

DRAFT MAR 1981

CASTLE SERIES-A REPORT OF DOD PARTICIPATION

**Kaman Tempo
816 State Street
Santa Barbara, California 93101**

CONTRACT No. DNA 001-79-C-0472

BEST COPY AVAILABLE

**Prepared for:
Director
DEFENSE NUCLEAR AGENCY
Washington, D.C. 20305**

CASTLE SERIES FACT SHEET DRAFT

CASTLE was a nuclear weapons test series held at the Atomic Energy Commission's (AEC) Pacific Proving Ground (PPG) in Spring 1954. The PPG consisted of Enewetak and Bikini atolls in the northwestern Marshall Islands in the Central Pacific Ocean. There were six detonations in the series and they are listed in the following table:

Date	Assigned Name	Location	Magnitude (equivalent tons TNT)
1 March	BRAVO	Bikini; sandspit off Nam Island	15 (MT)
27 March	ROMEO	Bikini; barge in BRAVO crater	11 (MT)
.7 April	KOON	Bikini; surface of Eneman Island	110 (KT)
26 April	UNION	Bikini; barge in lagoon off Iroij	6.9 (MT)
5 May	YANKEE	Bikini; barge in UNION crater	13.5 (MT)
14 May	NECTAR	Enewetak; barge in MIKE ^a crater	1.69 (MT)

^a10.4 MT detonation in 1952.

HISTORICAL BACKGROUND

The CASTLE series was held for the purpose of testing large-yield thermonuclear weapons. President Truman ordered this development in 1950 and the work had progressed through the GEORGE experimental shot on GREENHOUSE (1951) and the MIKE shot of IVY (1952). MIKE was the first

At Rongerik, 135 nmi (250 km) east of Bikini, 25 men of the 6th Weather Squadron operated a weather observatory for the Weather Reporting Element, Test Support Unit, TG 7.4, and 3 men from the 9710th TSU operated an ionospheric sounder for Project 6.6, TU 13, TG 1.

A fallout-recording device had been left by a representative of the Health and Safety Laboratory (HASL) of the AEC, New York Operations Office, who was concerned with recording offsite fallout. The device was calibrated to record the low levels of radiation expected at offsite locations. Its maximum reading was 100 mR/hr and the HASL representative had warned the Rongerik personnel to contact him if the meter reading went "off-scale" (i.e., if the radiation exceeded the measuring capacity of the device). Such a message was sent at 1515, was received at the AAC Center at Enewetak at 1543, and delivered to the Army Communications Center at Enewetak at 1547 for retransmittal to Hq JTF 7. Records do not show if this message was retransmitted or not but, at any rate, the command levels were unaware of the extent of the fallout at Rongerik (CPT #10).

The personnel at Rongerik continued normal activities during the remainder of the day. Most changed from the usual tropical short sleeves and shorts to long sleeves and long pants. The fallout material gathered to a depth of 1/4 to 1/2 inch (0.6 to 1.2 cm) deep in places and left a visible layer on tables in the mess hall and barracks (CPO 7.1.U13#938).

Table 5.3. Offsite fallout summary.

