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February 15, 1980

To: Dr. C. L. Yarbro

From: George D. Kerr (4-6258) GDK

Subject: Access to weapon data reports at TIC

I would like to have access to review reports on weapon data, such as:

W. A. Biggers and F. Waddell, "External Neutron Measurements 1946 to 1956," WT-9004 (October 1957),

and to reports on some specific weapons tests, such as:

E. Storm, "Gamma Radiation Exposure as a Function of Distance-Operation Ranger," LA-1228 (March 1951).

The specific tests which are of interest are:

Crossroads: Able
Ranger: Fox
Buster-Jangle: Dog
Upshot-Knothole: Grable
Teapot: Wasp, Moth, Hornet, Bee, and Wasp Prime
Hardtack Phase II: Mora, Lea and Socorro
Storax: Small Boy, Little Feller I, and Little Feller II

These weapon-test designations are taken from the enclosed article by M. W. Carter and A. A. Moghessi, Health Phys. 33:55 (1977).

GDK:jp

Enclosure

cc: D. C. Parzyck
P. J. Walsh
File - GDK

2/19/80

Approved for weapons effects and gamma/neutron dosimetry data related to nuclear (limited to fission) detonations./CLYarbro:bl
SRD-Sigma 3, as required, in connection with visit to TIC during period 2/11/80 – 6/11/80 Sold Visitor Control. /L. Johnson

REPOSITORY Oak Ridge Operations Records Holding area
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Health Physics Pergamon Press 1977. Vol. 33 (July), pp. 55–71. Printed in Northern Ireland

THREE DECADES OF NUCLEAR TESTING

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Abstract—This paper lists in chronological order all the nuclear detonations which have been announced by the six countries which have conducted nuclear detonations. The numbers of such detonations and the cumulative yield are underestimates for reasons presented and discussed. In a 30-yr span, beginning on 16 July 1945, and ending on 30 June 1975, some 801 nuclear detonations have been announced with a cumulative yield of about 325 Mt.

Statistics for nuclear detonations are tabulated in a useful format and figures. International treaties and agreements which affected and continue to affect nuclear testing are discussed in relation to their effects.

INTRODUCTION

THE ERA of nuclear weapons and their testing was ushered in on the morning of 16 July, 1945 at 1230 Greenwich Civil Time (GCT) in the desert near Alamogordo, New Mexico. The world's first nuclear test, Trinity, had a fission yield of approx 19 kilotons (kt) and this size device was subsequently referred to as nominal yield. The device was detonated on a steel tower at a height of about 30 m above the desert floor.

Statistical data on the nuclear detonations are scattered. Probably, the most complete listing of nuclear detonations up to 1961 has been published by Glasstone (Gl 62). A revised version of his data containing additional data up to 1963 appeared in 1964. Springer and Kinnaman (Sp 7; Sp 75) published comprehensive seismic source summary data for U.S. testing activities up to 1973.

No comprehensive information is available on the testing of other nations subsequent to 1963, nor has additional information on testing activities, which has become available since the publication of the Glasstone data, been conveniently summarized. Also, this information on nuclear tests should help preclude the need to correlate environmental radiation data attributed to nuclear testing with information available through press releases (Lo 73).

In the ensuing 30 yr, there have been about 800 nuclear detonations conducted by the United States (US), Russia (USSR), United Kingdom (UK), Republic of France (F), People's Republic of China (PRC), and India (In). All but two of these detonations have been tests of nuclear devices for various purposes. The two exceptions were the weapons used during World War II at Hiroshima and Nagasaki, Japan, during August 1945.

A nuclear test can be defined as an experimental study of a nuclear weapon or device which involves a nuclear detonation. Also included are safety tests which involve a detonation of the high explosive in the weapon or device and may produce a small amount of nuclear yield. As the terms imply, a weapon is in a configuration for military application; whereas, a device is an experimental apparatus which may require considerable engineering to transform into a weapon.

A nuclear detonation or explosion is caused by the extremely rapid release of a large amount of energy within a limited space with the bulk of the energy derived from nuclear processes. They may be either from nuclear fission or fusion. In general, a fission reaction is used to provide the high temperatures and pressures required to initiate and sustain a fusion reaction. These latter reactions are referred to as thermonuclear (H) and can be made to release extremely large amounts of energy.

The release of energy, yield, is usually measured in terms of trinitrotoluene (TNT) equivalent. One ton of TNT releases 10^9 calories of energy (Gl 62). The largest nuclear

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test was about 58 Mt and was conducted by the USSR in October 1961.

The testing of nuclear devices is usually for the purposes of gaining knowledge of nuclear explosive phenomena and of the effects of nuclear detonations. Purposes for testing nuclear weapons and devices by the US have included effects on military equipment and systems, biomedical entities, and structures; development of seismic measurement systems and calibrations; verification of untried principles and selection of choices among theoretical designs; circumvention of lengthy and tedious laboratory experiments and calculations; bases for extensive engineering prior to stockpiling; gathering important scientific knowledge, notably, fundamental physical data; determination of efficiency and performance characteristics; safety; and training. However, it is reasonable to assume that most tests may have multiple purposes.

A major division of nuclear tests has been between those for peaceful purposes and military applications. This may be a technical distinction. It would be prudent to assume that any announced test for peaceful purposes could have military overtones.

The US program to develop and use nuclear devices for peaceful purposes is named Plowshare. Thus far, 27 experiments have been conducted under this program. These experiments have involved specific device development, stimulation of underground natural gas production, excavation (cratering), selected isotope production, nuclear produced effects in specific geological formations, heavy element production, development of emplacement techniques, and investigation of energy development systems.

As an example of specific device development, it is desirable to have a particular explosive for use in stimulation of natural gas in deep underground formations. It is generally packaged in a configuration suitable for deployment in a conventional drilled well of relatively small diameter. Also, it should be relatively free of tritium as this nuclide becomes part of gas molecules, such as methane and ethane, and forms tritiated water. Therefore, device development would aim towards design and construction of devices in small diameter configurations and with explosive products deficient in tritium.

An important aspect of nuclear testing is the emplacement of the nuclear device. Tests can be categorized as underwater (UW), underground (UG), atmospheric (AT), and high altitude (HA). Those conducted underground have been placed in tunnels, vertical shafts, and standing cavities. Atmospheric placements or positioning have been by or on towers, tethered ballons, airdrop, 280 mm cannon, rockets, missiles and at ground level. Of course, rockets and missiles have been used to conduct high altitude, above 10 km, tests. Our major categories in several cases are not clearly defined and there is overlap between them; for example, an underground detonation which vents releasing fission products to the atmosphere could be placed into the atmospheric category. For our purpose, a device placed and detonated underground is designated as underground even though it may have been designed to produce a release to the atmosphere or may have accidentally vented.

This paper contains statistical data on the nuclear testing program during its 30 yr history. Because atmospheric and seismic data have been previously published and are conveniently available, they have been excluded. All data are expressed in metric units. The yield values were not corrected in the conversion process because the difference between the British and metric ton is considerably less than inherent inaccuracies in those values. In every case, the latest available yield data were used.

Nuclear test statistics contained in this paper are those which have been announced by the country conducting the test or by the US. Not all tests conducted by the US and the USSR have been announced. This may also be true for several other countries which have conducted tests. Also, it is conceivable that a singly announced event may have involved several simultaneous nuclear detonations.

NUCLEAR TESTING STATISTICS

The Appendix contains publicly announced information on nuclear tests conducted throughout the world by the six countries which have demonstrated this capability. The data are presented by country and are given in

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chronological order. They include, when available, identification of the event, the GCT date, geographical site, type of placement, yield and pertinent comments.

Event identifications are given by code names and series in most cases whereas the locations are given by site name. The major testing site locations are as follows:

US		
Nevada Test Site (NTS)	31°N	116°W
Pacific Proving Ground		
Eniwetok	11°N	162°E
Bikini	11°N	165°E
Johnston Island (JIA)	17°N	169°E
Christmas Island (CIA)	2°N	157°W
USSR		
Novaya Zemlya (Arctic)	75°N	55°E
Siberia	52°N	78°E
Semipalatinsk	50°N	80°E
USSR	Soviet Territory	
UK		
Monte Bello Islands, Australia	20°S	115°E
Woomera, Australia	31°S	137°E
Maralinga Proving Ground, Australia	30°S	131°E
Christmas Island	2°N	157°W
F		
Reggan, Sahara Desert	27°N	0
Mururoa, Tuamotu Archipelago	21°S	137°W
Fangataufa, Tuamotu Archipelago	21°S	137°W
Sahara Desert	24°N	5°E
PRC		
Lop Nor, Sinkiang Province	40°N	90°E
In		
Thar Desert, Jaisalmer District	27°N	72°E

Other nuclear tests have been conducted at various sites. For example, the US has conducted tests in the Atlantic, the Pacific, on Amchitka Island, in Colorado, New Mexico, Mississippi and in parts of Nevada.

As indicated earlier, yields are given in terms of kt, when this information is available. However, yields are also presented in qualitative terms such as ranges, less than values, greater than values, approximate values, and "no values". This, of course, affects the cumulative yield information and reflects the approximate nature of the data.

In preparing summaries of yield data, a convenient system was adopted for use. Less than and greater than values were used in additions. Also, approximately half of the range was used in additions; e.g. 0–20, 20–200, and 200–1000 kt would be represented by 10, 100, and 600 kt, respectively. Any yield less than 0.1 kt is considered as 0.1 kt in the summaries.

Table 1 is a summary of nuclear testing statistics for the indicated countries. It indicates the types and numbers of detonations conducted and the total yields for each category, atmospheric, underground, underwater, and high altitude of nuclear test. The total

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Table 1. Numbers and yields of nuclear detonations

Type of test and yields	US	USSR	UK	F	PRC	In	TOTALS
Underground							
number	381	11	5	13	1	1	412
yield (kt)	29,700	18,700	160	703	—	13	49,273
Underwater							
number	5	1					6
yield (kt)	70	20					90
High altitude							
number	10	3					13
yield (kt)	5440	300					5740
Atmospheric							
number	183	121	21	30	15		370
yield (kt)	42,300	187,985	18,060	6255	15,640		270,240
TOTALS							
number	579	136	26	43	16	1	801
yield (kt)	77,510	207,005	18,220	6995	15,640	13	~325,360

yield for the 801 announced detonations is 325 Mt. It is of interest that the US has conducted the most detonations, 578; whereas, the USSR tests have involved the highest cumulative yield, 207 Mt.

In Table 2 are presented the numbers and yields of nuclear tests by years and the cumulative totals for these parameters. These data have been plotted as Figs. 1 and 2 on semilogarithmic graph paper.

In Fig. 1, the cumulative numbers of nuclear detonations are plotted versus the year in which they occurred. The effects of the nuclear testing moratorium, from November 1958 until September 1961, are evident. It is also clear that 1962 was a year in which a large

Table 2. Numbers and yields of nuclear detonations by year

Year	Number	Cumulative total	Yield (kt)	Cumulative yield (kt)
1945	3	3	59	59
1946	2	5	40	99
1947	—	5	—	99
1948	3	8	104	203
1949	1	9	—	203
1950	—	9	—	203
1951	18	27	159	362
1952	11	38	11,704	12,066
1953	15	53	2252	14,318
1954	7	60	1610	15,928
1955	19	79	1197	17,125
1956	27	106	15,832	32,957
1957	48	154	9724	42,681
1958	96	250	32,117	74,798
1959	—	250	—	74,798
1960	3	253	105	74,903
1961	45	298	72,545	147,448
1962	143	441	108,257	255,705
1963	36	477	1132	256,837
1964	33	510	999	257,836
1965	35	545	1335	259,171
1966	51	596	3490	262,661
1967	34	620	4702	267,363
1968	38	668	10,104	277,467
1969	30	698	7250	284,717
1970	40	738	12,685	297,402
1971	18	756	9380	306,782
1972	11	767	1435	308,217
1973	13	780	13,235	321,452
1974	11	791	1173	322,625
1975	10	801	2420	325,045

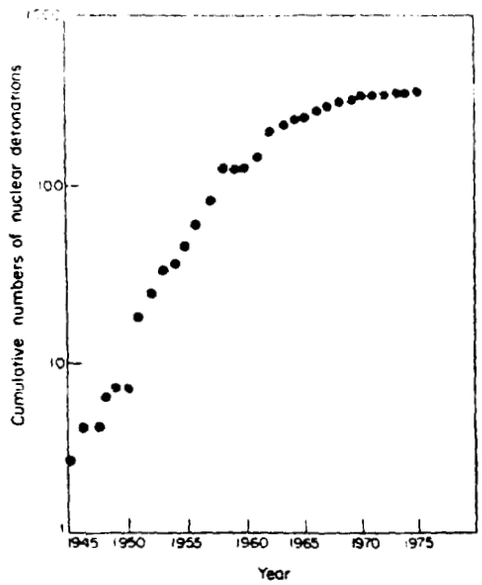

FIG. 1. Numbers of nuclear detonations.

number of tests were conducted. Actually, 143 tests were announced for 1962 and the second greatest number of tests, 96, was in 1958.

