[redacted]

ENCLOSURE L

TO THE
REPORT BY

COMMANDER
JOINT TASK FORCE EIGHT

ON THE

1962 PACIFIC NUCLEAR TESTS

(OPERATION DOMINIC) (U)

★

SCIENTIFIC SUMMARY

★

[redacted]

DISTRIBUTION STATEMENT A
APPLIES PER NTPR REVIEW.
[signature] DATE 24 Aug 2007

Declassified with deletions.
Authority: E.O. 12958, as amended
And DOE 00SA20B000249-MB,
DOE 01SA20C000105-BP,
DTRA: [signature] Date: 08/16/2007

[redacted]

Report Documentation Page							*Form Approved OMB No. 0704-0188*
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.							
1. REPORT DATE **04 JUN 1964**			2. REPORT TYPE **Summary**				3. DATES COVERED **-**
4. TITLE AND SUBTITLE **Report by Commander Joint Task Force Eight to the Chairman, United States Atomic Energy Commission and the Joint Chiefs of Staff on the 1962 Pacific Nuclear Tests (Operation Dominic) Enclosure L Report of Scientific Summary**							5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)							5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Headquarters Joint Task Force Eight Washington, DC 20305**							8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)							10. SPONSOR/MONITOR’S ACRONYM(S) 11. SPONSOR/MONITOR’S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release, distribution unlimited**							
13. SUPPLEMENTARY NOTES **Declassified with deletions. Authority: E.O. 12958, as amended and DOE 00SA20B000249-MB, DOE 01SA 20C000105-BP, DTRA.**							
14. ABSTRACT **This enclosure describes the participation of Joint Task Force Eight in Operation DOMINIC, the nuclear test series conducted during the Spring, Summer, Fall of 1962. Additional information on the participation of subordinate units is also covered in a general manner. It covers the time period from the initial activiation of Joint Task Force EIGHT until termination of the operational period for Operation DOMINIC. It describes the magnitude of the tasks accomplished, problems encountered, and recommendations for organizations involved in future nuclear test operations. This report is not intended to be a scientific treatise on the technical aspects of the operation as these points are covered in technical publications of the scientific laboratories participating. Rather it is a general description of the support afforded the scientific effort and a brief outline of the scientific information gleaned during the operation.**							
15. SUBJECT TERMS **Christmas Island ADOBE Event AZTEC Event ARKANSAS Event QUESTA Event YUKON Event MESILLA Event MUSKEGON Event ENCINO Event SWANEE Event CHETCO Event TANANA Event NAMBE Event ALMA Event TRUCKEE Event YESO Event HARLEM Event RINCONDA Event DULCE Event PETIT Event OTOWI Event BIGHORN Event BLUESTONE Event SUNSET Event PAMLICO Event**							
16. SECURITY CLASSIFICATION OF:				17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON	
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**SAR**	**104**		

[redacted]

HEADQUARTERS
JOINT TASK FORCE EIGHT
WASHINGTON, D.C. 20305

4 JUN 1964

JJC-T

TO: See Distribution

SUBJECT: CJTF 8 Report of Scientific Summary for 1962 Pacific Nuclear Tests

1. The subject report is forwarded herewith.

2. This report comprises Enclosure L of the overall report by CJTF 8 to the Chairman, AEC and to the JCS on the 1962 Pacific Nuclear Tests by Joint Task Force EIGHT (Operation DOMINIC). That report, and its other separately-bound enclosures which give details of further aspects of the operation, will be distributed as they are completed and approved.

Charles F. Mudgett, Jr.

CHARLES F. MUDGETT, JR.
Brigadier General, U.S. Army
Commander

1 Encl
a/s

Distribution: Appendix F

WHEN ENCLOSURE 1 IS WITHDRAWN
THIS CORRESPONDENCE WILL BE
DOWNGRADED TO UNCLASSIFIED

[redacted]

[redacted]

REPORT BY COMMANDER JOINT TASK FORCE EIGHT

to the

CHAIRMAN, UNITED STATES ATOMIC ENERGY COMMISSION

and the

JOINT CHIEFS OF STAFF

on the

1962 PACIFIC NUCLEAR TESTS

(OPERATION DOMINIC)

- - - - - - - - - - - - - - -

ENCLOSURE L

- - - - - - - - - - - - - - -

REPORT OF SCIENTIFIC SUMMARY

[redacted]

[redacted]

TABLE OF CONTENTS

[redacted]

[redacted]

[redacted]A

[redacted]

ENCLOSURE L

\- - - - - -

REPORT OF SCIENTIFIC SUMMARY

GENERAL

1. This enclosure describes the participation of Joint Task Force EIGHT in Operation DOMINIC, the nuclear test series conducted during the Spring, Summer and Fall of 1962. Additional information on the participation of subordinate units is also covered in a general manner. It covers the time period from the initial activation of Joint Task Force EIGHT until termination of the operational period for Operation DOMINIC. It describes the magnitude of the tasks accomplished, problems encountered, and recommendations for organizations involved in future nuclear test operations. This report is not intended to be a scientific treatise on the technical aspects of the operation as these points are covered in technical publications of the scientific laboratories participating. Rather it is a general description of the support afforded the scientific effort and a brief outline of the scientific information gleaned during the operation.

2. In the summer of 1962 the Soviet Union made the decision to abrogate the then existing nuclear test moratorium. In order to maintain any lead we had in nuclear weapon designs, efficiencies of yields and advanced concepts and to further our technical knowledge in these fields, the United States had no recourse but to go ahead with a nuclear testing program following the Soviet Union's unilateral action in these scientific and military areas. The security and welfare of this Nation as well as the bargaining position at the conference tables in world politics is extremely dependent on our weapons systems complex of which nuclear weapons play the key role. Thus, in late 1961 Operation DOMINIC was established, an operation that was organized, planned and executed in about 12 months. The operation was complex and far flung as tests were conducted at several locations with scientific and Task Force operation locations dispersed throughout the Pacific Ocean from Alaska to the American Samoas and from the West Coast of the United States to Okinawa. This vast and complex operation was conducted by Joint Task Force EIGHT commanded by Major General Alfred D. Starbird. The Scientific Deputy of the Task Force was Dr. William E. Ogle of the Los Alamos Scientific Laboratory.

[redacted]

[redacted]

APPENDIX A TO ENCLOSURE L

REPORT OF THE CHRISTMAS ISLAND AIR DROPS

INDEX

A. INTRODUCTION AND SUMMARY:

1. During Operation DOMINIC 24 devices were air dropped over the ocean at ground zero targets located off the southeast coast of Christmas Island. These devices were designed and developed by Lawrence Radiation Laboratory (LRL), Livermore, California and Los Alamos Scientific Laboratory (LASL), Los Alamos, New Mexico with each laboratory providing 12 devices.

Deleted DOE

2. One of the primary reasons for conducting this test series was to preserve our Nation's lead in weapon design through the advancement of concepts in this area. To this end 24 developmental tests were fired in the Christmas Island portion of Operation DOMINIC commencing on 25 April 1962 and ending on 11 July 1962. These were followed by five developmental tests conducted near Johnston Island in conjunction with the completion of the high altitude effects tests in the Fall of 1962. The Christmas Island developmental tests could be classified as tests of the following categories:

a. Groups:

(1) Stockpile ballistic missile warheads (10 total).

[redacted]

[redacted]

(2) Future ballistic missile warheads —

(3) Stockpile air drop weapons —

(4) Lightweight — Deleted

(5) Other experimental devices —

B. OBJECTIVES:

1. A primary objective of Operation DOMINIC was to obtain data from the detonation of nuclear devices used in weapon systems already in stockpile, programmed for admission into stockpile or from advanced concept devices highly experimental in nature. Highly sophisticated diagnostic recording instruments were installed at land-based scientific sites, primarily at Sites "A" and "MM". To test the feasibility of an all airborne operation, diagnostic measurements were made from aircraft as well as the ground. This technique of data acquisition proved so successful that in the final phase of air drop operations, at Johnston Island, this technique was employed in place of a land-based scientific platform. Two C-130 aircraft were used as instrument platforms, each carrying fireball cameras, bhangmeters, and time interval measuring equipment. The B-52 was equipped with fireball cameras and bhangmeters. To make use of the fireball pictures, the distance between the camera and the burst point had to be known, thus, two DME (Distance Measuring Equipment) systems were used. The Sandia DME system was used to measure the distance from the burst to the B-52 drop aircraft and to the companion package used for the HHRT (High High Resolution Telemetry) alpha measurements on the LASL shots. The second DME, designed and operated by the Air Force Special Weapons Command, was used to measure the distance from burst to all three aircraft. The most important diagnostic measurements made were those of yield Deleted In addition, there was an experiment designed to measure the alpha of primaries while some primaries tested had radio-chemical detectors. The total yield was obtained from measurements of the rate of growth of fireball obtained from fireball photography and from measurements of the time to the first minimum in light intensities using bhangmeters. The fission yield was obtained from radio-chemical analysis of the debris of the explosion obtained from samples collected by manned aircraft equipped with special sampling equipment. The sampler aircraft were directed by a controller from the sponsoring laboratory to insure representative samples. After removal from the sampling aircraft, the samples were placed in shielded containers and transported directly to the laboratory. Generally, samples were received in less than 12 hours after shot time. The time interval between the primary and secondary Deleted were measured by observations at very early times, of the electromagnetic signal generated

[redacted]

[redacted]

by the shot and, of the light intensity. These were obtained by both the land-based sites and the C-130 aircraft. The telemetered alpha measurements provided diagnostic information concerning the performance of primaries Deleted by utilizing high time resolution techniques. A timing system operated by TU 8.1.6 (Edgerton, Germeshausen and Grier, Inc.) furnished timing signals to all experimentors. Signals were sent out by both hard wire and radio for ground and airborne equipment. Until release time all time signals were initiated manually. At release, a timer was started which sent out all signals up to the 15 second signal, and the ARM BARO signal started a second timer which automatically furnished all later signals. These timers were controlled by a time system synchronized with WWVH which also gave the time of release and time of burst. The Sandia radar tracked the drop plane until release, then tracked the test vehicle until burst. Mounts were slaved to these radars at both sites for mounting cameras and photocells for the experimentors.

2. While detailed information about each event, including objectives, is presented in Annexes which follow, the general objectives of these tests were:

a. To proof test designs not previously tested which are in the present stockpile or are soon to be added.

b. To test designs which were modifications of stockpile devices to obtain data for new designs and check design methods.

c. To test designs which embody new principles, give high efficiencies or reduce weight.

C. UNITS PARTICIPATING:

TU 8.1.1	Los Alamos Scientific Laboratory
TU 8.1.2	Lawrence Radiation Laboratory
TU 8.1.3	Field Command, Defense Atomic Support Agency
TU 8.1.4	Sandia Corporation
TU 8.1.6	Edgerton, Germeshausen and Grier, Inc.

D. PLANNING AND PREPARATIONS:

1. The devices, after assembly by the laboratories, were delivered to Sandia Corporation for mounting in an external ballistic case (Mk 15 or Mk 36). Sandia Corporation also provided and mounted the fuzing and

[redacted]

[redacted]

firing components, along with the telemetering system used to monitor the performance up to burst time. The complete assemblies were ferried from the point of assembly, by aircraft of the Air Force Logistic Command, to Barbers Point Naval Air Station, Hawaii. There Task Unit 8.1.4 (Sandia Corporation) and laboratory personnel assisted by Air Force loading/handling crews, provided final instrumentation checks. The device was then loaded into a USAF B-52 bomber aircraft for delivery to the target. When in the target area, a 16 minute race track pattern was utilized by the drop aircraft to accurately release the device on the appropriate target after several dry runs to permit checking essential equipment, adjust for any adverse weather conditions and allow for instrument readjustment. Safety procedures were well established for all phases of the operation and in particular when concerned with device delivery and firing. A full-scale burst at the surface or under water would have caused a large amount of local fallout, therefore all devices had safety features which prevented a nuclear burst after the device had dropped below the preset minimum burst height. In some devices the firing voltage was shorted, in others self-destruct circuits were activated. The B-52 drop aircraft was controlled by the CJTF 8 through the Air Operation Controller located at the Joint Command Center, the Airborne Air Operation Center (an RC-121 aircraft), and the Sandia Radar and Plotting Center. Delivery accuracy was considered outstanding.

E. OPERATIONS:

1. The targets were small barges moored in the deep water off the island at the following ground zero locations:

GROUND ZERO (Statute Miles from Site "A")	COORDINATES
10	1°39'10" N, 157°17'17" W
12	1°37'39" N, 157°16'25" W
15	1°35'23" N, 157°15'06" W
17	1°33'00" N, 157°13'21" W
20	1°30'34" N, 157°18'46" W
25	1°25'55" N, 157°14'56" W
30	1°21'35" N, 157°14'01" W

These targets contained stroblights, beacons and radar reflectors to assist in accurate delivery. Results indicate that exceptional techniques were employed as the circular error probabilities were exceedingly small for all drops. Moors for the target barges were placed

[redacted]

[redacted]

by Joint Task Group 8.3, with assistance in positioning from the Sandia Radar and Plotting Centers at Sites "A" and "MM".

F. RESULTS:

1. Although the device detonations were of primary interest to AEC, these tests provided the Department of Defense the opportunity to participate on various tests and experiments. These experiments are listed below:

a. Chorioretinal Burns (Project 4.1): This was a study of chorioretinal burns in animals. Five C-118 aircraft at an altitude of about 20,000 feet and five C-54 aircraft at burst altitude at various distances from the burst were employed as test stations containing rabbits and monkeys. These aircraft were flown during the ENCINO, SWANEE, TANANA, NAMBE, YESO and HARLEM events, and were staged out of Hickam AFB, Hawaii.

b. Test of Protective Devices (Project 4.1): Four types of eye protective devices based on shuttering mechanisms were tested. These were the electro-mechanical goggles, explosive lens flash-blindness devices, the stressed plate shutter and the indirectly actuated phototropic device. Seven different directly actuated phototropic filters were tested. These are darkened by a chemical process initiated by the nuclear flash.

c. Study of Temporary Flash-Blindness (Project 4.2): This project was concerned with finding the requirements for a flash-blindness protective device.

d. Attenuation of Radar Signals by Fireball and Cloud (Project 7.3): The objective of this experiment was to determine the degree of attenuation, and the extent and duration, of a radar signal transmitted through the fireball and cloud after a nuclear detonation. An X-band and S-band radar were set up to scan an array of reflectors dropped behind the fireball. An aircraft equipped with a beacon was also used as a target and the strength of the beacon signal through the burst was measured.

e. Airborne Thermal Measurements (Project 7.5): For this experiment three instrumented B-57B aircraft, positioned by ground-based radar were utilized. The aircraft exteriors were painted with a paint having less than 0.15 absorptivity and had thermal curtains certified to withstand 60 calories per centimeter within two seconds. The objectives of this project were to measure thermal radiation from nuclear yields at and below burst height, to evaluate the influence of surface and cloud reflections, and to improve thermal prediction techniques.

[redacted]

[redacted]

f. Optics Studies (Project 16.4): This project was conducted by personnel of Task Unit 8.1.1, Los Alamos Scientific Laboratory. Light versus time curves were observed, utilizing millisecond resolution, for 14 detonations. In some cases the polarization of the scattered light was measured. Various optical filters were used to select wave lengths, primarily in the red and infra-red bands.

g. Electromagnetic Effects: Electromagnetic pulse measurements on Christmas Island shots were made by many agencies. Projects were located at all of the scientific sites on Christmas Island plus Fanning, Palmyra and Penrhyn Islands. The prime objective of the EM measurements on these shots was to measure the time interval between stages of the devices being tested. Related measurements, but with a different goal, were conducted by the United Kingdom and Denver Research Institute groups. Their objective was to investigate the propagation of the pulse containing staging information to distance of interest for remote detection and diagnosis of nuclear explosions. Other objectives were the investigation of sensors (probes and loops) and recording techniques for this measurement and the investigation of low frequency components (10 kc/s and lower) of the EM pulse. The time interval measurements by all groups concerned were considered very successful.

h. Water Wave Measurements (Program 50): These measurements were made by Marine Advisers, Inc., under the direction of Scripps Institute of Oceanography. Their purpose was to study the production of water waves from nuclear detonations over open water and to prepare forecasts of waves. Deep and shallow water recorders were installed at Christmas Island to study the waves near the explosion. Regular tsunami recorders were located at Wake, Johnston, Canton and Malden Islands to study the open ocean wave propagation characteristics at points distant from the source and, in addition, shallow water recorders were installed on the bottoms of certain bays and harbors of the large islands of Hawaii, Oahu and Tutuila. Additional data was obtained from three tsunami recorders belonging to the University of Hawaii located off-shore from Hilo, Hawaii.

i. Ground Thermal Measurements: Two measurements were made of the thermal radiation received at Site "A". One measurement, made by Task Unit 8.1.4, used a calorimeter aimed at the burst. The other, made by Task Unit 8.1.1 used photodiodes.

j. Shock Overpressure: Shock overpressure was measured by Task Unit 8.1.4 at Sites "A", "MM" and at the Joint Operations Center.

2. The principle effects realized from design improvements were:

a. Improved yield-to-weight ratios in all yield ranges.

[redacted]

[redacted]

b. Smaller dimensions for a given yield Deleted

c. Environmental "hardening" of the warhead to meet the more stringent environmental requirements of the delivery systems.

d. Increased design efficiencies to reduce costs, materials, weights and to develop special purpose weapons.

G. CONCLUSIONS:

1. The 24 devices fired at Christmas Island may be divided into the following five categories:

a. Stockpile Ballistic Missile Warheads.

b. Future Ballistic Missile Warheads.

c. Stockpile Air Drop Weapons.

d. Lightweight Deleted

e. Other Experimental Devices.