Location	True Bearing	Distance (mi)	Fallout Time of Arrival	Intensity (mR/hr)	Infinity Dose (R)	Intensity (mR/hr)	Time	Intensity (mR/hr)	Time	Average Resultant Wind Speed to Tropopause (knots)
Lae	160	174	H+39			0.08				3.2
Ujae	170	168	H+37			0.1				3.2
Wotho	154	100	H+13.2	2.3	0.17	1.0		400	H+29.7	3.8
Ailinginae	115	79	H+3.6	12,000	220	445	H+58	1,350	H+30.9	8.1
Rongelap	109	100	H+5.6	9,800	350	1,400 ^a	H+36			8.9
Enewetak	105	98.5	H+5.4	46,800	4,200	3,000 ^a	H+53.2			8.9
Rongerik	098	133	H+8	9,000	350	2,000	H+28.5			10.4
Rongerik	052	280	H+16.3	1,400	120	600	H+33			14.4
Taongi	084	285	H+21.6	450	48	160	H+55	53/10	D+6.3	10.2
Bikar	096	270	H+20.3	290		160	H+34			10.4
Utirik	097	261	H+30.2							9.6
Taka	104	340	H+27.1	110	13	76	H+34.8			8.9
Mejit	107	291	H+24.8			18	H+34.7			8.8
Ailuk	110	268	H+26.2			6	H+48.5			8.1
Jemo	115	262				0.016	H+38.9			4.2
Likiep	142	265				0.08	H+51.6			4.8
Nam	142	338				0.6	H+51.4			5.3
Ailinglupalap	142	4641				2.0	H+50.9			5.5
Arno	127	441				0.36	H+50.6			7.1
Majuro	122	400				3.6	H+50.2			6.8
Avur	117	387	H+42.3			4.0	H+50.0			6.0
Maleolap	119	321	H+40.0			20.0	H+50.0			
Erikub	114	321	H+39.0			0.5	H+54.4			
Hotje	200	225				2.0	H+49.5			
Kusaie	235	503								
Ponape	245	286								
Ujelang	245	286								
Pingelap	229	426								

Note:

^aReading on ground.

Source: CPO 7.0#2

Table 5.7. Summary of estimated fallout exposure for BRAVO.

Group	Persons	Mean Gamma Dose (R)	Collective Dose	
			(man-rem)	(%)
JTF 7				
Headquarters	86 ^a	0.1 ^b	9	<1
Task Group 7.1				
Enewetak	520 ^c	0.1 ^b	52	<1
Bikini	485 ^c	0.5 - 2.4 ^d	447	1.4
Task Group 7.2	1287 ^e	0.1 ^b	129	<1
Task Group 7.3	5628 ^f	1 ^f	5,628	17.4
Task Group 7.4	17259	0.1 ^{b,o}	173	<1
Task Group 7.5				
Enewetak	1220 ^h	0.1 ^b	122	<1
Bikini	590 ^h	0.5 ^d	295	<1
Rongerik Detachment	28	78 ⁱ	2,184	6.7
TOTAL JTF 7			9039	27.9
Patapsco (AOG-1)	124 ^j	3.3 ^k	409	1.3
TOTAL U.S.			9,948	30.7
Rongelap Marshallese	64 ⁱ	175 ⁱ	11,200	34.6
Rongelapese on Ailinginae	18 ⁱ	69 ⁱ	1,242	3.8
Utirik Marshallese	157 ⁱ	14 ⁱ	2,198	6.8
Ailuk Marshallese	401 ^l	4 ^m	1,604	5
Daigo Fukuryu Maru	23 ⁿ	290 ⁿ	6,670	20.6
Grand Total			32,362	100

Sources:

^aConsolidated List (CPO 7.1.U.7#3)

^bMicrofilm 5x8 cards (CPO 7.1.U.7#4, Index 1020 control film 4904-10)

^cTG 7.1 Historical Report, Installment 4, p. 20 (CPO 7.1#2)

^dMean of ships used in evacuation weighted by number of personnel (*Ibid*)

^eTG 7.2 History 3rd Installment

^fTable 5.4 (Source: CPT #7)

^gFinal Report Commander TG 7.4 (CPO 7.4#1)

^hCompletion Report, p. 4-6, 4-7 (CPO 7.5#2)

ⁱCPT #6, p. 7

^jNormal complement

^kNOOSC memo 25 Jan 1979 (CPT #15)

^lRadSafe Vol 2 (CPO 7.1.U7#2)

^mEstimated as ratio of Utirik

ⁿLapp *Voyage of Lucky Dragon*, p. 158 (CPT #8)

^oDoes not consider sampler aircraft crew.

Table 6.5. ROMEO radiation summary (R/hr).

