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NIE 11-2A-58
4 February 1958

NATIONAL INTELLIGENCE ESTIMATE

NUMBER 11-2A-58

THE SOVIET ATOMIC ENERGY PROGRAM

Submitted by the

DIRECTOR OF CENTRAL INTELLIGENCE

The following intelligence organizations participated in the preparation of this estimate: The Central Intelligence Agency and the intelligence organizations of the Departments of State, the Army, the Navy, the Air Force, The Joint Staff, and the Atomic Energy Commission

Concurred in by the

INTELLIGENCE ADVISORY COMMITTEE

on 4 February 1958. Concurring were the Director of Intelligence and Research, Department of State; the Assistant Chief of Staff, Intelligence, Department of the Army; the Director of Naval Intelligence; the Assistant Chief of Staff, Intelligence, Department of the Air Force; the Deputy Director for Intelligence, The Joint Staff; and the Atomic Energy Commission Representative to the IAC. See appropriate footnotes, however, for the dissenting views of the Director of Naval Intelligence. The Assistant Director, Federal Bureau of Investigation, abstained, the subject being outside of the jurisdiction of his Agency.

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NATIONAL INTELLIGENCE ESTIMATE

THE SOVIET ATOMIC ENERGY PROGRAM

NIE 11-2A-58

4 February 1958

This estimate consists of a revision of those parts of NIE 11-2A-57 wherein significant changes have taken place between May 1957 and 1 January 1958. The estimates contained herein supersede those in NIE 11-2A-57 for the following topics:

Uranium Ore Production
Plutonium Equivalent Production
U-235 Production
Nuclear Weapons Tests
Nuclear Weapons Developments

Revision of subjects other than the above have not been included in this estimate although minor changes may be possible.

For a complete assessment of the Soviet Atomic Energy Program, this estimate must be used in conjunction with NIE 11-2A-57. The next estimate which will cover all phases of the Soviet program will be published in January 1959.

This estimate was prepared and agreed upon by the Joint Atomic Energy Intelligence Committee which is composed of representatives of the Departments of State, Army, Navy, Air Force, the Atomic Energy Commission, The Joint Staff and the Central Intelligence Agency. See appropriate footnotes, however, for the dissenting views of the Navy member. The FBI abstained, the subject being outside of its jurisdiction.

A group of expert consultants working with the Joint Atomic Energy Intelligence Committee has reviewed this estimate and generally concurs with it. The estimate, with footnotes, was approved by the Intelligence Advisory Committee on 4 February 1958.

