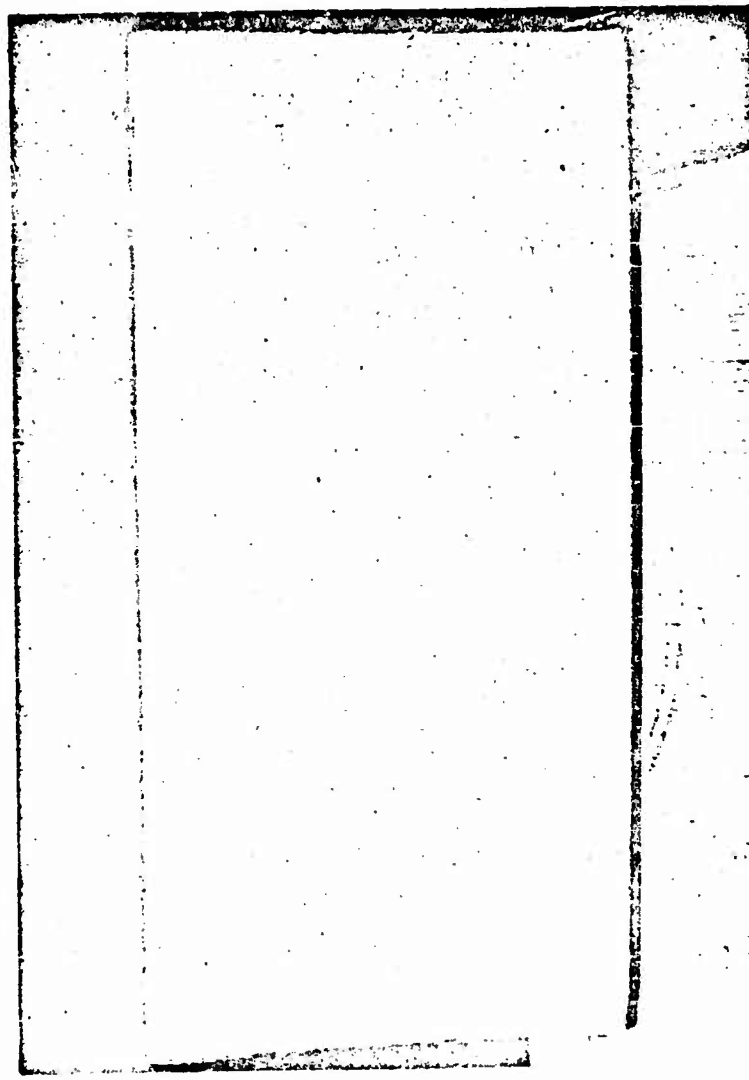


Figure 2.1 Concrete monitoring block. (DASA 6881)

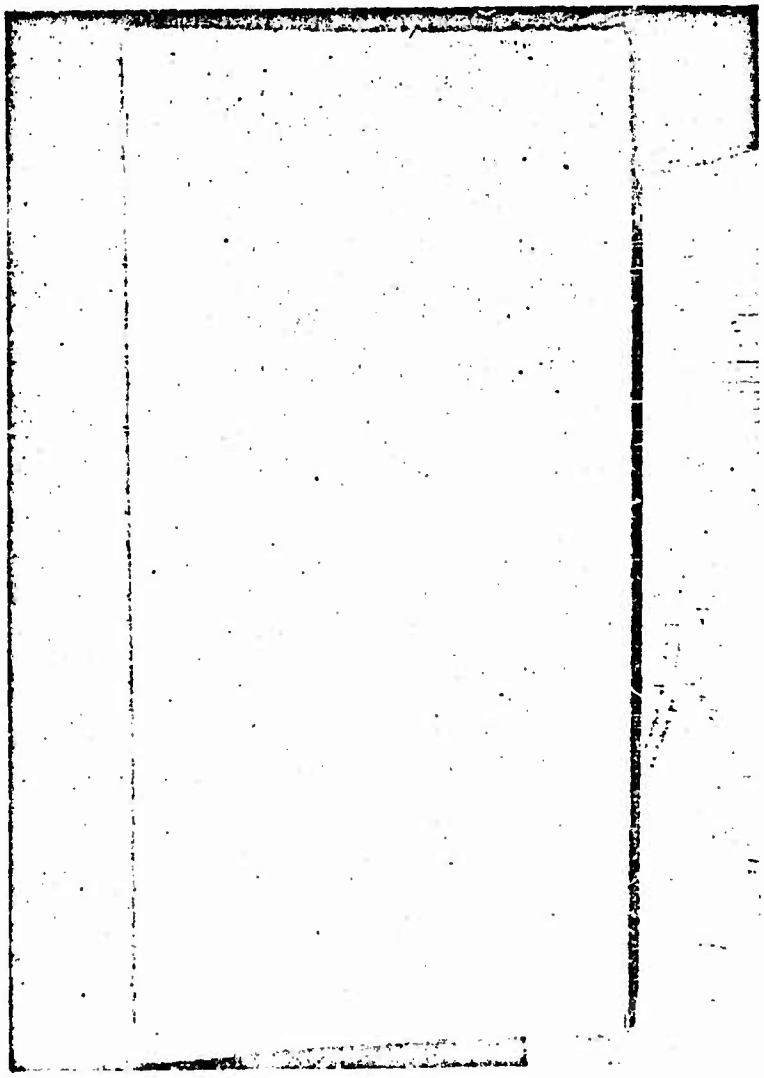
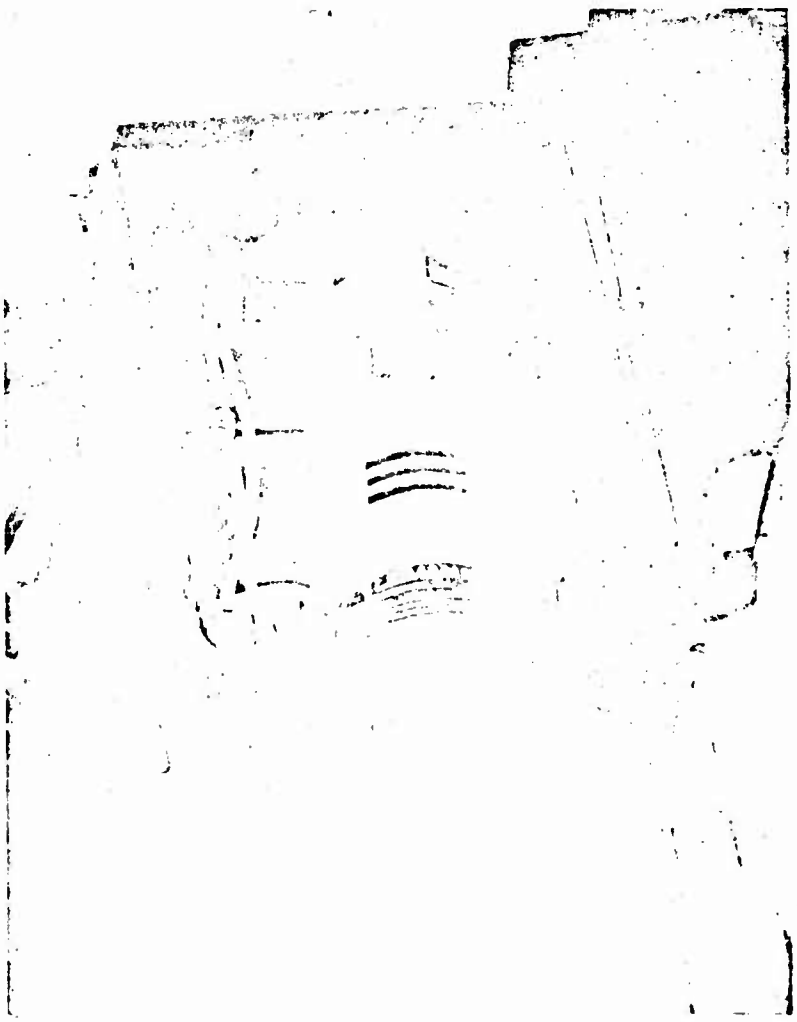