Island	Extrapolated H+4	D+1	D+2	BRAVO Background at ROMEO
Eneu	0.03	0.03	0.06	0.03
Bikini ^a	0.20	0.12	0.14	0.12
Aomen	0.80	0.80	0.60	0.22
Lomilik ^a	1.6	1.7	0.75	1.1
Odrik ^a	0.8 - 1.4	1.4	0.85	1.2
Iroij ^a	0.8 - 1.0	1.3	1.0	1.3
Nam ^a	2,000		100	0.6
Bokbata ^a	1,000	50.0 ^b	55	1.2
Oroken	0.04	0.10 ^c	0.16 ^c	0.04
Adrikan	0.02	0.40 ^c	0.32 ^c	0.02
Enidrik	0.005	0.005	0.05	0.01
Aerokoj	0.005	0.005	0.04	0.01
Eneman	0.012	0.012	0.06	
Crater		1,100 ^d		
Ships			0.02 - 0.04	

Notes:

^aContamination by ROMEO shot.

^b200-foot (60-meter) altitude.

^cRadiation shine from water in southwest passage.

^dAt 300 feet (90 km).

Table 6.7. ROME0 airborne monitoring survey results by the AEC NYKOPO.

Location ^a	Flight Able					
	Local Time (19 March)	Maximum Ground Reading (mR/hr)	Local Time (28 March)	Maximum Ground Reading (mR/hr)	Local Time (31 March)	Maximum Ground Reading (mR/hr)
Kwajalein	1200	0.10	0704	0.00	1435	0.20
Lae	1602	0.012	0747	0.00	0832	0.08
Ujae	1615	0.06	0754	0.00	0840	0.24
Wotho	1643	0.05	0829	0.00	0910	1.70
Ailinginae (Sifo Island)	1710	20.00	1123	6.00	1005	26.00
Rongelap Island	1720	15.00	1134	28.00	1022	78.00
Rongerik Island	1739	80.00	1153	36.00	1036	48.00
Taongi	--	--	1315	1.00	1158	0.40
Bikar	1848	12.00	1415	0.08	1257	15.00
Utirik Island	1910	12.00	1438	0.00	1320	6.80
Taka	--	--	1448	0.80	1330	6.80
Ailuk	1938	1.00	1503	1.60	1345	2.40
Jemo	1951	0.02	1518	0.80	1400	2.40
Likiep	--	--	1525	0.40	1407	1.00

Flight Baker			Other NYKOPO Flights		
Location ^a	Local Time (3 April)	Maximum Ground Reading (mR/hr)	Flight	Date	Maximum Ground Reading (mR/hr)
Nam	0834	0.40	Dog ^b	1 April	0.00
Ailinglapalap	0857	0.55	Fox ^b	3 April	0.00
Namorik	0933	0.70			
Ebon	959	1.10			
Kili	1004	0.90			
Jaluit	1035	1.40			
Mili	1125	0.70			
Arno	1146	0.90			
Majuro	1153	0.90			
Aur	1209	0.90			
Maloelap	1230	0.50			
Erikub	1253	0.09			
Wotje	1304	1.40			
Kwajalein	1354	1.40			

Note:

^aAtoll is specified unless otherwise indicated.

^bSee Chapter 2 for description of Dog and Fox flights.

Table 6.14. K00N radiation summary (R/hr).

Island	Extrapolated H+4	D+1	D+2	BRAVO and ROMEO Background at K00N
Eneu	0.03	0.03	0.03	0.03
Bikini ^a	5.0	0.67	0.07	0.10
Aomen ^a	20.0	2.5	1.6	0.35
Lomilik ^a	10.0	1.6	0.80	0.50
Odrik ^a	5.0	1.0	0.60	1.47
Iroij ^a	5.2	1.0	0.60	1.45
Nam ^a	250.0	30.0	16.0	1.5
Bokbata ^a	600.0		16.0	9.0
Oroken ^a	0.60	0.08	0.02	0.012
Adrikan ^a	0.50	0.07	0.01	0.008
Enidrik ^a	210.0	2.4 ^b	1.8	0.008
Eneman			0.02	0.010
Aerokoj	0.02	0.02	0.02	0.018
Crater	5000.0 ^d	50.0 ^c	60.0 ^d	

Source: CPO 7.1.U13#940.