Figure 2 represents the cumulative yield plotted against time. The total yield is approx

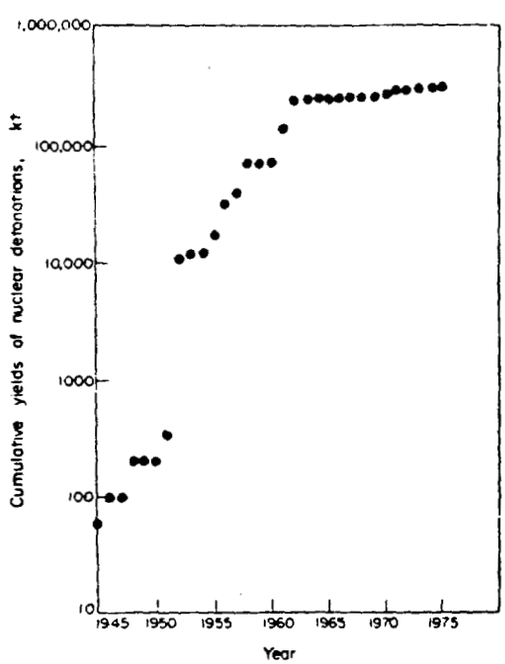

FIG. 2. Yields of nuclear detonations.

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325 Mt and the largest yearly yield was in 1962 and amounted to about 108 Mt. As mentioned previously, the largest nuclear test, 58 Mt, was conducted by the USSR in 1961. They also detonated two devices in 1962 which were about 30 Mt each; whereas, the largest test conducted by the US was Bravo on 28 February 1954 with a yield of 15 Mt.

In both Figs. 1 and 2, it is obvious that the rate of nuclear testing and the associated yield are decreasing with time. This is especially true for the last 5 yr.

SIGNIFICANT EVENTS IN NUCLEAR TESTING

Those events having a significant effect on nuclear testing are given in Table 3. The years of the first nuclear test and first H test are presented by country. Also, the dates of pertinent treaties and agreements as well as the participating countries are indicated. These treaties and agreements include:

Moratorium on Nuclear Testing

This declared Agreement involved the US, UK, and USSR. It was 1-yr (later extended) moratorium on nuclear testing to prepare the way for political negotiations. In effect, it started during November, 1958 and, for practical purposes, continued until the USSR began a large scale nuclear test series in the atmosphere in September 1961. During this period, early in 1960, France tested its first nuclear device and also conducted two additional nuclear tests before the end of 1960.

Limited Test Ban Treaty

This Treaty prohibited treaty participants from conducting nuclear weapons tests in the atmosphere, underwater, and in space and in any other environment if the test would cause radioactive debris to be present outside the territorial limits of the nation under whose jurisdiction or control such a test explosion is conducted.

Non-Proliferation Treaty

The major provisions of this Treaty were to prevent the supplying and acceptance of nuclear weapons and nuclear weapon's materials by the nuclear nations and the non-nuclear nations, respectively. Also, international inspections were agreed upon and the great nuclear powers agreed to enter into sincere negotiations to limit the nuclear arm's race.

Strategic Arms Limitations Talks

These so called SALT talks have led to the Threshold Test Ban Treaty which was scheduled to become effective 31 March 1976. This Treaty was signed by the heads of government, US and USSR, on 28 May 1976. A major provision of this Treaty would be to prohibit all underground nuclear tests having a yield of greater than 150 kt. An exception is simultaneous detonation of multiple devices, total yield not to exceed 1500 kt, for peaceful purposes. These treaty provisions, of course, are important steps in helping to limit the nuclear arm's race.

USSR Proposal to the United Nations in September 1975

This proposal would prohibit all testing of nuclear weapons and devices. This proposal will be considered and discussed by the United Nations in the near future and is, perhaps, a logical extension of the treaties previously discussed.

Acknowledgements—The authors want to acknowledge the interest of and assistance from the U.S. Energy Research and Development Administration; especially its Office of Public Affairs in

Table 3. Significant events in nuclear testing

Event	US	USSR	UK	F	PRC	In
First nuclear test	(1945)	1949	(1945)	1960	1964	1974
First thermonuclear test	1952	1952	1957	1968	1967	
Highest yield (kt)	15,000	58,000	>1000	>1000	~3000	
Moratorium on nuclear testing*	X	X	X			
Limited test ban treaty†	X	X	X			
Non proliferation treaty‡	X	X	X			
Threshold test ban treaty§	X	X	X			
Total test ban¶						

* Declared in fall of 1958, began during November 1958 and ended in September 1961.
† Entered into force 10 October, 1963.
‡ Entered into force 5 March, 1970.
§ Scheduled to become effective 31 March, 1976.
¶ Proposal to the United Nations by the USSR in September 1975.

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Washington, D.C., and the Office of Public Affairs at its Nevada Operations Office in Las Vegas, Nevada. Also, we acknowledge similar contributions from these offices when they were units of the U.S Atomic Energy Commission. Special thanks and gratitude are expressed to Mrs. Tony Joy and Messrs. James S. Cannon, David G. Jackson, and David F. Miller of the Energy Research and Development Administration. The efforts of Ms. April J. Haynes and Ms. Kathy Dolezal in handling the secretarial responsibilities of the manuscript are greatly appreciated.

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Sp75 Springer D. L. and Kinnaman R. L., 1975, *Ibid.* **65**, 343.

APPENDIX

Nuclear detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
TRINITY:						
Trinity	16/7/45	Alamogordo	AT	30	19	Tower, First Test
World War II	5/8/45	Hiroshima	AT	~560	<20	First Combat Use
	9/8/45	Nagasaki	AT	~560	<20	Second Combat Use
CROSSROADS:						
Able	30/6/46	Bikini	AT	160	<20	
Baker	24/7/46	Bikini	UW	~30	<20	
SANDSTONE:						
X-Ray	14/4/48	Eniwetok	AT	60	37	Tower
Yoke	30/4/48	Eniwetok	AT	60	49	Tower
Zebra	14/5/48	Eniwetok	AT	60	18	Tower
RANGER:						
Able	27/1/51	NTS	AT	320	1	
Baker	28/1/51	NTS	AT	330	8	
Easy	1/2/51	NTS	AT	330	1	
Baker-2	2/2/51	NTS	AT	340	8	
Fox	6/2/51	NTS	AT	430	22	
GREENHOUSE:						
Dog	7/4/51	Eniwetok	AT	90		Tower
Easy	20/4/51	Eniwetok	AT	90	47	Tower
George	8/5/51	Eniwetok	AT	60		Tower
Item	24/5/51	Eniwetok	AT	60		Tower
BUSTER-JANGLE:						
Able	22/10/51	NTS	AT	30	<0.1	Tower
Baker	28/10/51	NTS	AT	340	3.5	
Charlie	30/10/51	NTS	AT	350	14	
Dog	1/11/51	NTS	AT	430	21	
Easy	5/11/51	NTS	AT	400	31	
Sugar	19/11/51	NTS	AT	1	1.2	Surface
Uncle	29/11/51	NTS	UG	~5	1.2	
TUMBLER-SNAPPER:						
Able	1/4/52	NTS	AT	240	1	
Baker	15/4/52	NTS	AT	320	1	
Charlie	22/4/52	NTS	AT	1050	31	
Dog	1/5/52	NTS	AT	320	19	
Easy	7/5/52	NTS	AT	90	12	Tower
Fox	25/5/52	NTS	AT	90	11	Tower
George	1/6/52	NTS	AT	90	15	Tower
How	5/6/52	NTS	AT	90	14	Tower
IVY:						
Mike	31/10/52	Eniwetok	AT		10400	Surface, Experimental
King	15/11/52	Eniwetok	AT		>200	H Device
UPSHOT-KNOTHOLE:						
Annie	17/3/53	NTS	AT	90	16	Tower
Nancy	24/3/53	NTS	AT	90	24	Tower
Ruth	31/3/53	NTS	AT	90	0.2	Tower
Dixie	6/4/53	NTS	AT	1840	11	
Ray	11/4/53	NTS	AT	30	0.2	Tower
Badger	18/4/53	NTS	AT	90	23	Tower
Simon	25/4/53	NTS	AT	90	43	Tower
Encore	8/5/53	NTS	AT	740	27	
Harry	19/5/53	NTS	AT	90	32	Tower
Grable	25/5/53	NTS	AT	160	15	280 mm Gun
Climax	4/6/53	NTS	AT	410	61	

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Nuclear detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
CASTLE						
Bravo	28/2/54	Bikini	AT		15,000	Surface. Experimental H Device
Romeo	26/3/54	Bikini	AT			Barge
Koon	6/4/54	Bikini	AT		110	Surface
Union	25/4/54	Bikini	AT			Barge
Yankee	4/5/54	Bikini	AT			Barge
Nectar	13/5/54	Eniwetok	AT			Barge
TEAPOT:						
Wasp	18/2/55	NTS	AT	230	1	
Moth	22/2/55	NTS	AT	90	2	Tower
Tesla	1/3/55	NTS	AT	90	7	Tower
Turk	7/3/55	NTS	AT	150	43	Tower
Hornet	12/3/55	NTS	AT	90	4	Tower
Bee	22/3/55	NTS	AT	150	8	Tower
ESS	23/3/55	NTS	UG	−20	1	
Apple-1	29/3/55	NTS	AT	150	14	Tower
Wasp Prime	29/3/55	NTS	AT	230	3	
Ha	6/4/55	NTS	AT	11200	3	(MSL)
Post	9/4/55	NTS	AT	90	2	Tower
Met	15/4/55	NTS	AT	120	22	Tower
Apple-2	5/5/55	NTS	AT	150	29	Tower
Zucchini	15/5/55	NTS	AT	150	28	Tower
WIGWAM:						
Wigwam	14/5/55	29°N, 126°W	UW	−610	30	
1956	18/1/56	NTS	AT			Surface. Safety Exp.
REDWING:						
Lacrosse	4/5/56	Eniwetok	AT		40	Surface
Cherokee	20/5/56	Bikini	AT	1320	>1000	First Air Drop of H Weapon
Zuni	27/5/56	Bikini	AT		3530	Surface
Erie	30/5/56	Eniwetok	AT	90		Tower
Seminole	6/6/56	Eniwetok	AT		12	Surface
Flathead	11/6/56	Bikini	AT			Barge
Blackfoot	11/6/56	Eniwetok	AT	60		Tower
Osage	16/6/56	Eniwetok	AT	210		
Dakota	25/6/56	Bikini	AT			Barge
Apache	8/7/56	Eniwetok	AT			Barge
Navajo	10/7/56	Bikini	AT			Barge
Tewa	20/7/56	Bikini	AT		5010	Barge
Huron	21/7/56	Eniwetok	AT			Barge
PLUMBBOB:						
Boltzmann	28/5/57	NTS	AT	150	12	Tower
Franklin	2/6/57	NTS	AT	90	0.140	Tower
Lassen	5/6/57	NTS	AT	150	0.0005	Balloon
Wilson	18/6/57	NTS	AT	150	10	Balloon
Priscilla	24/6/57	NTS	AT	210	37	Balloon
Hood	5/7/57	NTS	AT	460	74	Balloon
Diablo	15/7/57	NTS	AT	150	17	Tower
John	19/7/57	NTS	AT	610	~2	Rocket
Kepler	24/7/57	NTS	AT	150	10	Tower
Owens	25/7/57	NTS	AT	150	9.7	Balloon
Pascal A	26/7/57	NTS	UG		<20	
Stokes	7/8/57	NTS	AT	460	19	Balloon
Shasta	18/8/57	NTS	AT	150	17	Tower
Doppler	23/8/57	NTS	AT	460	11	Balloon
Franklin Prime	30/8/57	NTS	AT	230	4.7	Balloon
Smoky	31/8/57	NTS	AT	215	44	Tower
Galileo	2/9/57	NTS	AT	150	11	Tower
Wheeler	6/9/57	NTS	AT	150	0.197	Balloon
Coulomb B	6/9/57	NTS	AT		0.3	Surface
Laplace	8/9/57	NTS	AT	230	1	Tower
Fizeau	14/9/57	NTS	AT	150	11	Balloon
Newton	16/9/57	NTS	AT	460	12	
Rainier	19/9/57	NTS	UG	−240	1.7	Tunnel
Whitney	23/9/57	NTS	AT	150	19	Tower
Charleston	28/9/57	NTS	AT	460	12	Balloon
Morgan	7/10/57	NTS	AT	150	8	Balloon
Pascal C	6/12/57	NTS	UG		<20	Vertical Shaft
Coulomb C	9/12/57	NTS	AT		0.5	Surface
HARDTACK PHASE I:						
Yucca	28/4/58	12°37'N 163°01'E	AT	26000		Balloon
Cactus	5/5/58	Eniwetok	AT		18	Surface
Fir	11/5/58	Bikini	AT			Barge
Butternut	11/5/58	Eniwetok	AT			Barge
Koa	12/5/58	Eniwetok	AT		1370	Surface
Wahoo	16/5/58	Eniwetok	UW	−150		
Holly	20/5/58	Eniwetok	AT			Barge
Nutmeg	21/5/58	Bikini	AT			Barge