Deleted

The device information has been compiled from information supplied by the Technical Task Units through formal and informal sources. The information contained herein should not be considered as the final opinion nor absolute in accuracy. Complete technical data, and in particular, design information has not been included in this report.

[redacted]

[redacted]

ANNEX A

TO APPENDIX A, REPORT OF ADOBE EVENT

Device: — Deleted	Date/Time: 251545Z Apr 1962
Design Yield: —	Location: GZ-10
Actual Yield: 200 KT	Height of Burst: 2,730 Feet

1. **OBJECTIVES:**

Deleted DOE

2. **APPLICATION:**

3. **RESULTS:** The Scientific Laboratories of the AEC, Los Alamos Scientific Laboratory (LASL) and Lawrence Radiation Laboratory (LRL), represented in the operation by Task Units 8.1.1 and 8.1.2 respectively, participated on this first event of Operation DOMINIC. Participation was successful although fireball photography data from two stations was reduced because of cloud formations. Electromagnetic and radio-chemical sampling was successful. Successful firing of the device utilized for this event provided conclusive evidence that the component design, developed during the test ban moratorium and based on extrapolations, rather than actual tests, were functional and reliable.

Deleted DOE

The actual yield of 200 KT determined by radio-chemical sampling Deleted provided data for correction of extrapolated calculations.

[redacted]

[redacted]

ANNEX B

TO APPENDIX A, REPORT OF AZTEC EVENT

Device: Deleted

Design Yield:

Actual Yield: 408 KT

Date/Time: 271601Z Apr 1962

Location: GZ-10

Height of Burst: 2,610 Feet

---

1. OBJECTIVES: The AZTEC event was a test of Deleted Component designs were made from extrapolations, rather than tests, during the moratorium and verification of the design was required. Deleted DOE The test Deleted

a. Provided a confidence point for future advancements.

b. Verified its performance.

2. APPLICATION: This device is the warhead for the PERSHING missile. The device was the same as that employed in the ADOBE event with the exception of a change in the secondary to increase its yield.

3. RESULTS: Deleted DOE The device performed properly

The effects of new departures in design were experimentally verified and a confidence point was reached to verify the feasibility of new steps for further advancements. Scientific participation in this event was extremely successful. Fireball photography, radio-chemical sampling and electromagnetic measurement data acquisition was excellent.

[redacted]

[redacted]

ANNEX C

TO APPENDIX A, REPORT OF ARKANSAS EVENT

Device: – Deleted	Date/Time: 021801Z May 1962
Design Yield: -	Location: GZ-15
Actual Yield: 1,090 KT	Height of Burst: 5,300 Feet

1. **OBJECTIVES:**

Deleted

2. **APPLICATION:** DOE

3. **RESULTS:**

Scien-tific participation in this event was excellent. Weather conditions and visibility were such that fireball photography was very successful. Radio-chemical sampling and electromagnetic measurements obtained were excellent.

[redacted]

[redacted]

ANNEX D

TO APPENDIX A, REPORT OF QUESTA EVENT

Device: — Deleted	Date/Time: 041904Z May 1962
Design Yield: —	Location: GZ-12
Actual Yield: 670 KT	Height of Burst: 5,230 Feet

1. OBJECTIVES: Deleted DOE

The device is another extrapolated design executed during the moratorium. The experiment was necessary to:

a. Verify the design calculations.

b. Provide a normalization point for more advanced design in this general class.

2. APPLICATION: This is Deleted

3. RESULTS: The total yield for QUESTA was 670 KT

Deleted

Although the results of the test were not up to expectations, the acquisition of diagnostic data by AEC scientific participants was excellent.

[redacted]

[redacted]

ANNEX E

TO APPENDIX A, REPORT OF YUKON EVENT

Device: – Deleted

Design Yield: –

Actual Yield: 119 KT

Date/Time: 081801Z May 1962

Location: GZ-10

Height of Burst: 2,880 Feet

---

1. OBJECTIVES: YUKON was the first test in Operation DOMINIC of the family of Deleted

2. APPLICATION: This device was one of a group of Deleted devices fired during Operation DOMINIC to test designs which embody new principles, give higher efficiencies or reduce weight. A device in this weight class could be used for application in submarine launch ballistic missiles, mobile ballistic missiles and as clusters.

3. RESULTS: This event produced an actual yield of 119 Deleted. was another highly successful event which produced extensive scientific data on design advancements. In this test radio-chemical sampling was satisfactory in all respects. Some doubt existed as to success of fireball photography and electromagnetic measurements which should be resolved through further reduction and analysis of the acquired data.

[redacted]

[redacted]

ANNEX F

TO APPENDIX A, REPORT OF MESILLA EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 69 KT

Date/Time: 091701Z May 1962

Location: GZ-10

Height of Burst: 2,000 Feet

---

1. OBJECTIVES: This event tested another of the Deleted devices utilizing advanced concepts in the design Deleted

2. APPLICATION: MESILLA was another experimental test of Deleted design for possible application in the development of a warhead

Deleted

3. RESULTS: Good fireball photography was obtained at all stations. Electromagnetic measurements and radio-chemical sampling were highly successful.

Deleted

The event confirmed new design features

From the scientific data obtained, this was considered a very successful event.

[redacted]

[redacted]

ANNEX G

TO APPENDIX A, REPORT OF MUSKEGON EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 50.4 KT

Date/Time: 111537Z May 1962

Location: GZ-10

Height of Burst: 3,000 Feet

---

1. OBJECTIVES: This device was aimed toward the design

Deleted

2. APPLICATION: Like the other devices in this category, which were developmental in nature, production of such light, efficient systems are of interest for application in submarine launched ballistic missiles, mobile ballistic missiles and others where a reduced weight of the warhead will permit introduction of increased instrumentation in the payload or re-entry vehicles for penetration and anti-interference aids.

3. RESULTS: Scientific stations obtained diagnostic data from good fireball photography and electromagnetic measurements. Radio-chemical sampling was successful.

Deleted

[redacted]

[redacted]

ANNEX H

TO APPENDIX A, REPORT OF ENCINO EVENT

Device: - Deleted	Date/Time: 121702Z May 1962
Design Yield: -	Location: GZ-12
Actual Yield: 512 KT	Height of Burst: 5,300 Feet

1. OBJECTIVES: This experiment was designed to: (1) Provide a normalization point for further advanced designs, and (2) to verify this

Deleted

2. APPLICATION: Deleted

3. RESULTS: The scientific participation in this event was satisfactory in all respects as was the fireball photography and electromagnetic measurements. Radio-chemical sampling results were good, with sampling rockets providing additional data in the first use of this method for this series. The shot was another successful

Deleted

[redacted]

[redacted]

ANNEX I

TO APPENDIX A, REPORT OF SWANEE EVENT

Device: — Deleted	Date/Time: 141521Z May 1962
Design Yield: —	Location: GZ-10
Actual Yield: 97 KT	Height of Burst: 2,700 Feet

1. OBJECTIVES: This was an experiment designed to provide salient information Deleted

Because of the lack of previous experience in this area, this device was considered highly experimental. Deleted

2. APPLICATION: This can be classed as an experimental warhead Deleted

3. RESULTS: Scientific participation was generally successful although fireball photography was somewhat hampered by unexpected visibility limitations due to cloud formations. All electromagnetic stations obtained good data as did the projects concerned with radiochemical sampling. The actual yield was 97 KT

Deleted.

[redacted]

[redacted]

ANNEX J

TO APPENDIX A, REPORT OF CHETCO EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 77.6 KT

Date/Time: 191536Z May 1962

Location: GZ-10

Height of Burst: 6,800 Feet

---

1. OBJECTIVES: CHETCO was a further experiment in the lightweight,

Deleted

2. APPLICATION: Data obtained from these experiments are to be used toward the development

Deleted DOE

Such warhead reduction in the weight-to-yield ratio makes it possible to earmark weight savings to penetration and guidance aids.

3. RESULTS: Scientific participation resulted in obtaining the finest diagnostic data up to this point in the series of tests. Excellent weather conditions enhanced procurement of phenomena data and the diagnostic participation was considered extremely successful. The actual yield was 77.6 KT

Deleted

This event provided considerable data for use in furthering design sophistication and improvement in yield-to-weight ratios for future weapons.

[redacted]

[redacted]

ANNEX K

TO APPENDIX A, REPORT OF TANANA EVENT

Device: — Deleted

Design Yield:

Actual Yield: 2.8 KT

Date/Time: 251608Z May 1962

Location: GZ-10

Height of Burst: 9,030 Feet

---

1. **OBJECTIVES:** This device was planned to test

Deleted

2. **APPLICATION:** Deleted another of the family of experiments in the low weight,

3. **RESULTS:** Deleted scientific participation in this event was considered successful from the standpoint of acquisition of diagnostic data. Electromagnetic and optical measurements were not obtained

Deleted

[redacted]

[redacted]

ANNEX L

TO APPENDIX A, REPORT OF NAMBE EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 42.5 KT

Date/Time: 271702Z May 1962

Location: GZ-10

Height of Burst: 7,140 Feet

---

1. OBJECTIVES: Inclusion of this event in the air drop series was initiated by the requirement for development

Deleted

Verification of this design was required and fulfilled by the completion of this event.

2. APPLICATION: — was a further experiment in the family of lightweight,

Deleted

3. RESULTS: Scientific participation was considered successful in all respects. Good fireball photography was obtained at all stations. Data acquisition in electromagnetic measurements were satisfactory. Excellent weather conditions permitted highly successful radio-chemical sampling results. The actual yield of 42.5 KT

. Deleted

the results of this event were highly satisfactory and the data acquired has provided points of departure for improved and functionally advanced designs

Deleted

[redacted]

[redacted]

ANNEX M

TO APPENDIX A, REPORT OF ALMA EVENT

Device: Deleted

Design Yield: —

Actual Yield: 807 KT

Date/Time: 081702Z Jun 1962

Location: GZ-15

Height of Burst: 8,865 Feet

---

1. **OBJECTIVES:** Deleted

2. **APPLICATION:** Deleted DOE

3. **RESULTS:** Acquisition of test diagnostic data was completely successful. Electromagnetic measurements, radio-chemical sampling and fireball photography projects obtained excellent data from this event.

Deleted

[redacted]

[redacted]

ANNEX N

TO APPENDIX A, REPORT OF TRUCKEE EVENT

Device: – Deleted

Design Yield: –

Actual Yield: 225 KT

Date/Time: 091537Z Jun 1962

Location: GZ-10

Height of Burst: 6,970 Feet

---

1. OBJECTIVES: This event was a test

Deleted
DOE

2. APPLICATION: Deleted

3. RESULTS: Scientific participation on this event was only partially successful due to premature triggering of diagnostic equipment resulting from a false timing signal. Electromagnetic measurements were obtained by those stations that were able to operate independently of timing signals. Radio-chemical sampling was completely successful. The total yield was 225 KT

Deleted DOE

[redacted]

[redacted]

ANNEX O

TO APPENDIX A, REPORT OF YESO EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 3,130 KT

Date/Time: 101601Z Jun 1962

Location: GZ-20

Height of Burst: 8,325 Feet

---

1. OBJECTIVES: This was a test of an advanced design with an objective of developing Deleted
This design was a major extension from previously tested areas
Deleted and required experimental verification.

The design principles can, of course, be adapted to other weights and yields.

2. APPLICATION: Deleted DOE

It could be used as a replacement

Also it could be utilized for advanced weapons systems with a warhead requirement Deleted such as the B-47, B-52 and B-70 systems.

3. RESULTS: Scientific participation resulted in excellent data being obtained by all projects. Electromagnetic measurements and fireball photography was accomplished successfully. Radio-chemical sampling efforts provided returns from both aircraft and rocket systems. The actual yield of 3,130 KT

Deleted

 [redacted]

[redacted]

ANNEX P

TO APPENDIX A, REPORT OF HARLEM EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 1,100 KT

Date/Time: 121547Z Jun 1962

Location: GZ-17

Height of Burst: 13,645 Feet

---

1. **OBJECTIVES:** Deleted

One other important design change was tested by this shot.

2. **APPLICATION:** Deleted

3. **RESULTS:**: AEC participation resulted in acquisition of excellent diagnostic data from the HARLEM event. All systems functioned smoothly, therefore providing satisfactory electromagnetic measurements, aircraft and rocket radio-chemical sampling and fireball photography. Deleted The actual yield was 1,100 KT Deleted

[redacted]

[redacted]

ANNEX Q

TO APPENDIX A, REPORT OF RINCONADA EVENT

Device: Deleted

Design Yield:

Actual Yield: 815 KT

Date/Time: 151600Z Jun 1962

Location: GZ-17

Height of Burst: 9,105 Feet

---

1. OBJECTIVES: Deleted The device was modified slightly and the objective of this event was to experimentally determine the effects of these design changes.

2. APPLICATION: Deleted Testing of the modified device in this event was necessary to obtain additional data for future designs which would be more effective and reliable and demonstrate higher efficiency.

Deleted DoE

3. RESULTS: AEC participation in this event was considered successful insofar as satisfactory data were obtained on fireball photography, electromagnetic measurements and radio-chemical sampling. However, minor data loss was experienced at some photo and electromagnetic data sites due to a premature triggering of RF activated equipment from an undetermined source of electrical noise. The actual yield was 815 KT

Deleted Further analysis will be necessary to determine the full significance of the comparison. The results will be useful in determining the final design Deleted as well as applying the information to new applications.

[redacted]

[redacted]

ANNEX R

TO APPENDIX A, REPORT OF DULCE EVENT

Device: — Deleted	Date/Time: 171600Z June 1962
Design Yield: —	Location: GZ-10
Actual Yield: 54.3 KT	Height of Burst: 9,090 Feet

1. OBJECTIVES: DULCE tested another of the lightweight, Deleted advance concept designs with some design modifications.

2. APPLICATION: This was an experimental device included in the air drop program to gain further data on design criteria for developing light, efficient warheads Deleted

3. RESULTS: In this shot, AEC participation in data gathering activities was completely successful in all respects. Excellent weather and visibility, combined with smooth operation of all systems and equipment provided very satisfactory acquisition of diagnostic data at all stations. Deleted The actual yield was 54.3 KT. The methods used in designing this device and the modifications are valid. The data obtained from this event, in conjunction from that obtained from the other events in this group of experiments will provide valuable information for future design improvements.

[redacted]

[redacted]

ANNEX S

TO APPENDIX A, REPORT OF PETIT EVENT

Device: —
Design Yield: — Deleted
Actual Yield: 3 KT

Date/Time: 191501Z Jun 1962
Location: GZ-17
Height of Burst: 14,995 Feet

---

1. OBJECTIVES: Deleted tested in this event was an experimental design The growing concern of the ability of missiles to penetrate enemy defenses has led to the necessity of reducing weight and space requirements for the warhead to allow inclusion of additional penetration aids. Deleted

2. APPLICATION: Deleted was an advanced design programmed for use Because of the many novel and unusual features in the design, Deleted was considered highly experimental. Diagnostic phenomena recorded from this event, were a part of the large amount of scientific and technical data obtained for designing advanced type devices for new missile requirements.

3. RESULTS: Scientific participation was successful from a data procurement aspect. All diagnostic stations functioned as planned. Radiochemical sampling was conducted by B-57 aircraft only. Rocket sampling was cancelled because of the low yield. The actual yield was about three kilotons. From the data obtained, there was no indications that the fuzing and firing systems failed to function properly. Very good records were obtained Deleted

[redacted]

[redacted]

ANNEX T

APPENDIX A, REPORT OF OTOWI EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 81.5 KT

Date/Time: 221600Z Jun 1962

Location: GZ-10

Height of Burst: 9,010 Feet

---

1. OBJECTIVES: In this event, a new concept Deleted was investigated along with testing a device Deleted However, several modifications in design were introduced for experimental investigation and verification.

2. APPLICATION: This was another of the highly experimental investigations by the scientific laboratories to obtain new data on design parameters of lightweight, Deleted for use in advanced designs of new concept weapons.

3. RESULTS: The acquisition of data by the AEC laboratories and other technical personnel from the firing of this device was considered successful. Their participation resulted in obtaining excellent diagnostic data. All systems functioned as planned, providing good electromagnetic measurements, aircraft radio-chemical sampling and fireball photography. The actual yield of 81.5 KT Deleted These data, again, when combined with the tremendous amount of data obtained from the other experimental shots will give our scientific laboratories a vast stockpile of information for use in designing warheads for weapon systems of the future.

[redacted]

[redacted]

ANNEX U

TO APPENDIX A, REPORT OF BIGHORN EVENT

Device: Deleted

Design Yield:

Actual Yield: 7,650 KT

Date/Time: 271519Z Jun 1962

Location: GZ-30

Height of Burst: 11,810 Feet

---

1. OBJECTIVES: The principle objective of this event was to investigate the phenomena and design modifications Deleted

This was one of two large yield devices planned for firing during the early phases of the Christmas Island portion of Operation DOMINIC.

Deleted

2. APPLICATION: This device, along with Deleted YESO, were two devices fired which had higher yields The object of the tests was to develop new warheads Deleted which can replace warheads with higher yield devices without increasing weight and to develop warheads for new application. Data from these shots will also aid in the design of similar devices in other weight classes.

3. RESULTS: Favorable weather conditions contributed greatly toward obtaining all the necessary fireball photography, electromagnetic measurements and radio-chemical samples from rockets and sample aircraft. Six rockets were fired for sampling and five nose cones were recovered. The actual yield of 7,650 KT Deleted the test was considered to be highly successful in obtaining data useful in reducing the yield-to-weight ratio

Deleted

[redacted]

[redacted]

ANNEX V

TO APPENDIX A, REPORT OF BLUESTONE EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 1,270 KT

Date/Time: 301521Z Jun 1962

Location: GZ-17

Height of Burst: 4,980 Feet

---

1. OBJECTIVES: Deleted

This event tested with experimental changes to obtain data while testing new design concepts and variations Deleted

2. APPLICATION:

Deleted

New information will be applied to design improvements increasing yield-to-weight ratio and for introduction as modification changes in present production lines.