Notes:

^aContaminated by K00N shot.

^bReading at 100 feet (30 meters).

^cReading at 200 feet (60 meters).

^dAltitude not given.

Table 6.15 Preliminary results, NYKOPO airborne monitoring survey flights on and about 7 April 1954.

Location ^a	Flight Able			Flight Baker			
	Local Time (8 April)	Maximum Ground Readings (mR/hr)	Local Time (12 April)	Maximum Ground Readings (mR/hr)	Location	Local Time (12 April)	Maximum Ground Readings (mR/hr)
Lae	0915	0.17	0920	0.04	Nam	0916	0.4
Ujae	0930	0.25	0930	0.02	Ailinglapalap	0937	0.4
Wotho	0956	1.1	0959	0.25	Namorik	1013	0.3
Ailinginae	1022	57	1059	7.7	Ebon	1037	0.2
Rongelap Island	1033	94	1109	17.8	Kili	1104	0.3
Rongerik	1047	82	1124	18.6	Jaluit	1116	0.3
Taongi	1210	0	1247	0.04	Mili	1201	0.8
Bikar	1312	20	1345	8.0	Arno	1225	1.2
Utirik	1332	12	1415	3.8	Majuro	1245	0.2
Taka	1338	16	1422	1.9	Ani	1245	0.2
Ailuk	1356	1.7	1441	0.8	Maloelap	1328	0.2
Jemo	1407	2.0	1452	0.4	Erikub	1352	0.2
Likiep	1414	1.2	1457	0.04	Wotje	1404	0.8
Kwajalein	1454	0.53	1200	1.5 ^b	Kwajalein	1452	0.4

Notes:

^aAtoll unless otherwise indicated.

^bGround observation (probably erroneously high reading).

Table 6.20. UNION radiation summary (R/hr).

Island	Extrapolated H+4	D+1	D+4	Background
Eneu ^a	0.75	0.10	0.03	0.01
Bikini ^a	70.00	8.50	0.80	0.03
Aomen ^a	140.00	15.00	2.00	0.40
Lomilik ^a	140.00	15.00	2.40	0.40
Odrik ^a	85.00	10.00	1.00	0.36
Nam			1.00	2.50
Iroij ^a	85.00	10.00	1.00	0.40
Bokbata		1.20	2.20	4.00
Oroken		0.01	0.50 ^b	0.01
Adrikan		0.01	0.60 ^b	0.01
Enidrik		0.06	0.10 ^b	0.90
Eneman Crater		6.50	4.00	100.00
Aerokoj		0.01	0.01	0.01
Crater ^a	4.20 ^c		0.01	0.00

Source: CPO 7.1.U13#940.

Notes:

^aContaminated by UNION.

^bRadiation from contaminated water.

^cReading at 500 feet (150 meters).

Table 6.21. UNION atoll survey by Wilson 3 and 4 on shot day.

Atoll	Time	Reading (mR/hr)	Altitude (feet/meters)
Ailinginae	1500	5	300/92
Rongelap	1507	7	450/137
Rongerik	1525	7	450/137
Bikar	1632	5	600/183
Utirik	1655	4	600/183
Taka	1702	6	600/183
Ailuk	1725	4	600/183
Jemo	1732	3	600/183
Wotje	1803	3	400/122
Mejit	1848	3	---
Likiep	1901	<1	---
Wotho	2341	1	200/61

Table 6.22. Secondary UNION fallout noted on vessels of JTF 7 on shot day.

