

**MARSHALL ISLANDS FILE TRACKING DOCUMENT**

---

**Record Number:** 714

**File Name (TITLE):** Very Preliminary Report on  
the Results of

**Document Number (ID):** 126893

**DATE:** \_\_\_\_\_

**Previous Location (FROM):** CIC

**AUTHOR:** JTF7/TG7.1

**Additional Information:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**OrMIbox:** 6

**CyMIbox:** 4

PARTIAL DOCUMENT

THIS DOCUMENT CONSISTS OF [REDACTED]  
NO. 11 OF 24 COPIES, [REDACTED]

WD-76

OPERATION CASTLE

A VERY PRELIMINARY REPORT

126893

ON THE

RESULTS OF THE [REDACTED] SHOT

DELETED VERSION ONLY

Submitted by

Task Group 7.1

[REDACTED]

CLASSIFICATION CANCELLED  
WITH DELETIONS  
BY AUTHORITY OF DOE/OC

REVIEWED BY

*M. West* DATE *3/21/86*

*W. E. Ogle*  
W. E. Ogle,  
CTG 7.1

*W. D. Higgins for*  
A. J. Hudgins,  
CTU-12

*H. K. Gilbert*  
H. K. Gilbert,  
CTU-13

RG 326 US ATOMIC ENERGY  
COMMISSION

Location LANL

Collection J. Div.

Folder Op Castle, Prelim. Report

JF-8305

Copied/DOE  
LANL, J-Div.

*6503*  
*1/2/57*

27 April 1954  
(Date)

TABLE OF CONTENTS

INTRODUCTION

Page

115

PART I

114

Program & Project

1 BLAST AND SHOCK MEASUREMENTS

1.1a, 1.1b, Blast Measurements . . . . .	16
1.1c & 1.1d	
1.2a Pressure vs Time (Moderate Pressures). . . . .	16
1.2b Pressure vs Time (High Pressures). . . . .	17
1.3 Shock Winds and Afterwinds . . . . .	18 27
1.5 Acoustic Pressure Signals in Water (SOFAR) . . . . .	19 28
1.6 Water Wave Studies . . . . .	20 29
1.7 Close-in Ground Acceleration . . . . .	21 30
1.8 Dynamic Pressure Investigation . . . . .	23 32

2 NUCLEAR EFFECTS

2.1 Total Gamma Exposure Measurement . . . . .	27 36
2.2 Gamma Rate vs Time . . . . .	31 40
2.5a Fall-out Distribution Studies. . . . .	32 41
2.5b Fall-out Distribution Studies. . . . .	34 43
2.6a Chemical, Physical and Radiochemical Analysis. . . . . of Surface Contamination	36 45
2.6b Radiochemical Analysis of Surface Contamination. . . . .	42 51

3 STRUCTURES

3.1 Loading of Structures. . . . .	45 54
3.2 Crater Survey and Evaluation . . . . .	48 57
3.3 Tree Stand Studies . . . . .	49 57



TABLE OF CONTENTS

Page

PART II (Cont'd)

Program & Project

18 THERMAL RADIATION

18.1	Time Interval Between Reactions . . . . .	105 95
18.2	Power as a Function of Time . . . . .	96
18.3	Spectroscopy . . . . .	105 96
18.4	Atmospheric Transmission . . . . .	96
18.5	Total Thermal Energy . . . . .	105 96

21 GAS ANALYSIS

21.4	Gas Analysis . . . . .	106 97
------	------------------------	-----------

22 GANEX, TENEX AND PRIMARY ALPHA EXPERIMENT

22	Ganex, Tenex & Primary Alpha . . . . .	107 98
----	--	-----------

23 SCIENTIFIC PHOTOGRAPHY

23.1	Hot Spot Time Interval Measurements . . . . .	114 110
23.2	Ball of Fire Photography . . . . .	110

24 EXTERNAL NEUTRON MEASUREMENTS

24.1	Phonex . . . . .	120 111
------	------------------	------------

PART III TU-7

TU-7	Radiological Safety . . . . .	126 117
------	-------------------------------	------------