3. RESULTS: Atomic Energy Commission scientists from the two laboratory task units felt their participation in this event was one of the most successful of the series. Scientific stations reported no equipment failures and excellent data was obtained. The weather and visibility were ideal and excellent fireball photography was obtained. Electromagnetic, radio-chemical and optic measurements were outstanding. Tracking, control and weapon telemetry functioned well throughout the test. Three rockets were fired for sampling and one nose cone was recovered. The actual yield was 1,270 KT, Deleted further gains may be made by extending present concepts.

[redacted]

[redacted]

ANNEX W

TO APPENDIX A, REPORT OF SUNSET EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 810 KT

Date/Time: 101630Z Jul 1962

Location: GZ-17

Height of Burst: 5,000 Feet

---

1. OBJECTIVES: Deleted device was fired in this shot

2. APPLICATION:
This event was one of a series of tests Deleted devices hoping to produce data for increasing efficiency, reducing cost and increasing the yield-to-weight ratio for weapons and warheads as well as proof testing the functional capabilities of the device and associated components. Data obtained from this event will be used to improve future designs of warheads of this type and provide in-process production improvements.

3. RESULTS: Typical AEC scientific participation was accomplished on this event and diagnostic data collected. All stations participated and, even though weather was a problem, excellent fireball photography was obtained. Electromagnetic and radio-chemical sampling were most satisfactory. Tracking, control and telemetry functioned normal throughout the drop. Deleted Future designs, for these purposes, will require development from different design parameters.

[redacted]

[redacted]

ANNEX X

TO APPENDIX A, REPORT OF PAMLICO EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 3,820 KT

Date/Time: 111537Z Jul 1962

Location: GZ-25

Height of Burst: 14,330 Feet

---

1. OBJECTIVES: Deleted was a test of a new concept. It was a highly experimental, device, designed and built by the Lawrence Radiation Laboratory in a month's time. Deleted

2. APPLICATION: Results from this test, along with the test Deleted offer the possibility, after further development and experimentation, Deleted It is felt this shot, through further design experimentation, may lead to warheads of higher yield Deleted

3. RESULTS: This event, the final event in the Christmas Island Air Drop Series, was a physics investigation Deleted Data acquisition for this event was considered highly successful. The smooth operation of all diagnostic stations, tracking and telemetry enhanced acquisition of excellent data from all stations. Although local cloud conditions were a slight problem, all desired fireball photography was obtained. Electromagnetic measurements and radio-chemical sampling were satisfactory. The actual yield was 3,850 KT,

Deleted.

[redacted]

[redacted]

APPENDIX B TO ENCLOSURE L

REPORT OF THE JOHNSTON ISLAND AIR DROPS

INDEX

A. INTRODUCTION AND SUMMARY:

1. After the successful completion of the Christmas Island portion of Operation DOMINIC, scientific personnel began the task of reducing, analyzing and compiling diagnostic data obtained to confirm tested extrapolations and proceed to new concepts in weapon design with the hope of testing these new developments in a new nuclear test series, should it be forthcoming. The missile pad destruction caused by the THOR failure on the BLUEGILL Prime event, 25 July 1962, at Johnston Island interrupted the progression of the FISH BOWL Series and necessitated a delay of several months to refurbish the damaged pad. This delay provided the scientific laboratories with the opportunity to make use of the data obtained in the Christmas Island portion of Operation DOMINIC to pursue new concepts in weapon design and provided a time frame for manufacture

[redacted]

and testing, providing approval could be obtained, for inclusion of these events in the present series. It was about this time that the Soviet government announced their intention to conduct further atmospheric tests. This delay, coupled with the strong possibility of Soviet test resumption, encouraged the laboratories to make every effort to prepare their experiments. In early August the Lawrence Radiation Laboratory, Livermore, California (LRL) proposed to include air drops near Johnston Island utilizing new or modified design concepts.

2. The experience gained from the Christmas Island Air Drop Program led to the ability to conduct experiments with rapidity and a minimum of operational preparation. It also demonstrated our capability to detonate, and to obtain adequate information to satisfy the diagnostic requirements of these nuclear detonations, solely by means of a completely airborne operation. This capability was established in a relatively short time by Joint Task Group 8.4 under the guidance of Brigadier General John S. Samuel, Task Force Deputy for Air. Five developmental shots were fired in this phase within the Johnston Island Danger Area.

B. OBJECTIVES:

1. Additional developmental tests were included in the latter stages of Operation DOMINIC because of the necessity to obtain further information on concepts, tested earlier at Christmas Island, which appeared to be extremely promising approaches to the design of thermonuclear weapons.

The requirement for including penetration aids in the payload made the latter increasingly desirable in an effort to make our missile weapons systems more effective and less vulnerable to enemy interference.

2.

[redacted]

3. The growing concern over the ability of our strategic missiles to penetrate enemy defenses has developed a requirement for penetration aids which must be included in the payload. Thus, it was important to pursue approaches in warhead design which might provide the required warhead yields at substantially less weight. It was hoped by experimentation

Success with this design, it was also believed, could lead within a year or two, to weapon prototype designs

Therefore, the selection designs were originally proposed for inclusion in the remaining portion of Operation DOMINIC along with three additional low-yield, high altitude events.

4. The Los Alamos Scientific Laboratory proposed an experiment of in an event called TOCITA. This was eventually replaced by the CHAMA event, a test which was designed to produce

Two other experiments were added to this group of events prior to completion of the series.

This brought to a total of five devices added as air drops in this continuation phase of Operation DOMINIC.

C. UNITS PARTICIPATING:

TU 8.1.1	Los Alamos Scientific Laboratory
TU 8.1.2	Lawrence Radiation Laboratory
TU 8.1.3	Field Command, Defense Atomic Support Agency
TU 8.1.4	Sandia Corporation
TU 8.1.6	Edgerton, Germeshausen and Grier

D. PLANNING AND PREPARATIONS:

1. The original concept of device movement under this portion of the operation was to load the device in a B-52 aircraft at either Travis AFB, California or Kirtland AFB, New Mexico, depending on the laboratory

[redacted]

[redacted]

involved. This would have followed preparation and mounting of the device in the appropriate case by Sandia Corporation. The device checks would proceed to about five hour readiness and then the drop aircraft would proceed to Barbers Point Naval Air Station where final checks would be made by Task Unit 8.1.4 personnel and DME instruments in the other array aircraft to be calibrated with the device. The key, which enabled the device to detonate, would be placed in the unit at Barbers Point and the aircraft could then proceed to the target for the drop. After consideration of the problems involved in an operation of this type, it was finally resolved to revert to an operation similar to that for Christmas Island air drops where the device was ferried to Barbers Point Naval Air Station for subsequent checking and loading on the B-52 at that point. It must be pointed out that all handling, movement and testing of the devices fired during Operation DOMINIC were conducted without an incident or accident of any type, which was an outstanding accomplishment by the civilian and military personnel involved.

E. OPERATIONS:

1. The targets employed for these air drops were bright colored target rafts containing an APN-69 radar beacon, a MK-10 IFF, perimeter and strob lights to aid in positioning the drop and diagnostic aircraft. The target moors were installed and the targets maintained by JTG 8.3. Installation of these moors in extremely deep water and in precise positions was completed in an outstanding manner by the personnel involved and required exceptional ingenuity and seamanship. The targets were located well within the established Johnston Island danger area at the following positions:

TARGET	COORDINATES
SZ-1	15°50' N, 163°50' W
SZ-2	14°30' N, 168°15' W
SZ-3	14°30' N, 168°45' W
SZ-4	13°40' N, 172°10' W

F. RESULTS:

1. The ability to conduct experiments with rapidity and a minimum of operational preparation was due, largely, to the recent experience gained from the Christmas Island air drop program which had demonstrated our capability to detonate and to obtain adequate information to satisfy the diagnostic requirements solely by means of a simplified and completely airborne operation. Approval for inclusion of these air drops during the

[redacted]

later stages of Operation DOMINIC was partially due to this demonstrated ability to acquire the diagnostic information desired from the proposed experiments, which included Deleted yields by bhangmeter, fireball photography and radio-chemistry. The primary scientific platforms were two C-130 aircraft extensively instrumented by each laboratory, Task Unit 8.1.6 (EG&G) and Sandia Corporation in conjunction with the Weapons Effects Test Directorate, AFSWC. The B-52 aircraft contained instrumentation for fireball photography, bhangmeters and other diagnostic equipment. Two KC-135 aircraft were primary photography aircraft. The C-130 aircraft were equipped with Sandia Corporation, LRL, and AFSWC DME to provide range measurements of the aircraft from the burst, necessary in the analysis of fireball data. B-57D aircraft provided the radio-chemical sampling functions. Considerable thought was given to modification of U-2 aircraft to provide sampling for the higher yield firings because of the expected higher cloud base which was above the capabilities of the B-57D's. The U-2's, however, were not modified nor employed for this purpose during this operation, but were used for high altitude cloud reconnaissance. The airborne instrumentation aircraft provided the laboratories with time interval measurements, TM signals, fireball photography, electromagnetic measurements, bhangmeter and range measurements with sufficient accuracy to demonstrate the feasibility of a completely airborne operation in a nuclear test program of this type.

G. CONCLUSIONS:

1. Deleted DOE

The selection of from other possible candidates, was based on the necessity to obtain information on their concepts which appeared to be extremely promising approaches to the design of thermonuclear weapons.

Deleted DOE

Delays in testing these concepts, to obtain this information, would be reflected in a commensurate delay in achieving useful weapons, employing these advanced concepts, which are urgently needed. The Deleted was a design developed by LASL and later added as the CHAMA event

Deleted

DOE

Specific device information is provided in the Annexes which follow.

[redacted]

ANNEX A

TO APPENDIX B, REPORT OF ANDROSCOGGIN EVENT

Device: — Deleted

Design Yield: —

Actual Yield: 63 KT ± 10 KT

Date/Time: 021617Z Oct 1962

Location: SZ-4

Height of Burst: 10,260 Feet

---

1. <u>OBJECTIVES</u>: ANDROSCOGGIN was the first air drop event of the Johnston Island continuation phase. It was fired utilizing a completely airborne drop and diagnostic system. This system was proven feasible through the experimentation employed in data acquisition at Christmas Island. Deleted DOE The objectives of the Ripple concept were to investigate new ranges of yield-to-weight ratio possibilities in the design of high yield thermonuclear warheads. Deleted

The very gratifying results opened up new ranges of possibilities in the design of new high yield thermonuclear warheads. The Department of Defense is extremely interested in obtaining maximum yield warheads in the 3,000 to 10,000 pound weight class for use in the larger missiles. High yields with smaller weights will allow a larger percentage of the payload to be allotted to penetration aids and also permit penetration from substantially higher altitude while providing a yield which would create the desired ground damage. It was hoped that the United States would achieve, in two quick experiments, results exceeding the performance that has been obtained through many years with conventional designs. Deleted

2. <u>APPLICATION</u>: The growing concern over the ability of our strategic missiles to penetrate enemy defenses has developed a requirement for penetration aids which must be included in the payload. For larger missiles such as ATLAS, TITAN I and TITAN II, it might be possible to allocate a small fraction of the payload weight to penetration aids which would assist in successful penetration to altitudes in the neighborhood of 50,000 feet. However, detonations at such high altitudes will not create the desired damage on the ground unless sub-

[redacted]

stantially higher yields are available at useable weights.

Deleted. DOE

3. RESULTS: was dropped successfully at the target area on 2 October 1962, with a bombing error of less than 500 feet. Fireball photography was obtained from both C-130's and the B-52 aircraft. The AFSWC DME (Distance Measuring Equipment) was hampered by noise but data was useable. Task Unit 8.1.4 (Sandia Corporation) obtained DME measurements but Task Unit 8.1.2 (LRL) experienced equipment malfunctions and did not obtain desired data. Time interval measurements and TM signals were recorded and are being analyzed. The actual yield was determined to be 63 KT plus or minus 10 KT

Deleted

[redacted]

ANNEX B

TO APPENDIX B, REPORT OF BUMPING EVENT

Device: Deleted

Design Yield: -

Actual Yield: 11.9 KT ± 1.2 KT

Date/Time: 061602Z Oct 1962

Location: SZ-2

Height of Burst: 9,900 Feet

---

1. OBJECTIVES: Deleted was fired in the Christmas Island series which produced a yield

Deleted

Calculations on the design tested provided evidence for new design modifications which should achieve this objective. These calculations needed to be tested for experimental verification. It was felt, if this design was successful, it would permit development Deleted in the 400 to 1,000 pound weight class. This was an investigation to increase the yield-to-weight ratio in weapons design in the low weight warheads.

2. APPLICATION: The increased concern over the ability of our missiles to penetrate enemy defenses has led to a requirement for penetration aids which must be added to the missile payload. For smaller missiles such as MINUTEMAN and POLARIS, it may be necessary to reduce the warhead weight by as much as a factor of two in order to provide for the inclusion of necessary penetration aids. This, in turn, would involve a reduction of warhead yield by at least a factor of two. As a result, it is important to pursue approaches in warhead design which might provide the required warhead yield at a substantially less weight. In this weight class (300-700 pounds) Deleted seemed most promising.

DOE

3. RESULTS: was fired on 6 October 1962. Diagnostic equipment functioned satisfactory to provide needed technical data. Deleted

[redacted]

Page L-B-2-2 is deleted.

[redacted]

ANNEX C

TO APPENDIX B, REPORT OF CHAMA EVENT

Device: – Deleted

Design Yield: –

Actual Yield: 1,400 ± 300 KT

Date/Time: 181601Z Oct 1962

Location: SZ-3

Height of Burst: 11,976 Feet

---

1. OBJECTIVES: The CHAMA event was a LASL physics investigation Deleted This test was included in Operation DOMINIC late in the series and was developed as a design from calculations based on analysis of newly acquired data from the Christmas Island air drops. Deleted

2. APPLICATION: It was hoped that, if successful, this design would lead to a rugged, relatively lightweight and small diameter system Deleted

3. RESULTS: Participation by the Atomic Energy Commission Scientific Laboratories in the CHAMA event was considered thoroughly successful. Good fireball photography and range measurements were obtained from both C-130's, the C-135 and B-52 aircraft. Good signals were obtained from optical and electromagnetic airborne stations. Radio-chemical sampling was successfully obtained by four B-57 sampler aircraft. Data acquisition was considered highly successful on this event and verified the confidence of the laboratories that a completely airborne operation (considering the drop and data acquisition only) was scientifically feasible. The actual yield was approximately 1.4 MT Deleted

[redacted]

[redacted]

ANNEX D

TO APPENDIX B, REPORT OF CALAMITY EVENT

Device: Date/Time: 271546Z Oct 1962

Design Yield: Deleted Location: SZ-2

Actual Yield: 800 KT Height of Burst: 11,780 Feet

---

1. **OBJECTIVES:** Deleted DOE
It was a further physics investigation to experimentally verify design calculations

Deleted

2. **APPLICATION:** Data obtained from this experiment Deleted would provide a basis for new design concepts for our larger ICBM systems.

3. **RESULTS:** The CALAMITY device was fired 27 October 1962 after a near perfect drop having a circular burst error of less than 500 feet. AEC participation was successful as diagnostic equipment on both C-130 aircraft functioned satisfactorily and sufficient scientific data was obtained to consider the mission a success. The yield of the Ripple III device was recorded by bhangmeter to be 800 KT.

Deleted

[redacted]

[redacted]

ANNEX E

TO APPENDIX B, REPORT OF HOUSATONIC EVENT

Device: Deleted

Design Yield:

Actual Yield: 10,000 KT

Date/Time: 301601Z Oct 1962

Location: SZ-4

Height of Burst: 12,130 Feet

---

1. OBJECTIVES: After analysis of the data obtained

Deleted

DOE

a.

b.

c.

d.

2. APPLICATION: Deleted

Data obtained could also be utilized for new designs of advanced concept warheads in the smaller weight range. This was the final device fired in the air drop phase of the Johnston Island events of Operation DOMINIC.

3. RESULTS: This device was fired on 30 October 1962 after a perfect mission by the B-52 air crew who dropped the device with a circular burst error of less than 100 feet. Scientific participation was ex-

[redacted]

[redacted]

cellent as diagnostic devices operated well. The Livermore Laboratory's DME equipment failed to get any returns from the device while the AFSWC and the TU 8.1.4 systems were satisfactory. TU 8.1.5 cameras functioned well as did all Los Alamos Scientific Laboratory gear. There was no damage to the B-52, which reported moderate shock from this detonation. The actual yield was 10,000 KT

Deleted

[redacted]

[redacted]

APPENDIX C TO ENCLOSURE L

REPORT OF THE FISH BOWL HIGH ALTITUDE EVENTS

INDEX

A. INTRODUCTION AND SUMMARY:

1. In the planning stages for a nuclear test program which began after the Soviet Union violated the test ban moratorium in early 1962, Operation FISH BOWL was first envisioned. It was originally planned for two high altitude events of varying nuclear yields and heights of

[redacted]

[redacted]

burst. The tests were to be weapons effects tests of primary concern to the Armed Forces. One other event, URRACA, Deleted and of primary interest to AEC was included as a part of Operation FISH BOWL to the extent that CHDASA would make such military weapons effects measurements with FISH BOWL project equipment as could be funded. Thus, the original planning consisted as follows:

a. Systems Proof Test - (TIGER FISH) about 1 May 1962, nonnuclear (THOR vehicle).

b. BLUE GILL - about 1 June 1962, Deleted (THOR vehicle) (DOD).

c. STAR FISH - about 15 June 1962, 1.45 MT at 400 km (THOR vehicle) (DOD).

d. URRACA - Deleted (THOR vehicle) (AEC).