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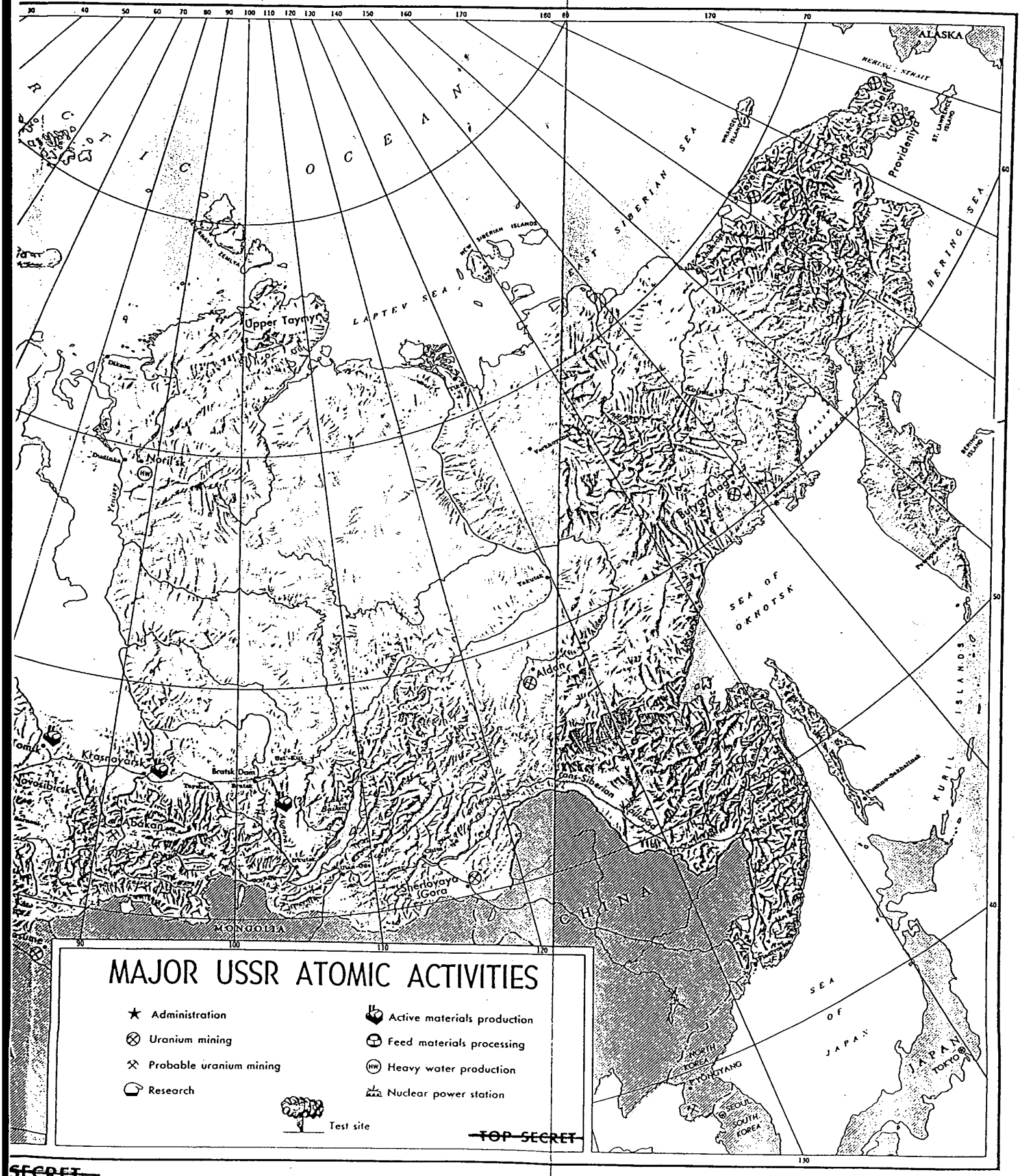

MAJOR USSR ATOMIC ACTIVITIES

- ★ Administration
- ⊗ Uranium mining
- ⚒ Probable uranium mining
- Research
- Active materials production
- Feed materials processing
- (HW) Heavy water production
- Nuclear power station
- Test site

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NATIONAL INTELLIGENCE ESTIMATE

NIE 11-2A-58

THE SOVIET ATOMIC ENERGY PROGRAM

THE PROBLEM

To update estimates and information on the Soviet atomic energy program contained in NIE 11-2A-57 pertaining to:

Uranium Ore Production
Plutonium Equivalent Production
U-235 Production
Nuclear Weapons Tests
Nuclear Weapons Developments

This estimate *does not* take into consideration the impact that any form of nuclear test moratorium or limitation on nuclear weapons production would have on the Soviet atomic energy program.

THE SOVIET ATOMIC ENERGY PROGRAM

SUMMARY AND CONCLUSIONS

A. General

In updating NIE 11-2A-57 we have (1) increased our estimates of the amounts of uranium ore from internal USSR sources and from Satellite countries; (2) doubled our previous estimate of the amount of plutonium to be produced during the period 1960-1968 [1]; and (3) estimated that the Soviets have made significant advances in weapons design which increase their capabilities to produce light-weight thermonuclear warheads.

B. Trend of the Soviet Atomic Energy Program

We estimate that the Soviet atomic energy program will continue to receive the very high priority that has been assigned to it in the past. With this priority it will continue to grow and achieve rapid progress in both military and non-military applications. (See Figure 1 for locations of major identified AE activities.)

C. Fissionable Material Production [1]

1. Although we estimate a substantial Soviet program for the expansion of fissionable material production, the availability of such materials will continue throughout the period of this estimate to be a limiting factor in determining the sizes of many military and non-military programs.

