

RETURN TO

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(Holmes & Narver, Inc., Los Angeles)  
Special Projects Division

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LEGEND

- 0 From Available Data
- No Available Information
- NA Not Applicable

Property of  
U.S. DEPARTMENT OF ENERGY  
DOE/NV TECHNICAL INFORMATICS  
RESOURCE CENTER  
Las Vegas, NV 89193

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TEST PROGRAM DATA

OPERATION IVY

Event Mike  
Station No. 1  
Date November 1, 1952  
Shot Vehicle Steel Building  
Site Flora

Vehicle Materials

Steel and Iron	538,917 lbs
Aluminum	12,794
Copper	3,778
Lead	-
Paraffin	-
Manganese	-
Misc. Metal	2,825
Plastic	1,658
Asphalt Roofing	10,107
Wood	30,532
Concrete	688,650
Coral Sand (Ballast)	NA
Silica Sand (Ballast)	NA

Height of Device above Surface 35 ft

Depth of Water NA

Crater

Depth	164 ft
Radius	2,845 ft

Remarks

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TEST PROGRAM DATA

OPERATION CASTLE

Event Bravo  
Station No. 20  
Date March 1, 1954  
Shot Vehicle Steel Building  
Site Charlie

Vehicle Materials

Steel and Iron	122,000 lbs
Aluminum	0
Copper	3,000
Lead	-
Paraffin	-
Manganese	-
Misc. Metal	-
Plastic	-
Asphalt Roofing	3,000
Wood	37,000
Concrete	1,231,000
Coral Sand (Ballast)	NA
Silica Sand (Ballast)	NA

Height of Device above Surface 16 ft

Depth of Water -

Crater

Depth	211 ft
Radius	3,100 ft

Remarks

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Vehicle Materials

Steel and Iron	518,000 lbs
Aluminum	0
Copper	0
Lead	0
Paraffin	-
Manganese	-
Misc. Metal	-
Plastic	-
Asphalt Roofing	-
Wood	25,000
Concrete	0
Coral Sand (Ballast)	44,000
Silica Sand (Ballast)	0
Height of Device above Surface	16 ft
Depth of Water	~ 211 ft
Crater	
Depth	(1)
Radius	(1)
Remarks	(1) In Castle Bravo Crater

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Event	Koon
Station No.	50
Date	April 7, 1954
Shot Vehicle	Steel Building
Site	Tare

Vehicle Materials

Steel and Iron	118,000 lbs
Aluminum	3,000
Copper	2,000
Lead	-
Paraffin	-
Manganese	-
Misc. Metal	-
Plastic	-
Asphalt Roofing	1,000
Wood	24,000
Concrete	494,000
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface 14 ft

Depth of Water NA

Crater

Depth	28 ft
Radius	330 ft

Remarks

Date \_\_\_\_\_

Shot Vehicle Barge

Site Off Dog

Vehicle Materials

Steel and Iron	584,000 lbs
Aluminum	0
Copper	0
Lead	16,000
Paraffin	-
Manganese	-
Misc. Metal	-
Plastic	-
Asphalt Roofing	-
Wood	42,000
Concrete	153,000
Coral Sand (Ballast)	167,000
Silica Sand (Ballast)	0

Height of Device above Surface 16 ft

Depth of Water 90 ft

Crater

Depth	250 ft
Radius	1,500 ft

Remarks

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TEST PROGRAM DATA

OPERATION CASTLE

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Event Yankee  
Station No. 40  
Date May 5, 1954  
Shot Vehicle Barge  
Site Off Dog

Vehicle Materials

Steel and Iron	561,000 lbs
Aluminum	0
Copper	2,000
Lead	-
Paraffin	-
Manganese	-
Misc. Metal	-
Plastic	-
Asphalt Roofing	0
Wood	14,000
Concrete	0
Coral Sand (Ballast)	106,000
Silica Sand (Ballast)	0

Height of Device above Surface 16 ft

Depth of Water 243 ft

Crater

Depth	(1)
Radius	(1)

Remarks (1) In Castle Union Crater

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Silica Sand (Ballast)	-
Height of Device above Surface	16 ft
Depth of Water	130 ft
Crater	
Depth	143 ft
Radius	(1)
Remarks	(1) In Ivy Mike Crater