PART IV TU-15 AND GENERAL INFORMATION

TU-15	Timing and Firing . . . . .	125 120
-------	-----------------------------	------------

GENERAL INFORMATION

Shot Day Weather Table . . . . .	121
Pre-Shot Picture of <del>REDACTED</del> Ground Zero . . . . .	122
Post-Shot Picture of <del>REDACTED</del> Ground Zero . . . . .	123
Map of Bikini Atoll . . . . .	124
Distribution List . . . . .	125

4

LIST OF TABLES

Program & Project

Page

PART I

1 BLAST AND SHOCK MEASUREMENTS

1.2a-1	Overpressures, <del>DELETED</del> . . . . .	8
1.2b-1	Ground Surface Air Pressure . . . . .	12
1.3-1	Dynamic Pressure, Pitot-Static Gage . . . . .	18
1.3-2	Overpressure, Pitot-Static Gage . . . . .	18
1.7	Ground Accelerations . . . . .	22
1.8-1	Field Layout . . . . .	25
1.8-2	Pressure vs Distance . . . . .	25
1.8-3	Damage Results . . . . .	26

2 NUCLEAR EFFECTS

2.1-1	Gamma Exposures . . . . .	28
2.1-2	Decay Exponents . . . . .	29
2.5a-1	Radioactivity in Total Collector Bottles and on Gum Paper Collectors . . . . .	33
2.6a-1	Gross Analysis of Fall-out Material. . . . .	37
2.6a-2	Gamma Activity in Physical State Fractions . . . . .	38
2.6a-3	Gross Sample Decay. . . . .	39
2.6b-1	Comparison of Liquid vs Solid Fall-out . . . . .	42
2.6b-2	Activity Removed from Aomoe Sand by Leaching. . . . .	43

6 TESTS OF SERVICE EQUIPMENT AND OPERATION

6.1-1	B-50 Positions . . . . .	55
-------	--------------------------	----

7 LONG RANGE DETECTION

7.1-1	Preliminary Field Analysis Results . . . . .	68
-------	--	----

5

LIST OF ILLUSTRATIONS

Program & Project

Page

PART I

1 ELAST AND SHOCK MEASUREMENTS

1.2b-1 Ground Level Pressure vs Distance . . . . . 17

2 NUCLEAR EFFECTS

2.1-1  $RD^2$  vs D plot . . . . . 30

3 STRUCTURES

3.3-1 Rukoji Pisonia Stand ~~XXXXXXXXXX~~ . . . . . 54

3.3-2 Rukoji Pisonia Stand ~~XXXXXXXXXX~~ . . . . . 54

6 TESTS OF SERVICE EQUIPMENT AND OPERATION

6.1-1 Initial Radar Scope Return . . . . . 57

6.1-2 Radar Scope Return, about H+12 sec . . . . . 57

6.1-3 Radar Scope Return, about H+2 min. . . . . 58

6.1-4 Radar Scope Return showing "horseshoe". . . . . 58

6.6-1 F2 Layer Virtual Height following ~~XXXXXXXXXX~~ . . . . . 64

6.6-2 F2 Layer Critical Frequency following ~~XXXXXXXXXX~~ . . . . . 65

7 LONG RANGE DETECTION

7.1-1 Timing Record - Parry Station . . . . . 69

7.1-2 Timing Record - Sweep Speed  $14 \mu\text{sec/cm}$ . . . . . 69

7.1-3 Timing Record - Sweep Speed  $1 \mu\text{sec/cm}$ . . . . . 69

7.1-4 Timing Record - Sweep Speed  $34 \mu\text{sec/cm}$ . . . . . 70

7.1-5 Timing Record - Sweep Speed  $320 \mu\text{sec/cm}$  . . . . . 70

PART II

11 RADIOCHEMISTRY

11.2-1 Shot Cloud H+30 min. . . . . 85





[REDACTED]

LIST OF ILLUSTRATIONS

Program & Project

Page

PART IV

A-1	Pre-shot Picture of Ground Zero . . . . .	122
A-2	Post-shot Picture of Ground Zero . . . . .	123
A-3	Map of Bikini Atoll . . . . .	124

~~XXXXXXXXXX~~

INTRODUCTION

The ~~XXXXXXXXXX~~ shot was detonated on Eninman Island of ~~XXXXXXXXXX~~. The device was designed by the UCRL at Livermore to test a ~~XXXXXXXXXX~~ ~~XXXXXXXXXX~~ than that used in the previously tested devices.