Figure 2.1 Concrete monitoring block. (DASA 6881)



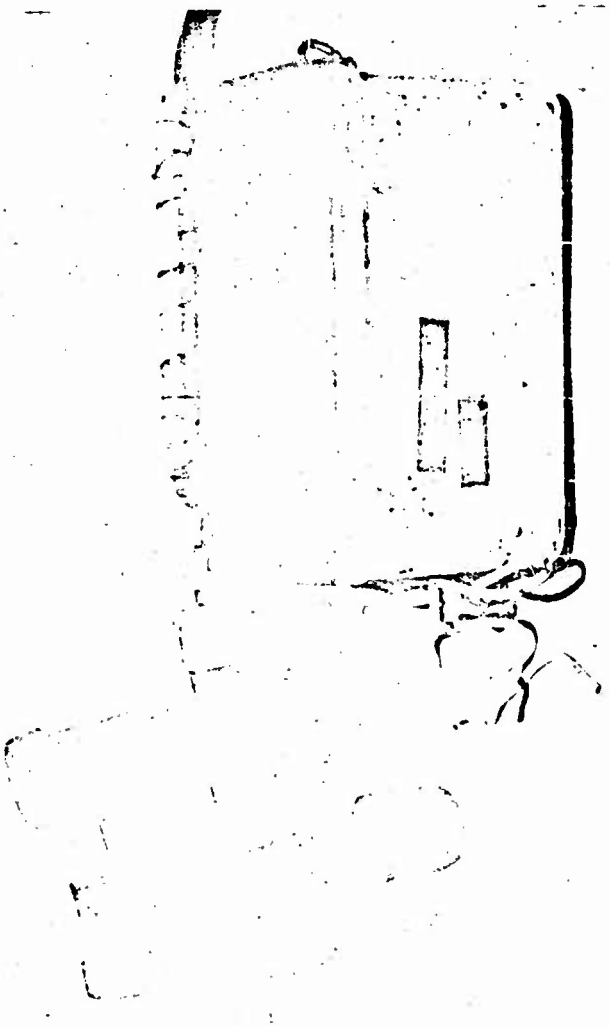


Figure 2.3 Cascade Impactor. (DASA 6880)

Figure 2.4 EG&G tone barrel. (DASA photo)

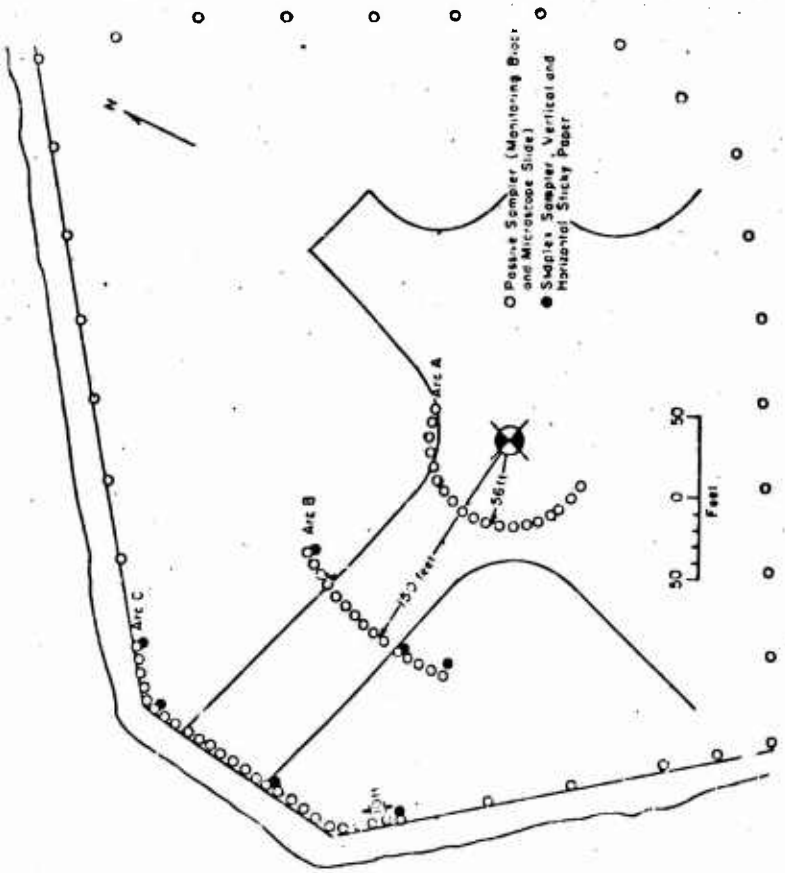


Figure 2.3 Land layout for Blue Gill Double Prime and Sting Fish.