2. *Uranium Ore.* We estimate that approximately 11,600 metric tons of uranium (in terms of recoverable metal) were mined during 1957 in the USSR and its Satellites, of which approximately 4,800 metric tons were obtained in East Germany and 4,000 metric tons in the USSR. These estimated amounts are more than sufficient to support the current estimates of fissionable material production. Substantial uranium ore reserves exist within the Soviet Bloc and particularly the USSR. The exploitation of these resources, as well as of other raw materials essential to atomic energy activities, is being steadily expanded.

3. *Uranium-235 Production.* Soviet production of U-235 continues on a high priority basis. An assessment of both old and new intelligence tends to confirm the previously estimated cumulative amounts of U-235. We estimate that the Soviets will have a stockpile of 27,000 kilograms of 90% enriched U-235 by mid-1958 and 350,000 kilograms by mid-1968.

[1] The Director of Naval Intelligence believes the Soviet Atomic Energy Program is directed toward the maximum utilization of U-238 as well as U-235, avoiding the necessity for storage of more than 99% of the processed uranium. He believes that the major trend is more likely to be toward breeder reactors, prototypes of which could be completed in 1959 or 1960. Large-scale breeders

4. *Plutonium Production.* The estimated plutonium production through mid-1958 is similar to that estimated in NIE 11–2A–57. Indications of continuing construction activities at reactor sites and evidence of increased uranium ore procurement have led to an increased estimate of future plutonium equivalent stockpiles. We estimate that the Soviets will have a stockpile of 7,400 kilograms of plutonium equivalent by mid-1958 and 88,000 kilograms by mid-1968.

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could become available as early as 1963. Further, the evidence indicates to him that the interim power reactor program is directed towards the development of self-sustaining reactors and that the Soviet uranium isotope separation program is consonant with these reactor objectives as well as the production of material of weapon grade.

Based on an analysis of the evidence on Soviet time schedules, availability of barrier material known to be used, and a mathematical analysis of barrier characteristics for optimum performance, the Director of Naval Intelligence believes that the cumulative production of U–235 by mid-1953 was about 300 kg; by mid-1958 it will be about 7,500 kg, and by mid-1962 of the order of 20,000 kg. The limited expenditure of U–235 in the Soviet weapons test program as compared to the large quantity of plutonium used supports this estimate. However, subject to the successful development of new methods of isotope separation and success of the Soviet breeder reactor program, the production rates can undergo radical change after 1962.

The Director of Naval Intelligence believes that the cumulative production of plutonium by mid-1958 will be about 4,200 kg, and by mid-1962 about 9,000 kg.

D. Soviet Nuclear Weapons

1. Fifteen Soviet nuclear tests were detected during 1957, ranging in yield from about 4 kilotons to 4.3 megatons. Ten of these tests were at Semipalatinsk, two were at a new weapons proving ground on the island of Novaya Zemlya, two were low-yield naval tests (one underwater and one surface burst) off the southwestern tip of Novaya Zemlya and one was near the Kapustin Yar guided missile rangehead.[

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2. Further evaluation of the 2.7 megaton test on 17 November 1956, JOE 27, has revealed the achievement of sophisticated techniques in the design of thermonuclear weapons. Marked advances were exhibited in the 1957 test series in the development of light-weight, high-yield thermonuclear warheads.

3. We estimate that during 1958 the Soviet stockpile could include a variety of weapons including those capable of yields from 2 KT to 20 MT. In general, we anticipate that the USSR will be capable of producing improved nuclear weapons of the range of yield and characteristics required to support its major military needs.

DISCUSSION

I. INTRODUCTION

1. In updating NIE 11–2A–57 we have, in general: (a) increased our estimates of the amounts of uranium ore from internal USSR sources and from Satellite countries; (b) increased our estimate of the growth of the plutonium stockpile after 1958; and (c) estimated a more advanced Soviet weapons capability on the basis of new weapons technology demonstrated in the 1957 nuclear tests.

II. SOVIET URANIUM ORE PROCUREMENT

2. *Present Mining and Milling Activities.* Much quantitative information is available on mining and ore enrichment in East Germany. Some new quantitative information is available on the other Satellites, notably Czechoslovakia, Rumania and Bulgaria, but the reliability of the estimates on these countries is considerably less than that on East Germany. Reliable information on East German ore grades received from a Soviet defector in late 1956 has caused us to reassess our estimates of contained uranium in other European Satellite ore operations. This reassessment taken together with new information, such as ground photographs of the large mill near Bukhovo, Bulgaria, has resulted in a general increase of about 50% over last year's estimate for Czechoslovakia, Bulgaria and Rumania. The situation in Poland remains obscure and we estimate only a small output. We have excellent documentary information on Hungarian uranium mining operations which indicates a nominal production until about 1958. A chemical concentrating plant will be in operation in Hungary by 1959. Reliable information has been received indicating that current ore procurement from China is still small.