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Nuclear detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
Yellowwood	26/5/58	Eniwetok	AT			Barge
Magnolia	26/5/58	Eniwetok	AT			Barge
Tobacco	30/5/58	Eniwetok	AT			Barge
Sycamore	31/5/58	Bikini	AT			Barge
Rose	2/6/58	Eniwetok	AT			Barge
Umbrella	8/6/58	Eniwetok	UW	−45		
Maple	10/6/58	Bikini	AT			Barge
Aspen	14/6/58	Bikini	AT			Barge
Walnut	14/6/58	Eniwetok	AT			Barge
Linden	18/6/58	Eniwetok	AT			Barge
Redwood	27/6/58	Bikini	AT			Barge
Elder	27/6/58	Eniwetok	AT			Barge
Oak	28/6/58	Eniwetok	AT		8900	Barge
Hickory	29/6/58	Bikini	AT			Barge
Sequoia	1/7/58	Eniwetok	AT			Barge
Cedar	2/7/58	Bikini	AT			Barge
Dogwood	5/7/58	Eniwetok	AT			Barge
Poplar	12/7/58	Bikini	AT			Barge
Juniper	22/7/58	Bikini	AT			Barge
Oliver	22/7/58	Eniwetok	AT			Barge
Pine	26/7/58	Eniwetok	AT			Barge
Teak	1/8/58	Johnston Island	HA	77000	>1000	Rocket
Orange	12/8/58	Johnston Island	HA	43000	>1000	Rocket
ARGUS:						
Argus I	27/8/58	S. Atlantic	HA	−480000	1–2	Rocket
Argus II	30/8/58	S. Atlantic	HA	−480000	1–2	Rocket
Argus III	6/9/58	S. Atlantic	HA	−480000	1–2	Rocket
HARDTACK PHASE II:						
Otero	12/9/58	NTS	UG	−146	0.038	
Bernalillo	17/9/58	NTS	UG	−139	0.015	
Eddy	19/9/58	NTS	AT	150	0.083	Balloon
Luna	21/9/58	NTS	UG	−148	0.0015	
Valencia	26/9/58	NTS	UG	−148	0.002	
Mars	28/9/58	NTS	UG		0.013	Tunnel, Venting
Mora	29/9/58	NTS	AT	460	2	Balloon
Hidago	5/10/58	NTS	AT	115	0.077	Balloon
Colfax	5/10/58	NTS	UG	−107	0.0055	
Tamalpais	8/10/58	NTS	UG	−100	0.072	Slight Venting
Quay	10/10/58	NTS	AT	30	0.079	Tower
Lea	13/10/58	NTS	AT	460	1.4	Balloon
Neptune	14/10/58	NTS	UG	−30	0.113	Venting
Hamilton	15/10/58	NTS	AT	15	0.0002	Tower
Logan	16/10/58	NTS	UG	−250	5	
Dona Ana	16/10/58	NTS	AT	140	0.037	Balloon
Vesta	17/10/58	NTS	AT		0.024	Surface
Rio Arriba	18/10/58	NTS	AT	22	0.09	Tower
Socorro	22/10/58	NTS	AT	440	6	Balloon
Wrangell	22/10/58	NTS	AT	460	0.115	Balloon
Rushmore	22/10/58	NTS	AT	150	0.188	Balloon
Catron	24/10/58	NTS	AT	22	0.021	Tower
Juno	24/10/58	NTS	AT		0.0017	Surface
Sanford	26/10/58	NTS	AT	460	4.9	Balloon
Ceres	26/10/58	NTS	AT	8	0.0007	Tower
De Baca	26/10/58	NTS	AT	460	2.2	Balloon
Chavez	27/10/58	NTS	AT	16	0.0006	Tower
Evans	29/10/58	NTS	UG	−260	0.055	Venting
Humboldt	29/10/58	NTS	AT	8	0.008	Tower
Santa Fe	30/10/58	NTS	AT	460	1.3	Balloon
Bianca	30/10/58	NTS	UG	250	19	Slight Venting
Titania	30/10/58	NTS	AT	8	0.0002	Tower
NOUGAT:						
Antler	15/9/61	NTS	UG	−400	2.6	Tunnel
Shrew	16/9/61	NTS	UG	−100	<20	
Chena	10/10/61	NTS	UG	−255	<20	Tunnel
Mink	29/10/61	NTS	UG	−190	<20	
Fisher	3/12/61	NTS	UG	−365	13.5	
GNOME PROJECT:						
Gnome	10/12/61	Carlsbad, NM	UG	−360	3.1	Plowshare
NOUGAT (Continued):						
Mad	13/12/61	NTS	UG	−120	0.43	
Ringtail	17/12/61	NTS	UG	−360	<20	
Feather	22/12/61	NTS	UG	−250	<20	Tunnel
Stoat	9/1/62	NTS	UG	−300	4.5	
Agouti	18/1/62	NTS	UG	−260	5.9	
Dormouse	30/1/62	NTS	UG	−360	<20	
Stillwater	8/2/62	NTS	UG	−190	2.7	
Armadillo	9/2/62	NTS	UG	−240	6.6	
Hardhat	15/2/62	NTS	UG	−290	5.9	
Chinchilla I	19/2/62	NTS	UG	−150	1.8	
Codsaw	19/2/62	NTS	UG	−210	<20	
Cimarron	23/2/62	NTS	UG	−30	11.2	
Platypus	24/2/62	NTS	UG	−58	<20	

Event identification
Danny Boy
Ermine
Brazos
Hognose
Hoosic
Chinchilla II
Dormouse II
Passaic
Hudson
Platte
Dead
DOMINIC:
Adobe
Aztec
NOUGAT (Cont
Black
DOMINIC (Con
Arkansas
Questa
Frigate Bird
NOUGAT (Con
Paca
Aardvark
DOMINIC (Con
Yukon
Mesilla
Muskegon
Swordfish
Encino
Swanee
NOUGAT (Con
Eel
DOMINIC (Con
Chetco
NOUGAT (Con
White
DOMINIC (Con
Tanana
Nambe
NOUGAT (Cont.
Raccoon
Packrat
DOMINIC (Con
Alma
Truckee
Yeso
Harlem
NOUGAT (Cont.
Des Moines
DOMINIC (Con
Rinconada
Dulce
Pent
NOUGAT (Con
Daman I
DOMINIC (Con
Otowi
Bighorn
NOUGAT (Con
Haymaker
Marshmallow
DOMINIC (Con
Bluestone
NOUGAT (Con
Sacramento
STORAX:
Sedan
Little Feller II

1081014

Nuclear detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
Danny Boy	5/3/62	NTS	UG	-34	0.42	Cratering Test
Ermine	6/3/62	NTS	UG	-73	<20	
Brazos	8/3/62	NTS	UG	-260	7.6	
Hognose	15/3/62	NTS	UG	-240	<20	
Hoonic	28/3/62	NTS	UG	-190	3	
Chinchilla II	31/3/62	NTS	UG	-140	<20	
Dormouse Prime	5/4/62	NTS	UG	-260	10	
Passaic	6/4/62	NTS	UG	-230	<20	
Hudson	12/4/62	NTS	UG	-150	<20	
Platte	14/4/62	NTS	UG	-170	1.7	Tunnel
Dead	21/4/62	NTS	UG	-190	<20	
DOMINIC:						
Adobe	27/4/62	CIA	AT		20–200	
Aztec		CIA	AT		20–200	
NOUGAT (Continued):						
Black	27/4/62	NTS	UG	220	<20	
DOMINIC (Continued):						
Arkansas	2/5/62	CIA	AT		>1000	
Questa	4/5/62	CIA	AT		20–200	
Frigate Bird	6/5/62	CIA	AT			Polaris Launched Missile
NOUGAT (Continued):						
Paca	7/5/62	NTS	UG	-260	<20	
Aardvark	12/5/62	NTS	UG	-430	38	
DOMINIC (Continued):						
Yukon	8/5/62	CIA	AT		20–200	
Mesilla	9/5/62	CIA	AT		20–200	
Muskegon	11/5/62	CIA	AT		20–200	
Swordfish	11/5/62	E. Pacific	UW		<20	Antisubmarine Rocket
Encino	12/5/62	CIA	AT		20–200	
Swanee	14/5/62	CIA	AT		20–200	
NOUGAT (Continued):						
Eel	19/5/62	NTS	UG	-200	<20	
DOMINIC (Continued):						
Chetco	19/5/62	CIA	AT		20–200	
NOUGAT (Continued):						
White	25/5/62	NTS	UG	-190	<20	
DOMINIC (Continued):						
Tanana	25/5/62	CIA	AT		<20	
Nambe	27/5/62	CIA	AT		20–200	
NOUGAT (Continued):						
Raccoon	1/6/62	NTS	UG	-160	<20	
Packrat	6/6/62	NTS	UG	-260	<20	
DOMINIC (Continued):						
Alma	8/6/62	CIA	AT		20–200	
Truckee	9/6/62	CIA	AT		20–200	
Yeso	10/6/62	CIA	AT		>1000	
Harlem	12/6/62	CIA	AT		20–200	
NOUGAT (Continued):						
Des Moines	13/6/62	NTS	UG	-190	<20	Tunnel
DOMINIC (Continued):						
Rinconada	15/6/62	CIA	AT		20–200	
Dulce	17/6/62	CIA	AT		20–200	
Petit	19/6/62	CIA	AT		<20	
NOUGAT (Continued):						
Daman I	21/5/62	NTS	UG	-260	<20	
DOMINIC (Continued):						
Otowi	22/6/62	CIA	AT		20–200	
Bighorn	27/6/62	CIA	AT		>1000	
NOUGAT (Continued):						
Haymaker	27/6/62	NTS	UG	-410	67	
Marshmallow	28/6/62	NTS	UG	-270	<20	Tunnel
DOMINIC (Continued):						
Bluestone	30/6/62	CIA	AT		>1000	
NOUGAT (Continued):						
Sacramento	30/6/62	NTS	UG	-150	<20	
STORAX:						
Sedan	6/7/62	NTS	UG	-190	100	Plowshare No. 2 Cratering
Little Feller II	7/7/62	NTS	AT	1	<20	Above Ground

1081015

Nuclear Detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
DOMINIC (Continued):						
Starfish Prime	9/7/62	JIA	HA	400000	1400	
Sunset	10/7/62	CIA	AT		20–200	
Pamlico	11/7/62	CIA	AT		>1000	
STORAX (Continued):						
Johnny Boy	11/7/62	NTS	UG		0.5	Below Ground
Merrimac	13/7/62	NTS	UG		>20	
Small Boy	14/7/62	NTS	AT		<20	Above Ground
Little Feller 1	17/7/62	NTS	AT		<20	Above Ground
Wichita	27/7/62	NTS	UG	−150	<20	
York	24/8/62	NTS	UG	−230	<20	
Bobac	24/8/62	NTS	UG	−210	<20	
Hydrax	14/9/62	NTS	UG	−220	<20	
Peba	20/9/62	NTS	UG	−240	<20	
Allegheny	29/9/62	NTS	UG	−210	<20	
DOMINIC (Continued):						
Androscoggin	2/10/62	JIA	AT		20–200	
Bumping	6/10/62	JIA	AT		<20	
STORAX (Continued):						
Mississippi	5/10/62	NTS	UG	−490	110	
Roanoke	12/10/62	NTS	UG	−160	<20	
DOMINIC (Continued):						
Chama	18/10/62	JIA	AT		>1000	
STORAX (Continued):						
Bandicoot	19/10/62	NTS	UG	−240	<20	
DOMINIC (Continued):						
Checkmate	20/10/62	JIA	HA	10000	<20	
STORAX (Continued):						
Santee	27/10/62	NTS	UG	−320	<20	
DOMINIC (Continued):						
Bluegill Triple Prime	26/10/62	JIA	HA	10000	<1000	
Calamity	27/10/62	JIA	AT		20–200	
Housatonic	30/10/62	JIA	AT		>1000	
Kingfish	1/11/62	JIA	HA	10000	<1000	
Tightrope	4/11/62	JIA	HA	10000	<20	
STORAX (Continued):						
Anacostia	27/11/62	NTS	UG	−230	<20	Plowshare No. 3
Madison	12/12/62	NTS	UG	−350	<20	Tunnel
Numbat	12/12/62	NTS	UG	−240	<20	
Casselman	8/2/63	NTS	UG	−310	<200	
Acushi	8/2/63	NTS	UG	−260	<200	
Carmel	21/2/63	NTS	UG	−160	<20	
Kaweah	21/2/63	NTS	UG	−230	<20	Plowshare No. 4
Gerbil	29/3/63	NTS	UG	−280	<20	
Ferret Prime	5/4/63	NTS	UG	−240	<20	
Stones	22/5/63	NTS	UG	−390	20–200	
Yuba	5/6/63	NTS	UG	−240	<20	
Hutia	6/6/63	NTS	UG	−130	<20	
Mataco	14/6/63	NTS	UG	−200	<20	
Kennebec	25/6/63	NTS	UG	−230	<20	
NIBLIC:						
Pekan	12/8/63	NTS	UG	−300	<20	
Satsop	15/8/63	NTS	UG	−225	<20	
Kohocton	20/8/63*	NTS	UG	−260	<20	
Ahtanum	23/8/63	NTS	UG	−230	<20	
Bilby	13/9/63	NTS	UG	−740	−200	
Grunion	13/9/63	NTS	UG	−260	<20	
Torrillo	11/10/63	NTS	UG	−150	<20	Plowshare No. 5
Clearwater	11/10/63	NTS	UG	−550	20–200	
Shoal	16/10/63	NTS	UG		−12	Vela Uniform
Anchovy	26/10/63	Near Fallon, Nevada	UG	−260	<20	
Mustang	14/11/63	NTS	UG	−170	<20	
Greys	15/11/63	NTS	UG	−300	<20	
Sardine	22/11/63	NTS	UG	−260	<20	
Eagle	4/12/63	NTS	UG		<20	Slight Venting
Fore	12/12/63	NTS	UG	−490	20–200	
Oconto	16/1/64	NTS	UG	−260	<20	
Klickitat	23/1/64	NTS	UG	−490	20–200	Plowshare No. 6
Pike	20/2/64	NTS	UG	−110	<20	Venting
Hook	13/3/64	NTS	UG	−200	<20	
Sturgeon	14/4/64	NTS	UG	−150	<20	
Turf	15/4/64	NTS	UG	−510	20–200	
	24/4/64	NTS				

* JFK ADDITION. Add 23 UG Tests at NTS between 13/9/61 and 20/8/63. Announcement made 20 August 1963. (Use 3 in 1961, 12 in 1962, and 8 in 1963.)