Vessel	Time	Average (mR/hr)	Maximum (mR/hr)
<u>USS Cocopa</u>	2200	2	4
<u>USS Mender</u>	2100	2	4
<u>USS Shea</u>	0730	3	5
LST- 1157	1930	2	3
<u>USS Nicholas</u> ^a	1320	15	25
	1416	37	110

Note:

^aNicholas reported all clear at 1443; departed for Bikini (ETA 1745, 26 April)

Table 6.23. NYKOPO airborne monitoring survey flights on or about 25 April 1954.

Location ^a	Flight Able				Other NYKOPO Flights				
	Local Time (21 April)	Maximum Ground Reading (mR/hr)	Local Time (27 April)	Maximum Ground Reading (mR/hr)	Local Time (1 May)	Maximum Ground Reading (mR/hr)	Flight	Date	Maximum Ground Reading (mR/hr)
Lae	0824	0.30	0853	0	0655	0.04	Baker	21 April	0.40
Ujae	0834	0	0903	0.20	0707	0.08	Baker	2 May	0.12
Wotho	0901	0	0930	0	0737	0.30	Charlie	2 May	0.07
Ailinginae	0952	2.40	1029	1.60	0830	0.04			
Rongelap Island	1006	12.00	1041	8.00	0845	20.00			
Rongerik	1020	8.00	1055	11.00	0858	8.00			
Taongi	1145	0.04	1223	0.20	1014	0.04			
Bikar	1241	0.40	1318	0	1111	3.70			
Utirik	1259	0.80	1335	2.00	1135	1.70			
Taka	1304	0.40	1342	2.40	1138	0.70			
Ailuk	1323	0.10	1402	0.40	1159	0.60			
Jemo	1332	0.08	1410	0	1209	0.12			
Likiep	1343	0.04	1422	0.60	1216	0.08			
Kwajalein	1435	0	1510	0	1200	0.10 ^b			

Notes:

^aAtoll unless otherwise indicated

^bGround observation.

throughout the atoll and lagoon both to the east and west. The radiation intensities on islands of the atoll are shown in Table 6.27. No significant secondary fallout was encountered at Bikini as a result of this detonation.

Table 6.27. YANKEE radiation summary (R/hr).

Island	Extrapolated H+4	D+1	D+5 ^a	Background
Eneu ^b	18.00	2.00	0.44	0.02
Bikini ^b	225.00	25.00	2.00	0.32
Aomen ^b	50.00	6.00	0.80	1.00
Lomilik ^b	65.00	7.50	1.20	1.00
Odrik ^b	95.00	12.00	2.00	0.25
Iroij ^b	95.00	12.00	4.00	1.00
Nam ^b	10.00		1.00	0.80
Bokbata			0.95	3.00
Oroken ^b	3.50(?)	0.50 ^c	0.12 ^c	0.01
Adrikan ^b	1.30	0.60 ^c	0.01 ^c	0.08
Enidrik ^b	0.18	0.01	0.1 - 1.0	0.03
Aerokoj ^b	0.505	0.01	0.01	0.01
Crater		1.00 ^d		
Lagoon			80.00 (west)	

Source: CPO 7.1.U13#940.

Notes:

^aFinal aerial survey.

^bContaminated by YANKEE.

^cRadiation shine from water in southwest passage.

^dReading at 100 feet (30.5 meters).

Table 6.28. NYKOPO airborne monitoring survey flights on or about 5 May 1954 (conducted by Health and Safety Laboratory, New York Operations Office, AEC).