3. Quantitative information on uranium ore production within the USSR remains scant so that any estimate of this activity must be subject to considerable uncertainty. The USSR is known to have opened up a number of new mining areas during recent years. However, it has not had to resort to extensive extraction of uranium from very low grade ores, indicating that medium grade reserves are still the main source of supply for uranium operations within the USSR. Ground photographs of the mill near Pyatigorsk in the Caucasus, built several years ago, indicate that the Russians have well constructed, modern appearing mills. These facts and considerable additional supporting information warrant a general increase over the values in our previous estimates for internal ore production, especially in more recent years.

4. The estimated cumulative ore production by country for the Soviet Bloc through 1957 is tabulated below. While the reliability of these estimates varies greatly from country to country, actual total cumulative production is believed to be not more than 30% smaller or 50% greater than the estimated value through 1957. These estimated amounts are more than sufficient to support current estimates of fissionable material production. (See Table I)

5. *Future Sources and Production.* The US Geological Survey estimates that the Soviet Bloc has reserves of several hundred thousand tons of uranium in medium grade ore deposits and an even greater quantity in low grade deposits. Many of these reserves are within the Soviet Union and China and could be exploited by present ore recovery methods. Thus expansion of ore procurement depends only on the need for increased production and the over-all cost of such an increase to the Bloc economy. By continuing present trends throughout the various countries of the Soviet Bloc a reasonable estimate can be made of future ore procurement, though the possible error in estimation will be necessarily very large.

6. There is reliable information that ore production in East Germany will begin to decrease by 1959, probably by a few hundred tons per year. The level of prospecting in eastern Czechoslovakia suggests an intention to increase or at least maintain production in that country. The eastern part of Czechoslovakia is an area where uranium is likely to be found, and the prospecting operation will probably be successful. Prospecting in Bulgaria is at a low level, but current processing plant capacity seems larger than current mine output. Judging by estimated reserves production in Bulgaria may decrease by 1965. The USSR seems uninterested in Polish ore, which is believed to be of low grade, and at one time attempted to break the Soviet-Polish purchasing agreement. Extensive prospecting continues in Rumania with new deposits expected to be discovered. Detailed plans for Hungarian expansion through 1962 suggest this country may become a major producer by 1967. Reliable information indicates that China is now implementing a major ore production program with the possible implication that not all the resulting ore will go to the USSR.

TABLE I

ESTIMATED SOVIET BLOC URANIUM ORE PRODUCTION 1946–1968

(*Metric Tons of Recoverable Uranium*)

	USSR	East Germany	Czechoslovakia	Bulgaria	Poland	Rumania	Hungary	China	Total Annual	Total Cumulative Rounded
Pre-1946 Stocks	20	200	70	Nominal	..	..	..	..	290	300
1946	130	60	30	Nominal	..	..	..	..	220	500
1947	170	300	50	20	Nominal	..	..	..	540	1,100
1948	370	500	150	30	20	..	..	..	1,070	2,100
1949	780	1,000	250	60	50	..	..	..	2,140	4,300
1950	1,000	1,200	400	100	90	..	..	..	2,790	7,100
1951	1,400	1,700	450	100	100	..	..	Nominal	3,750	11,000
1952	1,600	2,400	600	150	100	50	..	40	4,940	16,000
1953	2,000	3,300	800	200	100	80	..	40	6,520	22,000
1954	2,500	3,800	1,000	300	100	150	..	60	7,910	30,000
1955	2,900	4,300	1,200	400	100	500	..	60	9,460	40,000
1956	3,400	4,600	1,500	400	100	580	..	60	10,640	50,000
1957	4,000	4,800	1,500	500	100	600	Nominal	100	11,600	62,000
1958	4,500				8,200				12,700	74,000
1959	4,900				8,500				13,400	88,000
1960	5,500				8,900				14,400	100,000
1961	6,000				9,300				15,300	120,000
1962	6,500				9,900				16,400	135,000
1963	7,000				10,400				17,400	150,000
1964	7,500				10,700				18,200	170,000
1965	7,900				11,000				18,900	190,000
1966	8,400				11,700				20,100	210,000
1967	8,900				11,500				20,400	230,000
1968	9,400				11,100				20,500	250,000