Event identification
Pipefish
Backswing
Minnow
Ace
Fade
Dub
WHETSTONE:
Bye
Alva
Canvasback
Haddock
Guanay
Auk
Par
Barbel
Salmon
Forest
Handcar
Crepe
Parrot
Mudpack
Sulky
Wool
Cashmere
Alpaca
Merlin
Wishbone
Wagtail
Cup
Kestrel
Cambric
Palanquin
Gumdrop
Tee
Buteo
Scaup
Tweed
Petrel
Diluted Waters
Tiny Tot
FLINTLOCK:
Bronze
Mauve
Centaur
Screamer
Elkhart
Long Shot
Sepia
Corduroy
Emerson
Buff
Maxwell
Lampblack
Dovekie
Plaid II
Rex
Red Hot
Finfoot
Clymer
Purple
Templar
Lime
Stutz
Tomato
Duryea
Pin Stripe
Traveler
Cyclamen
Chartreuse
Tapestry
Piranha
Dumont
Discus Thrower
Pile Driver
Tan
Puce
Double Play
Kankakee
Vulcan
Halfbeak
LATCHKEY:
Saxon
Rovena
Derringer
Daiquiri

1081016

Nuclear detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
Pipefish	29/4/64	NTS	UG	−260	<20	
Backswing	14/5/64	NTS	UG	−160	<20	
Minnow	15/5/64	NTS	UG	−240	<20	
Ace	12/6/64	NTS	UG	−260	<20	Plowshare No. 7
Fade	25/6/64	NTS	UG	−220	<20	
Dub	30/6/64	NTS	UG	−260	<20	Plowshare No. 8
WHETSTONE:						
Bye	16/7/64	NTS	UG	−390	20–200	
Alva	19/8/64	NTS	UG	−170	<20	
Canvasback	22/8/64	NTS	UG	−450	<20	
Haddock	28/8/64	NTS	UG	−360	<20	
Guanay	4/9/64	NTS	UG	−260	<20	
Auk	2/10/64	NTS	UG	−450	<20	
Par	9/10/64	NTS	UG	−400	38	Plowshare No. 9
Barbel	16/10/64	NTS	UG	−260	<20	
Salmon	22/10/64	Hattiesburg, MI	UG	−830	5.3	Vela Uniform
Forest	31/10/64	NTS	UG	−380	<20	
Handcar	5/11/64	NTS	UG	−400	12	Plowshare No. 10
Crepe	5/12/64	NTS	UG	−400	20–200	
Parrot	16/12/64	NTS	UG	−180	1.2	Venting
Mudpack	16/12/64	NTS	UG	−150	2.4	
Sulky	18/12/64	NTS	UG	−30	0.092	Plowshare No. 11, Venting
Wool	14/1/65	NTS	UG	−210	<20	
Cashmere	4/2/65	NTS	UG	−30	<20	
Alpaca	12/2/65	NTS	UG	−220	<20	Venting
Merlin	16/2/65	NTS	UG	−300	10	
Wishbone	18/2/65	NTS	UG	−180	<20	
Wagtail	3/3/65	NTS	UG	−750	20–200	
Cup	26/3/65	NTS	UG	−540	20–200	
Kestrel	5/4/65	NTS	UG	−450	20	
Cambric	14/4/65	NTS	UG		0.75	
Palanquin	14/4/65	NTS	UG	−80	4.3	Plowshare No. 12, Cratering
Gumdrop	21/4/65	NTS	UG	−300	<20	Tunnel
Tee	12/5/65	NTS	UG	−700	<20	Venting
Buteo	12/5/65	NTS	UG	−700	<20	
Scaup	14/5/65	NTS	UG	−430	<20	
Tweed	21/5/65	NTS	UG	−280	<20	
Petrel	11/6/65	NTS	UG	−180	1.2	
Diluted Waters	16/6/65	NTS	UG	−190	<20	Venting
Tiny Tot	17/6/65	NTS	UG	−110	<20	
FLINTLOCK:						
Bronze	23/7/65	NTS	UG	−530	20–200	
Mauve	6/8/65	NTS	UG	−320	<20	
Centaur	27/8/65	NTS	UG	−170	<20	
Screamer	1/9/65	NTS	UG	−300	<20	
Elkhart	17/9/65	NTS	UG	−220	<20	
Long Shot	29/10/65	Amchitka Isl.	UG	−700	−80	Vela Uniform
Sepia	12/11/65	NTS	UG	−240	<20	
Corduroy	3/12/65	NTS	UG	−680	20–200	
Emerson	16/12/65	NTS	UG	−260	<20	
Buff	16/12/65	NTS	UG	−500	20–200	
Maxwell	13/1/66	NTS	UG	−180	<20	
Lampblack	18/1/66	NTS	UG	−560	20–200	
Dovekie	21/1/66	NTS	UG	−330	<20	
Plaid II	3/2/66	NTS	UG	−270	<20	
Rex	24/2/66	NTS	UG	−670	16	
Red Hot	5/3/66	NTS	UG	−400	<20	Tunnel, Venting
Finfoot	7/3/66	NTS	UG	−200	<20	
Clymer	12/3/66	NTS	UG	−400	<20	
Purple	18/3/66	NTS	UG	−330	<20	
Templar	24/3/66	NTS	UG	−150	<20	Plowshare No. 13
Lime	1/4/66	NTS	UG	−560	<20	
Stutz	6/4/66	NTS	UG	−220	<20	
Tomato	7/4/66	NTS	UG	−230	<20	
Duryea	14/4/66	NTS	UG	−740	65	
Pin Stripe	25/4/66	NTS	UG	−300	<20	Venting
Traveler	4/5/66	NTS	UG	−200	<20	
Cyclamen	5/5/66	NTS	UG	−300	12	
Chartreuse	6/5/66	NTS	UG	−670	70	
Tapestry	12/5/66	NTS	UG	−250	<20	
Piranha	13/5/66	NTS	UG	−550	20–200	
Dumont	19/5/66	NTS	UG	−670	20–200	
Discus Thrower	27/5/66	NTS	UG	−340	21	
Pile Driver	2/6/66	NTS	UG	−460	56	
Tan	3/6/66	NTS	UG	−560	20–200	
Puce	10/6/66	NTS	UG	−490	<20	
Double Play	15/6/66	NTS	UG	−1980	<20	
Kankakee	15/6/66	NTS	UG	−460	20–200	
Vulcan	25/6/66	NTS	UG	−320	25	Plowshare No. 14
Halfbeak	30/6/66	NTS	UG	−820	300	
LATCHKEY:						
Saxon	28/7/66	NTS	UG	−150	<20	Plowshare No. 15
Rovena	10/8/66	NTS	UG	−190	<20	
Derringer	12/9/66	NTS	UG	−250	<20	Venting
Daiquiri	23/9/66	NTS	UG	−560	<20	

1081017

Nuclear detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height/m	Event yield/kt	Remarks
Newark	29/9/66	NTS	UG	−230	<20	
Simms	5/11/66	NTS	UG	−200	<20	Plowshare No. 16
Ajax	11/11/66	NTS	UG	−240	<20	
Cerise	18/11/66	NTS	UG	−210	<20	
Sterling	3/12/66	Hattiesburg, MI	UG	−830	0.38	Vela Uniform
New Point	13/12/66	NTS	UG	−240	<20	
Greeley	20/12/66	NTS	UG	−1200	825	
Nash	19/1/67	NTS	UG	−360	20–200	Venting
Bourbon	20/1/67	NTS	UG	−560	20–200	
Ward	8/2/67	NTS	UG	−260	<20	
Persimmon	23/2/67	NTS	UG	−300	<20	
Agile	23/2/67	NTS	UG	−730	20–200	
Rivet III	2/3/67	NTS	UG	−270	<20	
Fawn	7/4/67	NTS	UG	−270	<20	
Chocolate	21/4/67	NTS	UG	−240	<20	
Effendi	27/4/67	NTS	UG	−220	<20	
Mickey	10/5/67	NTS	UG	−500	20–200	
Commodore	20/5/67	NTS	UG	−750	250	
Scotch	23/5/67	NTS	UG	−46	150	
Knickerbocker	25/5/67	NTS	UG	−630	71	
Switch	22/6/67	NTS	UG	−500	<20	Plowshare No. 17
Midi Mist	26/6/67	NTS	UG	−380	<20	Tunnel
Umber	29/6/67	NTS	UG	−310	<20	Venting
CROSSTIE:						
Stanley	27/7/67	NTS	UG	−480	20–200	
Washer	10/8/67	NTS	UG	−470	<20	
Bordeaux	18/8/67	NTS	UG	−330	<20	
Door Mist	31/8/67	NTS	UG	−450	<20	Tunnel, Venting
Yard	7/9/67	NTS	UG	−520	20–200	
Marvel	21/9/67	NTS	UG	−170	2.2	Plowshare No. 18
Zaza	27/9/67	NTS	UG	−670	20–200	
Lampher	18/10/67	NTS	UG	−710	20–200	
Sazerac	25/10/67	NTS	UG	−300	<20	
Cobbler	8/11/67	NTS	UG	−670	<20	
Gasbuggy	10/12/67	Farmington, New Mexico	UG	−1300	29	Plowshare No. 19 Gas Stimulation
Stilt	15/12/67	NTS	UG	−330	<20	
Hupmobile	18/1/68	NTS	UG	−250	<20	Venting
Staccato	19/1/68	NTS	UG	−440	20–200	
Faultless	19/1/68	Hot Creek Va., Nevada	UG	−980	200–1000	Calibration
Cabriolet	26/1/68	NTS	UG	−50	2.3	Plowshare No. 20, Cratering
Knox	21/2/68	NTS	UG	−650	20–200	
Dorsal Fin	29/2/68	NTS	UG	−410	<20	Tunnel
Buggy	12/3/68	NTS	UG	−40	5.4	Plowshare No. 21
Pommard	14/3/68	NTS	UG	−210	1.4	5 Detonations, Cratering
Stinger	22/3/68	NTS	UG	−670	20–200	
Milk Shake	25/3/68	NTS	UG	−260	<20	
Noor	10/4/68	NTS	UG	−380	20–200	
Shuffle	18/4/68	NTS	UG	−490	20–200	
Scroll	23/4/68	NTS	UG	−220	<20	Vela Uniform
Boxcar	26/4/68	NTS	UG	−120	1200	
Clarksmobile	17/5/68	NTS	UG	−470	20–200	
Tub	6/6/68	NTS	UG	−190	<20	
Rickey	15/6/68	NTS	UG	−680	20–200	
Chateaugay	28/6/68	NTS	UG	−610	20–200	
BOWLINE:						
Tanya	30/7/68	NTS	UG	−380	20–200	
Diana Moon	27/8/68	NTS	UG	−240	<20	
Sled	29/8/68	NTS	UG	−730	20–200	
Noggin	6/9/68	NTS	UG	−580	20–200	
Knife A	12/9/68	NTS	UG	−330	<20	
Stoddard	17/9/68	NTS	UG	−470	20–200	
Hudson Seal	24/9/68	NTS	UG	−330	<20	Tunnel
Knife C	3/10/68	NTS	UG	−300	<20	
Crew	4/11/68	NTS	UG	−600	20–200	
Knife B	15/11/68	NTS	UG	−360	<20	
Ming Vase	20/11/68	NTS	UG	−310	<20	
Tinderbox	22/11/68	NTS	UG	−440	<20	
Schooner	8/12/68	NTS	UG	−110	35	Plowshare No. 23, Cratering
Tyg	12/12/68	NTS	UG	−270	<20	
Benham	19/12/68	NTS	UG	−1400	1100	
Packard	15/1/69	NTS	UG	−250	<20	
Wineskin	15/1/69	NTS	UG	−520	20–200	
Vise	30/1/69	NTS	UG	−450	20–200	
Cypress	12/2/69	NTS	UG	−410	<20	Tunnel
Barsac	20/3/69	NTS	UG	−300	<20	
Coffer	21/3/69	NTS	UG	−460	<100	
Thistle	30/4/69	NTS	UG	−557	20–200	
Blenton	30/4/69	NTS	UG	−562	20–200	
Purse	7/5/69	NTS	UG	−600	20–200	
Torrido	27/5/69	NTS	UG	−520	20–200	
Tapper	12/6/69	NTS	UG	−300	<20	
MANDREL:						
Ildrim	16/7/69	NTS	UG	−410	20–200	
Hutch	16/7/69	NTS	UG	−550	20–200	