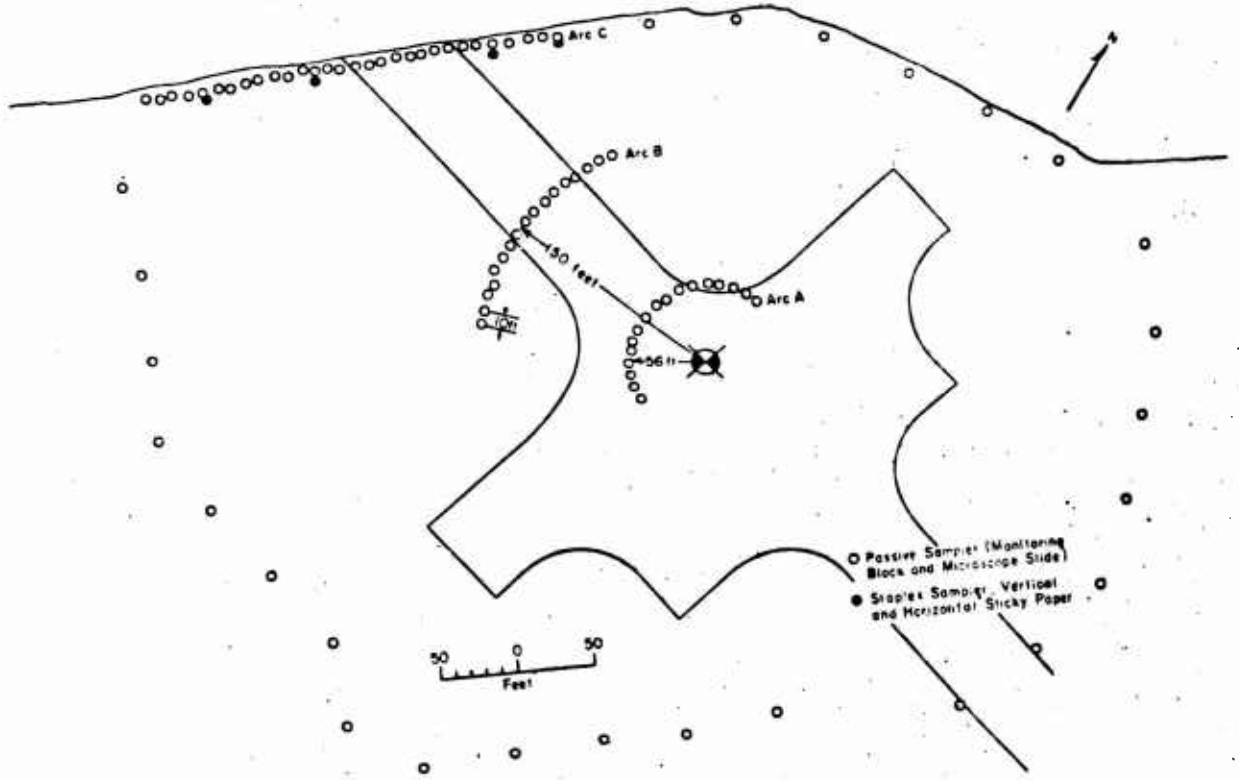
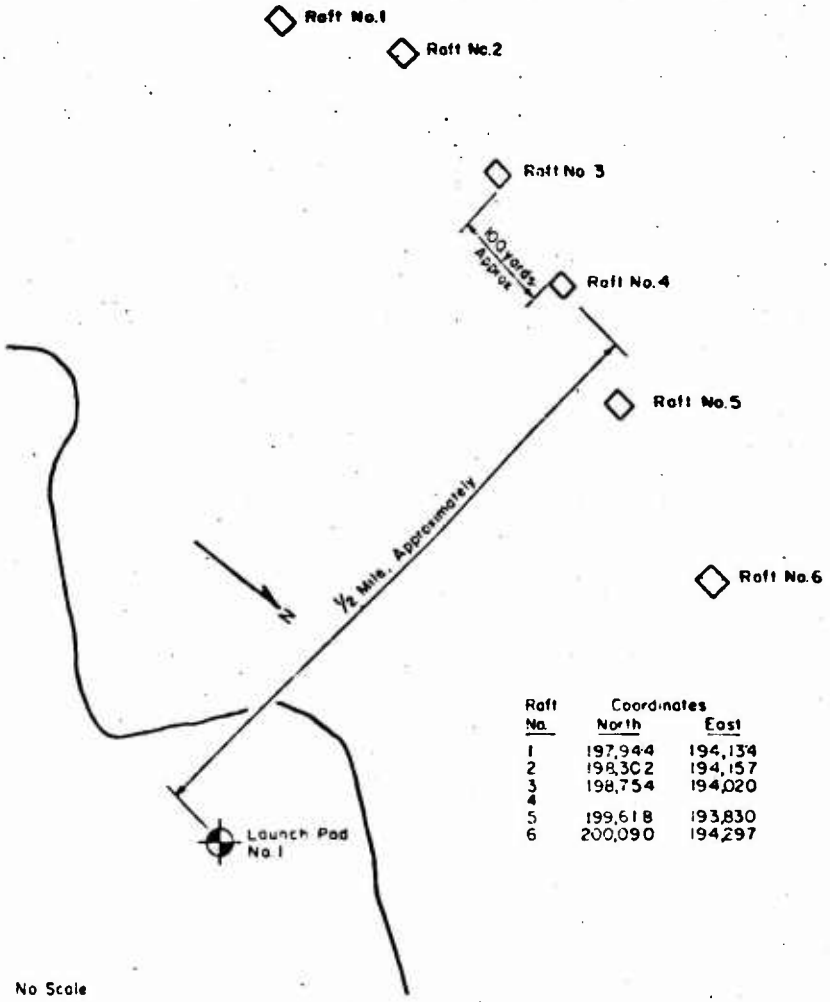
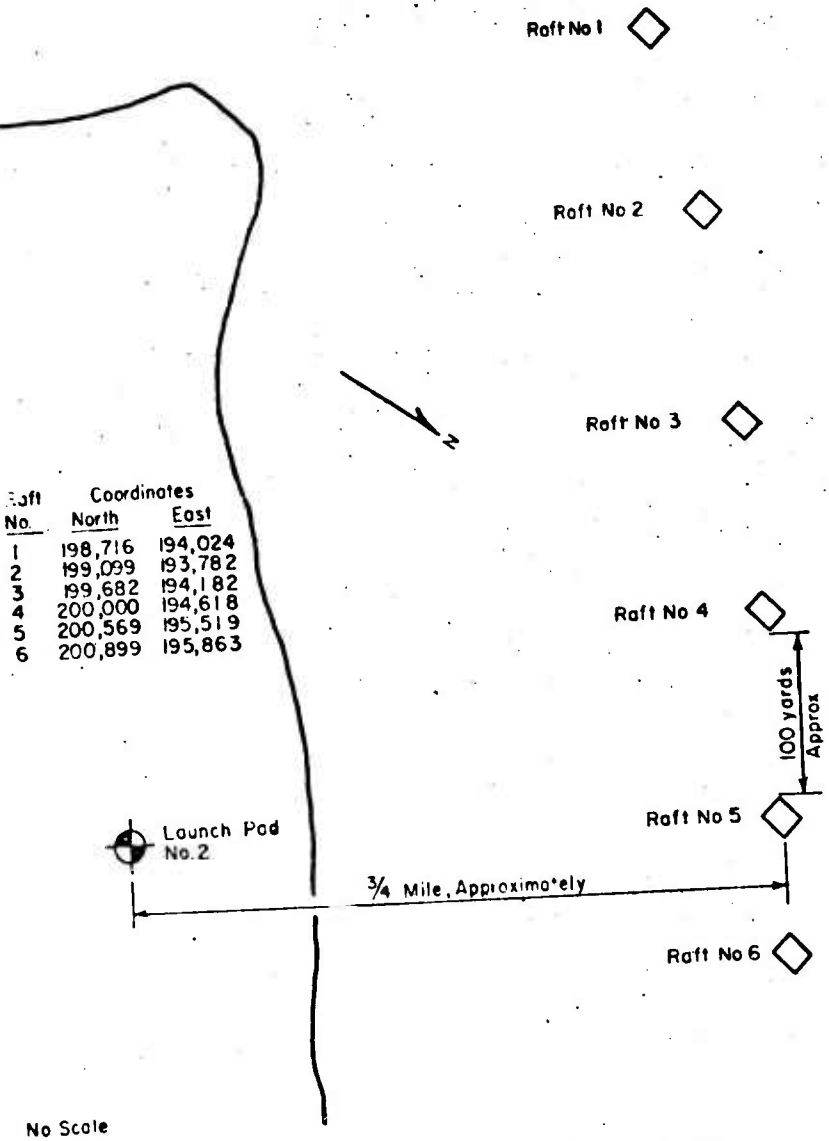


Figure 3.6 Land layout for Blue Gill Triple Prime.



Raft No.	Coordinates North	East
1	197,944	194,134
2	198,302	194,157
3	198,754	194,020
4		
5	199,618	193,830
6	200,090	194,297

Figure 2.7 Overwater sampling are for Blue Gill Double Prime and King Fish.



Raft No.	Coordinates North	East
1	198,716	194,024
2	199,099	193,782
3	199,682	194,182
4	200,000	194,618
5	200,569	195,519
6	200,899	195,863

Figure 2.8 Overwater sampling arc for Blue Gill Triple Prime.