7. The USSR evidently considers its internal known reserves inadequate, since in 1956 P. Ya. Antropov, Minister of Geology and Mineral Conservation stated that "a major task of the Sixth Five-Year Plan is the prospecting for radioactive ore and the expansion of reserves adequate to meet the needs of the Soviet Union." This attitude, taken in conjunction with reliable information that activation of several new mining areas has been started during the last two years, indicates the USSR intends to expand its internal ore production. In addition, the Soviets over the past several years have been emphasizing research on better ore dressing methods for medium and low-grade ores, and a number of scientific conferences have considered the problem of processing low-grade ores.

8. In summary, while there is good reason for expecting a decrease in East German ore production over the next ten years, the overall Bloc production is expected to increase considerably in a manner similar to that tabulated in Table I.

III. FISSIONABLE MATERIAL PRODUCTION [2]

9. *U–235 Production.* The Soviet U–235 production program has been re-analyzed on the basis of both old and some new information. Reliable information on the 1952 values of the efficiencies of Soviet gaseous diffusion plants then under design, as well as some new information on the electric power supplied to known U–235 plant areas, tends to reaffirm the cumulative values of U–235 production used in NIE 11–2A–57. In addition, the new information has increased our confidence in assessing the likely minimum stockpile. While many gaps in information still exist, we believe the margin of uncertainty in this estimate probably does not exceed minus 30% or plus 100% of the mid-1958 values in Table II. Future U–235 production could be substantially greater or smaller than estimated, since these figures are based on assumptions of future Soviet capabilities and plans, and some of the latter may not yet have been decided by the Soviets themselves.

10. *Plutonium Equivalent [3] Production to Mid-1958.* The values in Table II for estimated Soviet plutonium equivalent production up to 1958 are similar to those reported in NIE 11–2A–57. The probable uncertainty in cumulative production values is considered to be plus or minus 20% prior to mid-1954 but increases to one-half to twice the stated values by mid-1958.

11. *Future Plutonium Equivalent Production.* We estimate that the USSR will continue to place a high value on plutonium equivalent and will make a considerable effort to produce large quantities of it. Further information on continued construction for the Soviet atomic energy program at several localities known to be reactor sites indicates that plutonium production will continue to increase at a high rate. We estimate that a sizeable part of this increase will come from new production reactors, some of which may produce by-product power. It is likely that the announced power reactor program of the USSR and Satellite countries will provide additional plutonium as a by-product. In the light of all this information the estimated plutonium production during the period 1960–1967 has been increased over that estimated in NIE 11–2A–57. Table II includes estimates of plutonium production from both production and power reactors.

12. It must be recognized that the uncertainties about future Soviet plans introduce large errors into production estimates beyond 1958. These uncertainties increase rapidly as the estimate is extended into the future, and a meaningful numerical range cannot be assigned to them after mid-1958.

[2] See footnote 1, page 1, for the position of the Director of Naval Intelligence.

[3] The term "plutonium equivalent" is used because our method of estimation does not permit us to distinguish between plutonium, U–233, tritium or other reactor produced isotopes.

TABLE II

ESTIMATED SOVIET PRODUCTION OF NUCLEAR MATERIALS 1949–1968 [a] [b]

(Cumulative Amounts in Kilograms)

Mid Year	U-235 (90% Enriched)		Plutonium Equivalent
	Estimated Production (Rounded)	Available for Weapon Usage (Rounded)	Estimated Production (Rounded) [c]
1949	..	..	6
1950	50	..	80
1951	300	..	220
1952	900	800	500
1953	2, 100	2, 000	900
1954	4, 100	4, 000	1, 400
1955	7, 300	7, 000	2, 300
1956	12, 000	11, 000	3, 900
1957	18, 000	17, 000	5, 600
1958	28, 000	27, 000	7, 400
1959	42, 000	40, 000	9, 700
1960	59, 000	55, 000	13, 000
1961	80, 000	75, 000	19, 000
1962	106, 000	100, 000	25, 000
1963	135, 000	130, 000	33, 000
1964	172, 000	165, 000	42, 000
1965	213, 000	200, 000	52, 000
1966	260, 000	245, 000	63, 000
1967	312, 000	295, 000	75, 000
1968	368, 000	350, 000	88, 000

[a] See paragraphs 9 through 12 for the limits of uncertainty and validity of these values.