TEST PROGRAM DATA

OPERATION REDWING

Event ~~CONFIDENTIAL~~  
Cherokee

Station No. 18

Date May 21, 1956

Shot Vehicle Airdrop

Site Off Charlie

Vehicle Materials

Steel and Iron	-
Aluminum	-
Copper	-
Lead	-
Paraffin	-
Manganese	-
Misc. Metal	-
Plastic	-
Asphalt Roofing	-
Wood	-
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface 4,320 ft

Depth of Water NA

Crater

Depth	NA
Radius	NA

Remarks



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Depth of Water

NA

Crater

Depth

103 ft

Radius

1,155 ft

Remarks

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TEST PROGRAM DATA

OPERATION REDWING



Event Flathead  
Station No. 13  
Date June 12, 1956  
Shot Vehicle Barge  
Site Off Dog

Vehicle Materials

Steel and Iron	416,625 lbs
Aluminum	0
Copper	411
Lead	310
Paraffin	-
Manganese	-
Misc. Metal	1,500
Plastic	177
Asphalt Roofing	-
Wood	20,000
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface -

Depth of Water -

Crater

Depth	(1)
Radius	(1)

Remarks (1) In Castle Union and Yankee Craters



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TEST PROGRAM DATA

OPERATION REDWING

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Event Mohawk  
Station No. 3  
Date July 3, 1956  
Shot Vehicle Steel Tower  
Site Ruby

Vehicle Materials

Steel and Iron	436,334 lbs
Aluminum	-
Copper	2,848
Lead	34,000
Paraffin	-
Manganese	-
Misc. Metal	510
Plastic	3,963
Asphalt Roofing	-
Wood	1,300
Concrete	443,500
Coral Sand (Ballast)	NA
Silica Sand (Ballast)	NA

Height of Device above Surface 300 ft

Depth of Water NA

Crater

Depth	13 ft
Radius	670 ft

Remarks

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Radius (1)

Remarks (1) In Ivy Mike and Castle Nectar Crater

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TEST PROGRAM DATA

OPERATION REDWING

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Event Navajo  
Station No. 11  
Date July 11, 1956  
Shot Vehicle Barge  
Site Off Dog

Vehicle Materials

Steel and Iron	416,625 lbs
Aluminum	-
Copper	411
Lead	310
Paraffin	-
Manganese	-
Misc. Metal	1,500
Plastic	177
Asphalt Roofing	-
Wood	20,000
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface -

Depth of Water -

Crater

Depth	(1)
Radius	(1)

Remarks (1) In Castle Union and Yankee Craters

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TEST PROGRAM DATA

OPERATION REDWING

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Event Tewa  
Station No. 15  
Date July 21, 1956  
Shot Vehicle Barge  
Site Off Charlie

Vehicle Materials

Steel and Iron	416,625 lbs
Aluminum	-
Copper	411
Lead	310
Paraffin	-
Manganese	-
Misc. Metal	1,500
Plastic	177
Asphalt Roofing	-
Wood	20,000
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface 9 ft

Depth of Water 21 ft

Crater

Depth	129 ft
Radius	2,000 ft

Remarks

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<del>Aspirant Rooming</del>	
Wood	17,500
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	462,000
Height of Device above Surface	-
Depth of Water	-
Crater	
Depth	(1)
Radius	(1)
Remarks	(1) In Castle Bravo and Romeo Craters

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TEST PROGRAM DATA

OPERATION HARDTACK I

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Event Koa  
Station No. 21  
Date May 13, 1958  
Shot Vehicle Steel Tank  
Site Gene

Vehicle Materials

Steel and Iron	70,795 lbs
Aluminum	2,864
Copper	368
Lead	6
Paraffin	-
Manganese	293
Misc. Metal	334
Plastic	58
Asphalt Roofing	230
Wood	11,835
Concrete	278,200
Coral Sand (Ballast)	NA
Silica Sand (Ballast)	NA

Height of Device above Surface 3 ft

Depth of Water NA

Crater

Depth	171 ft
Radius	2,000 ft

Remarks

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TEST PROGRAM DATA

OPERATION HARDTACK I

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Event Yellowwood  
Station No. 28  
Date May 26, 1958  
Shot Vehicle Barge  
Site Off Janet

Vehicle Materials

Steel and Iron	411,514 lbs
Aluminum	23,844
Copper	326
Lead	313
Paraffin	-
Manganese	1,956
Misc. Metal	1,849
Plastic	202
Asphalt Roofing	1,250
Wood	20,800
Concrete	28,350
Coral Sand (Ballast)	-
Silica Sand (Ballast)	392,000