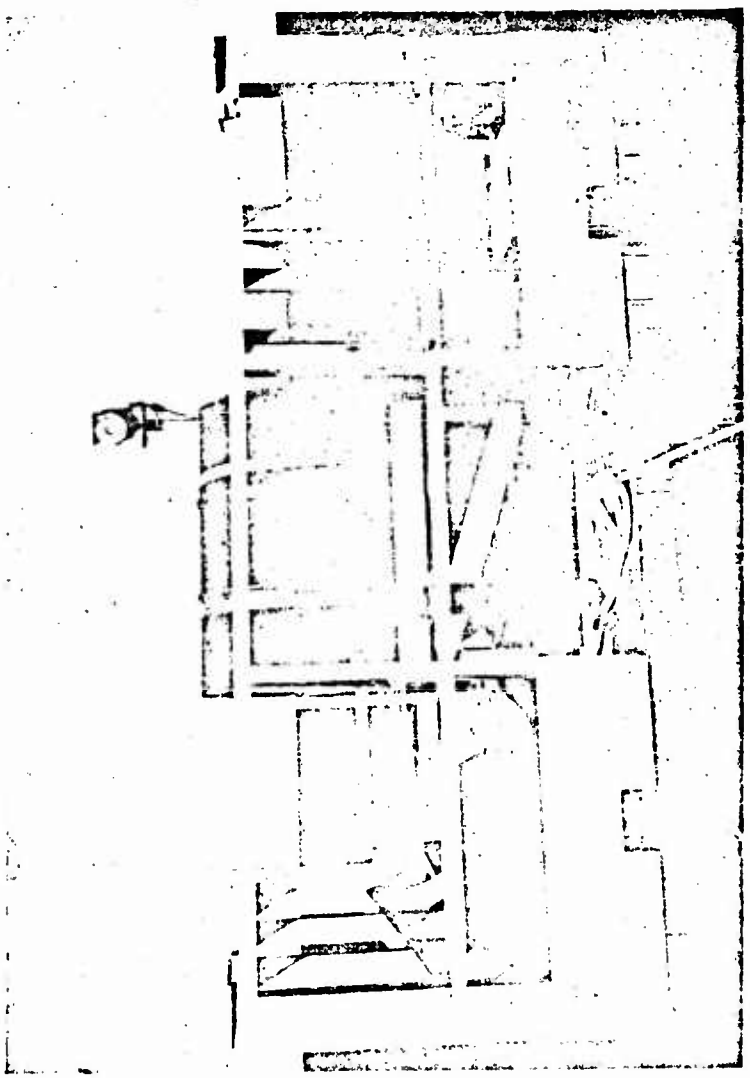


Figure 2.9 Front view of raft. (DASA photo)

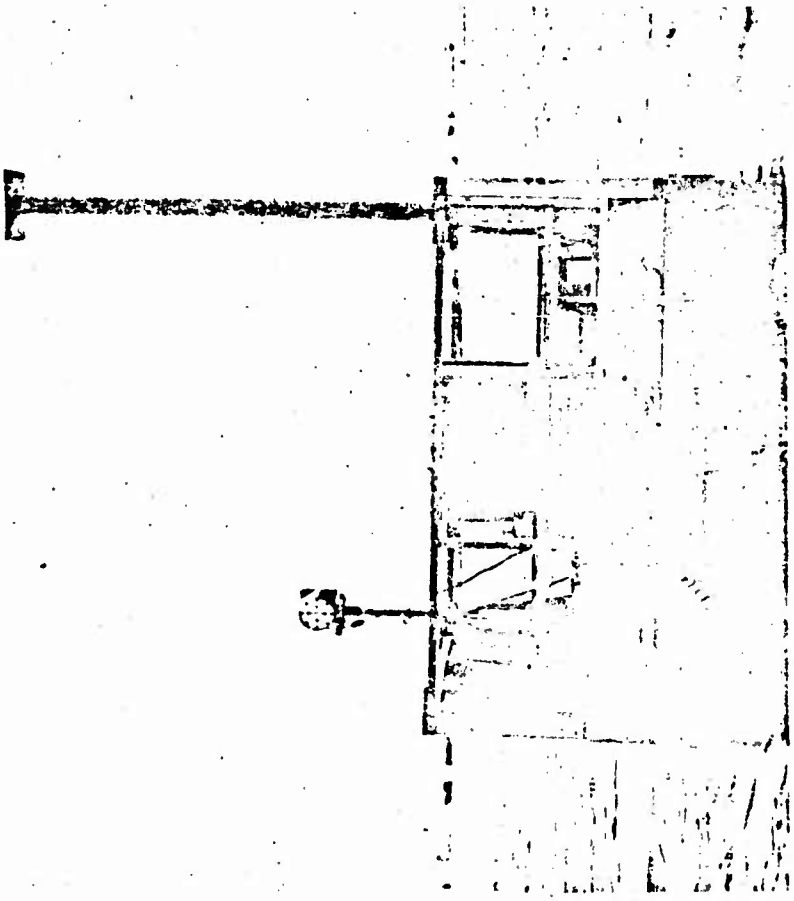


Figure 2.10 Rear view of raft. (DASA photo)

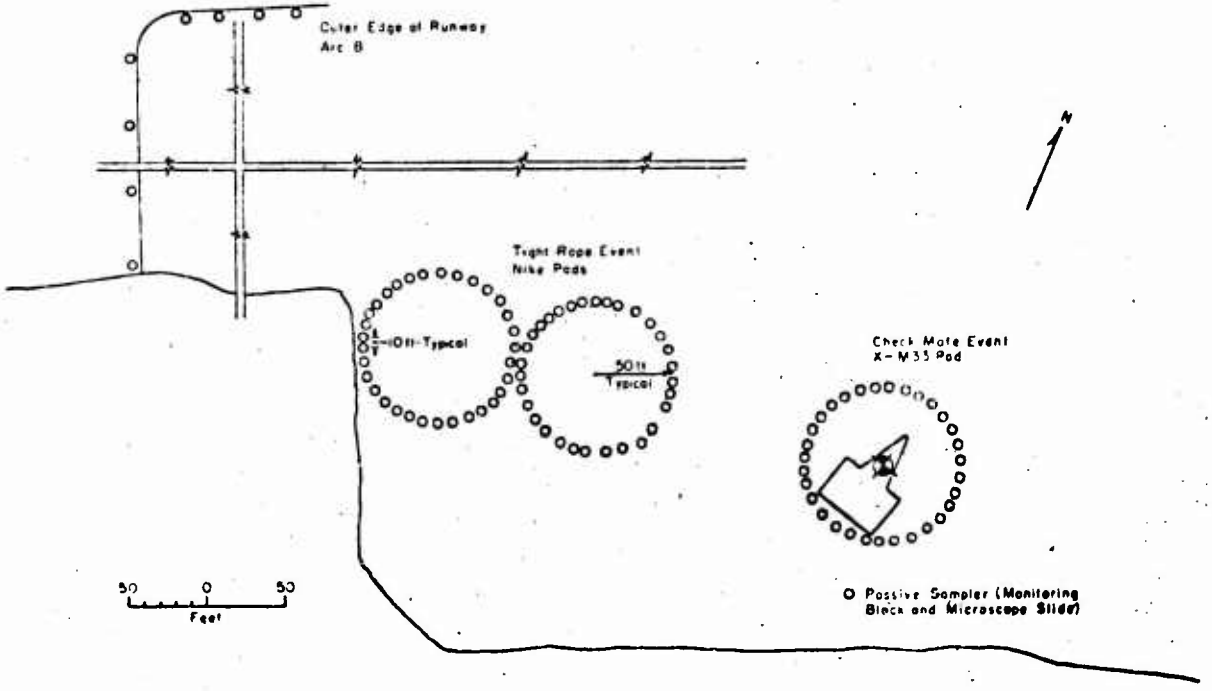


Figure 3.11 Land layout for Check Mate and Tight Rope.