[b] See footnote [1], page 1 for the position of the Director of Naval Intelligence.

[c] Non-weapons uses of plutonium equivalent are expected to be negligible during the time period of this estimate.

IV. SOVIET NUCLEAR WEAPONS

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13. *Nuclear Tests.* The first Soviet nuclear test was conducted in 1949, at the main Soviet proving ground in the vicinity of Semipalatinsk. A total of 43 tests have been detected to 1 January 1958[

14. *1949 and 1951 Nuclear Tests.* [

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15. *1953 Nuclear Tests.* The four explosions detected in 1953 demonstrated that the USSR was seeking to supplement the medium-yield weapons tested in 1951 by the addition of both

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high-yield weapons and low-yield, smaller diameter weapons. JOE 4, a relatively poor thermonuclear device detonated on 12 August, yielded about 300 kilotons.

JOE 5, 6, and 7 apparently constituted a series investigating reduced diameter weapons.

16. *1954 Nuclear Tests.* Seven explosions were detected in 1954. The first, JOE 8 which took place near Totskoye on 14 September, we estimate to have been an airdrop of a nuclear weapon as part of a military exercise and weapons effects test. The remaining six tests occurred at the main Soviet proving ground in the vicinity of Semipalatinsk. All tests of this series yielded 100 kilotons or less.

17. *1955 Nuclear Tests.* Five nuclear detonations were detected in 1955. JOE 17, on 21 September, was the first Soviet nuclear explosion known to have occurred under water. The JOE 18 test on 6 November yielded about 200 kilotons, and is considered to have been the airburst of a weaponized version of the JOE 4 device, but with a much lower efficiency than its prototype. A development of great significance was JOE 19, the test on 22 November of a thermonuclear weapon which yielded about 1.7 megatons, and marked the effective beginning of a Soviet multi-megaton nuclear weapon capability.

18. *1956 Nuclear Tests.* The 1956 Soviet nuclear tests are particularly significant. Tests extended throughout the entire year, from 2 February until 14 December, and nine nuclear explosions were detected. We believe that the majority of these detonations involved tests of thermonuclear devices and weapons. We estimate that JOE 20, on 2 February, probably involved the test of a nuclear warhead in a ballistic missile of nominal 700 nautical mile range.

JOE 21, JOE 23, JOE 25 and JOE 26 were probably tests related to thermonuclear weapons development; and JOE 24 and JOE 27 were air burst tests yielding 2.2 and 2.7 megatons, respectively.

19. *1957 Nuclear Tests.* The first test detected in 1957 (JOE 29) was an air burst yielding about 4 KT on 19 January at 50°N., 48°E., about 100 miles NNE. of Kapustin Yar. The fact that the test was a relatively low air burst, was detonated near a known Soviet guided missile range head, but not at the ballistic missile test range, and was completely removed from any previous nuclear test location, suggests the test of a nuclear warhead in a missile, probably an air-to-surface type.

20. The spring series was conducted at the Semipalatinsk test site. JOE 30, on 8 March, was a 15 kiloton air burst

The two air burst shots fired on 3 and 6 April (JOE 31 and JOE 32), were both presumed to be TN development tests. JOE 33 on 10 April was an air burst of a TN device and produced a yield of 1,300 KT. It was apparently smaller and lighter than any previously tested Soviet TN device. The other TN device tested in this period was an air burst fired 16 April (JOE 35) producing a 750 KT yield. It is notable for its low TN efficiency. The most interesting test in the spring series, however, was fired as an air burst on 12 April (JOE 34)

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21. The fall phase of the 1957 series included concurrent testing at Novaya Zemlya and Semipalatinsk[

The other two TN devices tested have not yet been fully evaluated, but it appears that the shots which were fired at Novaya Zemlya on 24 September (JOE 39) and 6 October (JOE 40) produced yields of 3,200 and 4,300 KT.