2. The THOR missile was selected as launch vehicle, after considerable deliberation, primarily because it could carry the three 1,200 pound, heavily instrumented pods, a new venture in diagnostic data acquisition measures. Eventually the STRYPI (a XM-33 rocket, modified by the addition of two recruit booster engines and instrumentation) and NIKE-HERCULES were added to the family of launch vehicles for these events. Between the early planning in late 1961 and the completion of the final high altitude event on 4 November 1962, the FISH BOWL Program underwent considerable changes in events, carriers and scheduling due to resulting contingencies and some unplanned circumstances. The URRACA event was cancelled and ultimately replaced by KING FISH which began as Deleted and was eventually fired with Two other events were added in the high altitude, low yield category. These were CHECK MATE which employed a modified XM-33 (STRYPI) rocket as carrier to detonate a Deleted and TIGHT ROPE, an event which used the NIKE-HERCULES carrier to place Deleted A total of five high altitude events were completed successfully in Operation FISH BOWL.

B. OBJECTIVES:

1. Since the advent of the high altitude events in previous test operations, the scientific community was aware of the existence of tremendous gaps in fundamental knowledge on the multitude of effects of a nuclear detonation at a relatively high altitude. It was necessary to obtain data to provide a firm foundation for evaluating the effectiveness of a nuclear blackout as a penetration aid for ballistic missiles at various altitudes. Adequate knowledge in the areas of

[redacted]

effects of a high nuclear burst on communications links and navigation systems was sorely needed. Knowledge and data on the effects of a burst on guidance systems, detection and tracking systems involving stellar sensors and infrared radiation was needed for offensive and defensive weapons systems. Bio-medical effects data from a high altitude detonation was needed to fill the many gaps in fundamental areas. We needed to know the effect on satellites from electrons trapped in the geomagnetic field. The major scientific objectives to be derived from the high altitude events could be categorized as:

a. Evaluation of missile kill mechanisms produced by these events.

b. Evaluation of the effects of a high altitude nuclear detonation on electromagnetic surveillance capability.

c. Effects on communication links and navigational systems.

d. Investigation of the basic characteristics of a high altitude nuclear detonation and the physical basis of the effects.

e. Evaluation of high altitude nuclear detonation weapon diagnostic techniques.

f. Evaluation of high altitude nuclear detonation detection systems.

2. The reasons for the choice of the combination of yield and height of burst is provided in detail in the Annex of each event and were important factors in obtaining the experimental data needed to provide foundations for adequate evaluations of the effects produced. The addition of the low yield, high altitude, effects tests were necessary to permit, within limits, evaluation of the utility of such explosions as penetration aids, that is as a precursor burst to permit penetration of ABM defenses by an ICBM.

Deleted

In addition to the investigation of the potential of low yield explosions per se, the comparison of observations on such shots with larger yield events would provide a better understanding of the variations of high altitude effects with yield.

C. UNITS PARTICIPATING:

TU 8.1.1	Los Alamos Scientific Laboratory
TU 8.1.2	Lawrence Radiation Laboratory

[redacted]

TU 8.1.3	Field Command, Defense Atomic Support Agency
TU 8.1.4	Sandia Corporation
TU 8.1.5	Space Systems Division, USAF
TU 8.1.6	Edgerton, Germeshausen and Grier
TU 8.1.7	U.S. Army Missile Command, Redstone Arsenal

D. PLANNING AND PREPARATIONS:

1.

Deleted
DOE

There were a number of different gamma dosimeters on the pods and gamma detectors on rockets. Electromagnetic surveillance capabilities after a high altitude nuclear detonation were studied by a large number of experiments. Attempts were made to track objects, in, near, and at large distances from the debris and to measure the attenuation and refraction of radar signals. Measurements were made of radar signals. Measurements were made of radar scatter and clutter due to the debris and ionospheric disturbances. These experiments covered the radar frequency spectrum, specifically including those frequencies of greatest interest in anti-missile missions. The period from before detonation until after detonation effects disappeared was covered. Long and short range communications were tested throughout the world by communications simulation experiments and by monitoring a large number of existing communication nets. Both government and private communications systems were exercised during the period of interest with the aim of determining signal propagation conditions as a function of frequency, path location, and time relative to burst. The basic physical characteristics and effects of high altitude nuclear detonations were studied both for applicability to the other objectives of the high altitude events and for their inherent scientific interest. Two of the phenomena of prime importance were the debris expansion history and the geomagnetic effects. Experiments to obtain data on these phenomena included determination of the ionospheric composition, cosmic electro-

[redacted]

[redacted]

magnetic noise transmissions through the ionosphere, magnetic field strength measurements, various satellite-borne experiments, earth current measurements, sky brightness measurements, and measurements of nuclear radiations. Ultraviolet, visible and infrared spectroscopic and photographic measurements were made near the point of burst and in the north and south magnetic conjugate areas. Weapon test diagnostic techniques were tested by considering both the direct emission from the weapon and the effect of these emissions on their surroundings. The bomb energy emitted as X-rays was determined by direct measurement of the total X-ray energy and measurements of the apparent bomb temperature. X-ray excited air fluorescence was studied. Neutron flux and energy distribution were determined, as were gamma ray fluxes and time histories. The behavior of the bomb debris was studied and rocket-borne debris samplers were tested. There were electromagnetic and optical measurements of the time interval between the weapon primary and secondary, as well as an attempted measurement of bomb early alpha by high resolution telemetry techniques. It was hoped that the yield could be determined by an analysis of the direct thermal radiation, the X-ray yield as inferred from air fluorescence, and the kinetic energy of the bomb debris. High altitude nuclear detonation detection systems were directly tested in the high altitude events through the use of the Vela Sierra air fluorescence systems and direct optical systems. The spectral characteristics of the air fluorescence were studied to aid in distinguishing nuclear detonations from lightning flashes. Optical and electromagnetic time interval measurements were of interest in this area, as were the various measurements of the electromagnetic signal from the weapon. In addition many of the basic effects which were studied could have applications in detection systems.

E. OPERATIONS:

1. Scientific stations to obtain data from the various experiments were established throughout the Pacific Area, with the most concentrated group on Johnston Island. From Johnston Island, rockets were fired in support of experiments, and a large array of optical and electromagnetic instrumentation was operated. In the area surrounding the island, a fleet of ships and aircraft operated with technical stations aboard. Stations were established in the Hawaiian area to observe the burst from elevated areas and to observe the northern conjugate area. A large number of rocket-borne instruments were launched from a firing area at Barking Sands, Kauai. The southern conjugate area was covered by establishing stations in the Fiji, Samoan and Cook groups and by stationing ships and aircraft in the general area. Other shipboard stations were utilized throughout the Pacific to study the effects of ionospheric disturbance on RF transmission and reception. Many groups participated voluntarily in the event, generally invited by the Department of Defense, in order to take advan-

[redacted]

tage of the substantial interest in the event by the world's scientific community.

F. RESULTS:

1. The Department of Defense conducted these experiments to obtain critically needed weapons effects data. The firings on Johnston Island produced much of this data.

a. Vulnerability of Re-entry Vehicles: Very little data was obtained to predict vulnerability of various types of re-entry vehicles to nuclear bursts at various high altitudes. Of particular concern was the X-ray effect on certain materials.

b. Penetration Aids: The solution to the problem of penetration aids was materially advanced as a result of these experiments.

Deleted
DOE

Communications outages were short-lived. Short-range, lower frequency (shorter than 500 cm) scatter, and line-of-sight communications circuits showed few outages and then were limited to less than a few minutes.

c. Warhead Kill Radius: AICBM warhead kill radius is independent of altitudes above 80-90 km (and perhaps much lower). It appears that AICBM burst at this altitude and at low dip angles would not seriously degrade the performance of acquisition and tracking radars at UHF frequencies and above.

d. Effects on Optical Systems: Data obtained shows that the intensity and time duration of infrared (IR) radiation produced by high altitude nuclear detonations can seriously degrade the performance of optical systems depending upon IR sensors.

Deleted

e. Debris Spread: The debris from these shots was not confirmed locally. A large portion of the debris expanded rapidly upward and slowly diverging outward to extremely high altitudes. The debris spread north and south along magnetic field lines ultimately depositing in a widespread area from Alaska to New Zealand, except for the equatorial region. The east-west distribution of debris was not uniform but fell off with longitude from the magnetic meridian through the burst. The manner in which the debris spread out indicated that very little debris becomes neutralized at an early time. The relative quantities of debris in the northern and southern regions is unknown. However, there is no positive indication to contradict the assumption that equal quantities of debris were utimately deposited in each area.

f. Radiation Belts; Of the FISH BOWL events, only STAR FISH made a major contribution to the existing long lived radiation belt or belts.

Deleted

(A great deal of satellite data is yet to be analyzed, so the information presented here may change as analysis proceeds).

2. Valuable data was obtained on the nuclear detonation effects in a possible NIKE-ZEUS tactical situation. The use of a nuclear detonation as an aid to penetration for incoming missiles by disrupting enemy anti-missile radars was explored by the STAR FISH event Deleted The STAR FISH event also produced the greatest surprise of the series, producing spectacular auroral effects without strong focal effects and was the only event to contribute significantly to the trapped electron radiation belt in the magnetic field. Specific data on tentative results for each event is given in the Annexes to this Appendix, however in general, considerable useful data has been obtained in the following areas:

a. Effects of nuclear detonations, as a function of size and altitudes, on electromagnetic radiation involving radar blackout and clutter, absorption and reflection; on acquisition and tracking systems and on missile guidance and control systems; and on design in ABM application.

b. Capabilities of long range detection systems.

c. Variation in partition of energy from detonations with altitude.

d. Effects of a nuclear detonation on incoming re-entry vehicles from X-ray and neutron fluxes, thermal radiation, blast and shock and the vulnerability of our ICBM's.

e. Bio-medical data, particularly in the area of chorio-retinal burns, which will add significantly to our limited knowledge in this field.

 [redacted]

f. Effects of a nuclear detonation as a function of yield and altitude, on injection of electrons into the earth's magnetic field and the associated effects of artificial radiation belts on satellites.

g. Warhead kill radius and effects on optical systems.

h. Communication outages were generally short-lived. No large-scale communications effects were expected. However, the STAR FISH shot was a surprise in that the phenomenology was much different than expected and the communications effects were much reduced. The other shots produced results which were unspectacular when compared to the TEAK and ORANGE shots of 1958, but were sufficiently widespread to allow good comparison with theory and enhance greatly the understanding of communications in a nuclear blast environment.

G. CONCLUSIONS:

1. In spite of the difficulties experienced in the execution and completion of the five high altitude effects tests, from a technical standpoint this part of Operation DOMINIC is considered highly successful. Although four failures were encountered during this operation caused by tracking and launch difficulties, considerable operational knowledge and experience was garnered from these events. From the successful detonations, a profusion of technical data was gathered. Throughout the tests an amazingly high percentage of experiments obtained useful data. This data, when reduced and with meaningful analysis, will furnish a firm foundation for evaluating the effectiveness of nuclear blackout as a penetration aid for ballistic missiles, the effects of high altitude bursts on radio communication links and navigation systems and the effects on guidance systems involving stellar sensors. Of great military significance will be the evaluation of the effects of a nuclear burst on detection and tracking systems involving infrared radiation and the effects on satellites from electrons trapped in the geomagnetic field. Some information has been obtained which will be of value in determining the vulnerability of our ICBM's, yet it is believed some of the fundamental questions in this area will remain unanswered.

 [redacted]

[redacted]

ANNEX A

TO APPENDIX C, REPORT OF BLUE GILL EVENT

Device: Deleted	Date/Time: 040957Z Jun 1962
Predicted Yield:	Predicted Burst Alt: Deleted
Actual Yield: N/A	Actual Burst Alt: N/A
Vehicle: THOR	Geographical Location: N/A

1. GENERAL: The BLUE GILL event was the first missile launch in Operation DOMINIC at Johnston Island which carried a live nuclear warhead. This operation was preceeded by the TIGER FISH certification shot which was launched on 2 May 1962. TIGER FISH was conducted to evaluate performance of the THOR missile range safety re-entry vehicle and pod systems and utilized an inert warhead. The successful completion of the certification shot led to the preparation for and launching of the BLUE GILL missile, originally planned to be executed about fifteen days after certification. The THOR missile launch of the BLUE GILL event inaugurated the high altitude weapons effects portion of Operation DOMINIC, the most extensive and widely dispersed operation of its kind in the history of nuclear testing.

2. CONFIGURATION AND INSTRUMENTATION: The THOR was originally selected as the launch vehicle to be utilized in the FISH BOWL events because of its ability to carry pods and re-entry vehicles. These pods, externally carried, were to be placed at specified positions from the burst point. They were heavily instrumented and were designed to be recoverable. The primary reason for the pod program was to enable the direct measurement of the effects of fireball thermal radiation as they concern ICBM kill mechanisms and vulnerability. This was to be done by exposing representative re-entry vehicle materials and by measuring inducted total momentum and X-ray spectra at an accurately known distance from the burst to the pods. The importance of the pods is that the sensors can be placed fairly precisely, that the post shot pod locations can be fixed with great accuracy and that the X-ray or gamma ray flux causing the effects are from weapons in the yield ranges of military importance. It was felt that the United States did not have adequate X-ray effects data from nuclear detonations at yields of military operational interest and an urgent requirement existed to obtain these data. There was not sufficient confidence that laboratory experiments and computations of simulated X-ray fluxes and their effects on various materials were representative of real nuclear detonation effects. The pod program provided a tie-in between the extensive simulated X-ray effects work in

[redacted]

[redacted]

laboratory, the real X-ray effects data from tests at the Nevada Test Site and the effects of large, operational yields, minimizing needs for extrapolation. The subsequent failure of STAR FISH, BLUE GILL Prime and BLUE GILL Double Prime events using the THOR vehicle with instrumented pods led to extensive study and serious consideration towards replacing the vehicle or eliminating the pods. However, no positive information has been made available showing the pods contributed in any significant way to decreased reliability of the THOR system and the pod/re-entry vehicles were successfully carried in TIGER FISH, BLUE GILL, STAR FISH Prime, BLUE GILL Triple Prime and KING FISH events. Extensive scientific instrumentation was established at Johnston Island, on ships and aircraft strategically arrayed near burst point and conjugate areas and at other locations throughout the Pacific area. Rocket-borne instrumentation and measurement recording devices were installed at Johnston Island and Kauai Island to test this new method of gathering diagnostic data on detonations.

3. INITIAL RESULTS: The THOR missile carrying the three pods and an Deleted warhead was launched on 4 June 1962 shortly after midnight. The THOR flew what appeared to be a normal trajectory, but the re-entry vehicle was lost by the tracking system before an impact prediction could be determined thereby guaranteeing a safe trajectory. The BLUE GILL event was the most demanding missile experiment, from a safety point of view; therefore, complete tracking was an absolute requirement. Although extensive diagnostic experimentation in the weapon effects area characterized this event, one of the primary purposes of this experiment was to secure data on the effect of the blast on RF transmissions. One of the key experiments was to transmit signals from rocket-borne instruments, above the fireball, to receivers in ships which were displaced very near the surface point below the fireball, so they might realize a high probability of securing good data on transmission effects through the burst point. The Commander Joint Task Force EIGHT had hoped to reacquire track until late in the trajectory, but when he felt there was no longer a possibility of determining the re-entry vehicle was on a safe trajectory the missile was commanded to destruct in interest of the safety of the ship array. The fact that the firing system worked perfectly in TIGER FISH and the destruct system worked as commanded in the BLUE GILL event indicated the firing-safety system was sound. The destruct time was 0957:47.936Z on 4 June 1962. This was a serious setback in the FISH BOWL Program and caused a reanalysis of the tracking capability and the inclusion of a back-up tracking system for use in the subsequent high altitude events. None of the desired effects data was obtained because no nuclear detonation took place in this event.

[redacted]

[redacted]

ANNEX B

TO APPENDIX C, REPORT OF BLUE GILL PRIME EVENT

Device: — Deleted

Predicted Yield: —

Actual Yield: N/A

Vehicle: THOR

Date/Time: 260915Z Jul 1962

Predicted Burst Alt: Deleted

Actual Burst Alt: N/A

Geographical Location: N/A

---

1. GENERAL: The BLUE GILL weapons effects test using Deleted approximately 35 KM south of Johnston Island, was not again attempted until 26 July 1962 due to the STAR FISH event attempted on 19 June 1962 and the STAR FISH Prime event successfully completed on 8 July 1962. A minimum of 15 days was required between launches for refurbishing and technical adjustments required to be completed on the pad and associated equipment. By this time in the program, three independent tracking systems were available providing a high probability of being able to predict impact with acceptable accuracy. Analysis and review of these various tracking systems used on STAR FISH Prime indicated that for BLUE GILL Prime the ships, S-1 through S-4, could be repositioned to receive transmissions from the Project 6.1a rockets, without introducing a substantial possibility that would require destroying the missile because of the threat to the ships. Therefore, the BLUE GILL Prime ship array was established with the center located on a bearing of 192 degrees from Johnston Island, with the nearest ship to the surface impace point of the planned trajectory being 13.4 nautical miles, as contrasted with 9.3 nautical miles which applied to BLUE GILL.

a. Burst Point Ship Array: The four ships concerned were enclosed in a "protected area" based on a radius approximating three nautical miles (for possible navigational errors), to which an additional 1.6 nautical miles was extended beyond each ship to make the total protected area around the center of the ship array. It was planned to detonate the weapon if the predicted impact was within an area extending from 10 nautical miles to 100 nautical miles south of Johnston Island and enclosed on the two sides by radii from Johnston Island with bearings of 100 degrees and of 270 degrees, excluding the protected area mentioned above.