Height of Device above Surface 10 ft

Depth of Water 75 ft

Crater

Depth	133 ft
Radius	960 ft

Remarks

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Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	394,000
Height of Device above Surface	-
Depth of Water	-
Crater	
Depth	-
Radius	-
Remarks	

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OPERATION HARDTACK I

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Event ~~CONFIDENTIAL~~  
Aspen

Station No. 7

Date June 15, 1958

Shot Vehicle Barge

Site Off Charlie

Vehicle Materials

Steel and Iron	402,532 lbs
Aluminum	20,368
Copper	656
Lead	195
Paraffin	-
Manganese	1,900
Misc. Metal	1,607
Plastic	334
Asphalt Roofing	2,670
Wood	17,500
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	334,000

Height of Device above Surface -

Depth of Water -

Crater

Depth	(1)
Radius	(1)

Remarks (1) In Castle Bravo and Romeo and in  
Hardtack I Fir Craters

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OPERATION HARDTACK I

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Event Walnut  
Station No. 37  
Date June 15, 1958  
Shot Vehicle Barge  
Site Off Janet

Vehicle Materials

Steel and Iron	416,312 lbs
Aluminum	28,157
Copper	538
Lead	190
Paraffin	-
Manganese	1,860
Misc. Metal	1,876
Plastic	275
Asphalt Roofing	1,280
Wood	20,200
Concrete	27,100
Coral Sand (Ballast)	-
Silica Sand (Ballast)	462,000

Height of Device above Surface -

Depth of Water ~ 133

Crater

Depth	(1)
Radius	(1)

Remarks (1) In Hardtack I Yellowwood Crater

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TEST PROGRAM DATA

OPERATION HARDTACK I

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Redwood

Event

Station No.

9

Date

June 28, 1958

Shot Vehicle

Barge

Site

Off Fox

Vehicle Materials

Steel and Iron	402,160 lbs
Aluminum	29,008
Copper	656
Lead	195
Paraffin	-
Manganese	1,900
Misc. Metal	1,918
Plastic	334
Asphalt Roofing	2,670
Wood	17,500
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	478,000

Height of Device above Surface

-

Depth of Water

-

Crater

Depth

-

Radius

-

Remarks

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Remarks

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TEST PROGRAM DATA

OPERATION HARDTACK I

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Event Oak  
Station No. 25  
Date June 29, 1958  
Shot Vehicle LCU Hull  
Site Off Alice

Vehicle Materials

Steel and Iron	442,750 lbs
Aluminum	173
Copper	334
Lead	168
Paraffin	-
Manganese	2,250
Misc. Metal	783
Plastic	220
Asphalt Roofing	360
Wood	10,304
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface 6 ft

Depth of Water 13 ft

Crater

Depth	196 ft
Radius	2,200 ft

Remarks

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Silica Sand (Ballast)	120,000
Height of Device above Surface	-
Depth of Water	-
Crater	
Depth	(1)
Radius	(1)
Remarks	(1) In Castle Bravo and Romeo and in Hardtack I Fir and Aspen Craters

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TEST PROGRAM DATA

OPERATION HARDTACK I

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Event Dogwood  
Station No. 2  
Date July 6, 1958  
Shot Vehicle LCU Hull  
Site Off Janet

Vehicle Materials

Steel and Iron	443,300 lbs
Aluminum	134
Copper	496
Lead	180
Paraffin	-
Manganese	2,230
Misc. Metal	919
Plastic	342
Asphalt Roofing	110
Wood	8,900
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface -

Depth of Water -

Crater

Depth	(1)
Radius	(1)

Remarks (1) In Hardtack I Elder Crater

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TEST PROGRAM DATA

OPERATION HARDTACK I

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Event	Poplar
Station No.	4
Date	July 12, 1958
Shot Vehicle	Barge
Site	Off Baker

Vehicle Materials

Steel and Iron	401,982 lbs
Aluminum	18,528
Copper	656
Lead	195
Paraffin	-
Manganese	1,900
Misc. Metal	1,811
Plastic	334
Asphalt Roofing	2,670
Wood	17,500
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	300,000

Height of Device above Surface	-
Depth of Water	12 ft
Crater	
Depth	177 ft
Radius	-