Event identification
Spider
Piers
Rulison
Minute Steak
Jorum
Milrow
Pipkin
Cruet
Pod
Calabash
Piccalilli
Diesel Train
Grape A
Lovage
Terrine
Fob
Ajo
Grape B
Labis
Diana Mist
Cumarin
Yannigan
Cyathus
Arabis
Jal
Shaper
Handley
Snubber
Can
Beebalm
Hod
Mint Leaf
Diamond Dust
Cornice
Manzanas
Morrones
Hudson Moon
Flask
Arnica
EMERY:
Tijeras
Abeytas
Artesia
Cream
Carpetbag
Baneberry
Embudo
Laguna
Harbell
GROMMET:
Diamond Mine
Miniata
Algodones
Pedernal
Cathay
Cannikin
Diagonal Line
Chuenacus
Lonchamps
Misty North
Zinnia
Monero
TOGGLE:
Diamond Scull
Oscuro
Delphinium
Flax
Miera
Angus
Starwort
Rio Blanco
Dido Queen
Almendro
Portulaca
ARBOR:
Husky Ace
Bernal
Latir
Ming Blade

1081018

Nuclear detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
Spider	14/8/69	NTS	UG	−340	<20	
Piers	27/8/69	NTS	UG	−240	<20	
Rulison	10/9/69	Grand Val., Co	UG	−2580	40	Plowshare No. 24 Gas Stimulation
Minute Steak	12/9/69	NTS	UG	−260	<20	
Jorum	16/9/69	NTS	UG	−1200	<1000	
Milrow	2/10/69	Amchitka Isl	UG	−1220	~1000	
Pipkin	8/10/69	NTS	UG	−620	200–1000	
Cruet	29/10/69	NTS	UG	−260	<20	
Pod	29/10/69	NTS	UG	−310	20–200	Venting
Calabash	29/10/69	NTS	UG	−630	110	
Piccalilli	21/11/69	NTS	UG	−390	20–200	
Diesel Train	5/12/69	NTS	UG	−420	20	
Grape A	17/12/69	NTS	UG	−550	20–200	
Lovage	17/12/69	NTS	UG	−380	20	
Terrine	18/12/69	NTS	UG	−460	20–200	
Fob	23/1/70	NTS	UG	−270	<20	
Ajo	30/1/70	NTS	UG	−300	<20	Mined Shaft
Grape B	4/2/70	NTS	UG	−550	20–200	
Labis	5/2/70	NTS	UG	−440	20–200	
Diana Mist	11/2/70	NTS	UG	−400	<20	Tunnel
Cumarin	25/2/70	NTS	UG	−410	20–200	
Yannigan	26/2/70	NTS	UG	−390	20–200	
Cyathus	6/3/70	NTS	UG	−290	<20	
Arabis	6/3/70	NTS	UG	−250	<20	
Jal	19/3/70	NTS	UG	−300	<20	
Shaper	23/3/70	NTS	UG	−560	20–200	
Handley	26/3/70	NTS	UG	−1210	>1000	
Snubber	21/4/70	NTS	UG	−340	<20	
Can	21/4/70	NTS	UG	−400	20–200	
Beebalm	1/5/70	NTS	UG	−390	<20	
Hod	1/5/70	NTS	UG	−270	<20	
Mint Leaf	5/5/70	NTS	UG	−410	<20	Tunnel
Diamond Dust	12/5/70	NTS	UG	−250	<20	Tunnel, Vela Uniform
Cornice	15/5/70	NTS	UG	−440	20–200	
Manzanas	21/5/70	NTS	UG	−240	<20	
Morrones	21/5/70	NTS	UG	−480	20–200	
Hudson Moon	26/5/70	NTS	UG	−400	<20	Tunnel
Flask	26/5/70	NTS	UG	−530	105	Plowshare No. 25
Arnica	26/6/70	NTS	UG	−310	20–200	
EMERY:						
Tijeras	14/10/70	NTS	UG	−560	20–200	
Abeytas	5/11/70	NTS	UG	−390	20–200	
Artesia	16/12/70	NTS	UG	−490	20–200	
Cream	16/12/70	NTS	UG	−290	<20	
Carpetbag	17/12/70	NTS	UG	−660	220	
Baneberry	18/12/70	NTS	UG	−280	<20	Venting
Embudo	16/6/71	NTS	UG	−300	<20	
Laguna	23/6/71	NTS	UG	−460	20–200	
Harbell	24/6/71	NTS	UG	−520	20–200	
GROMMET:						
Diamond Mine	1/7/71	NTS	UG	−270	<20	Tunnel, Vela Uniform
Miniata	8/7/71	NTS	UG	−530	20–200	Plowshare No. 26
Algodones	18/8/71	NTS	UG	−530	20–200	
Pedernal	29/9/71	NTS	UG	−380	<20	
Cathay	8/10/71	NTS	UG	−380	<20	
Cannikin	6/11/71	Amchitka Isl.	UG	−1800	<5000	Spartan Warhead
Diagonal Line	24/11/71	NTS	UG	−260	<20	Venting
Chaenactis	14/12/71	NTS	UG	−330	20–200	
Longchamps	19/4/72	NTS	UG	−330	<20	
Misty North	2/5/72	NTS	UG	−380	<20	Tunnel
Zinnia	17/5/72	NTS	UG	−320	<20	
Monero	19/5/72	NTS	UG	−540	<20	
TOGGLE:						
Diamond Sculls	20/7/72	NTS	UG	−420	<20	Tunnel
Oscuro	21/9/72	NTS	UG	−560	20–200	
Delphinium	26/9/72	NTS	UG	−300	15	
Flax	21/12/72	NTS	UG	−690	20–200	
Miera	8/3/73	NTS	UG	−570	20–200	
Angus	25/4/73	NTS	UG	−450	20–200	
Starwort	26/4/73	NTS	UG	−560	85	
Rio Blanco	17/5/73	NTS	UG	−1780 −1900 −2040	90	Plowshare No. 27, 3 Devices Gas Stimulation
Dido Queen	5/6/73	NTS	UG	−390	<20	Tunnel
Almendro	6/6/73	NTS	UG	−1060	200–1000	
Portulaca	28/6/73	NTS	UG	−470	20–200	
ARBOR:						
Husky Ace	12/10/73	NTS	UG	−410	<20	Tunnel
Bernal	28/11/73	NTS	UG		<20	
Latir	27/2/74	NTS	UG		20–200	
Ming Blade	19/6/74	NTS	UG		<20	Tunnel

Cratering

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23. Cratering

1081019

Nuclear detonations of the United States

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
BEDROCK						
Escabosa	10/7/74	NTS	UG		20–200	
Puye	14/8/74	NTS	UG		<20	
Portmanteau	30/8/74	NTS	UG		20–200	
Stanyan	26/9/74	NTS	UG		20–200	
Hybla Fair	28/10/74	NTS	UG		<20	Tunnel
Topgallant	28/2/75	NTS	UG		20–200	
Cabrillo	7/3/75	NTS	UG		20–200	
Dining Car	5/4/75	NTS	UG		<20	Tunnel
Edam	24/4/75	NTS	UG		20–200	
Obar	30/4/75	NTS	UG		20–200	
Tybo	14/5/75	NTS	UG		200–1000	
Stilton	3/6/75	NTS	UG		20–200	
Mizzen	3/6/75	NTS	UG		20–200	
Mast	19/6/75	NTS	UG		200–1000	
Camembert	26/6/75	NTS	UG		200–1000	

Nuclear denotations of the U.S.S.R.

Event identification	Date (GCT)	Detonation location	Placement category	Event yield (kt)	Remarks
	29/8/49	USSR	AT		First U.S.S.R. Nuclear Test
	3/10/51*	USSR	AT		
	22/10/51*	USSR	AT		
	12/8/53	USSR	AT		H
	23/8/53	USSR	AT		A
	28/10/54*	USSR	AT		
	4/8/55*	USSR	AT		
	24/9/55*	USSR	AT		
	10/11/55*	USSR	AT		
	23/11/55*	USSR	AT	>1000	
	21/3/56*	USSR	AT		
	2/4/56*	USSR	AT		
	24/8/56	Siberia	AT	<1000	
	30/8/56	Siberia	AT	200–1000	
	2/9/56	USSR	AT		
	10/9/56	USSR	AT		
	17/11/56	USSR	AT	200–1000	
	19/1/57	USSR	AT		
	8/3/57	USSR	AT		
	3/4/57	USSR	AT		
	6/4/57	USSR	AT		
	10/4/57	USSR	AT	200–1000	
	12/4/57	USSR	AT		
	16/4/57	Siberia	AT	200–1000	
	22/8/57	Siberia	AT	>1000	
	9/9/57*	Siberia	AT	20–200	
	24/9/57	Artic	AT	>1000	
	6/10/57	USSR	AT		H
	10/10/57	Artic	AT	<20	
	28/12/57	Siberia	AT		
	23/2/58	Arctic	AT	>1000	
	27/2/58	Arctic	AT	>1000	
	27/2/58	Arctic	AT	200–1000	
	14/3/58	Arctic	AT	<1000	
	14/3/58	Arctic	AT	<1000	
	15/3/58	Arctic	AT	<1000	
	20/3/58	Arctic	AT	<20	
	21/3/58	Siberia	AT		
	22/3/58	Arctic	AT	20–200	
	30/9/58	Arctic	AT	200–1000	
	30/9/58	Arctic	AT	200–1000	
	2/10/58	Arctic	AT	20–200	
	2/10/58	Arctic	AT	20–200	
	6/10/58	Arctic	AT		
	10/10/58	Arctic	AT	>1000	
	12/10/58	Arctic	AT	>1000	
	15/10/58	Arctic	AT	>1000	
	18/10/58	Arctic	AT	>1000	
	19/10/58	Arctic	AT	<20	
	20/10/58	Arctic	AT	>1000	
	22/10/58	Arctic	AT	>1000	
	24/10/58	Arctic	AT	>1000	
	25/10/58	Arctic	AT	200–1000	
	1/11/58	Siberia	AT	<20	
	3/11/58	Siberia	AT	<20	
	1/9/61	Semipalatinsk	AT	20–200	
	4/9/61	Semipalatinsk	AT	<20	
	5/9/61	Semipalatinsk	AT	20–200	
	6/9/61	E. of Stalingrad	AT	20–200	
	10/9/61	Novaya Zemlya	AT	>1000	
	10/9/61	Novaya Zemlya	AT	20–200	

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Nuclear detonations of the U.S.S.R.

Event identification	Date (GCT)	Detonation location	Placement category	Placement height (m)	Event yield (kt)	Remarks
	12/9/61	Novaya Zemlya	AT		>1000	
	13/9/61	Semipalatinsk	AT		20–200	
	13/9/61	Novaya Zemlya	AT		20–200	
	14/9/61	Novaya Zemlya	AT		>1000	
	16/9/61	Novaya Zemlya	AT		>1000	
	17/9/61	Semipalatinsk	AT		20–200	
	18/9/61	Novaya Zemlya	AT		>1000	
	20/9/61	Novaya Zemlya	AT		>1000	
	22/9/61	Novaya Zemlya	AT		>1000	
	2/10/61	Novaya Zemlya	AT		>1000	
	4/10/61	Novaya Zemlya	AT		>1000	
	6/10/51	Novaya Zemlya	AT		>1000	
	8/10/61	Novaya Zemlya	AT		>20	
	12/10/61	Semipalatinsk	AT		20–200	
	20/10/61	Novaya Zemlya	AT			
	23/10/61	Novaya Zemlya	AT		~25	
	23/10/61	S. of Novaya Zemlya	UW		<20	
	25/10/61	Novaya Zemlya	AT		200–1000	
	27/10/61	Novaya Zemlya	AT		20–200	
	30/10/61	Novaya Zemlya	AT		58000	3760 mm
	31/10/61	Novaya Zemlya	AT		>1000	
	31/10/61	Novaya Zemlya	AT		200–1000	
	2/11/61	Novaya Zemlya	AT		20–200	
	2/11/61	Novaya Zemlya	AT		20–200	
	4/11/61	Novaya Zemlya	AT		>1000	
	2/2/62	Semipalatinsk	UG			
	5/8/62	Novaya Zemlya	AT		30000	
	7/8/62	Central Siberia	AT		<20	
	10/8/62	Novaya Zemlya	AT		<1000	
	20/8/62	Novaya Zemlya	AT		>1000	
	22/8/62	Novaya Zemlya	AT		>1000	
	25/8/62	Novaya Zemlya	AT		>1000	
	25/8/62	Semipalatinsk	AT		<20	
	27/8/62	Novaya Zemlya	AT		>1000	
	2/9/62	Novaya Zemlya	AT		20–200	
	8/9/62	Novaya Zemlya	AT		>1000	
	15/9/62	Novaya Zemlya	AT		>1000	
	16/9/62	Novaya Zemlya	AT		>1000	
	18/9/62	Novaya Zemlya	AT		>1000	
	19/9/62	Novaya Zemlya	AT		>1000	
	21/9/62	Novaya Zemlya	AT		>1000	
	25/9/62	Novaya Zemlya	AT		>1000	
	27/9/62	Novaya Zemlya	AT		<30000	
	7/10/62	Novaya Zemlya	AT		20–200	
	14/10/62	Semipalatinsk	AT		<20	
	22/10/62	Central Asia	HA		>100	
	22/10/62	Novaya Zemlya	AT		>1000	
	27/10/62	Novaya Zemlya	AT		20–200	
	28/10/62	Central Asia	HA		20–200	
	28/10/62	Semipalatinsk	AT		<20	
	29/10/62	Novaya Zemlya	AT		20–200	
	30/10/62	Novaya Zemlya	AT		20–200	
	1/11/62	Central Asia	HA		20–200	
	1/11/62	Novaya Zemlya	AT		20–200	
	4/11/62	Semipalatinsk	AT		20–200	
	8/11/62	Novaya Zemlya	AT		20–200	
	8/11/62	Novaya Zemlya	AT		20–200	
	17/11/62	Semipalatinsk	AT		<20	
	18/12/62	Novaya Zemlya	AT		20–200	
	18/12/62	Novaya Zemlya	AT		20–200	
	20/12/62	Novaya Zemlya	AT		<20	
	22/12/62	Novaya Zemlya	AT		20–200	
	23/12/62	Novaya Zemlya	AT			
	24/12/62	Novaya Zemlya	AT		~20000	
	25/12/62	Novaya Zemlya	AT			
	15/1/65	Semipalatinsk Region	UG		20–200	
	27/10/66	Novaya Zemlya	UG		>200	
	18/12/66	Semipalatinsk Region	UG		<200	
	14/10/70	Novaya Zemlya	UG		3000–6000	
	27/9/71	Novaya Zemlya	UG		2000–4000	
	28/8/72	Novaya Zemlya	UG		~1000	
	23/7/73	Semipalatinsk	UG		200–1000	
	12/9/73	Novaya Zemlya	UG		3000–6000	
	27/10/73	S. Novaya Zemlya	UG		3000–6000	
	30/1/74	Semipalatinsk Region	UG		20–200	From Seismic Signals