2. CONFIGURATION AND INSTRUMENTATION: The flight vehicle was a THOR missile, Number 180, whose primary objective was to deliver a re-entry vehicle with a nuclear warhead to a burst-point in space at a precise

[redacted]

[redacted]

time from lift-off. A secondary objective was to carry and release three instrumented pods/re-entry vehicles at specified positions with respect to the re-entry vehicle to obtain weapons effects data from the BLUE GILL Prime detonation. The pod instrumentation was similar to that of BLUE GILL. The back plates of the pods held numerous small experiments. The pods were stabilized by heavy internal flywheels and it was hoped that after the pods were released from the missile at main engine burnout time they would remain in a near vertical position. Release times were programmed so that the pods would be below the burst with their back plates approximately normal to the lines from the pods to the detonation. The pods contained transponders to assist in determining actual position after detonation and recovery gear so they could be located and recovered.

3. INITIAL RESULTS: Final preparations were satisfactorily completed and the launch was attempted on 25 July 1962 at 23:13:57 (Hawaiian Standard Time). Abnormal ignition characteristics, failure to achieve main stage and a subsequent oxidizer pump explosion resulted in the Commander Joint Task Force EIGHT requiring range safety to issue the re-entry vehicle command destruct at 23:14:8 HST. Following this event the liquid oxygen tank exploded and destroyed the missile on the launch pad. Later analysis showed the cause to be the main oxidizer valve opened only partially, allowing insufficient liquid oxygen to flow, while the main fuel valve functioned normally and operated to full position. This allowed large amounts of fuel to be pumped into the main thrust chamber and the fuel became ignited and flames enveloped the missile. Following the re-entry vehicle destruct, the liquid oxidizer (LOX) tanks exploded and completely destroyed the missile on the pad. The ensuing fires and explosions caused extensive damage to the pad and associated missile equipment. There were no injuries incurred by personnel on or near Johnston Island. Immediate steps were taken to contain the conflagration and minimize the possibility of personnel contamination by disaster control teams. However, as no back-up pad was programmed in the original planning of facilities for the missile launchings at Johnston Island, this event caused an unexpected delay of approximately two months in the planned sequence of subsequent high altitude events. Because of the complete destruction of the firing pad, a new pad had to be located, transported, installed and checked-out before the next launch could take place. The effect of this delay on the nuclear testing program caused the Commander Joint Task Force EIGHT, in conjunction with the other high level associated defense agencies, to reappraise the single launch pad concept and consequently led to a decision to place a second launch pad on Johnston Island for back-up in the event of a future recurrence of pad damage as experienced on this event. Ultimately some gains were experienced from this seemingly catastrophe when the Atomic Energy Commission laboratories were able to include five additional air drop developmental tests when the test series resumed in late September. Also, two subsequent high altitude, low yield events were added to the test program.

[redacted]

[redacted]

ANNEX C

TO APPENDIX C, REPORT OF BLUE GILL DOUBLE PRIME EVENT

Device: — Deleted

Predicted Yield: —

Actual Yield: N/A

Vehicle: THOR

Date/Time: 160915Z Oct 1962

Predicted Burst Alt: Deleted

Acutal Burst Alt: N/A

Geographical Location: N/A

---

1. GENERAL: The launch pad area and associated components at Johnston Island were completely refurbished about eight weeks after the unfortunate conflagration resulting from the BLUE GILL Prime premature destruction and resulting fires and explosions. A second launch pad was also brought in and assembled to provide a back-up pad, should one be needed, to eliminate any further delays due solely to the inability to launch a vehicle. This event was originally planned to be executed in late September. Considerable concern was visible from a scientific viewpoint, because during the interim period one of the heavily instrumented KC-135 aircraft experienced an unfortunate accident on a non-JTF 8 mission which required replacement and reconfiguration of the aircraft. Completion of the modification could not be accomplished until early October. However, this problem was resolved and the aircraft was included in the array when the manned orbital flight, MA-8, was brought into the picture about this time. To prevent any interference to this high priority space project the BLUE GILL Double Prime event was scheduled for MA-8 plus 11 days which resulted in the event taking place on 15 October 1962 at 2315 hours (HST). Three additional ships were added to the ship array, primarily for the KING FISH event, and were located as follows: (1) S-6, 151 nautical miles at a true bearing of 036.3 degrees, (2) S-7, 202.5 nautical miles at a true bearing of 010 degrees and (3) S-8, 151 nautical miles at a true bearing of 343.5 degrees.

2. CONFIGURATION AND INSTRUMENTATION: The vehicle prepared for this event was a THOR missile, number 156, to which three heavily instrumented pods were externally attached. The operation and function of these pods was the same as that in the preceding BLUE GILL events. Preparation for this event differed in one respect, however, in that a NIKE-HERCULES capability was being prepared as a THOR back-up for the BLUE GILL Double Prime event. Certifications were undertaken to determine the feasibility of using the NIKE-HERCULES carrying Deleted warhead if the THOR experienced further difficulties. Subsequently two failures of the NIKE-HERCULES system were experienced in which the self-destruct systems were activated shortly after launch,

[redacted]

[redacted]

believed to be caused by one or more elements in the intense electronic environment surrounding Johnston Island or inadequate spacing in the launch configuration.

3. INITIAL RESULTS: The third attempt to launch a THOR missile and successfully detonate a live warhead on 15 October 1962 ended in destruction of the warhead shortly after launch, due to a missile malfunction preventing the missile from executing its programmed trajectory. A preliminary study indicates the cause of failure was a random malfunction in the engine actuator circuitry. Telemetry showed the missile was given hard pitch at 86 seconds from launch and photography shows tumbling took place. Thrust was terminated at 94 seconds and the warhead was destroyed shortly thereafter via the command destruct signal. This failure, coupled with the others, gave rise to the feeling that the THOR failures might be due to the degrading of the basic flight reliability by the pods. Photographs showed that, beginning about 39 seconds after launch, backflow flames from the turbine exhaust enveloped pod number two. When recovered, this pod was badly scorched over its entirety, while the other two pods were not. Because of the uncertainty of the reliability of the THOR after this event, serious consideration was given to attempt the BLUE GILL Triple Prime launch employing a NIKE-HERCULES vehicle. Two primary disadvantages were evident if this vehicle would have substituted for the THOR. These were: (1) That pod experimentation would have been eliminated and (2) that a certain portion of the data gathering rockets launched from Johnston Island and Kauai would have to be fired prior to the NIKE-HERCULES launch. If the NIKE-HERCULES failed to launch, these rockets would have been lost. Two subsequent NIKE-HERCULES certification firings ended in self-destruction after launch by activation of the fail-safe system because of beacon loss for a preset period of time. Thus, the THOR was selected as the vehicle for the BLUE GILL Triple Prime event.

[redacted]

ANNEX D

TO APPENDIX C, REPORT OF BLUE GILL TRIPLE PRIME EVENT

Device: —

Predicted Yield: — Deleted

Actual Yield: —

Vehicle: THOR

Date/Time: 260959Z Oct 1962

Predicted Burst Alt: — Deleted

Actual Burst Alt: —

Geographical Location: 19.1 nautical miles from Johnston Island on bearing 192 degrees True

---

1. GENERAL: The 26th of October 1962 at 0959Z was significant, in the test series, because at that time the BLUE GILL event became a reality, after three previous unsuccessful attempts to detonate Deleted. warhead at near the prescribed point in space. The detonation occurred about one mile from the intended position and was the third successful detonation in the FISH BOWL high altitude test series (preceded by STAR FISH Prime and CHECK MATE). The data procured by the scientific projects from this event were considered exceptional in that participation was outstanding. The projects were in an exceptional state of readiness and with near ideal weather conditions prevailing for this event, excellent data were obtained. One of the primary objectives of this event was to evaluate the effects of a nuclear detonation Deleted on anti-missile radar surveillance capacity. The basic reason for choosing Deleted. Other major scientific objectives were:

a. Determination of effects of this detonation on communications.

b. Evaluation of re-entry vehicle kill mechanisms which result from the detonation.

c. Investigation of the basic characteristics and the geographical effects of such a detonation.

d. Evaluation of nuclear detonation diagnostic and detection techniques Deleted.

[redacted]

2. <u>CONFIGURATION AND INSTRUMENTATION:</u> Deleted. warhead used in this event was carried by the THOR vehicle, Number 141. Three pods, resembling re-entry vehicles were attached to the missile at the time of launch. The back plates of the pods held numerous small experiments. The pods were stabilized by heavy internal flywheels and it was hoped that, after the pods were released from the missile at about main engine burn-out time, they would remain in a near vertical position. Release times were programmed so that the pods would be below the burst with their back plates approximately normal to the lines from the pods to the detonation. The pods contained transponders to assist in tracking in order to determine H-hour positions and recovery gear so that they could be located. Desired pod distances from air zero were 2,500 feet, 4,000 feet and 6,000 feet.

a. Radar surveillance capabilities after the BLUE GILL detonation were studied with three types of measurements:

(1) NIKE-APACHE rockets carrying C-band transponders were launched from Johnston Island to the burst vicinity and tracked from the DAMP Ship (100 KM magnetic north of Johnston Island) with high precision radars.

(2) L-, C- and X-band and 300 mc transponders, carried in NIKE-CAJUN rockets launched from Johnston Island, transmitted through the fireball and burst vicinity to receivers on Johnston Island and ships nearby.

(3) Radar clutter was studied by observing radar reflections from the detonation on ship, aircraft and land-based radars. Communications effects of the detonation were studied by measuring both the direct communications degradation and the detonation produced ionospheric disturbance. High frequency communication paths throughout the Pacific were tested and monitored before and after the detonation, as were various communication paths from Johnston Island. Disturbances in the reception of low frequency communication signals at Johnston, Hawaii, Tongatapu and other stations were noted.

(a) Small rockets were launched from Johnston Island into the ionosphere to determine D-region composition in the vicinity of the burst.

(b) Ionosondes were used throughout the Pacific area to determine electron concentrations in the ionosphere.

(c) Riometers were used to measure fluctuations in ionospheric electron concentrations and to measure synchroton noise generated by detonation created electrons spiraling along the geomagnetic lines. There were also radio frequency radiometry measurements from

[redacted]

[redacted]

Johnston Island and airborne ionospheric measurements from a KC-135.

(d) Missile kill mechanisms were studied by instrumentation on the three pods. The back plates held neutron, gamma, X-ray and thermal radiation devices. The pods also contained accelerometers, overpressure gauges and various material samples for measuring structural response to the thermal radiation pulse.

(e) Photometric, spectroscopic and photographic coverage of the detonation was provided from Johnston Island, Hawaii, Maui, KC-135 aircraft, C-118 aircraft, ships in the vicinity of Johnston Island and stations at other locations such as Tongatapu and Tutuila. Variometers for measuring fluctuations in the earth's magnetic field and microbarographs for measuring pressure fluctuations were located throughout the Pacific area. Rocket-borne instruments for measuring D-, E- and F-region characteristics were launched from Johnston Island. Monkey and rabbit eyes and flash blindness protective devices were exposed to the thermal pulse of the detonation in C-118 aircraft and on Johnston Island as part of the retinal burn study. The electromagnetic signal from the weapon was measured at a number of locations throughout the Pacific area. Rocket-borne radio-chemical samplers were also launched from Johnston Island and a number of rockets were launched with instrumentation to obtain high altitude meteorological information.

3. INITIAL RESULTS:

a. Visual Phenomena: The detonation over Johnston Island produced spectacular phenomena. The cloud immediately formed into a "smoke-ring" shape until dispersed by high altitude winds. The visible phenomena was seen as an orange flash from Oahu and Hawaii. From Kauai it appeared as a rainbow-like flash with a brief bit of green, yellow and red on the horizon. Samoa reported a narrow band of bright pink at the horizon, northward along the magnetic field line, to green about thirty degrees above the horizon. These colors faded to a dull pink at H-plus three minutes, at H-plus ten minutes was gray and still visible at H-plus 20 minutes. Detonation at Johnston Island was accompanied by a brilliant white flash and a thermal pulse that was noticeably felt on the bare skin. At H-plus ten minutes the cloud was about 120 degrees across and its glow permitted the dial of a watch to be easily read. It was still visible at H-plus 30 minutes but was no longer apparent by H-plus one hour. Spectacular visible phenomena was also seen at the DAMP Ship located 100 KM magnetic north of Johnston Island.

b. Pod Instrumentation: Pod positioning seemed to be satisfactory and although orientation needed to be confirmed by examination of the X-ray and thermal pinhole cameras, it appeared that all pods were correctly aligned. All three pods were recovered and instrumentation removed; pod two did sustain moderate structural damage but its instrumen-

[redacted]

[redacted]

tation was in fair condition. Radiation levels probably caused by neutron induced beta and gamma activity, measured at the back plates at H-plus eight hours were: Pod #1, 14 R/hour; Pod #2, 5 R/hour and Pod #3, 3 R/hour. No alpha activity was detected on the pods. Useful data on impulse thermal and X-ray loading of Pods #1 and #2 was obtained by Project 8A.3. Blast measurement data was obtained by Project 1.1 which recovered all pod instrumentation. External neutron flux measurements, under Project 2.1, were very successful as all neutron foils, except one set in Pod #2, were recovered intact.

c. Biomedical: Four out of the five aircraft assigned to projects in this area participated in BLUE GILL Triple Prime biomedical measurements. The program was estimated as 75 per cent successful. One of the aircraft, at 34.5 miles and 22,450 feet altitude, reported 12 of 12 possible rabbit burns and two of two possible monkey burns. Thermal measurements were obtained on this aircraft along with good photographic data. The other aircraft participating were successful in obtaining considerable data, by various methods, for study in the chorioretinal burn area.

(1) Two inadvertent human exposures were added to the Project 4.1 retinal burn study as a result of this event. Preliminary observation revealed that these individuals suffered bilateral fovea burns and the history of these personnel will be followed by project personnel initially at Tripler Army Hospital, Honolulu, Hawaii and subsequently at the USAF Aviation Medicine Division, Brooks AFB, Texas.

d. Electromagnetic Projects:

(1)

Deleted.

Pages L-C-4-5 and L-C-4-6 are deleted.

[redacted]

[redacted]

Deleted the middle pod impacted abnormally, degrading its instrumentation. Pod orientation appears to have been correct. Geomagnetic disturbances were noticeable but moderate; the magnetic field fluctuations were approximately a factor of 10^3 smaller than from STAR FISH Prime (1.4 MT at 400 KM altitude)

Strong electromagnetic pulses from the detonation were observed in the Pacific area. Two inadvertent human eye exposures resulted in bilateral foveal burns; rabbit and monkey retinal burns were obtained as part of the chorioretinal burn studies.

[redacted]

[redacted]

ANNEX E

TO APPENDIX C, REPORT OF STAR FISH EVENT

Device: — Deleted	Date/Time: 200808Z Jun 1962
Predicted Yield: —	Predicted Burst Alt: 400 KM
Actual Yield: N/A	Actual Burst Alt: N/A
Vehicle: THOR	Geographical Location: N/A

1. GENERAL: STAR FISH was the second high altitude event attempted from Johnston Island under Operation FISH BOWL to obtain urgently needed weapons effects data along with seeking answers in the physics investigation of associated phenomena. The STAR FISH vehicle was launched at 2308 (HST) on 19 June 1962 and ended in failure some 60 to 70 seconds later.

2. CONFIGURATION AND INSTRUMENTATION: The configuration was the same as STAR FISH Prime and the description is given under that event.

3. INITIAL RESULTS: The missile flew a nominal course until 59 seconds after lift-off when a flash was observed and the rocket motor ceased functioning. At approximately 65 seconds after lift-off, the Range Safety Officer transmitted the destruct signal to the booster and the re-entry vehicle. The telemetry indicated that the booster and re-entry vehicle had not separated when the signal was received at 66 seconds. The missile was at an altitude of between 30,000 and 35,000 feet when destroyed. The cause of the flight failure was a localized heating of the engine section external skin due to a base heat phenomena which caused a failure of the THOR boat-tail structure. It was established by examination of the THOR remnants that the main thrust beam moved forward as the outer engine section skin failed in shear. The movement of the thrust beam caused the entire engine pump to rotate rupturing the propellent ducts. This rupture was immediately followed by an explosion in the engine section. The examination of the engine and turbo pumps definitely proved that the engine and turbo failure was not the cause of the explosion. The metallurgical examination of the recovered engine structure indicated that the temperature of the outer skin was in excess of 400 degrees farenheit which would cause a structural failure. The photography of the launch graphically shows the extreme heating of the AVCO pod fairing structure due to the reverse flow of the turbine exhaust. In addition, the telemetry also indicated that an instant prior to final destruction the missile pitched in a manner that would be expected due to collapse of the main beam thrust. The excessive heating occurred because base pressures behind

[redacted]

[redacted]

the pod fairings were lower than those on the missile base. This caused the turbine exhaust products, which normally flow about the insulated THOR base, to be pushed forward on the uninsulated engine section cylinder. TIGER FISH and BLUE GILL used three GDA pods which more nearly filled the base area behind the fairings. STAR FISH used one GDA pod and two AVCO pods. Lower base pressure existed behind the AVCO pod fairings and hence there was more pumping of hot exhaust products into the area. The proposed fix to correct this condition called for an additional thickness of fiberglass insulation on the aft bulkhead and the engine section was surrounded with an additional .020 inch thick insulator. All pod support hardware was coated with thermo-lag. A bulkhead was also installed to close the flow path between the pod and the fairing. All wiring in the pod area was given an additional wrapping of insulation.