Remarks

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TEST PROGRAM DATA

OPERATION HARDTACK I

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Event Pisonia  
Station No. 22  
Date July 18, 1958  
Shot Vehicle LCU Hull  
Site Off Yvonne

Vehicle Materials

Steel and Iron	441,684 lbs
Aluminum	280
Copper	274
Lead	214
Paraffin	-
Manganese	2,225
Misc. Metal	1,077
Plastic	240
Asphalt Roofing	106
Wood	240
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface -

Depth of Water -

Crater

Depth -

Radius -

Remarks

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TEST PROGRAM DATA

OPERATION HARDTACK I

Event Olive  
Station No. 16  
Date July 23, 1958  
Shot Vehicle LCU Hull  
Site Off Janet

Vehicle Materials

Steel and Iron	443,300 lbs
Aluminum	134
Copper	496
Lead	190
Paraffin	-
Manganese	2,230
Misc. Metal	919
Plastic	342
Asphalt Roofing	110
Wood	8,900
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface -

Depth of Water -

Crater

Depth	(1)
Radius	(1)

Remarks (1) In Hardtack I, Elder and Dogwood Craters

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TEST PROGRAM DATA  
OPERATION HARDTACK I

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Event Pine  
Station No. 10  
Date July 27, 1958  
Shot Vehicle Barge  
Site Off Janet

Vehicle Materials

Steel and Iron	424,000 lbs
Aluminum	164
Copper	638
Lead	320
Paraffin	-
Manganese	2,140
Misc. Metal	1,527
Plastic	320
Asphalt Roofing	640
Wood	18,600
Concrete	-
Coral Sand (Ballast)	488,000
Silica Sand (Ballast)	-
Height of Device above Surface	-
Depth of Water	-
Crater	
Depth	-
Radius	-

Remarks

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TEST PROGRAM DATA

OPERATION HARDTACK I

Event	Teak
Station No.	J-40
Date	July 31, 1958
Shot Vehicle	Rocket
Site	Johnston Island

Vehicle Materials

Steel and Iron	-
Aluminum	-
Copper	-
Lead	-
Paraffin	-
Manganese	-
Misc. Metal	-
Plastic	-
Asphalt Roofing	-
Wood	-
Concrete	-
Coral Sand (Ballast)	-
Silica Sand (Ballast)	-

Height of Device above Surface 250,000 ft

Depth of Water NA

Crater

Depth	NA
Radius	NA

Remarks

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MATERIAL ANALYSIS

Sand Ballast

The chemical composition of the crystal amber (Silica) sand used to

Ballast the Operation Hardtack, Phase I barges was:

Silica (SiO <sub>2</sub> )	81.80%
Iron Oxide (Fe <sub>2</sub> O <sub>3</sub> )	0.11
Alumina (Al <sub>2</sub> O <sub>3</sub> )	11.07
Lime (CaO)	1.18
Magnesia (MgO)	0.09
Loss on Ignition	0.44
Lime and Magnesia calculated to equivalent Calcium Carbonate (CaCO <sub>3</sub> )	2.32
Percent loss in weight after immersion for 24 hours in warm concentrated hydrochloric acid at 80°C	1.06

The screen analysis of the amber sand was

Screen No. 8	Percent Passing	99
Screen No. 10	" "	96
Screen No. 14	" "	90
Screen No. 16	" "	81
Screen No. 20	" "	68
Screen No. 24	" "	56
Screen No. 30	" "	32
Screen No. 40	" "	12
Screen No. 50	" "	2

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MATERIAL ANALYSIS Cont'd.

Sand Ballast

The chemical analysis of coral cores drilled on Bikini Island, Bikini

Atoll was found to be:

Depth of Sample	CaCO <sub>3</sub>	MgCO <sub>3</sub>	Insoluble residue
83 ft	97.00%	1.42%	0.40%
115 ft	98.07	1.84	0.19

Trace elements found in these cores by Spectrographic analyses were

Depth of Sample	Mg	Sr	Ba	Si	Al	Fe	Mn	Na	Cr	B
45 ft	1.2	0.9	0.002	0.4	0.05	0.007	.002	0.4	0.000x	0.000x
60 ft	1.0	.6	.001	.08	-	.008	.001	0.3	.00x	.000x

Coral sand used to ballast barges was manufactured from rock removed from the reef west of Parry Island, Eniwetok Atoll.

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