* Date of announcement, not necessarily shot date

Nuclear detonations of the United Kingdom

Event identification	Date (GCT)	Detonation location	Placement category	Event yield (kt)	Remarks
Hurricane	3/10/52	Monte Bello Isl.	AT	<1000	Ship
Totem	14/10/53	Woomera	AT	<1000	Tower
	26/10/53	Woomera	AT	<1000	Tower

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Nuclear detonations of the United Kingdom

Event identification	Date (GCT)	Detonation location	Placement category	Event yield (kt)	Remarks
Mosaic	16/5/56	Monte Bello Isl.	AT	<1000	Tower
	19/6/56	Monte Bello Isl.	AT	<1000	Tower
Buffalo	27/9/56	Maralinga	AT	<1000	Tower
	4/10/56	Maralinga	AT	<20	Surface
	11/10/56	Maralinga	AT	<20	Air
	22/10/56	Maralinga	AT	<1000	Tower
Grapple	15/5/57	CIA	AT	>1000	Air
	31/5/57	CIA	AT	>1000	Air
	19/6/57	CIA	AT	>1000	Air
Antler	14/9/57	Maralinga	AT	<20	Tower
	25/9/57	Maralinga	AT	<1000	Tower
	9/10/57	Maralinga	AT	<1000	Balloon
Grapple	8/11/57	CIA	AT	>1000	Air
Grapple—1958 Series	28/4/58	CIA	AT	>1000	Air
	22/8/58	CIA	AT	<1000	Balloon
	2/9/58	CIA	AT	>1000	Air
	11/9/58	CIA	AT	>1000	Air
	23/9/58	CIA	AT	<1000	Balloon
U.S.-U.K.1	1/3/62	NTS	UG	<20	Joint US–UK Test
U.S.-U.K. 2	7/12/62	NTS	UG	<20	Joint US–UK Test
Cormorant	17/7/64	NTS	UG	<20	Joint US–UK Test
Charcoal	19/9/65	NTS	UG	20–200	Joint US–UK Test
British Test	1974	NTS	UG		Joint US–UK Test Announced on 24/6/74 as being conducted several weeks ago

Nuclear detonations of the Republic of France

Event identification	Date (GCT)	Detonation location	Placement category	Event yield (kt)	Remarks
	13/2/60	Reggan	AT	60–70	Tower, 110m. First French Test
	1/4/60	Reggan	AT	<20	Surface
	27/12/60	Reggan	AT	<20	Tower
	25/4/61	Reggan	AT	<20	Tower
Agate	7/11/61	Sahara Desert	UG	<20	
Beryl	1/5/62	Sahara Desert	UG	20–200	
Emeraude	18/3/63	Sahara Desert	UG	<20	
Amethyste	30/3/63	Sahara Desert	UG	<20	
Rubis	20/10/63	Sahara Desert	UG	20–200	
Opale	14/2/64	Sahara Desert	UG	<20	
Topaze	15/6/64	Sahara Desert	UG	<20	
Turquoise	28/11/64	Sahara Desert	UG	<20	
Saphir	27/2/65	Sahara Desert	UG	20–200	
Jade	30/5/65	Sahara Desert	UG	<20	
Corindon	1/10/65	Sahara Desert	UG	<20	
Tourmaline	1/12/65	Sahara Desert	UG	<20	
Grenat	16/2/66	Sahara Desert	UG	<20	
Aldebaran	2/7/66	Mururoa	AT	<20	Barge
Tamouré	19/7/66	Mururoa	AT	<20	Balloon
Betelgeuse	11/9/66	Mururoa	AT	<20	Balloon
Rigel	24/9/66	Fangatuafa	AT	<20	Barge
Sirius	4/10/66	Mururoa	AT	200–300	Barge
Altair	3/6/67	Mururoa	AT	<20	Balloon
Antarès	27/6/67	Mururoa	AT	<20	Balloon
Arcturus	2/7/67	Mururoa	AT	<20	Balloon
Capella	7/7/68	Mururoa	AT	<20	Balloon
Castor	15/7/68	Mururoa	AT	500	Balloon
Pollux	3/8/68	Mururoa	AT	20–200	Balloon
Canopus	24/8/68	Fangataufa	AT	<1000	First H-Bomb, Balloon
Procyon	8/9/68	Mururoa	AT	<1000	Balloon
Andromede	15/5/70	Mururoa	AT	<20	Balloon
Cassiopee	22/5/70	Mururoa	AT	20–200	Balloon
Dragon	30/5/70	Fangataufa	AT	1000	Balloon
Eridan	24/6/70	Mururoa	AT	<20	Balloon
Licorne	3/7/70	Mururoa	AT	1000	Balloon
Pegase	27/7/70	Mururoa	AT	<20	Balloon
Orion	2/8/70	Fangataufa	AT	20–200	Balloon
Toucan	6/8/70	Mururoa	AT	20–200	Balloon
Dione	5/6/71	Mururoa	AT	<0	Balloon
Encelade	12/6/71	Mururoa	AT	20–200	Balloon
Japet	4/7/71	Mururoa	AT	<20	Balloon
Phoebe	8/8/71	Mururoa	AT	<20	Balloon
Rhea	14/8/71	Mururoa	AT	200–1000	Balloon

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Nuclear detonations of the People's Republic of China

Event identification	Date (GCT)	Detonation location	Placement category	Event yield (kt)	Remarks
	16/10/64	Lop Nor	AT	< 20	First Nuclear Test ^{235}U
	14/5/65	Lop Nor	AT	~ 20	^{235}U
	9/5/66	Lop Nor	AT	20–60	^{235}U + TN
	27/10/66	Lop Nor	AT	20–200	^{235}U
	28/12/69	Lop Nor	AT	> 200	^{235}U + TN
	17/6/67	Lop Nor	AT	~ 3000	TN
	24/12/67	Lop Nor	AT	< 20	
	27/12/68	Lop Nor	AT	~ 3000	TN
	22/9/69	Lop Nor	UG		
	29/9/69	Lop Nor	AT	~ 3000	
	14/10/70	Lop Nor	AT	~ 3000	
	18/11/71	Lop Nor	AT	~ 20	
	7/1/72	Lop Nor	AT	< 20	
	18/3/72	Lop Nor	AT	20–200	
	26/6/73	Lop Nor	AT	2000–3000	
	17/6/74	Lop Nor	AT	200–1000	

Nuclear detonations of India

Event identification	Date (GCT)	Detonation location	Placement category	Event yield (kt)	Remarks
	17/5/74	Rajaschar Desert	UG	10–15	First Nuclear Test

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OAK RIDGE NATIONAL LABORATORY
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NUCLEAR DIVISION

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

February 13, 1980

J. E. Rounsaville, Jr.
Chief, Administrative Services Branch
Energy Programs and Support Division
U.S. Department of Energy
Oak Ridge, Tennessee 37830

Dear Mr. Rounsaville:

Enclosed is a sampling of correspondence which I hope will clearly establish a need for access to classified reports on weapons effects at TIC. This correspondence is related to activities being carried out under contractor no. 000801 (08) and to a special study being carried out for the NCRP/ICRP at the request of DOE.

Please maintain this information in your files for future reference. I will initiate additional requests for access to classified reports and/or data on weapons effects at other installations, such as LASL, within the coming months.

Sincerely yours,

George D. Kerr

George D. Kerr
Health and Safety Research Division

GDK:jp

Enclosures

cc: D. C. Parzyck
P. J. Walsh

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NCRP

w/xc TDJ
EDK/J

National Council on Radiation Protection and Measurements

7910 WOODMONT AVENUE, SUITE 1016, WASHINGTON, D. C. 20014 AREA CODE (301) 657-2652

WARREN K. SINCLAIR, *President*
HYMER L. FRIEDELL, M.D., *Vice President*
W. ROGER NEY, *Executive Director*

September 20, 1977

Dr. James L. Liverman, Director
Division of Biomedical & Environmental Research
U. S. Energy Research & Development Administration
Washington, D. C. 20545

Dear Dr. Liverman:

In the last two years serious questions have been raised about the interpretation of the data for human leukemia induced by radiation at Hiroshima and Nagasaki (see Rossi, H. H., Radiation Research 71, pp. 1-8, 1977). The critical point is that, according to the Rossi interpretation, neutrons are much more toxic at low doses than previously thought, and even at current occupational levels might have caused observable harm in the form of leukemia. At the same time, gamma rays appear to be less toxic than previously thought. These interpretations are clouded by the difficulties of clearly distinguishing between the effects due separately to gamma rays and to the neutrons, and consequently the retrospective dosimetry becomes critical to valid interpretations.

The NCRP has been considering the possibility that neutrons are more toxic than previously thought, for 18 months or so, and both Scientific Committee 1 and Scientific Committee 40 and, indeed, the Board and Council of NCRP have been involved. Scientific Committee 40, chaired by Dr. V. P. Bond, will be addressing this problem specifically in the coming months.

A facet of this problem, already noted above, is the retrospective dosimetry. Recognizing this, the NCRP set up a special task group of Committee 40, under Dr. Harold Wyckoff, to examine the basis for past dosimetry efforts as they relate to this problem in the spring of 1976. The task group has met several times and has just concluded a two day meeting at Oak Ridge. They conclude that there is a difference in the basis for the 1957 and 1965 estimates of the kermas (T57D and T65D) from the bombs dropped at the two cities which is not fully explained in the literature. In the 1957 estimates, the relaxation lengths of the gamma rays ascribed to the two bombs were the same. In the 1965 estimates, the relaxation lengths were different, Hiroshima being shorter by some 100 meters. Although this change

may well be justified, the reasons for it were never documented in detail. Since the spectrum of radiations and their components is critical to the further interpretation of the data, the NCRP wishes to recommend that a re-examination of the dosimetry be undertaken by those most familiar with this matter and, in particular, to write up the basis for the difference in relaxation lengths.

Specifically, we request that Dr. John Auxier, Mr. Troyce Jones, and Mr. George Kerr at Oak Ridge be authorized to examine this matter and write up in detail their findings. We understand this effort could involve one-two man years of their time. Nevertheless, we feel the effort is most important and urge the assistance of ERDA in this. It might also be useful if Mr. Eisenhauer and Dr. Roesch of the NCRP group were given the opportunity to review the findings before final publication.

Dr. Bond, Chairman of SC-40, joins me in urging that this study be authorized.

Yours sincerely,

W. K. Sinclair
President

wks/dlv

cc: J. Auxier, ORNL
V. P. Bond, BNL
C. Richmond, ORNL
H. Wyckoff

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RECEIVED
SEP 25 1978
HEALTH AND SAFETY
RESEARCH DIVISION

Department of Energy
Washington, D.C. 20545

SEP 14 1978

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EBoi ___ SymF ___ [illegible] ___ [illegible] ___
[illegible] ___ [illegible] ___ [illegible] ___ ExCm ___
Per Info ___ For Action ✓ File ___ CommSyst ___

Let's discuss.

Dr. Chester R. Richmond
Associate Director
Biomedical and Environmental
Sciences
Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37830

Dear Chet:

Enclosed is a letter from Harold Wyckoff that is self-explanatory.

As we discussed earlier, and as indicated in Harold's letter, ICRU appears to have a real need for the information requested as soon as it can be produced.

I would like you to advise me what is needed to produce the information on a timely basis. I also recommend that the work be done in close coordination with Harold to assure our responsiveness in this matter.

I appreciate your assistance in this matter.