At the time of firing the atmospheric conditions with respect to fall-out and sampling criteria were satisfactory, but heavy showers in the area caused serious difficulties from the point of view of test instrumentation. Records show that the light transmission conditions were such as to automatically prevent firing of the shot from about 4 A.M. until about ten minutes before shot time. At shot time the transmission from Eninman to Enyu was sufficient to allow firing, but scattering of the light by fog or rain was such as to prevent proper photography. Thus no photographs of the fireball were obtained from any station, and the early "hot spot" photography also failed even though the instrumentation operated properly. However, enough data were obtained by other means (Radiochemistry, progress of reaction studies, threshold detectors, shock arrival times) to obtain a fair picture of what went on.

The times of arrival and overpressures on Airukiraru, Airukijji and Eniirikku indicate a total energy release of some

DELETED

~~DELETED~~ with the lower number being perhaps more plausible in the light of the hydrodynamic yield. Observation of the total number of 14 Mev neutrons by means of threshold detectors suggest ~~DELETED~~

The first check in determining the cause of the unexpectedly

~~DELETED~~ is to ascertain the operation of the

~~DELETED~~ The initial alpha

**DELETED**

**DELETED**

[REDACTED]

Project 2.6b - RADIOCHEMICAL ANALYSIS OF SURFACE

CONTAMINATION

Project Officer - R. C. Tompkins -

Objectives

The objectives of this work were to study the distribution of certain nuclides within fall-out particles and to determine some of the differences in radiochemical properties between liquid and solid fall-out.

Instrumentation

Total fall-out collectors were set up on Enyu, Rukoji, Arriikan, and Bokororyuru Islands. On account of a failure in the timing circuit, the collector on Bokororyuru operated before the shot. The collector on Enyu did not operate properly. Collectors on Rukoji and Arriikan operated properly.

Results

Since the yield [REDACTED] ~~DELETED~~ the samples recovered were too small to size-grade. Comparisons of the aqueous and solid phases were made, however, as shown in Table 2.6b-1. Additional data will be covered in later reports.

TABLE 2.6b-1  
COMPARISON OF LIQUID VS SOLID FALL-OUT

Location	Mo <sup>99</sup> Aqueous/Solid Ratio
Rukoji	0.303
Arriikan	0.74

A sample of coral sand was scooped up from the ground on Aomoen Island for leaching studies to determine distribution of activities within the fall-out particles. The sample was leached once with water and then with successive portions of dilute hydrochloric acid. Data are given in Table 2.6b-2. Weight of total sample was 2.1453 g.

TABLE 2.6b-2  
ACTIVITY REMOVED FROM AOMOEN SAND BY LEACHING  
CORRECTED TO K+12.2 DAYS

Leach No.	Weight Dissolved (mg)	Specific Activity of Solution (c/min/mg)			Mo <sup>99</sup> /Zr <sup>95</sup> at Zero Time
		Gross F.P.'s	Mo <sup>99</sup>	Zr <sup>95</sup>	
1	2.4	1.40 x 10 <sup>4</sup>	1.7 x 10 <sup>3</sup>	4.8 x 10 <sup>2</sup>	63
2	38.9	6.41 x 10 <sup>3</sup>	6.1 x 10 <sup>1</sup>	6.2 x 10 <sup>1</sup>	18
3	98.4	2.12 x 10 <sup>3</sup>	2.8 x 10 <sup>1</sup>	1.0 x 10 <sup>1</sup>	50
4	97.3	9.15 x 10 <sup>2</sup>	9.4	5.7	30
5	91.0	5.61 x 10 <sup>2</sup>	Not Determined		
6	187.3	2.73 x 10 <sup>2</sup>	Not Determined		
7	187.8	1.57 x 10 <sup>2</sup>	9.0 x 10 <sup>-2</sup>	5.1 x 10 <sup>-1</sup>	3.2
8	378.5	3.84 x 10 <sup>2</sup>	6.4 x 10 <sup>-1</sup>	2.0	6.0
9	179.0	4.07 x 10 <sup>2</sup>	Undetectable	4.8x10 <sup>-1</sup>	Very Low
10-14	Data not yet available				