Location ^a	Flight Able				Other NYKOPO Flights			
	Local Time (6 May)	Maximum Ground Reading (mR/hr)	Local Time (7 May)	Maximum Ground Reading (mR/hr)	Local Time (9 May)	Maximum Ground Reading (mR/hr)	Flight Date	Maximum Ground Reading (mR/hr)
Lae	0830	0	0822	1.20	0726	0.10	Baker 9 May	0.40 ^c
Ujae	0845	0	0832	0.80	0737	0.16	Charlie 9 May	0.20
Wotho	0912	0.08	0857	1.60	0810	0.20	Easy 12 May	0.60
Ailinginae	1024	0.80	1005	10.00	0916	1.20		
Rongelap Island	1038	8.00	1019	30.00	0928	6.50		
Rongerik	1052	3.00	1033	21.60	0943	4.00		
Taongi	1215	0.20	1151	0.20	1111	0		
Bikar	1315	15.00	1247	34.00	1203	4.00		
Utirik	1335	0.80	1318	6.00	1223	1.20		
Taka	1340	0.80	1312	5.60	1226	1.50		
Ailuk	1400	0.20	1330	0.70	1245	0.70		
Jemo	1410	0.20	1339	3.20	1245	0.30		
Likiep	1415	0.20	1346	3.20	1302	0.50		
Kwajalein	1455	0.40	1800	4.50 ^b	1335	0.20		

Notes:

^aAtoll unless otherwise indicated

^bGround observation.

^cMaximum 0.30 mR/hr at Ani

Table 6.33. NECTAR radiation summary (R/hr).

Island	Extrapolated		
	H+4	D+1 ^a	D+2
Enewetak	0	0	0
Medren	0	0	0
Japtan	0	0	0
Jinimi	0	0	0
Ananij	0	0	0
Jinedrol	0	0	0
Runit	0	0	0
Billae	0.05	0.006	0.006
Alembel	0.08	0.01	0.01
Lojwa	0.10	0.01	0.01
Bijile	0.12	0.014	0.01
Aomon	0.17	0.02	0.02
Eleleron	0.17	0.02	0.02
Lujor	0.10	0.012	0.02
Aej	0.14	0.016	0.02
Elle	0.17	0.02	0.02
Bokenelab	0.17	0.02	0.02
Kidrinen	0.35	0.04	0.04
Mijikadrek	0.42	0.04	0.06
Enjebi	0.70	0.08	0.08
Boken	0.98	0.12	0.14
Bokaidrik		0.22	0.60
Dridrilbwij	60.0	6.8	7.00
Louj	70.0	8.0	12.00
Bokinwotme	75.0	8.4	1.00
Kiruna	8.0	0.80	0.36
Bokombako	3.9	0.44	0.36
Bokoluo	2.2	0.26	0.28
Biken	0	0	
Kidrenen	0	0	
Ribewon	0	0	
Boken	0	0	
Mut	0	0	
Ikuren	0	0	

Note:

^aPeriod preceded by heavy rainfall.

Source: CPO 7.1.U13#940.

Table 6.34. NYKOPO airborne monitoring survey flights on or about 14 May 1954.

Location ^a	Flight Able				Other NYKOPO Flights		
	Local Time (15 May)	Maximum Ground Reading (mR/hr)	Local Time (16 May)	Maximum Ground Reading (mR/hr)	Flight	Date	Maximum Ground Reading (mR/hr)
Lae	0722	0.20	0647	0.08	Baker	16 May	0.15
Ujae	0733	0.08	0657	0.06	Charlie	16 May	0.10
Wotho	0800	0.08	0722	0.08			
Ailinginae	0854	1.40	0823	0.80			
Rongelap Island	0907	5.80	0836	4.20			
Rongerik	0925	5.80	0854	3.00			
Taongi	1046	0	1006	0			
Bikar	1142	3.00	1103	1.70			
Utirik	1204	1.00	1124	0.80			
Taka	1208	1.00	1125	0.60			
Ailuk	1228	0.40	1134	0.10			
Jemo	1248	0.40	1157	0.20			
Likiep	1335	0.10	1202	0.10			
Kwajalein	1335	0.10	1236	0.08			

Note:

^aAtoll unless otherwise indicated.

AIRCRAFT DECONTAMINATION. Following NECTAR, the aircraft sat for 24 hours while the contamination decayed to lower levels. The aircraft were contaminated less by NECTAR than any other CASTLE series event (see Table 6.35). Releases were made with intensity levels on all aircraft below 400 mR/hr as the series concluded. Table 6.36 lists the materials used in decontaminating the NECTAR aircraft.