Sincerely,

Walter

Walter H. Weyzen, Manager
Human Health Studies Programs
Division of Biomedical and
Environmental Research

Enclosure:
As stated

1081027

OAK RIDGE NATIONAL LABORATORY
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UNION CARBIDE CORPORATION
NUCLEAR DIVISION

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

November 13, 1978

Dr. Walter H. Weyzen
Manager, Human Health Studies Program
Division of Biomedical and Environmental Research
U.S. Department of Energy
Washington, D.C. 20545

Dear Dr. Weyzen:

Dosimetry for the Japanese Atomic-Bomb Survivors

Your letter of September 14, 1978 has been discussed with program managers and staff members at ORNL. The preparation of a more detailed ORNL report on the development of T65D air-dose curves of tissue kerma in air vs distance from the Hiroshima and Nagasaki weapons involves several problems. These problems considered individually or en masse could make it difficult to complete such a report in a period of less than one year.

One problem is the declassification of weapon data that would be needed in a more detailed discussion than that found in *Health Physics*. Some other problems are funding and responsibility for preparation of the report. The only staff member still actively engaged in studies related to the Japanese atomic-bomb survivors is George Kerr, and he was not involved in the development of the T65D curves.

If Dr. Kerr assumed overall responsibility for the report, he would have to rely on others to supply many of the intimate details. These individuals have other obligations; thus, their help would be available only on a part-time basis, and it could be assured only if some additional funding were available. The additional funding might be needed over two fiscal years and might total one person-year of effort.

A final problem involves the use of newer data. For example, the T65D air-dose curves rely in part on leakage radiation calculations by LASL, and they have recently updated their radiation leakage calculations for the Hiroshima and Nagasaki weapons. These newer LASL data and a few air-transport calculations of highly uncertain accuracy are the basis of

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the SAI air-dose curves. The SAI air-transport calculations have been revised several times with the latest revision being a two-fold increase in their values of neutron air-dose for both Hiroshima and Nagasaki.

There appears to be very little difference between the newer and older LASL data so far as the T65D air-dose curves are concerned, but a comparison of the data is needed as an illustration. Thus, a review of both the older and newer data relevant to the T65D curves would appear appropriate if a more detailed report is prepared for the benefit of the NCRP, ICRP, and others. The ORNL staff would attempt to complete a report on a timely basis, but a year or more could be involved due to the problems discussed above.

Sincerely,

Chester R. Richmond
Associate Director for
Biomedical and Environmental
Sciences

CRR:GDK:fs

cc: J. A. Auxier
T. D. Jones
S. V. Kaye
G. D. Kerr
D. C. Parzyck
P. J. Walsh

放研
RERF

財団法人 放射線影響研究所
RADIATION EFFECTS RESEARCH FOUNDATION
広島市および長崎市
HIROSHIMA AND NAGASAKI

Cable Address
RERF Hiroshima Japan

5-2 Hijiyama Park, Hiroshima 730
Telephone (0822) 41 3131

A Cooperative Japan - United States Research Organization
日本国と合衆国の共同研究機関

30 June 1979

Dr. George D. Kerr
Health Physics Division
Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37830

Dear Doctor Kerr:

The Radiation Effects Research Foundation would be very pleased if you would accept an appointment as a Consultant to the Dosimetry Program for the period 1 April 1979 through 31 March 1980. This is a continuation of the Consultant appointment which you kindly accepted last year. The fiscal year in Japan commences on 1 April so your appointment has been made retroactive, to coincide with the beginning of fiscal 1979.

RERF is most appreciative of your extremely valuable contributions to its program in the past. We sincerely hope that you will accept this appointment. I believe you understand that your accepting this appointment does not involve any formal obligation. It is an indication of your willingness to contribute suggestions and your expertise for the continuing development of the RERF Scientific Program. We would be honored if you would reply in the affirmative.

Sincerely yours,

Masao Tamaki

Masao Tamaki, M.D.
Chairman

1081030

放研
RERF

財団法人 放射線影響研究所
RADIATION EFFECTS RESEARCH FOUNDATION

Cable Address
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HIROSHIMA AND NAGASAKI

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A Cooperative Japanese-United States Research Organization

12 July 1979

Dr. George D. Kerr
Health Physics Division
Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tenn. 37830

Dear Dr. Kerr:

Our need for advice and counsel on matters radiophysical is no less now than it has been in the past. Indeed, our Scientific Councillors have called for a review of our activities in the fields of A-bomb dosimetry as well as therapeutic irradiation. We hope, therefore, that you will find it convenient to accept the invitation to continue to serve as a Consultant to our Dosimetry Program.

Cordially yours,

William J. Schull

William J. Schull, Ph.D.
Permanent Director

WJS:myu

Enc.

1081031

OAK RIDGE NATIONAL LABORATORY
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UNION CARBIDE CORPORATION
NUCLEAR DIVISION

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

September 18, 1979

Dr. Charles W. Edington
Acting Deputy Director
Office of Health and
Environmental Research
U. S. Department of Energy
Washington, D. C. 20545

Dear Dr. Edington:

Dosimetry for the Japanese Atomic-Bomb Survivors

The literature has been searched in the past month for newer data relevant to the dosimetry for the Japanese atomic-bomb survivors. Some of the most noteworthy data that have become available since the ORNL air-dose curves for Hiroshima and Nagasaki were developed in 1965 are:

1. Lord Penney, D. E. J. Samuels and G. C. Scourgie, "The Nuclear Explosive Yields at Hiroshima and Nagasaki", Roy. Soc. Lond. Phil. Trans. 226A, 357-424 (1970).

2. "Bomb Yields", Health Phys. Div. Ann. Progr. Rept. July 31, 1968, Oak Ridge National Laboratory Report ORNL-4316, pp. 232-234 (Oct. 1968).

3. H. H. Hubbell, Jr., T. D. Jones, and J. S. Cheka, "The Epicenters of the Atomic Bombs: Part 2. Reevaluation of All Available Physical Data with Recommended Values", Atomic Bomb Casualty Commission Report TR 3-69 (1969).

4. G. D. Kerr and D. L. Solomon, "The Epicenter of the Nagasaki Weapon: A Reanalysis of Available Data with Recommended Values", Oak Ridge National Laboratory Report ORNL/TM-5139 (Jan. 1976).

5. "Neutron and Gamma-Ray Output for Fat Man and Little Boy", Letter TD-3, MS-232) to C. P. Knowles, R and D Associates, from W. E. Preeg, Los Alamos Scientific Laboratory (5 April 1976).

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6. "Neutron and Gamma-Ray Leakage from the Hiroshima and Nagasaki Weapons", Health Phys. Div. Ann. Progr. Rept. July 31, 1969, Oak Ridge National Laboratory Report ORNL-4446, pp. 226-230 (Oct. 1969).

7. L. G. Mooney and R. L. French, "A New Look at the Fission-Product Gamma-Ray Component of Nuclear Weapon Initial Radiation". In: "A Review of Calculations of Radiation Transport in Air--Theory, Techniques, and Computer Codes" (Edited by D. K. Trubey and H. E. Comolander) Oak Ridge National Laboratory Report (ORNL-RSIC-33, pp. 251-279 (May 1972).

8. E. A. Straker, "The Effect of the Ground on the Steady-State and Time-Dependent Transport of Neutrons and Secondary Gamma Rays in the Atmosphere", Nuc. Sci. Eng. 46, 334-355 (1971).

There also is some relevant data in several recently published secret-restricted data reports. The need to use and/or refer to these reports has not been fully established. The current status (classified or declassified) of some early weapon-testing data will be established during a trip to Los Alamos Scientific Laboratory and Kirtland Air Force Base scheduled for the latter part of September. A recent recall of some previously declassified reports is causing some unanticipated problems at ORNL.

One area of concern to the NCRP ad hoc task group headed by Dr. H. O. Wyckoff has been the long relaxation path length for gamma rays from the Nagasaki weapon (350 m) compared to that for gamma rays from the Hiroshima weapon (250 m). Others (see for example S. Jablon, "Atomic Bomb Radiation Dose Estimation at ABCC, Atomic Bomb Casualty Commission Report TR 23-71, 1971) also have found this difference to be a troublesome feature of the ORNL air-dose curves for the two cities. J. A. Auxier et al. ("Free-Field Radiation-Dose Distributions from the Hiroshima and Nagasaki Bombings", Health Phys. 12, 425-429, 1966) state:

> The weapon used at Nagasaki was a plutonium-fueled implosion device similar to many weapons fired in early weapons tests. This weapon contained a large quantity of high explosive material which surrounded the plutonium. During fission, neutrons leaking from the core interacted with the nitrogen in the explosive charge producing through (n, γ) reactions an intense source of gamma rays with high energy (3-10 MeV). The scatter and capture of neutrons which produced the intense gamma-ray source resulted in a lower neutron leakage than for the Hiroshima weapon.
>
> For gamma rays the dose relaxation length is much less in Hiroshima than in Nagasaki because the hard component of the initial source (i.e. the neutron-capture gammas) is dispersed in a large volume (i.e. nitrogen in air) which, for

a given gamma-ray energy, results in a shorter relaxation length due to geometry considerations alone; there is reason to believe that the gamma-ray spectrum from the Hiroshima device was softer, but no experimental verification exists.

The dose relaxation length for gamma rays is undoubtedly shorter in Hiroshima than in Nagasaki, but not necessarily for the reasons outlined above.

The initial sources of gamma rays from a nuclear weapon (see for example L. S. Abbott, "Shielding Against Initial Radiation from Nuclear Weapons", Oak Ridge National Laboratory Report ORNL-RSIC-36, July 1973) are (1) prompt-fission gammas from the intact weapon, (2) neutron-capture gammas produced in air (i.e. air-secondary gammas), (3) neutron-capture gammas produced in ground (i.e. ground-secondary gammas), and (4) fission-product gammas from the fireball. For a Nagasaki-type weapon emitting an abundance of soft neutrons (energy less than about 1 keV), the principal gamma-ray sources are (2) and (4), and a dose relaxation length for these two components has clearly been established as 350 m from early weapons tests. Another principal source of gamma rays from a Hiroshima-type weapon emitting an abundance of hard neutrons (energy greater than about 1 keV) is (3). These hard neutrons (plus an equilibrium number of soft neutrons produced by scattering in air) turn the ground into an intense gamma-ray source, and the dose relaxation length for ground-secondary gammas is about the same as the dose relaxation path length for hard neutrons (200 m). Thus, the dose relaxation length of gamma rays from the Hiroshima weapon--sources (2), (3) and (4)--will be greater than 200 m but less than 350 m dose relaxation length of gamma rays from the Nagasaki weapon--sources (2) and (4).

An excellent discussion on gamma rays from sources (2) and (3) of a nuclear weapon is contained in the enclosed article by E. A. Straker (ref. 8 above). The difference in the dose relaxation length for gamma rays from a fission source in air over ground and in infinite air (i.e. the absence of ground) in Fig. 10 is especially noteworthy. Figures 2, 11 and 13 of Straker's article also show some noteworthy data related to Operation BREN which were fundamental in establishing the T65D air-dose curves for Hiroshima. These theoretical data give some important insight into the magnitude of the gamma rays from sources (2) and (3). Other theoretical data on air-dose curves for neutrons and gamma rays from the Hiroshima and Nagasaki weapons have been circulated by Dean C. Kaul of Science Applications, Inc. His latest data are discussed in a letter to W. C. Roesch, Battelle Northwest Laboratories (14 June 1978). Some comments concerning major differences between the T65D and SAI air-dose curves are (a) the dose relaxation

lengths for gamma rays are the same in both cities because the SAI calculations consider only sources (1), (2) and (4), and (b) the overall accuracy of the SAI gamma-ray calculations, especially those for source (4), is not very good (see for example M. L. Gritzner, E. A. Straker, T. E. Albert, and H. T. Smith, "Radiation Environments from Tactical Nuclear Weapons", Science Applications, Inc.--Defense Nuclear Agency Report DNA 4267F, July 1976). In reviewing and documenting the T65D air-dose curves, we will rely as before mainly on experimental data. These experimental data will be supplemented when possible and/or necessary with newer theoretical data.

The air-dose curves are of course the prime factors in the dosimetry for the Japanese atomic-bomb survivors. However, reliable dose estimates cannot be assigned without the best possible information on the hypocenter locations in the two cities and the location of each survivor at the time of bombing plus the shielding afforded each survivor by surrounding structures and other objects. The following schedule is therefore proposed for completing a comprehensive report on the radiation dose assignments for survivors denoted as T65D.

Period	Task
October-December 1979	General Background Information. Discuss and document such items as shielding histories for survivors, locations of hypocenters and heights of burst for the two cities, etc.
January-March 1980	Air-Dose Curves for Neutrons. Discuss and document such items as neutron leakage from the two weapons, dose build-up factors, source terms, dose relaxation lengths, etc.
April-June 1980	Air-Dose Curves for Gamma Rays in Nagasaki. Discuss and document using data mainly from early weapons tests.
July-September 1980	Air-Dose Curves for Gamma Rays in Hiroshima. Discuss and document using data from Operation BREN and data from more recent weapon tests.

The proposed approach in summarizing data from various dosimetry studies is illustrated in the attached table. Questions and comments are solicited from those appearing on the distribution list. However, the monthly report letters and data attached to these letters are for official use only. They should not be distributed to others or quoted in any way without permission. A final report will be circulated for comments by the NCRP ad hoc task group headed by Dr. H. O. Wyckoff and others.

Also enclosed with this letter are two reports which are relevant to the dosimetry for the Japanese atomic-bomb survivors. These reports entitled "A Review of Organ Doses from Isotropic Fields of Gamma Rays and Organ-Dose Estimates for the Japanese Atomic-Bomb Survivors" will be published in Health Physics. The latter report was prepared at the request of the BEIR Committee.