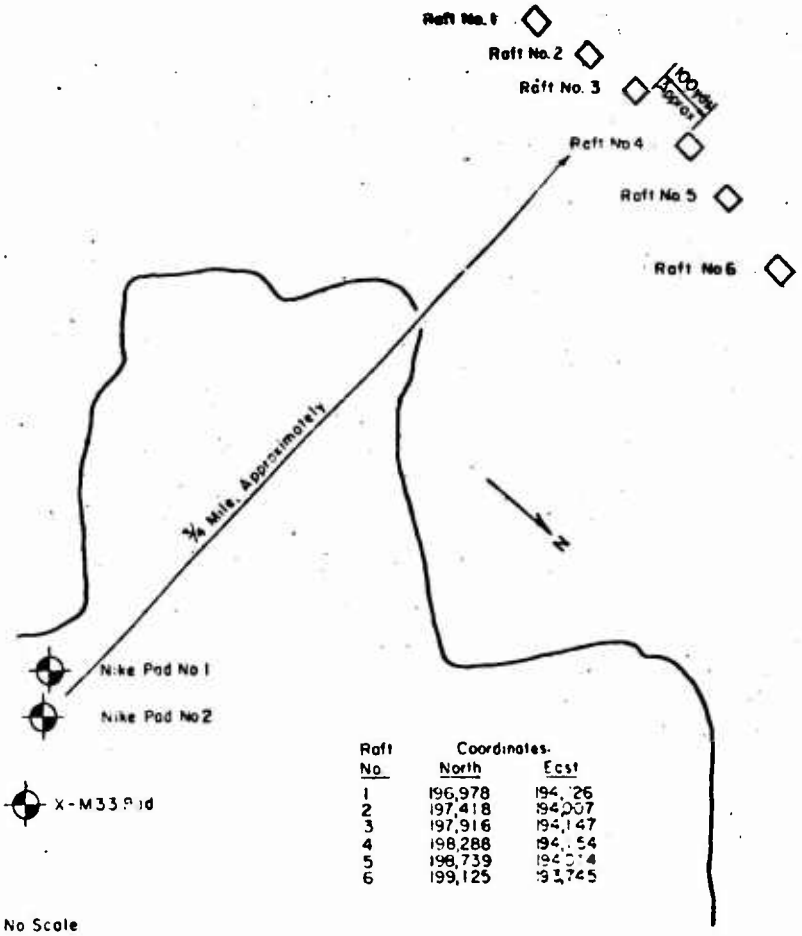


Figure 2.12 Overwater sampling arc for Check Mate and Tight Rope.

CHAPTER 3

RESULTS

3.1 BLUE GILL DOUBLE PRIME EVENT

The plutonium warhead on a modified Thor missile was destroyed approximately 109,000 feet above the launching pad at 2116 hours on 16 October 1962. Because the destruction took place at such high altitude, no results were obtained.

3.2 CHECK MATE EVENT

The missile in this event launched properly and a full-scale nuclear detonation occurred; no contamination data was obtained.

3.3 BLUE GILL TRIPLE PRIME EVENT

The missile in this event launched properly and a full-scale nuclear detonation occurred; no contamination data was obtained.

3.4 KING FISH EVENT

The missile in this event launched properly and a full-scale nuclear detonation occurred; no contamination data was obtained.

3.5 TIGHT ROPE EVENT

The missile in this event launched properly and a full-scale nuclear detonation occurred; no contamination data was obtained.

CHAPTER 4

RECOMMENDATIONS

4.1 EQUIPMENT

Many difficulties were encountered in setting up the overwater sampling array. The greatest difficulty faced was the lack of size of the raft used. It was thought at the onset of this project that an 8- by 8-foot raft would meet project requirements. Because of the existing tides and fast currents in the vicinity of Johnston Island, it is recommended that future projects considering the use of rafts use at least 15- by 15-foot rafts if a water array of this type is planned.

Equipment used on this project was not corrosion-resistant and, therefore, presented a great maintenance problem. It is recommended that all equipment for future projects of this type be fabricated of corrosion-resistant materials.

4.2 PERSONNEL

Because of the heavy workload for Project 2.3, personnel from other projects were obtained on loan to complete its mission. Existing tides, winds, and fast currents made it impossible at times for the two people assigned to the task of moving water stations to move them from site to site in time to properly monitor each event. It is recommended that at least three men be employed on a task of this type. Additionally, a full-time maintenance engineer with electromechanical capabilities is necessary to maintain the equipment.

APPENDIX

HEADQUARTERS
JOINT TASK FORCE EIGHT
Washington 25, D. C.

JJC

30 January 1963

SUBJECT: RADSAFE Responsibility for Johnston Island THOR Launch Pad No. 1

TO: Commander Joint Task Group 8.5
APO 105
San Francisco

1. As a result of the destruction of BLUEGILL PRIME on 25 July 1962, Launch Pad No. 1 was contaminated with plutonium as follows:

a. Plutonium contaminated debris was scattered throughout the wire-inclosed pad area. No contamination was found outside the concertina.

b. Metal revetment buildings were highly contaminated with alpha activity. Burning fuel flowing through the cable trenches caused contamination of the interior of the revetments and all equipment contained therein.

c. Fuel which spilled and flowed over the compacted coral surrounding the launch mounts and revetments resulted in highly contaminated areas.

d. Prevailing winds at the time of destruction caused general contamination of all areas downwind of the launch mount.

2. The following steps were taken to decontaminate and rehabilitate the pad:

a. All coral areas were sprinkled with oil to decrease the amount of contaminated airborne dust. Approximately two inches of topsoil was graded off the coral surface. This contaminated soil was bulldozed over the embankment into the water at the northwest corner of the pad area.

b. The concrete pad was scrubbed with detergents and solvents to remove all loose contamination. The pad under the launch mount was then coated with epoxy paint. The remainder of the concreted areas, including the fuel tank and lox tank pads, were covered with paint to fix the remaining contamination.

c. The revetments were washed, scrubbed, and painted.

d. The bottoms of all cable trenches were coated with one inch of concrete and the sides of the trenches were painted after scrub down and washing. Contaminated cable trench covers were disposed of and replaced with new covers. Cable conduit pipes leading from the cable trench sumps inside the revetments were sealed at each end with either concrete or steel plate.

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e. The missile shelter was scrubbed or scraped to bare metal and repainted. The wooden ties supporting the shelter rails were covered with concrete.

f. All electrical ground connection wells were filled with concrete.

g. All expansion joint grouting on the concrete pad was removed and replaced.

h. All equipment, tools, etc., that could not be decontaminated were disposed of in accordance with AEC standards by burial at sea.

i. The long range theodolite tower and the camera tower were scrubbed and repainted.

3. The following represents the condition of the launch pad area as of the present time.

a. All contaminated areas and surfaces are covered with protective coatings of either paint, concrete or clean coral sand. All contamination is fixed. There is no evidence that the plutonium contamination is being moved by either vehicles or personnel. Daily air samples show that no plutonium is being resuspended.