[redacted]

[redacted]

ANNEX F

TO APPENDIX C, REPORT OF STAR FISH PRIME EVENT

Device: — Deleted

Predicted Yield: —

Actual Yield: 1.15 MT

Vehicle: THOR

Date/Time: 090900Z Jul 1962

Predicted Burst Alt: 400 KM

Actual Burst Alt: 400 KM

Geographical Location: 31 KM from Johnston Island on a bearing of 190 degrees True

---

1. GENERAL: The STAR FISH Prime event was the first successful high altitude event of Operation FISH BOWL in which a live nuclear warhead was detonated. Deleted was launched from Johnston Island on a THOR vehicle whose trajectory carried the re-entry vehicle to an apogee and then down to the burst altitude. Detonation occurred at 0900:09:0240Z on 9 July 1962 at 400 KM approximately 31 KM from its launch pad with a nominal yield Deleted Scientific participation in obtaining desired data was considered to be highly successful. One startling result from this experiment was the change created in the radiation belt and its effect on certain "soft" satellites which will be covered in the results section of this report.

Deleted

Other major scientific objectives include:

a. Evaluation of missile kill mechanisms and vulnerability.

b. Evaluation of the effects of a high altitude nuclear detonation on electromagnetic surveillance capability.

c. Evaluation of the effects of a high altitude nuclear detonation on communications.

d. Investigation of the basic characteristics of a high altitude nuclear detonation and the physical basis of the effects.

e. Evaluation of high altitude nuclear detonation weapon diagnostic and detection techniques.

2. CONFIGURATION AND INSTRUMENTATION: The warhead, Deleted. was carried by a THOR missile. The missile was modified for this event by inclusion of telemetry, safety (destruct) systems, and

[redacted]

special external insulation to prevent excessive heating of the after structural members. Three 1,200 pound instrumentation pods, resembling re-entry vehicles, were attached to the missile at the time of launch. These pods were stabilized by heavy internal flywheels, designed to rotate at a specified RPM, and to be placed, after release, in a precalculated point in space and, it was hoped, in a vertical position to facilitate data acquisition. Release times were programmed so that the pods would be below the burst point with back plates perpendicular to it. The pods contained transponders to assist in determining actual positions after the detonation and recovery gear to facilitate location and recovery of pods after detonation. The back plate of the pods held numerous diagnostic recording and measuring instruments along with those contained internally. The re-entry vehicle, containing the warhead, was spin stabilized → Deleted during flight. It weighed 2,580 pounds. An unsuccessful attempt was made to launch two rockets from Point Arguello in California in support of the TU 8.1.1 effort.

3. <u>INITIAL RESULTS</u>:

a. <u>Visual Phenomena</u>: The visible phenomena due to the burst were widespread and quite intense; a very large area of the Pacific was illuminated by the auroral phenomena, from far south of the south magnetic conjugate area (Tongatapu) through the burst area to far north of the north conjugate area (French Frigate Shoals). A large amount of spectroscopic data were obtained. At twilight after the burst, resonant scattering of light from lithium and other debris was observed at Johnston and French Frigate Shoals for many days confirming the long time presence of debris in the atmosphere. At zero time at Johnston Island, a white flash occurred, but as soon as one could remove his goggles, no intense light was present. A second after shot time a mottled red disc was observed directly overhead and covered the sky down to about 45 degrees from the zenith. Generally, the red mottled region was more intense on the eastern portions. Along the magnetic north-south line through the burst, a white-yellow streak extended and grew to the north from near zenith. The width of the white streaked region grew from a few degrees at a few seconds to about 5-10 degrees in 30 seconds. Growth of the auroral region to the north was by addition of new lines developing from west to east. The white-yellow auroral streamers receded upward from the horizon to the north and grew to the south. At about two minutes the white-yellow bands were still about ten degrees wide and extended mainly from near zenith to the south. By about two minutes, the red disc region had completed disappearance in the west and was rapidly fading on the eastern portion of the overhead disc. At 400 seconds essentially all major visible phenomena had disappeared, except for possibly some faint red glow along the north-south line and on the horizon to the north. No sounds were heard at Johnston Island that could be definitely attributed to the detonation.

[redacted]

b. Pod Instrumentation:

Deleted DOE Pod S-1, closest to burst, was essentially at its desired location of eight kilometers from air zero.

Deleted DOE

The pod did have a circumferential crack and a dent in the lining, but these may have been caused by impact with the water or rough handling on recovery. Pod S-3, furthest from the burst, was 23 KM from air zero rather than the desired 14 KM. Its backplate was slanted from normal to the burst with the axis of the pod forming an angle of 40 degrees from a line through the burst point to the pod. As a result the experiments were degraded both by excessive distance and shadowing.

Deleted DOE

c. Biomedical: Project 4.1 participated in the study of chorioretinal effects through five airborne stations and ground stations at Johnston and Maui Islands. Measurements of the spectral distribution and intensity of the thermal energy were taken for correlation with chorioretinal burn data on rabbits. In this connection, various eye protection devices and photographic materials were also tested. Extensive photographic instrumentation was employed to view the specimen eyes and the burst. All stations reported no burns were evident. Tentative evaluation of the thermal pulse indicated peak irradiance of 0.5 watt/cm^2 at Johnston Island with the time to this pulse of less than five microseconds. Within six microseconds the pulse fell to less than one per cent of peak irradiance.

d. Electromagnetic Measurements:

Deleted.

Page L-C-L-4 is deleted.

[redacted]

[redacted]

Deleted

The injection of large amounts of debris into the geomagnetic field above the burst, and the mechanism of the subsequent debris distribution are not fully understood. The effects appear to be quite complex.

g. Summary:

(1) General: The STAR FISH Prime event significantly increased the understanding of high altitude nuclear detonations and their effects. Deleted

Some data were obtained on the direct effects of bomb X-rays on materials carried on pods near the burst, however, most pod experiments were not as successful as desired because of pod stabilization and positioning difficulties.

Deleted

High altitude nuclear detonation detection systems were tested with a very considerable degree of success. The small rocket weapons effects and phenomenology diagnostic program from Johnston Island was quite successful.

(2) STAR FISH Beta Injection: One of the early results of STAR FISH Prime injection of betas was the effect the increase in radiation had on satellite solar cells. The United Kingdom satellite "Ariel" must have been in the Southern Conjugate area of the STAR FISH Prime event at the time of arrival at the initial radiation. Follow-

Page L-C-6-6 is deleted.

[redacted]

[redacted]

ANNEX G

TO APPENDIX C, REPORT OF KING FISH EVENT

Device: —

Predicted Yield: — Deleted

Actual Yield: —

Vehicle: THOR

Date/Time: 011210Z Nov 1962

Predicted Burst Alt: — Deleted

Actual Burst Alt: —

Geographical Location: 70 KM from Johnston Island on bearing 191 degrees True

---

1. GENERAL: The KING FISH event was planned originally as a contingency event to be executed only if there was an unexpended THOR missile after completion of BLUE GILL, STAR FISH and URRACA (This event was later cancelled) providing Presidential approval would be granted. Approval was originally granted on 15 May 1962, by the Chairman of the Joint Chiefs of Staff, to prepare for the event using a backup THOR missile with a Deleted to be detonated at the altitude of The unsuccessful STAR FISH event on 19 June 1962 caused a reappraisal of the high altitude program and on 23 June 1962 the Commander Joint Task Force EIGHT was instructed to suspend all planning for it. Due to the extension of the Johnston Island portion of Operation DOMINIC, KING FISH was subsequently reinstated as a FISH BOWL high altitude event. The Chief of Naval Operations felt the KING FISH event would greatly increase the Navy's opportunity to collect valid data on operational communications and electronic equipment in a nuclear environment. The Commander Task Unit 8.1.3 felt that although not all the desirable measurements proposed for this event in BLUE ROCK (The 1965 Nuclear Effects Tests) could be obtained by its inclusion at this time, a sufficient number of important areas could be documented to make the event well worth the effort to overcome the operational difficulties and existing uncertainties. After lengthy consideration on retinal burn hazards, trajectory and data recovery problems, the KING FISH burst position was finally resolved Deleted altitude with the horizontal range 70 KM on a bearing of 191 degrees True from Johnston Island.

Deleted

Approval for execution of KING FISH was given to the Commander Joint Task Force EIGHT on 24 October 1962, only eight days prior to the actual firing. This approval was contingent upon the establishment of new satellite protection criteria and the acceptance by the CJTF 8 of authority to detonate the KING FISH device only at specified times, when damage to satellites would be minimized. The THOR missile carrying the device for this event was launched at

[redacted]

1154:47Z on 1 November 1962. After a normal trajectory the device detonated at 1210:06Z with a nominal yield Deleted within an acceptable burst accuracy. For this event there were some transient trapped electrons which did not get past the Atlantic anomaly. Some synchroton noise was detected for a few minutes near the equator between the burst and the meridian through the Atlantic anomaly. Satellite measurements show that little, if any, electrons were added to the radiation belts as a result of the KING FISH firing.

a. <u>Expected Phenomena:</u> The following qualitative remarks can be made about the phenomenology of KING FISH. Deleted

the bomb X-rays penetrate to a number of kilometers horizontally from the detonation point. As a result there should be a distinct and persistent fireball as is characteristic of lower altitude detonations. The altitude is sufficiently low for the debris to be largely contained by the surrounding air; the questions of how rapidly the bomb debris rises, and whether significant amounts of debris and decay betas are injected along the magnetic field lines as the debris rises, are ones of prime interest in the KING FISH event.

b. <u>Objectives:</u> The KING FISH high altitude nuclear detonation had the following major scientific objectives:

(1) Evaluation of the effects of a Deleted detonation on anti-missile radar surveillance capability.

(2) Evaluation of the effects of this detonation on long and short range communications.

(3) Evaluation of the re-entry vehicle kill mechanisms which result from the detonation.

(4) Investigation of the basic characteristics of Deleted detonation, and the geophysical effects of such a detonation.

(5) Evaluation of nuclear detonation diagnostic and detection techniques Deleted

(6) Deleted altitude for the KING FISH detonation was chosen to study the effects of a detonation in Deleted

altitude might have been more desirable, but was precluded by operational difficulties and safety considerations.

2. <u>CONFIGURATION AND INSTRUMENTATION:</u> The launch vehicle for KING FISH was a THOR missile, modified for the firing by the inclusion of telemetry, safety (destruct) systems and special internal insulation to pre-

vent excessive heating of the after structural members. The warhead, Deleted of a total re-entry vehicle weight of 1,350 pounds.

The KING FISH re-entry vehicle was spin stabilized along the longitudinal axis of the device and did not employ a heat shield. Three 1,200 pound pods, resembling re-entry vehicles, were attached to the missile at time of launch. These carried many small experiments, most of them mounted on the backplates for direct exposure to the burst. The pods were stabilized by heavy internal flywheels and it was hoped that after release from the missile, at about main engine burnout time, they would remain in a near vertical position. Release times were programmed so that the pods would be below the burst with their backplates approximately normal to the lines from the pods to the detonation. The pods also contained transponders to assist in determining actual H-hour position and recovery gear so that they could be located and recovered. Desired pod distances from air-zero were 1.9, 2.4 and 3.3 KM. From Johnston Island, 29 rockets were fired in support of experiments, and a large array of optical and electromagnetic instrumentation was operated. Surrounding the island, a fleet of ships and aircraft operated with technical stations aboard. Stations were established in the Hawaiian area to observe the burst from elevated locations. Fifteen rocket-borne instrument packages were launched from a firing area at Barking Sands, Kauai. Radar surveillance capabilities after the KING FISH detonation were studied with three types of measurements: First, NIKE-APACHE rockets carrying C-band transponders were launched from Johnston Island to the burst vicinity and tracked from the DAMP Ship (80 KM magnetic north of Johnston Island) with high precision radars (Project 6.13); second, L-, C-, and X-band and 300 mc transponders, carried in NIKE-CAJUN rockets from Johnston Island, transmitted through the fireball and burst vicinity to receivers on Johnston Island (Project 6.1); third, radar clutter was studied by observing radar reflections from the detonation on ship and aircraft radars and on Johnston Island (Project 6.9). Some of the basic characteristics and geophysical effects of the KING FISH detonation which were of particular interest are the following:

a. Intensity and duration of the thermal radiation pulse from the detonation.

b. Debris motion and rate of rise, and the related location and intensity of beta and debris pancakes in the magnetic conjugate areas.

c. The spatial extent, persistence, and intensity of the ionization in the vicinity of the burst.

d. Electromagnetic signal strength from the weapon as a function of time, frequency, and geographic location.

[redacted]

e. Geomagnetic field fluctuation and atmospheric pressure fluctuations resulting from the detonation.

The evaluation of detection and diagnostic techniques were, of course, closely related to the previously discussed objectives. The study of the radiation transport and low air density hydrodynamics are of special interest to diagnostic technique development. In addition, the Vela Sierra high altitude detection system was tested. Rocket-borne radio-chemical samplers were launched from Johnston Island and a number of rockets were launched with instrumentation to obtain high altitude meteorological information. Project 6.1 launched four NIKE-APACHE rockets to measure radar transmission through the fireball area and through the northern beta patch and debris pancake area. Project 6.2 launched three HONEST JOHN/NIKE-NIKE rockets to scan the gamma and beta ray flux intensity and directional dependence after burst. Project 6.3 launched four HONEST JOHN/NIKE-NIKE rockets and two NIKE-CAJUN rockets to measure D-region characteristics. These rockets carried beta and gamma flux meters, ion traps, mass spectrometers, and RF impedence probes. Project 6.4 launched two JAVELIN rockets containing payloads similar to the Project 6.3 rockets for measuring E-layer and F-layer characteristics. Most of the Project 6.2, 6.3 and 6.4 rockets contained three frequency beacons for measuring ionospheric electron concentration. Project 6.13 launched four NIKE-APACHE rockets for radar tracking experiments, broadcasting on C-band through the beta patch and fireball area to the DAMP Ship.

3. <u>INITIAL RESULTS:</u>

a. <u>Visual Phenomena:</u> At a few seconds after burst there was a ring with a transparent outer edge and an inner luminous circular region containing an irregular cloud-like mass. The outer transparent edge quickly disappeared leaving a luminous white-yellow region. Observers on the ground then saw what appeared to be two non-concentric, circular areas moving rapidly northward. The two circles seemed identical in size, with one displaced magnetic north of the other. The north edge of the northern circle became increasingly irregular as spikes grew northward from it. At about plus 60 seconds intense purple streamers had grown to the north with several early green streaks. At times there appeared to be rapid, twisting motion in the northward purple streamers. A purple glow region about ten degrees above the north horizon was separated by about 20 degrees elevation from the purple-green streamers and persisted until plus ten minutes. The luminous circular regions, in about a minute, straightened out into purplish magnetic north-south striations. To magnetic south of the burst, an oval pale green patch appeared early, persisted, and grew. This large pale green patch south of, but near the burst point, was the dominate visible area at times after plus five minutes. This green area grew into an elliptical region with

[redacted]

[redacted]

the long axis in an east-west direction and appeared to grow westward. At plus ten minutes, the oval was about 30 degrees east-west and 20 degrees north-south. At about plus 20 minutes, stars became visible through the green oval region. At plus 60 minutes the green area had become gray and covered 120 degrees of sky east-west and about 80 degrees north-south. At this time most of the light was emanating from areas close to the original detonation. The dull gray region persisted for at least three hours after burst. The event was first visible from Oahu as a bright flash of light which covered the entire field of view to the southwest. About ten seconds later a great white ball appeared to rise slowly out of the sea, preceded by a surrounding arc of red light. As the fireball cleared the horizon, it appeared as a white sphere completely surrounded by a well defined red ring. As it continued to rise the red ring diminshed in brightness and the white ball elongated vertically, asymmetric on the bottom. The debris stabilized approximately 20 degrees above the horizon and flattened out as the red ring disappeared and the cloud diminished in brightness. Eventually the debris separated into two cylinders, one above the other, which were canted 15 degrees to the horizon, the lower end to the observers left. The cloud was still easily visible at plus seven minutes; the brightness diminished rapidly until plus nine minutes when the cloud was no longer visible.

b. Pod Instrumentation: Pod release and pod tracking appears to be satisfactory. The near pod was recovered in excellent condition and superficial examination indicated that all instruments functioned and recorded data. Pod orientation appeared satisfactory. The middle pod was recovered with the backplate and major portion of the flare and tracking antenna portion of the nose missing. All Project 8B experiments were lost. The Project 8A.3 indentor gauge on this pod was recovered; the pod appeared to have been within 20 degrees of its desired orientation at burst. Pod #3 was recovered; unfortunately the backplate and almost all experiments were lost. Quantitative data from the pod experiments are not yet available.

c. Biomedical: Five C-118 aircraft participated by taking thermal measurements at 100, 198, 300, 399 and 50 nautical miles from the burst along with instrumentation stations at Johnston Island. Rabbits and monkeys were utilized and photovoltaic cells with filters and black body colorimeters were carried in the aircraft as a part of the chorioretinal burn investigation. No burns were reported but several filters darkened showing a fifty per cent failure.

d. Electromagnetic Projects: At this time, enough detailed information is not yet available on the small rocket trajectories

Deleted,

Pages L-C-7-6; L-C-7-7; and L-C-7-8 are deleted.