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22. Tests of two[ ]devices were detected, one on 7 September, JOE 37, south of Novaya Zemlya yielding 25 KT and the other at Semipalatinsk on 26 September, JOE 40, yielding 8 KT. JOE 37 may have been associated with the naval maneuvers then underway in the Barents Sea, and was followed shortly thereafter by a 20 KT underwater shot fired south of Novaya Zemlya on 10 October, JOE 42. Insufficient information is available to evaluate one test fired at Semipalatinsk on approximately 13 September, JOE 38, which probably yielded less than 20 KT.

23. JOE 43 was a separate test conducted at Semipalatinsk on 28 December 1957. The yield was in the range of 3–30 KT.[

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24. *Soviet Nuclear Weapon Development Potentiality.* No direct information is available on the specific nuclear weapon types in the USSR stockpile, however, Soviet nuclear tests have indicated that a number of types of weapons have been tested and that such weapon types have been included in the present stockpile.

25. *Future Soviet Weapon Development.* We have no basis for estimates of the rate of Soviet nuclear weapon development in the future. In general, we anticipate that the USSR will be capable of producing nuclear weapons of the range of yields and characteristics required for support of Soviet military requirements. After several years of development, these weapons could include thermonuclear weapons in a variety of sizes with yields ranging up to more than 20 MT and very small fission weapons with yields of less than 1 KT.

TABLE III

EVALUATION OF SOVIET NUCLEAR TESTS

No.	Date	Burst Height (ft.)	Yield (KT)
JOE 1	29 Aug 49	Surface	20
JOE 2	24 Sept 51	Surface	30
JOE 3	18 Oct 51	Air	15
JOE 4	12 Aug 53	Surface	300
JOE 5	23 Aug 53	Air	25
JOE 6	3 Sept 53	Air	8
JOE 7	10 Sept 53	Air	8
JOE 8	14 Sept 54	1,000–5,000	35–100
JOE 9	3 Oct 54	Air	4
JOE 10	5 Oct 54	Poss >20,000	45
JOE 11	8 Oct 54	..	<20
JOE 12	23 Oct 54	Air	90
JOE 13	26 Oct 54	Air	7
JOE 14	30 Oct 54	Air	25
JOE 15	29 July 55	Surface	4
JOE 16	2 Aug 55	Poss >20,000	30
JOE 17	21 Sept 55	Underwater	~20
JOE 18	6 Nov 55	3,500	200
JOE 19	22 Nov 55	4,500	1,700
JOE 20	2 Feb 56	Air	<20
JOE 21	16 Mar 56	Surface	30
JOE 22	25 Mar 56	Surface	25
JOE 23	24 Aug 56	Iron Tower	60
JOE 24	30 Aug 56	2,400–4,200	2,200
JOE 25	2 Sept 56	>1,500	100
JOE 26	10 Sept 56	1,500–3,000	90

TABLE III (*Continued*)

No.	Date	Burst Height (ft.)	Yield (KT)
JOE 27	17 Nov 56	5,800–9,600	2, 700
JOE 28	14 Dec 56	Air	25
JOE 29	19 Jan 57	Air	3. 5
JOE 30	8 Mar 57	Air	15
JOE 31	3 Apr 57	Air	70
JOE 32	6 Apr 57	Air	70
JOE 33	10 Apr 57	5,100–8,400	1, 300
JOE 34	12 Apr 57	Air	30
JOE 35	16 Apr 57	6,300	750
JOE 36	22 Aug 57	>2,000	500
JOE 37	7 Sept 57	Surface	25
JOE 38	13 Sept 57	Unknown	<20
JOE 39	24 Sept 57	Air	3, 200

TABLE III (*Continued*)

No.	Date	Burst Height (ft.)	Yield (KT)
JOE 40	26 Sept 57	Air	8
JOE 41	6 Oct 57	4,500–8,500	4, 300
JOE 42	10 Oct 57	Underwater	~20
JOE 43	28 Dec 57	Air	3–30

~ Approximately.
< Less than.
> Greater than.