4. The following are the procedures used in maintaining continuous surveillance:

a. Daily inspections are made of the entire launch pad area by RADSAFE personnel.

b. All painted surfaces which show any deterioration for any reason, such as missile firings or construction work, are checked for loose contamination and then repainted. Paint chips are placed in barrels for disposal at sea.

c. Any removal of the clean coral sand and exposure of the contaminated coral, either as a result of missile firing, heavy rains or construction, is immediately remedied by replacing by clean coral sand. Any loose coral sand that is contaminated is immediately disposed of by dumping in the lagoon.

d. All chipped or broken concrete is either replaced with fresh concrete or exposed surfaces are painted if contaminated. The concrete fragments are placed in barrels for later disposal at sea.

e. All personnel working in areas where contaminated coral is exposed are required to wear booties until such time as the contaminated areas are resurfaced with clean coral sand. Painters chipping paint or repainting contaminated surfaces are required to wear full RADSAFE gear, including respirators or face masks. No other RADSAFE restrictions are required.

f. Spot checks are periodically made of individual's shoes on leaving the pad area.

g. After each missile firing, RADSAFE personnel inspected the area with the launch pad post-firing safety crew to determine the extent of the contamination problem and initiate any RADSAFE rehabilitation.

h. All tools and equipment utilized in any decontamination or rehabilitation are monitored and decontaminated if necessary.

i. Periodic surveillance is made of the kitchen and dining rooms for any contamination.

5. In lieu of any further decontamination effort, the procedures outlined in paragraph 4 above, implemented by experienced RADSAFE personnel, provide necessary and adequate RADSAFE protection for personnel on Johnston Island.

6. CJTF 8 is currently exercising RADSAFE monitoring and control of the radiation hazard attendant to use of THOR Launch Pad No. 1. CJTF 8 will retain this responsibility for RADSAFE control of the pad until such time as control of Johnston Island is relinquished. In order to carry out CJTF 8 responsibility, CJTG 8.5, as the senior AEC member of Joint Task Force EIGHT, is directed to implement and enforce all RADSAFE procedures outlined in para 4 above. CJTG 8.5 will maintain this control until CJTF 8 responsibility is terminated at a future date, to be announced, at which time the radiological responsibility will be assumed by USAEC, and subject to appropriate arrangement between that agency and any user of the facility.

7. Inclosure 1 is a survey of the THOR Launch Pad No. 1 on 6 August 1962. It is a documentation of the extent and magnitude of the contamination remaining after the initial clean-up. The major portion of removable contaminant had been physically segregated for sea disposal. Some of the contamination shown was later physically removed and disposed of. The painting and fresh coral fill operation had commenced. This chart is useful in describing in a general manner the location and radiation levels of contamination prior to fixation. In case of reconstruction or fire-fighting, this chart would be useful in directing attention to locations where contamination had been fixed. The chart could be relied upon to disclose the expected locations where major alpha radiation would be encountered. The extent of potential airborne hazard would be primarily related to the amount of disturbance in the coral fill. Due to the nature of the 25 July 1962 mishap there was fuel runoff and irregular fire spread. Deposition of contaminant was not uniform. Rather, it was restricted to local hot patches and irregular dispersion. Consequently it is not possible to contour or grid the area. The monitoring of such a site consists of surveying contaminated areas and plotting radiation readings where concentrated alpha activity is present. There is also a practical limit in the number of such readings necessary to assess the extent of contaminant and the general level of activity confined to small area hot spots."

JJC
SUBJECT: RADSAFE Responsibility for Johnston Island THOR Launch Pad No. 1

8. Inclosure 2 is a representative survey of the THOR Launch Pad Nr. 1 made on 23 Nov 62. It shows the current condition of the pad and is typical of a periodic detailed survey. It serves as a check in locating deterioration as a natural consequence of weathering and/or major disturbances, and confirms that there is no major health hazard present. The monitoring technique consisted of taking several readings at key locations throughout the installation complex. There is a practical limit in such monitoring procedure. A series of random readings at apparent points of deterioration or disturbance will reveal any uncovered alpha activity. Ordinarily, the activity is fixed. By "fixed alpha" it is meant that no alpha contamination is detected on a cloth or paper "Swipe" which has been rubbed over the suspect area. Alpha contamination was detectable only on areas where paint or epoxy had been peeling. No alpha contamination was detectable on areas where paint was in good condition. A simple action of repainting the deteriorated surface is sufficient to refix the contaminant. This is a nuisance situation which must be accepted in the absence of a major decontamination effort of uneconomical proportions. All readings on road surfaces are on clean coral fill which covers contaminated coral. The covering layers of fresh (uncontaminated) coral is of sufficient thickness that vehicular traffic or natural weathering will not expose covered contaminant. Routine monitoring will disclose exposed contaminant if unusual work activity in the area occurs. This would result, for example, from cutting into fill (trenches, etc.) or possibly from heavy fire-fighting.

9. When separated, inclosures become UNCLASSIFIED.

FOR THE COMMANDER:

Frank J. Moran

FRANK J. MORAN
LCDR, USN
Deputy Adjutant General

Incls: a/s

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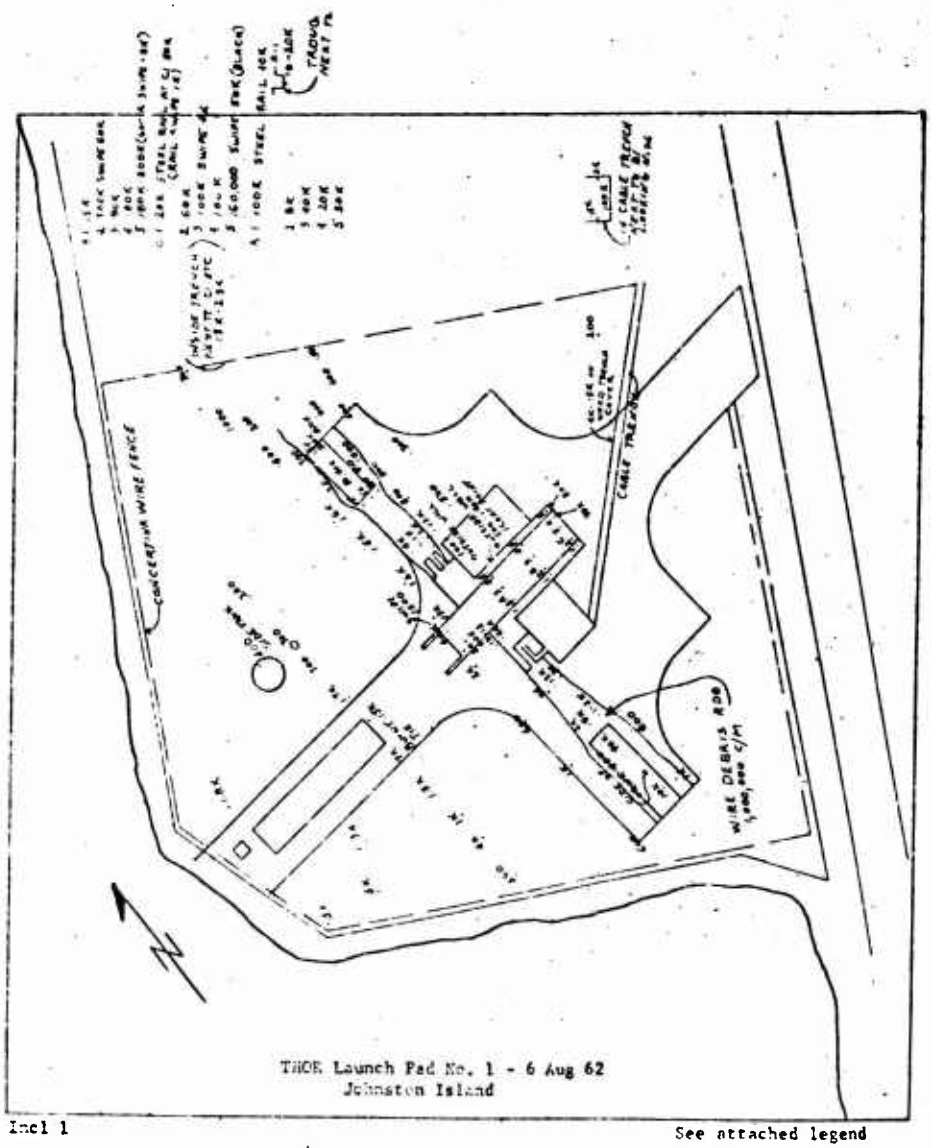
COMPACAFBASECOM, APO 953, San Francisco, Calif.
CJTG 8.6, APO 105, San Francisco, Calif.