[redacted]

[redacted]

ANNEX H

TO APPENDIX C, REPORT OF CHECK MATE EVENT

Device: —

Predicted Yield: — Deleted

Actual Yield: —

Vehicle: STRYPI (XM-33 Rocket, Modified)

Date/Time: 200830Z Oct 1962

Predicted Burst Alt: — Deleted

Actual Bürst Alt: —

Geographical Location: 37.5 nautical miles (approx. 70 km) from Johnston Island on a bearing of 190.5^{O}T

---

1. GENERAL: CHECK MATE was the first high altitude, low yield event in Operation FISH BOWL. Scientific readiness for this test was at a high degree and nearly all projects reported outstanding success in obtaining diagnostic data. Weather conditions at and in the vicinity of Johnston were excellent and favorable for optical projects. Considerable cloudiness did exist, however, in the southern conjugate area. The warhead for the CHECK MATE event was launched from Johnston Island on a STRYPI (XM-33) rocket and detonation occurred at 0830 hours on 20 October 1962 Deleted at a nominal horizontal distance of 70 km from the launch pad with a nominal yield Deleted. Because CHECK MATE was added rather late in the program the theoretical preparation was not as extensive as desired, but sufficiant preliminary and theoretical predictions were obtained for scientific purposes. Certification of the warhead (using a "black box" substitute), fuzing and firing system and range safety complex was complete so successfully on 7 October 1962 that a second planned certification event was considered unnecessary and therefore eliminated. Deleted altitude was chosen for the CHECK MATE event of DOMINIC because the phenomena associated

Deleted

It was anticipated that a beta induced ionization patch would be formed at the intersection of sufficient atmosphere and the magnetic fiėld lines in the vicinity of the burst. The important question to be answered by CHECK MATE was whether this beta induced ionization was sufficient to cause serious problems for radar tracking systems. Also of interest was whether debris rose to sufficiently high altitudes and rapidly enough to produce injection of betas into long lived radiation belts, a point of special importance to satellite problems and future manned

[redacted]

[redacted]

oribital flights. It was hoped that satellite data would provide enough detail to evaluate the problem for use in future test planning. Determination of the fraction of the weapon yield emitted as visible radiation should provide valuable data for eyeburn studies necessary for future test planning. The CHECK MATE high altitude nuclear detonation had the following major scientific objectives:

a. Evaluation of the effects of a Deleted anti-missile radar surveillance capability.

b. Investigation of the basic characteristics Deleted and the geophysical effects of such a detonation, in particular the disposition of beta particles and debris and the visible radiation emission.

c. Evaluation of nuclear detonation diagnostic and detection techniques Deleted

2. CONFIGURATION AND INSTRUMENTATION: The warhead for this event was Deleted It was carried on its projected trajectory by a XM-33 rocket which was modified to carry the warhead and by inclusion of telementry and safety (destruct) systems. Two RECRUIT booster rockets were attached to the base of the rocket to provide additional thrust during the first 1.5 seconds of flight. The XM-33 in this configuration was named STRYPI and weighed 3,380 pounds at burst, of which 1,240 pounds could be attributed to the test vehicle. Scientific stations to obtain data from various experiments were established throughout the Pacific area, with the most concentrated group on Johnston Island. From Johnston Island ten rockets were fired in support of experiments, and a large array of optical and electromagnetic instrumentation was operated. In the area surrounding the island, a fleet of ships and aircraft operated with technical stations aboard. Stations were established in the Hawaiian area to observe the burst from elevated areas. Twelve rocket-borne instrument packages were launched from a firing area at Barking Sands, Kauai. Radar surveillance capabilities after the CHECK MATE detonation were studies with two types of measurements: first, NIKE-APACHE rockets were launched from Johnston Island to the burst vicinity and tracked from the DAMP ship (190 km magnetic north of Johnston) with high precision radars (Project 6.13); second, radar clutter was studied by observing radar reflections from detonation on ship and aircraft radars and on Johnston Island (Project 6.9). Photometric, spectroscopic, and photographic coverage of the detonation were provided from Johnston, Maui, KC-135 aircraft, C-118 aircraft, ships in the vicinity of Johnston, and stations at the nothern and southern magnetic conjugate areas. Variometers for measuring fluctuations in the geomagnetic field and microbarographs for measuring pressure fluctuations were located throughout the Pacific area. Rocket-borne debris tracking instruments were launched from Johnston. On Johnston

[redacted]

[redacted]

Island, flash blindness protective devices were exposed to the thermal pulse from the detonation. The electromagnetic signal from the device was measured at a number of locations throughout the Pacific area. The evaluations of detection and diagnostic techniques were, of course, closely related to the previously discussed objectives. The study of the visible light characteristics was of special interest to diagnostic technique development. The Vela Sierra high altitude detection system was tested. Rocket-borne radiochemical samplers were launched from Johnston and a number of rockets were launched with instrumentation to obtain high altitude meteorological information. Much of the communications and geophysical disturbance measuring equipment, in place primarily for the larger yield high altitude detonations of DOMINIC was operated for CHECK MATE.

3. INITIAL RESULTS:

a. Visual Phenomena: At Johnston Island, CHECK MATE observers first was a green and blue circular region with spike-like protrusions from the edge. This region was surrounded by a blood-red auroral ring which faded in less than a minute. Auroral streamers oriented magnetic north-south formed almost immediately and gradually straightened out the initial circular patch. The blue-green streamers and numerous pink striations eventually extended to about a 50 degree elevation to the north and ten degrees away from the burst to the south. The blue-green streamers faded out at about plus three minutes, leaving pink streamers which gradually faded but were still visible at plus 30 minutes. A faint red auroral patch was seen for a few minutes to the north below and beyond the streamers. At Samoa, observers saw a bright white flash in the shape of a cone of 15 degrees originating some 45 degrees above the horizon and terminating at the southern magnetic conju gate point. The white color faded in a few seconds leaving an orange glow at the conjugate point which faded completely at about H plus one minute.

b. Debris Expansion and Motion: The early expansion consisted of three principal parts; one, a central core of high brightness but low expansion velocity, probably the booster; two, a rapidly expanding ring, with 600 km/second initial horizontal velocity, containing much debris; three, a veil-like outer ring, probably air containing little material, expanding with an initial horizontal velocity of 2,000 km/second. There was clearly defined massive ejection of debris in radial jets. After about four seconds the ring structure appeared to collapse and the debris was distorted along the magnetic field line. By about seven seconds the debris had its maximum diameter Deleted contained by the surrounding air and somewhat distorted along the geomagnetic field lines. Electron injection into the geomagnetic field formed the blue-green and pink striations going north and south from the burst. After the rapid expansion was stopped the debris began to rise at a velocity of about 1.6 km/second

Page L-C-8-4 is deleted.

[redacted]

[redacted]

Deleted

f. Summary: The CHECK MATE event added significantly to the understanding of high altitude nuclear detonations, and in particular to the understanding of the transition between low altitude containment of debris by air and high altitude geomagnetic containment. Initially the bomb expansion appeared as a bright central core of low expansion velocity, a debris containing ring expanding at hundreds of kilometers per second and an outer veil like ring, probably heated air, expanding at a few thousand kilometers per second. The radially expanding debris had a quite irregular turbulent appearance; debris expansion was stopped by the surrounding air at a horizontal diameter of less than 75 kilometers within ten seconds. In the first seconds, as the rapid debris expansion ceased, the main debris mass began to rise at a rate of a few kilometers per second and eventually reached an altitude Deleted above the burst. As the debris rose, auroral streamers formed along the magnetic field lines and the motion of the debris itself probably was distorted along the field lines. A persistent pancake did not form at the nearby northern magnetic conjugate area; auroral effects, but no pancake, were reported from the southern conjugate area. Some debris probably rose to 300 km altitude or higher but there was no noticeable long term injection of betas into high altitude radiation belts. A shock of Deleted microbars arrived at Johnston Island in 402 seconds.

Deleted

The visible light output from the device was about as expected, although the X-ray excited air fluorescence may have been greater than expected.

Deleted

Rocket-borne radio-chemical samplers were not recovered; other rocket-borne diagnostic measurements were quite successful in obtaining data.

[redacted]

[redacted]

ANNEX I

TO APPENDIX C, REPORT OF TIGHT ROPE EVENT

Device: — Deleted

Predicted Yield: Deleted

Actual Yield: —

Vehicle: Nike-Hercules

Date/Time: 040730Z Nov 1962

Predicted Burst Altitude: — Deleted

Actual Burst Altitude: — Deleted

Burst Location: 3 KM South of Johnston Island, bearing 190.5°T

---

1. GENERAL: The Tight Rope event was executed at Johnston Island on 4 November 1964 with detonation occuring at 0730:00.0678Z. This event, the second of the DOD high-altitude, low yield events of this series, concluded the test operations portion of Operation DOMINIC and signaled initiation of the roll-up phase. Detonation was programmed to occur Deleted during exit trajectory, on a bearing of 190.5 degrees true and three kilometers down-range from Johnston Island. Due to the predicted, and subsequently confirmed, reduction of widespread disturbances and effects as experienced in earlier DOMINIC events, the experimental effort on the Tight Rope event was greatly reduced from that on previous high altitude events; however, all projects that participated were in a high state of readiness and the excellent data obtained was a significant addition to the understanding of high altitude nuclear detonations. Final certification of the warhead fuzing and firing system and range safety complex was accomplished on 2 November 1962. The major objective of the Tight Rope event was to evaluate the effects Deleted on anti-missile radar surveillance.

2. CONFIGURATION AND INSTRUMENTATION: The nuclear warhead for this event was carried by a Nike-Hercules missile which had been modified for the firing by the inclusion of command arm and fire capabilities and an automatic disarm feature. Total vehicle weight at detonation, which occurred nose upward with the the second-stage sustainer below and attached, was 3224 pounds and dimensions were a length of 251 inches and diameter of 30 inches. The warhead was located in a section 87.5 to 150 inches from the nose of the missile, with the guidance package forward and the sustainer aft. Orientation of the longitudinal axis of the vehicle at detonation was 83 degrees up, and down range, from the reference horizontal plane of the tracking radar. Some of the Pacific area scientific stations established primarily for previous DOMINIC high altitude detona-

[redacted]

[redacted]

tions were operated during this event, with the heaviest concentration being on, or in the immediate vicinity of, Johnston Island. From Johnston Island, seven rockets were fired in support of experiments, and a large array of optical and electromagnetic instrumentation was operated. In the vicinity of Johnston Island, a fleet of ships and aircraft operated with technical stations aboard. Additional shipboard stations were utilized throughout the Pacific to study the effects of ionospheric disturbances on RF transmission and reception. An additional Nike-Hercules missile, launched five seconds prior to the Tight Rope vehicle, was used to carry a C-band radar beacon to a point behind the burst point in an attempt to measure the radar attenuation through the fireball. Radar surveillance capabilities during and after the Tight Rope detonation were directly studied with three experiments: first, radars on the DAMP ship (10 km north of Johnston) tracked the C-band beacon in the Nike-Hercules missile through the disturbed region; second, receivers on Johnston tracked L-, C-, and X-band beacons and 300 Mc transponders in four Nike-Cajun rockets through the burst vicinity; and third, ships, aircraft, and land based radars measured radar clutter by observing reflections from the detonation. Communications effects of the detonation were studied by measuring both the communications fluctuations and the detonation produced ionospheric disturbances. Ionosondes and riometers were used extensively in the Pacific area to determine electron concentrations in the ionosphere. Photometric,spectroscopic, and photographic coverages of the detonation were provided from Johnston, KC-135 aircraft, C-118 aircraft, ships in the vicinity of Johnston and stations in the south magnetic conjugate area. Variometers for measuring fluctuations in the earth's magnetic field and microbarographs for measuring pressures were located throughout the Pacific area. Monkey and rabbit eyes and flash blindness protective devices were exposed to the thermal pulse from the detonation in C-118 aircraft and on Johnston as part of a retinal burn study. The electromagnetic signal from the weapon was measured at a number of locations throughout the world.

3. INITIAL RESULTS:

a. Visual Phenomena. Visible effects were confined generally to the Johnston Island danger area, 320 nautical miles in diameter at the surface. On Johnston Island the Tight Rope detonation was accompanied by an intense bright flash. Even with high density goggles the fireball was too bright for direct observation during the first few seconds. A distinct thermal pulse was noticeable on bare skin at this early time. The bright yellow-orange disc rapidly evolved into a doughnut shape with purple tinges. At about 60 seconds the torus was well formed, had sharp edges, and a good deal of purple color. The torus soon became all purple. By about 200 seconds, the torus had become crown-like in appearance and had fringes

[redacted]

[redacted]

extending outward from the outside edge. The inner edge remained uniform circular. By 240 seconds, the purple color of the phenomena became less intense and the slowly deforming torus took on cloud-like appearance. In a few minutes the residue appeared as a glowing purple cloud that was still faintly visible at H plus 10 minutes. The cloud slowly moved north until it was no longer visible. From Hawaii, a short sharp flash of white light was visible on the horizon, lasting less than 2 seconds. No other evidence of the detonation was visible. No observable effects were seen at Tutuila, in the south conjugate area, although the weather was reported clear.

b. Overpressures. Overpressure Deleted were recorded on Johnston Island; overpressures at Oahu and Deleted at Kauai were recorded in the Hawaiian chain. The large amplitudes of the off-site measurements are indicative of a well developed ozonosphere sound duct to the northeast of Johnston Island.

c. Electromagnetic Measurements.

Deleted

d.

 [redacted]

[redacted]

Deleted

e.

Deleted

f. Summary: The overall results of the Tight Rope event were as predicted.

Deleted

The chorio-retinal experiments was successful with retinal burns obtained in test animals at a distance of 55 nautical miles from Johnston Island.

[redacted]

[redacted]

APPENDIX D TO ENCLOSURE L

REPORT OF THE POLARIS WEAPONS SYSTEM TEST

INDEX

A. INTRODUCTION AND SUMMARY:

1. The POLARIS Fleet Ballistic Missile Submarine basically provides the Department of Defense with a capability of launching a nuclear warhead

Deleted

2. Although for several years a significant portion of the National Defense Budget and effort had been invested in the POLARIS Program Deleted Operation FRIGATE BIRD was the first full-scale test of the weapon system ever conducted.

B. OBJECTIVES:

1. Operation FRIGATE BIRD was an operational weapon system test of this capability designed to fully demonstrate and prove the operational reliability of the POLARIS weapon system Deleted in an environment as near to normal conditions as was feasible.

[redacted]

[redacted]

C. UNITS PARTICIPATING:

TU 8.1.1	Los Alamos Scientific Laboratory
TU 8.1.2	Lawrence Radiation Laboratory
TU 8.1.3	Field Command, Defense Atomic Support Agency
TU 8.1.6	Edgerton, Germeshausen and Grier

D. PLANNING AND PREPARATIONS:

1. The primary consideration involved in selection of the test area was safety, in which the requirements were that: (1) Missile flight path must be selected to preclude flight over or near any populated area, and (2) launch point must be selected so as to be at least five miles further than the absolute maximum theoretical propulsion energy range from any island. In conjunction with these, consideration was accorded to the shipping lanes and airways to be overflown and the average density of traffic expected along these routes. Therefore, after consideration of these elements and due to the fact that a Danger Area had already been established in the vicinity of Christmas Island, it was deemed desirable to select a burst point within this already established Danger Area. However, to meet the stated requirements of the Commander Joint Task Force EIGHT, it was necessary to extend the northeast section of the Danger Area 120 miles to the east and 240 miles north-south, thereby encompassing the selected burst point of latitude 04 degrees 50 minutes north and longitude 149 degrees 25 minutes west. Launch position was selected to be latitude 12 degrees 32 minutes north and longitude 134 degrees 02 minutes west.

E. OPERATIONS:

1. Range safety tracking and control of destruct were the responsibility of the Task Group Range Safety Officer embarked in NORTON SOUND (AVM-1) located in the launch area. Modifications were made to the service missile to enhance long-range safety by addition of a C-band beacon (5400 mc) for tracking purposes and in-flight destruct system controlled by a 418 mc radio command carrier. Additionally, intensive surveillance (sanitization) was provided in the launch and burst areas and in an eight degree conical down-range section between these two points by carrier-based S2F aircraft, destroyers, and Christmas Island-based P2V and WV2 aircraft.

F. RESULTS:

1. Deleted

[redacted]

Deleted Therefore, instrumentation for acquiring data consisted primarily of those facilities necessary for documentation and verification, as follows:

a. Surface and airborne technical documentary photography in the missile launch, flight and burst areas.

b. Two submarines at periscope depth in the burst area to provide approximate warhead yield measurement by periscope bhangmeters, and burst height and documentary photography by periscope cameras.

c. Nuclear cloud sampling aircraft.

d. Two diagnostic aircraft near the burst area.

G. CONCLUSIONS:

1. Approved for execution by the President on 24 April 1962, this highly successful proof test was accomplished under the command of RADM L. M. Mustin, CJTG 8.8 on 6 May 1962 at a site approximately 500 miles east of Christmas Island. As a result of this conclusive operational test and the concurrent success of an air drop developmental test at Christmas Island Deleted the Department of Defense achieved a major advance in the nuclear weapons program.

[redacted]

ANNEX A

TO APPENDIX D, REPORT OF FRIGATE BIRD EVENT

Device: —

Design Yield: — Deleted

Actual Yield: —

Date/Time: 062330Z May 1962

Location: 04°50' N, 149°25' W

Altitude of Burst: 8360 ± 1000 Feet

1. OBJECTIVES: This was primarily a test of the POLARIS Fleet Ballistic Missile Submarine Weapon System utilizing Deleted System accuracy, viz., standards expected for firings from strategic deployment position against war targets, was not included as part of the proposed test since neither the launch nor impact areas had been accurately surveyed, and instrumentation for fixing burst position precisely was neither available nor desired.

2. APPLICATION: The device fired in this event was Deleted delivered to detonation point by an A-1P-130 REB POLARIS missile fired from a submerged submarine, USS ETHAN ALLEN (SSB(N)608).