R-factor calibration data for this operation are not available at this time. However, some indication can be obtained from the fact that a Mo<sup>99</sup>/Zr<sup>95</sup> ratio of about 23 is usually obtained in the home laboratory for a thermal bombardment of U<sup>235</sup>.

[REDACTED]

Conclusions

The data of Table 2.6b-2 appear to confirm the evidence from Operation Ivy that for the detonation of a thermonuclear device on a coral surface Mo<sup>99</sup> tends to concentrate on the surfaces of fall-out particles, while Zr<sup>95</sup> does not. Further work is in progress.

25

26

PAGES 54-90 WERE JUDGED  
IRRELEVANT AND WERE NOT COPIED

~~\_\_\_\_\_~~

Project 11.2 - CLOUD SAMPLING (H. Plank)

Because of gear trouble and accidental decompression the RB-36 sampling control aircraft was replaced by the back-up control B-36 with back-up control personnel. The back-up arrived in the shot area at approximately H+15 minutes with a clear view of the cloud lying above a solid cirrus layer, the top of which lay between 37 and 38 thousand feet. In addition to an opportunity to use the back-up control system, this shot also afforded the chance to try an emergency recovery of an F84G sample from the Bikini airstrip.

Although restricted from very high altitudes by the presence of the back-up control personnel, the secondary control B-36 (comprised by one of the high altitude B-36's) collected a sample at 45,000 feet after completing its control function. Blue Flight was prevented from collecting samples because of mechanical aircraft difficulties in one plane of each element. The number of fissions collected by each aircraft is shown in Table 11.2-1.

**DELETED**

**DELETED**

Although the number of fissions collected is about a factor of ten less than in previous shots on Castle, fraction-wise the present samples are similar. The high altitude B-36,



Floyd I, was in the topmost layers of the cloud at 55,000 feet absolute altitude and had to come down several thousand feet to conduct sampling. A private communication from Jere Knight indicates that the topmost section of the cloud had a calcium to fission ratio approximately 1% of that at lower altitudes.

A picture of the cloud taken from the control airplane soon after shot time is shown in Fig. 11.2-1 lying above the cirrus cover. In the original print dark portions suggest that a considerable portion of the cloud lay below the cirrus in the natural weather existing up to 37 - 38 thousand feet. Figs. 11.2-2 and 11.2-3 show the cloud at later times after burst when the wind shear effects can be seen from upwind and cross-wind views respectively. The long streamer seen in Fig. 11.2-3 is the result of a wind velocity at 55,000 feet (absolute) which is approximately 17 knots slower than at the cirrus level and is an illustration that negative as well as positive velocity shear can produce the same relative effects. A dimensional analysis of this photograph shows that the length of the streamer is commensurate with this velocity shear. A notable characteristic of this cloud was that the radiation intensities observed were a factor of from five to nine lower than for previous clouds at the same altitudes and times after burst.

TABLE 11.2-1  
SAMPLING RESULTS FOR [REDACTED] SHOT

Aircraft Code	Type Aircraft and Number	Avg. Sampling Time (Hrs. after Burst)
Red 1	F-84G 030	2:40
Red 2	F-84G 037	2:30
Red 3	F-84G 033	2:30
Red 4	F-84G 051	2:55
White 1	F-84G 046	3:40
White 2	F-84G 053	3:40
White 3	F-84G 038	3:55
White 4	F-84G 049	3:50
Blue 1	Abort	
Blue 2	Abort	
Blue 3	Abort	
Blue 4	Abort	
Floyd 1	FB-36 1086	4:35
Floyd 2	FB-36 1083	5:15
Wilson 1	WB-29 7269	3:10

**DELETED**

PAGES 94-124 WERE JUDGED  
IRRELEVANT AND WERE NOT COPIED

PART III

TASK UNIT 7

Copied/DOE  
LANL, J-DIV.