THOR Launch Pad No. 1 - 6 Aug 62
Johnston Island

Incl 1

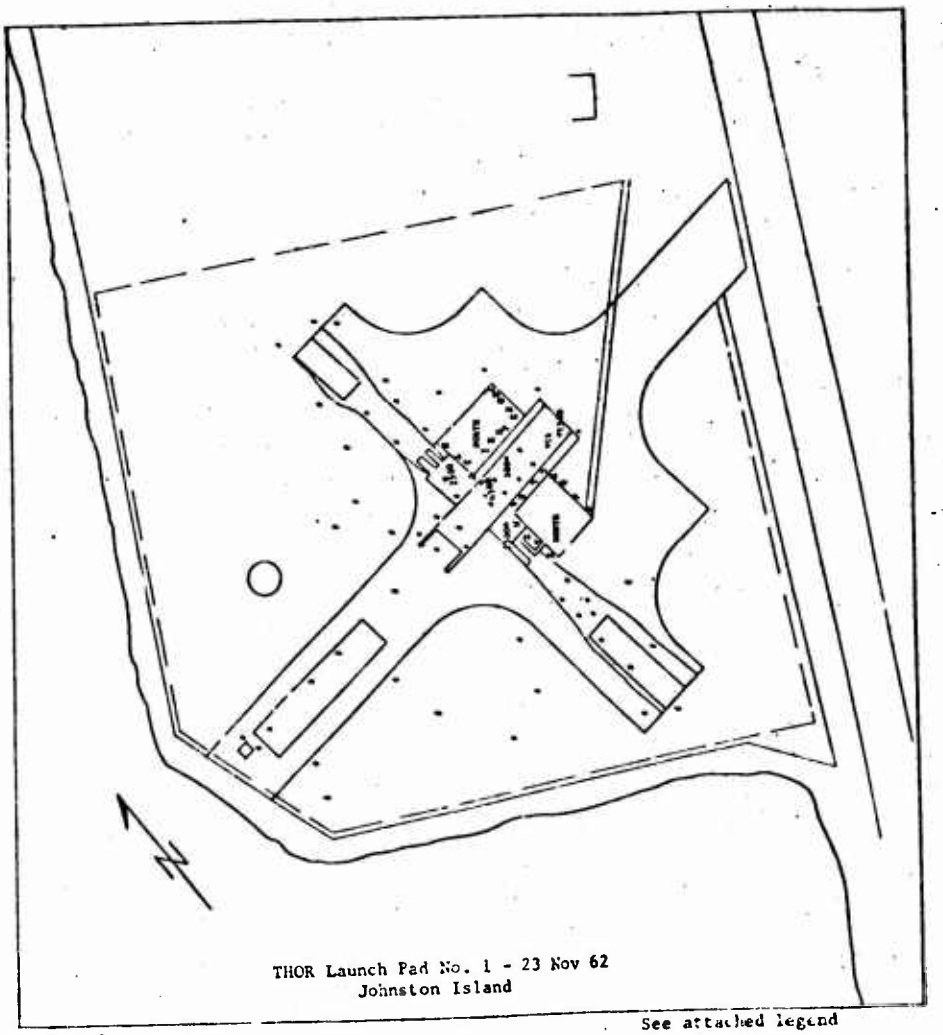
See attached legend

PLOT PLAN
Scale - 1/2"=50'

MONDAY - AUGUST 6, 1962

1. PAD HAS BEEN SCRUBBED WITH SANI-FLUSH.
2. RESURFACING NON-PAVED AREAS WITH CORAL HAS COMMENCED. S.E. AREA COMPLETED.
3. REVETMENTS PAINTED ONE COAT.
4. INSTRUMENT: PAC-1SA
5. ALL FIGURES: COUNTS PER MINUTE OF ALPHA CONTAMINATION.
6. K=1000

Enclosure 1



THOR Launch Pad No. 1 - 23 Nov 62
Johnston Island

See attached legend

Incl 2

PLOT PLAN

SCALE - 1" = 50' 1/2

THOR LAUNCH PAD NO. 1

READINGS TAKEN 23 NOV 62

INSTRUMENT USED: EBERLINE PAC-3G

ALL FIGURES: COUNTS PER MINUTE OF ALPHA CONTAMINATION

*Approximate point location of reading shown

@Approximate point location of a Zero (e.g. background) reading

SOUTH REVETMENT

POSITION ON MAP	BOTTOM CPM	MIDDLE CPM	TOP CPM
N	0	0	0
P	0	0	0
Q	0	0	0
R	0	0	0
S	150	0	650
T	2,500	0	0
U	0	15,000	0
V	0	10,000	500
W	0	0	1,000
X	9,000	0	1,000
Y	0	0	0
Z	0	0	500

NORTH REVETMENT

POSITION ON MAP	BOTTOM CPM	MIDDLE CPM	TOP CPM
A	0	0	0
B	0	0	0
C	0	0	0
D	0	0	0
E	4,000	100	1,000
F	6,000	0	0
G	20,000	4,000	2,500
H	8,000	7,500	15,000
I	10,000	0	10,000
J	150	0	850
K	0	4,500	2,500
L	1,150	0	3,000
M	4,000	0	1,000