Deleted

3. RESULTS:

a. This test was achieved on 6 May 1962 when the POLARIS missile was successfully launched and the warhead detonated in the target area A total of four holds were imposed prior to launch; three of these being for weather and one due to technical reasons. The hold for technical reasons occurred during simultaneous count-down of two missiles wherein one tube experienced a failure of the launch hatch interlocks and the other tube lost the 800 cycle reference voltage. Also, during final count-down of the subsequently launched missile, a slow hydraulic system build-up indicated conditions which required a short re-cycling period. The POLARIS missile was launched from tube number nine, with the normal surface-burst fuzing deactivated to preclude the likelihood of a much heavier radioactive fallout and water contamination problem in the event air burst did not occur.

b. Deleted

Page L-D-1-2 is deleted.

[redacted]

[redacted]

APPENDIX E TO ENCLOSURE L

REPORT OF UNDERWATER EFFECTS TEST

INDEX

A. INTRODUCTION AND SUMMARY:

1. SWORD FISH was an underwater weapon effects test conducted in the Pacific Ocean about 365 miles west of San Diego, California as part of Operation DOMINIC.

Deleted

B. OBJECTIVES:

1. SWORD FISH was the fifth underwater nuclear test conducted by the United States. It introduced information that will greatly increase understanding of Navy tactical problems (the major test interest) as related to stand-off distances for weapon delivery ships, effects on underwater sound detection and surveillance systems, and basic underwater detonation phenomena. In addition, it offered a better understanding of general DOD/AEC problems associated with underwater nuclear bursts.

[redacted]

C. UNITS PARTICIPATING:

NOL, White Oak

NEL, San Diego

NRDL, San Francisco

DTMB, Carderock, Maryland

BUSHIPS

BUWEPS

Edgerton, Germeshausen and Grier, Inc.

WHOI, Woods Hole, Mass.

Texas A&M College

D. PLANNING AND PREPARATIONS:

1. A special safety committee, convened to determine the overall level of safety, essentially concluded in a memorandum to CJTF 8 that test plans assured adequate safety. Certain risks, such as an erratic missile or a premature burst very close to the firing ship, were so negligible as to simply be accepted. Other risks, such as firing errors, premature air bursts, and radiation hazards from base surge, were minimized by appropriate procedures in the test plans.

E. OPERATIONS:

1. General conditions for achieving a successful test, with a bearing on selection of a test site were: (1) A smooth hard bottom at a depth between 1,500 and 2,200 fathoms with a very gradual slope, (2) water currents less than about 1 knot and fairly uniform with depth down to 2,000 feet, and (3) be close enough to an airfield to allow A3D aircraft at least two hours on-station time at the test site. In the early stages of planning, it was envisioned that these conditions could be met and the test conducted in the test areas of Christmas Island or Johnston Island which were already established by JTF 8; however, objection to this was made on the ground that an underwater nuclear test in either of these areas would very likely lead to radioactive contamination of commercially valuable fish. Therefore, it was decided to conduct SWORD FISH in the general area of the WIGWAM site since the latter was a known marine desert and radiation hazards to populated shores would be negligible provided the test was conducted several hundred miles from shore. Subsequently, the area for this test was selected, surveyed and marked by a buoy anchored at

[redacted]

longitude $124^{o}13.3'$ West and latitude $31^{o}20.6'$ North.

F. RESULTS:

1. SWORD FISH provided the opportunity to conduct a number of investigations concerning the effects of, and the possibility of detecting, underwater nuclear explosions. Sponsored by DOD (DASA, Navy and ARPA) and AEC, technical project participation included: Underwater pressure measurements and study of surface phenomena by NOL; hydroacoustic transmission effects and detection of underwater nuclear bursts by NEL and General Atronics, utilizing submarine simulators and sonar as well as ship/shore based detection stations; nuclear radiation measurements connected with base surge and contaminated water by NRDL; effects on operational ASW equipment by BUWEPS; ships response and shock damage by BUWEPS/BUSHIPS and DTMB; and shipboard monitoring and tracking of the contaminated pod plus marine life effects by NRDL and AEC. In accomplishing the numerous experiments, an extensive array of Navy surface ships, submarines, and aircraft was used, as well as a USC&GS oceanographic ship, numerous coracles and submerged instruments. In connection with the hydroacoustic studies, several distant ships and shore stations were utilized.

G. CONCLUSIONS:

1. This test was approved for execution and,was accomplished with the highest degree of success in all operational and technical aspects on 11 May 1962, with no damage, in excess of planned levels, to naval equipment. As a result, SWORD FISH data provides a substantial increment to previously existing information in DOD and AEC on the effects of underwater nuclear explosions and a basis for reevaluation of Naval Tactical Doctrine.

[redacted]

[redacted]

ANNEX A

TO APPENDIX E, REPORT OF SWORD FISH EVENT

Device: — DOE	Date/Time: 112003Z May 1962
Design Yield: — Deleted	Location: 31°14.8'N, 124°12.8' W
Actual Yield: —	Depth of Burst: Deleted DOE

1. OBJECTIVES: SWORD FISH weapon effects may be divided into two groups; those connected with on-site efforts (activities conducted within a 12 mile radius of surface zero) and those connected with off-site efforts. The on-site objectives were to: (1) Secure weapon effects information bearing on the establishment of a tactical doctrine for nuclear warhead delivery and, (2) enhance the general fund of information or effects of nuclear underwater explosions. The off-site objectives were to: (1) Obtain information on the effects of the burst upon strategic hydroacoustic detection systems and the improvement of long-range hydroacoustic theory, (2) study the long-time drift and diffusion of radioactive contamination left in the water and the effect of these on marine life and, (3) investigate the detection and identification of underwater nuclear explosions.

2. APPLICATION: USS AGERHOLM launched the ASROC nuclear depth charge, Deleted DOE The unique features of this test, as compared to previous nuclear tests, was the placement of operational ships equipped with a modern weapon system at ranges of tactical significance. As a result, the data obtained provides substantial increment to previously existing information on the effects of underwater nuclear explosions and a basis for re-evaluation of tactical doctrine.

3. RESULTS:

a. Surface Phenomena: The first evidence of the underwater burst visible at the water surface was the slick since the underwater fireball was not detected by human eye or camera. This slick indicated the outward spread of the shock front at the surface, and secondary slicks which were also observed offer clues as to the nature of other pressure waves. The spray dome stretched over a radius of nearly 1000 yards from surface zero and rose to a maximum height of about 750 feet in about six seconds. Radial plumes of water, which are powerful jets of water produced by the contracting and upwardly migrating steam bubble left to pulsate after burst, broke through the spray dome at about seven seconds and represented the first appearance of radioactive products above the surface. Plumes reached a maximum height of 2,100

[redacted]

[redacted]

feet at about 16 seconds and covered a radius of about 600 yards, followed by secondary plumes of less height a short time later. The visible base surge, consisting of small water droplets which surge outward when the plumes collapse, started to form at a radius of about 600 yards from surface zero at about 16 seconds. It pushed outward rapidly in roughly circular form at first, then slowed and lost symmetry as it came under the influence of the wind. At 110 seconds, the visible base surge reached a maximum upwind distance, from surface zero of about 2,000 yards; crosswind and downwind distances at this time were 2000 yards and 2,500 yards respectively with continuing outward motion. Also, at this time, maximum height of the visible base surge was about 2000 feet. Dispersion of the base surge occurred at about three minutes, with faint clumps of mist still visible up to at least ten minutes. An invisible aerosol, capable of contaminating ships and personnel, lingered in the area for at least 20 minutes.

b. Underwater Pressure Measurements: Underwater pressure measurements were made at depths extending from 25 feet below water surface down to 2,000 feet, using floating stations located between 1,000 and 6,000 feet from surface zero. Both the direct shock wave and sea-bottom reflected waves were recorded; no evidence of a bubble-pulse pressure had been noted at the present stage of data reduction. Based on measurements of the peak shock wave pressures near the surface of the water, the direct shock wave was characterized by a steep front followed by an exponential decay (the decay time constant was about 30 milliseconds), and the sea-bottom pressure wave had a slowly rising front followed by a complex history. The reflected pressure wave was apparently not symmetrical about surface zero.

c. Shock Motions: Motion histories of ship hulls and selected equipment were made and included the response to the direct shock wave and sea-bottom reflected pressure waves of BAUSELL, AGERHOLM, ANDERSON, HOPEWELL and RAZORBACK. The response to the bottom reflected wave was more severe than that from the direct shock wave in every ship except BAUSELL; in BAUSELL the response to the two types of input were about equal. Velocity motions recorded on the ships were predominately vertical in direction, with the exception of RAZORBACK, (submerged to periscope depth), wherein the vertical and horizontal velocities were about equal. Vertical motions were distributed fairly uniformly throughout each ship. Measurement of the peak vertical velocities was accomplished at various locations at the ship bulkheads since this type of location is representative of the ship structure and motions at these points are considered to be characteristic of the basic shock input.

d. Ship Damage: Several ships: BAUSELL, AGERHOLM, ANDERSON, HOPEWELL and PRESTON, received some significant damage (significant damage being damage definitely ascribable to the test which would

[redacted]

have immediately impaired the military capability of the ship for more than a few minutes) caused by the bottom reflected pressure wave in each ship except BAUSELL which received about equally severe shocks for both the direct and reflected waves. Damage occurring to AGERHOLM and ANDERSON suggests a statistical variation of damage in two apparently identical ships subjected to shocks of equal intensity. Moreover, BAUSELL, though subjected to two successive shocks each about twice as severe as the single shock sustained by AGERHOLM and ANDERSON, actually received less damage than either of the latter two ships. Summarily, the effect of sustained damage upon military capability is as follows:

(1) BAUSELL was capable of launching an ASROC missile immediately after burst. Anti-aircraft capability not impaired.

(2) AGERHOLM was capable of launching an ASROC missile immediately after burst. Anti-aircraft capability, under wartime conditions, would have been seriously impaired for at least one hour.

(3) Deleted DoE

Anti-aircraft capability, under wartime conditions, would have been seriously impaired for about three hours.

(4) HOPEWELL anti-aircraft capability was lost for about one hour.

(5) PRESTON anti-aircraft capability, under wartime conditions, would have been seriously reduced for at least four hours. ASW capability would have been lost, under wartime conditions, for about 15 minutes; under peacetime test conditions the loss was for two hours.

With regard to the above impairments, there are two notes of interest: (1) The impairments were caused by damage to individually insignificant equipment items; fuses, vacuum tubes, electrical contacts, etc., all of which were repaired on shipboard, and (2) the damage to these equipment items occurred in an appreciable portion of the total cases as a result of electrical power surges caused by shock; other causes of failure were shock breakage and mechanical derangements.

e. Base Surge Radiation: For the most part, the nuclear radiation observations consisted of gamma ray intensity histories recorded at eight coracle stations located along the windline and either side of surface zero, and at BAUSELL located upwind about 35 degrees off the windline. Additional data was acquired by an R5D aircraft which flew directly over the base surge area at an altitude of 3,000 feet 15 minutes after burst, recording intensities exceeding 50 r/hr, though the aircraft was not contaminated. Further flights were made

[redacted]

at 1,500 feet altitude 50 and 60 minutes after burst, during which intensities of about 800 mr/hr were recorded. The three upwind stations, BAUSELL and coracles #1 and #2, remained outside the base surge and contaminated pool, and received intensities ranging from 0.7 to 460 r/hr, whereas four of the interior coracles which were enveloped by base surge and the contaminated pool indicated early peak intensities as high as tens of thousands of roentgens per hour. The two downwind stations recorded intensities ranging from 200 to 450 r/hr, and although they were not washed by contaminated water, the geometry of these stations with respect to base surge has not been determined.

f. Contaminated Water Pool: Surface measurements indicated that intensities were not uniform throughout the pool area, and that as the radioactive products diffused and decayed the pool grew in size and maximum radiation intensity diminished. Simultaneously, the pool drifted with the current and at the end of the twenty days, after traveling a clockwise circular track, was about 50 miles due south of surface zero with a maximum surface intensity of .04 mr/hr. Measurements suggest that by at least one day after burst radioactive material was essentially confined to the water layer above the thermocline, at about 200 feet depth.

g. On-Site Sonar: The effect of the underwater nuclear burst in causing deterioration of sonar conditions was observed with ships tactical sonars and with sono-buoys employed with the Jezebel and Julie ASW systems. The burst completely masked all ship sonar screens, with clearing commencing at about 45 seconds and return to normal by about three minutes except for a section about surface zero. Sonar conditions were completely normal by about ten minutes after burst. Intermittent sonar contacts with the transponders were obtained by AGERHOLM from directly across surface zero 10 to 12 minutes after the burst. The burst blanked out the Jezebel localization (CODAR) and search (LOFAR) signals for about 20 and 37 minutes respectively; audio signals from Julie gear were masked for about five minutes, after which time signal to noise levels received from sonobuoys would have allowed detection of a submarine target at 3,000 yards range.

h. Marine Life: About 53 dead fish, all less than three feet in length, were counted after the burst; however, a portion of this may represent redundant observations. A considerable amount of marine life data was obtained but an intelligible assessment of the results must await laboratory analysis.

i. Off-Site Hydroacoustics: A number of observations connected with the long range transmission of hydroacoustic signals generated by the underwater nuclear burst were made from ship and shore stations.

Deleted DoE

[redacted]

[redacted]

Deleted DOE

Reverberations were recorded over a longer time. A notable result was that two ships behind the Hawaiian Islands received much weaker signals than did ships located so as to permit an unobstructed path to the burst. Signals were reported from the MILS stations of Eniwetok, Wake, Midway and Hawaii, with the channels at the first three stations over-loaded at intermittent periods throughout as much as five minutes of shock wave arrival; reverberations were noted at all stations for several hours after shock wave arrival. Six SOSUS stations located on the West Coast of the United States recorded two major groups of signals, viz., direct transmission and reflections from the Hawaiian Islands, noted at each station except the northernmost Pacific Beach station; at this station only the direct transmission was significant. Suffering reduced capability for at least two hours after burst, the SOSUS system was seriously impaired in ability to detect targets of prime interest for about 15 minutes when reception over the entire spectrum of 150 cps was masked. Individual stations had serously degraded capabilities up to three hours, with both degree and duration of degradation diminishing with distance northward; Pacific Beach had degraded capability for up to one hour.

j. Special Observations: The burst did not have any noticeable effect on radio transmission and reception at the test site. Voice count-down continued for about 20 seconds after burst on 243 mc and 2772 mc and was received, without any effects from the burst, by all ships. Radio teletype transmission were received on frequency 112.85 kc by several ships through burst time without any effects being noted.

4. CONCLUSIONS: SWORD FISH was executed successfully in both operational and technical aspects, with no damage, in excess of planned levels, caused to naval equipment. The following conclusions were formed on the basis of presently available information; many important implications will be apparent only after further study:

a.

Deleted DOE

b. A FRAM-1 destroyer proceeding at 20 knots or more could be as close as 1,600 yards upwind or crosswind, or 1,800 yards downwind, at burst time and sustain only limited impairment of fighting capability. Proper evasive action would result in personnel exposure to radiation of less than limits set for peacetime tests.

Deleted DOE

[redacted]

[redacted]

c. Deleted DOE

d. Deleted DOE

e. Re-emphasized the important role that sea-bottom reflected pressure waves play in establihsing surface ship safe delivery ranges.

f. Re-emphasized the role of the base surge as a carrier of radioactivity, with the possibility of an invisible, though contaminating, aerosol lingering in the area for as much as 20 minutes duration is probably longer.

g. No substantial danger was sustained by RAZORBACK, a Guppy conversion of a Balboa-class submarine without a modern weapon system (e.g., ASTOR system), submerged to periscope depth at 4,600 yards from surface zero.

h. Deleted DOE

i. The wide statistical variation in damage to identical ships under identical attacks underline the need for correlating ship damage resulting from underwater nuclear bursts with that resulting from underwater HE bursts.

j. The SOSUS system suffered reduced capability for at least two hours following burst, with seriously impaired ability to detect targets of prime interest for about 15 minutes and seriously reduced ability to classify such targets for a longer time.

k. The contaminated pool drifts with the current and can be tracked for weeks, while it diffuses and decays radioactively.

[redacted]

[redacted]

APPENDIX F

to

ENCLOSURE L

DISTRIBUTION

DOD ACTIVITIES:

Secretary of Defense	1
Deputy Secretary of Defense	1
Dir of Defense Research & Engineering	1
Assistant to Secretary of Defense (Atomic Energy)	3
Chairman, Joint Chiefs of Staff	4
Commander-in-Chief, Atlantic	1
Commander-in-Chief, Pacific	1
Director, Defense Atomic Support Agency	9
Commander, Field Command, Defense Atomic Support Agency	1
Director, Defense Communications Agency	1

AEC ACTIVITIES:

Chairman, U.S. Atomic Energy Commission	4
Director, DMA, USAEC	2
Nevada Operations Office, USAEC	2
Director, Los Alamos Scientific Laboratory	4
Director, Lawrence Radiation Laboratory	4
President, Sandia Corporation	4

U.S. ARMY ACTIVITIES:

Secretary of the Army	1
Chief of Staff, U.S. Army	1
Chief, Research and Development Command, U.S. Army	1
Commanding General, USA Material Command	1
Commanding General, USA Missile Command	1

U.S. AIR FORCE ACTIVITIES:

Secretary of the Air Force	1
Ass't Secretary of the Air Force (R&D)	1
Chief of Staff, U.S. Air Force	35
Commander-in-Chief, SAC	1
Commander-in-Chief, PACAF	1

[redacted]

[redacted]

U.S. NAVY ACTIVITIES:

Secretary of the Navy	1
Ass't Secretary of the Navy (R&D)	1
Chief of Naval Operations	1
CNO - OP-75	1
Chief of Naval Research	1

TASK FORCE ACTIVITIES:

Commander, Joint Task Group 8.3	1
Commander, Joint Task Group 8.4	1

[redacted]