125

2

3

TASK UNIT 7 - J. D. Servis, Maj, USA

RADIOLOGICAL SAFETY

(J. D. Servis)

A partial Rad-Safe survey was conducted on [REDACTED] day with incomplete atoll results. Results of this survey did indicate that Bokobyadaa, Namu, Enirikku, Bikini, and the Yurochi - Aomoen chain were materially contaminated. Reentry and recovery were accomplished to a large degree on shot day. No secondary fall-out was detected as having resulted from this shot.

Lagoon contamination was restricted to a V shape pattern with apex at Eninman and tips covering the Bokobyadaa - Aomoen area. A reading of 100 mr/hr was obtained over the Eninman anchorage at H+4 hours. Enyu anchorage was clear of contamination while Bikini anchorage showed traces of contamination at H+4 hours.

**DELETED**

TABLE TU-7-1

SUMMARY (r/hr)

Island	H+4 hrs Extrapolated	D+1 day	D+7 days	Pre-shot Background
Enyu	.03	.03	.03	.03
<u>Bikini</u>	5.0	.67	.07	.10
<u>Aomoen</u>	20.0	2.5	1.6	.35
<u>Romurikku</u>	10.0	1.6	.80	.50
<u>Uorikku</u>	5.0	1.0	.60	.47
<u>Yurochi</u>	5.2	1.0	.60	.45
<u>Namu</u>	250.	30.0	16.0	1.5
<u>Bokobyaadaa</u>	600.		16.0	9.0
<u>Ourukaen</u>	.60	.08	.02	.012
<u>Arrikan</u>	.50	.07	.01	.008
<u>Enirikku</u>	210.0	2.4 T	1.8	.008
Eninman			.02	.010
Airukijji	.02	.02	.02	.018
Crater	5000.	50.*	60.	

T - Reading at 100 feet

\* - Reading at 200 feet

Underlined islands indicate islands contaminated by shot.

Copied/DOE  
LANL J-DIV.

12  
3  
34

[REDACTED]

Task Unit 15 - TIMING AND FIRING (H. Grier)

(H. Grier)

World Time

The world time as measured by the world time clock on

[REDACTED]

1954. This figure is not corrected for transit time from the signal generators in Hawaii to the receiver at Station 70.

Timing System

The operation of the timing system including radio signals was normal.

[REDACTED]

TABLE A-1  
WEATHER (BIKINI ATOLL) AT 0620M, 7 APRIL 1954

Surface Pressure 1009.7 mb  
Surface Temperature 81°F  
Surface Humidity 82%

Altitude (ft)	Wind		Pressure (mb)	Temp. (°C)	Dew Pt. (°C)	Relative Humidity
	Direction (degrees)	Velocity (knots)				
Surface	040	20	1009.7	81	75	79
1000	070	17	973	23.5	22.0	
1500			958	22.4	21.2	
2000	060	16	940	21.1	20.4	82
3000	090	08	909	19.7	19.0	
4000	120	07	878	18.4	17.5	80
5000	150	08	848	17.1	16.2	
6000	170	12	819	15.8	14.9	78
7000	170	17	789	14.3	13.5	
8000	190	14	760	12.7	12.2	
9000	200	14	733	11.2	10.9	
10,000	210	14	705	9.6	9.5	75
12,000	180	17	655	6.5	5.6	
14,000	200	08	608	3.0	-0.9	69
16,000	190	10	563	-0.3	-10.4	67
18,000	200	10	522	-3.8	-12.9	64
20,000	220	04	483	-7.8	-23.6	24
25,000	190	20	396	-18.0	-29.6	24
30,000	210	22	322	-27.5	-32.9	42
35,000	210	28	258	-39.3		
40,000	230	34	206	-51.8		
45,000	280	24	161	-63.8		
50,000	240	35				
55,000	230	39				