Sincerely,

G. D. Kerr

G. D. Kerr

GDK:jp

Enclosures

cc/enc.: V. P. Bond
Seymour Jablon
Sheldon Levin
H. O. Wyckoff
W. H. Wyzen

cc: J. A. Auxier
T. D. Jones
S. V. Kaye
D. C. Parzyck
P. J. Walsh

1081036

Estimated yields of the Hiroshima (Little Boy) and Nagasaki (Fat Man) explosions.

Dosimetry system	Yield in equivalent kilotons of TNT[a]		References
	Hiroshima	Nagasaki	
Nominal values[b]	20	20	LASL (1950) Wilson (1956)
T57D[b]	18.5	23	York (1957)
T65D[c]	12.5 (±20%)	22 (±10%)	ORNL (1965)
Current best values[d]	12.5 (±10%)	22 (±10%)	ORNL (1968) Penney et al. (1970)

[a]One kiloton of TNT equivalent is defined as a total energy release of 10^{12} calories and is equal to 1.45×10^{23} fissions of either U-235 or Pu-239. See for example Glasstone and Dolan (1977).

[b]See also ORNL (1965) and Auxier et al. (1966).

[c]See also ORNL (1968) and Auxier (1977).

[d]See also Auxier (1977).

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NATIONAL RESEARCH COUNCIL
ASSEMBLY OF LIFE SCIENCES
2101 Constitution Avenue, N.W., Washington, D.C. 20418

DIVISION OF MEDICAL SCIENCES
Medical Research Agency

25 September 1979

Dr. Charles W. Edington
Acting Deputy Director
Office of Health and
Environmental Research
U. S. Department of Energy E-201
Washington, DC 20545

Dear Charles:

I received and have read (after my own fashion), George Kerr's letter to you dated September 18 and enclosures. You well know that I am not a physicist, and I'm not sure that I would recognize a particle fluence if I met one on the street, but I am impressed by the fact that a very great amount of work has been done. I was glad to have the explanation of the problems inherent in determining the relaxation lengths for gamma radiation in the two cities. Previously all I knew was that I didn't understand why the difference between the two cities; now at least I understand what some of the complications are that enter into that difference.

More generally, I can only applaud the attention being given now to the problems of dosimetry. Given the disputes and debates concerning RBE going on in BEIR, and NCRP, involving people like Mays and Rossi and others, it surely is necessary to know just how secure the estimates of neutron and gamma dose are, both at the kerma and tissue levels.

The program that Dr. Kerr outlines on page 4 of this letter sounds fine to me. I know nothing, of course, about how much effort each of his tasks will entail, so cannot pretend to judge the reasonableness of the schedule, but assuming that the result will be definitive statements about the various parameters that he names, with attached statements concerning uncertainties, the result would be extraordinarily valuable.

1081039

The National Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering to serve government and other organizations

A few months ago, for my sins, I was at a meeting attended also by Cochrane. He wanted to know "What was the accuracy of the estimated doses in Japan"? I replied that the root mean square error was of the order of 30 percent. His comment was "I don't believe it". I asked why not - and he replied that he just didn't believe it. Maybe Dr. Kerr can make Cochrane a believer - if not in 30 percent, in something.

Sincerely,

Seymour Jablon

SJ/pmk
cc: Dr. Kerr ✓
Dr. Auxier

1081040

NCRP

National Council on Radiation Protection and Measurements

7910 WOODMONT AVENUE, SUITE 1016, WASHINGTON, D. C. 20014 AREA CODE (301) 657-2652

WARREN K. SINCLAIR, *President*
HYMER L. FRIEDELL, M.D., *Vice President*
W. ROGER NEY, *Executive Director*

October 9, 1979

To: Dosimetry Group of NCRP 40

From: Harold O. Wyckoff

Perhaps you remember that the NCRP asked the Department of Energy some time ago to provide time for John Auxier, George Kerr and Troyce Jones to write up the rationale behind the T65 D free field kerma vs. distance curves for Hiroshima and Nagasaki. In the last few months the mechanisms for doing this has been set up. It appears that John Auxier and Troyce Jones are busy on other projects and cannot take an active part, although they will be available for consultation. The main burden will be carried by George Kerr.

George plans to write a monthly report and has divided the problem into four tasks. Enclosed is a copy of his first monthly report. Of course, this material should not be quoted or used in other publications because these reports may frequently be of an interim nature and subsequent reports may modify the material for the eventual published report on this subject. For this reason, George has asked that they not be further distributed. Also enclosed are copies of two reports by George Kerr that are mentioned in the monthly report.

In my discussion with George over the telephone, the possibility of committee meetings with him has arisen. Shouldn't we wait for a month or two to see how many questions members of the committee might have? However, it may be that some of the members of the committee would like to provide some input in the way of questions or problems that they forsee. If there are such and it is not readily possible to deal with them by correspondence, perhaps we should have a meeting. Please let me know your wishes. As there are three of us in the Washington area and three in the Oak Ridge area, one of these locations would probably be best for a meeting. However, I understand that John Storer may have some difficulties in travelling and perhaps Oak Ridge would be better for him. Again, please let me know your wishes.

If you do have comments or questions on the material from George would it be possible to send a copy to him and to each of the members of the committee?

cc: George Kerr
enclosures

1081041

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC.
Upton, New York 11973
Office of the Director
(516) 345- 3332

November 13, 1979

George D. Kerr
Health and Safety Research Division
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, Tennessee 37830

Dear George:

Many thanks for the information during my recent visit, which I found to be quite informative. As I indicated to you, Scientific Committee 40 of the NCRP is now putting together a report on radiation quality as related to radiation protection. In this context, the Hiroshima neutron data are unique and pivotal in that they may well allow us to use actual human data on carcinogenesis from an external fast neutron beam as a cornerstone for the risk of exposure to high-LET radiations. This would of course sidestep the older substitute approach, of relying on the still poorly defined low-LET curves for human carcinogenesis, and estimating the neutron risk by use of RBE data derived from animal work.

I have gone over your paper, "Estimators of Risk for Radiogenic Breast Cancer," and think it is quite well done and should be published. I have only one comment, and a couple of suggestions. The comment is on page 6, lines 3 and 4. Since "dose equivalent" is reserved for use in radiation protection, it would be better to avoid the implication that it is used in radiobiology. Although what you have stated for radiation protection, namely that the dose equivalent is the sum of the products of RBE and organ dose, this is true but more in principle than in fact. This whole area is poorly defined, and a number of the questions raised in the old ICRU-ICRP RBE report that you referred to have not been really addressed and they certainly need to be in the era of quantitative risk.

As to suggestions, I think that you should refer to and say a few words about the recent article by Bernard Cohen in Health Physics (Vol. 37, pages 509-516, October 1979). Also, when I talked to Peter Groer after leaving your office, we got into the subject of relative versus absolute risk for reasons unrelated to our conversation. I think it would be most useful to discuss your paper with him. I don't think this would necessarily lead to changes and delays in your paper, but I think it would be a very useful conversation.

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Also, I would like to be able to refer to your paper in the NCRP radiation quality report being prepared (John Boice is a member of that committee). Hence I would appreciate very much if you would let me know when and where it will be published.

Again, many thanks for the very useful information. Should you have reason to be in the New York area, we would very much like to see you here at Brookhaven.

Sincerely yours,

V. P. Bond, M.D.
Associate Director

edl

RERF

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A Cooperative Japan - United States Research Organization

1 November 1979

Dr. George D. Kerr
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, Tenn. 37830

Dear Dr. Kerr:

Seymour Jablon has recently sent to me a copy of your memorandum to Charles Edington dated October 17, 1979 and entitled "Dosimetry for the Japanese Atomic-bomb Survivors." Your memorandum makes a series of recommendations which have in fact already been completed. We "moved" the hypocenter in Nagasaki at the end of last year to the point you and Solomon recommended in your 1976 report and have recalculated the doses of all of the individuals included in the Nagasaki Life Span Study sample. A technical report is currently being prepared which identifies the consequences of these changes, and will serve as an annex to the Milton and Shohoji report of 1968. You may also be interested to know that when the cardinal radiation symptoms, namely epilation, oral pharyngeal lesions, and purpura are examined in the light of this new hypocenter, their distributions are much more symmetrical than was true with respect to the old hypocenter. Thus, there is we feel biological justification for these changes.

Largely as a consequence of our action, the Mayor of Nagasaki has seen fit to move the city's accepted hypocenter to the new location. This has prompted some debate, but no strong objections. I include here for your information a memorandum from Dr. Okajima at the Nagasaki University School of Medicine to Dr. Tamaki raising some questions about the actual location of the hypocenter. He notes that a recent Japanese map does not reconcile too well with the map prepared by the U.S. Army Map Service on which most of our calculations are based. It seems to me, however, that since all of our observations as to the distances of individuals and the like are based on the same map then the data are internally consistent if we assume there is no distortion in the map itself. Everyone would be displaced by some uniform amount.

We look forward to having you here at the meeting of the Scientific Councillors in Nagasaki in March. If there are specific issues which you would like to see us address in our presentations regarding A-bomb and medical dosimetry, we'd appreciate knowing of them as early as possible so that if tabulations are in order there will be ample time to prepare them.

Yours sincerely,

William J. Schull, Ph.D.
Vice-chairman and
Chief, Epidemiology and
Statistics Department

1081044

WJS:at

University of California
LOS ALAMOS SCIENTIFIC LABORATORY
Post Office Box 1663 Los Alamos, New Mexico 87545 505/667-5061

In reply refer to: X-9
Mail stop: 625

December 27, 1979

Dr. George Kerr
Health Safety Research, ORNL
P. O. Box X
Oak Ridge, Tennessee 37830

Dear George:

You asked for a letter containing the times to which the Fat Man and Little Boy calculations were run. The times and calculated yields are

Fat Man	13.45 μs	24.9 kt
Little Boy	10.00 μs	19.5 kt

The reference for these numbers is TD-3:75-87.

Thank you for the copy of your letter of November 19, 1979, to Dr. Charles W. Edington.

Sincerely,

Michael Henderson

Michael Henderson

MH/bm

CC: ISD-5 (2)
M. Henderson
P. Whalen

1081045

TWX 910-988-1773 Telex 66-0496 Fascimile 505/667-6937 (automatic) 505/667-7176 (operator assist)

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January 18, 1980

Dr. Charles W. Edington
Acting Deputy Director
Office of Health and
Environmental Research
U.S. Department of Energy
Washington, D. C. 20545

Dear Dr. Edington:

Dosimetry for the Japanese Atomic-Bomb Survivors

Enclosed is the review of Previous Dose-Estimation Studies for the atomic-bomb survivors. It will serve as an introductory section of a final draft report for the NCRP.

Work on the other sections of a draft report and the review of the T65D air-dose curves is progressing as expected. The monthly report letter for February will provide a draft of a section on the penetration of radiation in air-over-ground. This section and the data on neutron leakage in the November monthly report letter, which will also serve as a section of a final draft report, provide information needed to document the T65D air-dose curves for Hiroshima.

A meeting with the task group of the NCRP on dosimetry for the Japanese atomic-bomb survivors is scheduled for February 5. The meeting will be at the NCRP in Bethesda, Maryland.

Sincerely yours,

G. D. Kerr

G. D. Kerr
Health and Safety Research
Division

GDK:jp

Enclosure

cc.: J. A. Auxier
V. P. Bond
Seymour Jablon
T. D. Jones
S. V. Kaye
Sheldon Levin
D. C. Parzyck
P. J. Walsh
H. O. Wyckoff

1081046

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A Cooperative Japan - United States Research Organization

January 31, 1980

Dr. George D. Kerr
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, Tennessee 37830

Dear George:

Your recent letter and its enclosures are most timely. As you undoubtedly know, we are assembling the materials which we wish to distribute to our Scientific Councillors prior to their next meeting in March. At that time, A-bomb and medical dosimetry on the survivors are to be reviewed. I've circulated the reprints which you sent, and will include your published as well as the unpublished (if I may) reviews of the organ doses in the list of references.

You asked whether we had data similar to those which you quote in Table 1 and attribute to an article by Davis, Baker and Summers of the Dikewood Corporation. Indeed, we do have such data and I have asked the staff to tabulate the experiences of the Life Span Study cohort. You will recall that morbidity and mortality in this group constitutes the primary focus of our programmatic activities. As soon as I have the tabulation(s), I will have it forwarded to you. If there is any particular issue(s) which you believe we should present to the Scientific Councillors at their meeting which concern A-bomb exposures we would be pleased to do so. Our plans are to seek their counsel on the following questions or issues: What further can be done or should be done about the so-called "unknown" dose group? What can or should be done about the early entrants? What further can or should be done about the doses of individuals who have resided continuously in the fall-out zones? We hope that out of these discussions will come some positive courses of action, but if the consensus is that nothing further can be done we would like to see spread on the record a clear statement to this effect. Other areas which concern us are of course the tissue exposures. We are anxious to see reconciled the differences which exist between the Oak Ridge calculations and those from the National Institute of Radiological Sciences. We are also interested in knowing whether it is practicable to assign individual specific tissue exposures or must we content ourselves with values which are applied to all individuals irrespective of their size, age and the like.

Again thanks much for your help.

Sincerely yours,

William J. Schull, Ph.D.
Vice Chairman and
Acting Chief of Research

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