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57-38

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13 U S ARMY AIR DEFENSE BOARD
14 U S ARMY AVIATION BOARD
15 ARMY WAR COLLEGE
16 U S ARMY COMMAND AND GENERAL STAFF COLLEGE
17 U S ARMY AIR DEFENSE SCHOOL
18 U S ARMY ARMORED SCHOOL
19 U S ARMY ART'LLERY & MISSILE SCHOOL
20 U S ARMY AVIATION SCHOOL
21 U S ARMY INFANTRY SCHOOL
22 U S MILITARY ACADEMY
23 QUARTERMASTER SCHOOL U S ARMY
24 U S ARMY ORDNANCE & GUIDED MISSILE SCHOOL
25 CHEMICAL CORPS TRAINING COMD
26 U S ARMY CBR WEAPONS SCHOOL
27 U S ARMY SIGNAL SCHOOL
28 U S ARMY TRANSPORTATION SCHOOL
29 ENGINEER SCHOOL
30 MEDICAL FIELD SERVICE SCHOOL
31 U S ARMY NUCLEAR MEDICINE RESEARCH DET EUROPE
32 ARMED FORCES INSTITUTE OF PATH
33 ARMY MEDICAL RESEARCH LAB
34 WALTER REED ARMY INST OF RES
35 GENERAL SUPPLIES RESEARCH & ENGINEERING LAB
36 ENGINEER RESEARCH & DEV LAB
37 WATERWAYS EXPERIMENT STATION
38 ARMY RESEARCH OFFICE DURHAM
39 PICATINNY ARSENAL
40 DIAMOND ORDNANCE FUZE LABORATORY
41- 42 BALLISTIC RESEARCH LABORATORY
43 FRANKFORD ARSENAL
44- 46 U S ARMY MISSILE COMMAND
47 WHITE SANDS MISSILE RANGE
48 ORD MATERIALS RESEARCH OFFICE
49 U S ARMY MOBILITY COMMAND
50 U S ARMY MUNITIONS COMMAND
51 COMMUNICATIONS & ELECTRONICS COMMAND
52 U S ARMY ELCTRONIC PROVING GROUND
53 U S ARMY COMBAT SURVEILLANCE AGENCY
54 U S ARMY SIGNAL R&D LABORATORY
55 THE RESEARCH & ANALYSIS CORP
56 NUCLEAR DEFENSE LABORATORY
57 U S ARMY AIR DEFENSE COMBAT DEV AGENCY

NAVY ACTIVITIES

58- 59 CHIEF OF NAVAL OPERATIONS OPO5EG
60 CHIEF OF NAVAL OPERATIONS OP-0009
61 CHIEF OF NAVAL OPERATIONS OP-75
62 CHIEF OF NAVAL OPERATIONS OP-91
63 CHIEF OF NAVAL OPERATIONS OP-92B2
64 CHIEF OF NAVAL PERSONNEL
65- 66 CHIEF OF NAVAL RESEARCH
67- 68 BUREAU OF NAVAL WEAPONS RA1-3
69 BUREAU OF MEDICINE & SURGERY
70 DIRECTOR SPECIAL PROJECTS
71 BUREAU OF SHIPS CODE 423
72 BUREAU OF SHIPS CODE 372
73 BUREAU OF YARDS & DOCKS
74 U S NAVAL RESEARCH LABORATORY
75 U S NAVAL ORDNANCE LABORATORY
76 MATERIAL LABORATORY CODE 900
77 NAVY ELECTRONICS LABORATORY
78 U S NAVAL RADIOLOGICAL DEFENSE LAB
79 U S NAVAL CIVIL ENGINEERING LAB
80 U S NAVAL ACADEMY
81 U S NAVAL SCHOOLS COMMAND TREASURE ISLAND
82 U S NAVAL WAR COLLEGE
83 U S NAVAL POSTGRADUATE SCHOOL
84 U S NAVAL SCHOOL PORT HUENEME
85 NUCLEAR WEAPONS TRAINING CENTER ATLANTIC
86 NUCLEAR WEAPONS TRAINING CENTER PACIFIC
87 U S NAVAL DAMAGE CONTROL TNG CENTER
88 AIR DEVELOPMENT SQUADRON 5 VF-5
89 U S NAVAL AIR DEVELOPMENT CENTER
90 US NAVAL AIR SP WPNS FACILITY
91 U S NAVAL MEDICAL RESEARCH INSTITUTE
92 U S NAVAL ORDNANCE TEST STA
93 DAVID W TAYLOR MODEL BASIN
94 U S NAVAL SUPPLY R&D FACILITY
95 U S MARINE CORPS CODE A03H
96 FLEET MARINE FORCE ATLANTIC
97 FLEET MARINE FORCE PACIFIC
98 USMC DEVELOPMENT CENTER
99 USMC EDUCATIONAL CENTER

AIR FORCE ACTIVITIES

100 HQ USAF AFTAC-1D
101 HQ USAF AFRDC-AE
102 HQ USAF AFRDD-AU
103-104 HQ USAF AFOSR
105 HQ USAF AFOCE
106 HQ USAF OPERATIONS ANALYSIS OFFICE
107-111 HQ USAF AFCIN-3D1
112 AC OF S INTELLIGENCE
113 DC OF S RESEARCH & TECHNOLOGY
114 THE DIRECTOR GENERAL
115 TACTICAL AIR COMMAND
116 ALASKAN AIR COMMAND
117 AIR DEFENSE COMMAND
118-120 AIR FORCE SYSTEMS COMMAND
121 AIR FORCE BALLISTIC SYSTEMS DIVISION
122 SADC-SAALB/GRIFFISS AFB
123 PACIFIC AIR FORCES
124 SECOND AIR FORCE
125-126 AF CAMBRIDGE RESEARCH CENTER
127-129 AFSWC KIRTLAND AFB NMEX
130-131 AIR UNIVERSITY LIBRARY
132 LOWRY AFB
133 SCHOOL OF AVIATION MEDICINE
134-136 AERONAUTICAL SYSTEMS DIVISION
137-138 USAF PROJECT RAND
139 3908TH NAVIGATOR TRAINING WING
140 ELECTRONIC SYSTEMS DIV ESAT
141 BALLISTIC MISSILE EARLY WARNING PROJECT OFFICE
142 AIR TECHNICAL INTELLIGENCE CENTER
143 OFFICE OF AEROSPACE RESEARCH

OTHER DEPARTMENT OF DEFENSE ACTIVITIES

144 DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
145 ASST TO THE SECRETARY OF DEFENSE ATOMIC ENERGY
146 MILITARY LIAISON COMMITTEE
147 ADVANCE RESEARCH PROJECT AGENCY
148 WEAPONS SYSTEM EVALUATION GROUP
149 ASST SECRETARY OF DEFENSE INSTALLATION & LOGISTICS
150 INDUSTRIAL COLLEGE OF THE ARMED FORCES
151 ARMED FORCES STAFF COLLEGE
152-155 DEFENSE ATOMIC SUPPORT AGENCY

156 FIELD COMMAND DASA
157 FIELD COMMAND DASA PCTG
158-159 FIELD COMMAND DASA FCWT
160 NATIONAL AERONAUTICS & SPACE ADMINISTRATION
161-162 DEFENSE INTELLIGENCE AGENCY
163 U S COAST GUARD
164 JOINT TASK FORCE-8
165 COMMANDER-IN-CHIEF EUCOM
166 COMMANDER-IN-CHIEF PACIFIC
167 COMMANDER-IN-CHIEF ATLANTIC FLEET
168 STRATEGIC AIR COMMAND
169 CINCONAD
170-172 ASST SECRETARY OF DEFENSE CIVIL DEFENSE

FOR CIVILIAN DISTR CAT. U.S.
173 EDGERTON GERMESHAUSEN GRIER HOSTON ATTN TECH LIBRAR
174 EDGERTON GERMESHAUSEN GRIER LAS VEGAS ATTN CAHJER
175 ARMOUR RESEARCH FOUNDATION CHICAGO
176 KAMAN NUCLEAR COLORADO SPRINGS ATTN SHELTON

ATOMIC ENERGY COMMISSION ACTIVITIES
177-179 AEC WASHINGTON TECH LIBRARY
180-181 LOS ALAMOS SCIENTIFIC LAB
182-186 SANDIA CORPORATION
187-196 LAWRENCE RADIATION LAB LIVERMORE
197-200 NEVADA OPERATIONS OFFICE,LAS VEGAS
201 OTIE OAK RIDGE,MADTECH
202-251 OTIE OAK RIDGE SURPLUS