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# The Soviet Atomic Energy Program



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*This estimate was prepared and agreed upon by the Joint Atomic Energy Intelligence Committee which is composed of representatives of the Central Intelligence Agency and the intelligence organizations of the Departments of State, Defense, the Army, the Navy, the Air Force, AEC, NSA and FBI.*

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# THE SOVIET ATOMIC ENERGY PROGRAM

## THE PROBLEM

To evaluate significant recent information and developments in the Soviet Atomic Energy Program and to estimate the probable future course of that program to mid-1974.

## SUMMARY AND CONCLUSIONS

### General

1. Since publication of NIE 11-2-63, final evaluations of Soviet nuclear devices tested in 1961 and 1962 and re-evaluations of several earlier devices have led to some changes in the estimate of Soviet nuclear weapon capabilities. While new evidence has led to no changes in the previous estimate of U-235 production, a small upward revision of current and future plutonium-equivalent production has been necessary. The estimate has been extended to cover a ten-year period to mid-1974.

### Soviet Nuclear-Powered Submarine Program [1]

2. Three basic classes of nuclear-powered submarines are known to have been constructed in the USSR and identified in an operational status. (See Table IV). A number of these submarines are probably undergoing modifications. The performance of the LENIN and several of the nuclear submarines during 1963 indicates that the Soviets have probably improved the reliability of their naval nuclear propulsion system. We believe, however, that there is a need for further improvement in their nuclear propulsion technology and operational reliability. (*Paras. 17-18*)

[1] For the estimated number of Soviet submarines see National Intelligence Estimate 11-14-63, dated 8 January 1964.

## Fissionable Materials Production

### *Plutonium-Equivalent*

3. There are three plutonium production sites in the USSR; these are located at Kyshtym in the Urals, and near Tomsk and Krasnoyarsk in Central Siberia. [

] (*Para. 21*)

[

] (*Paras. 25–26*)

5. Future production estimates have taken into consideration Khrushchev's statement in April 1964 that the Soviet Government had decided "to discontinue now the construction of two new, big, atomic reactors for the production of plutonium." We have no basis, at present, for ascertaining whether or not such construction has been discontinued. The spread shown in Table VI for the years 1967–74 represents estimates with and without continuing construction of new reactor facilities. It is estimated that even if reactor construction is discontinued, improvements in reactor operation will lead to increases in future annual plutonium-equivalent production rates. (*Paras. 27–28*)

### *U-235 Production*

6. There are four gaseous diffusion isotope separation complexes in the USSR: one at Verkh-Neyvinsk in the Urals, one north of Tomsk in Central Siberia, a third at Angarsk in the Lake Baykal region, and a fourth which started operation recently, north of Zaozerniy near Krasnoyarsk. Consideration of all available information leads to a U-235 production estimate (See Table VI) which is essentially the same as that shown in NIE 11–2–63. (*Paras. 29–32*)



[ ]

7. We estimate that the probable Soviet cumulative U-235 production for mid-1964 is 170,000 kilograms and that it is unlikely that actual cumulative U-235 production is less than 100,000 or more than 220,000 kilograms.[2] There is no valid means, short of on-site inspection of determining whether or not or by how much the USSR will carry out the announcement by Khrushchev that the USSR has decided ". . . in the next several years to reduce substantially the production of U-235 for nuclear weapons . . .," therefore, a cut-back has not been assumed in the projected estimate. We estimate that by 1967 the [ ] will increase the Soviet U-235 production capacity 60 percent over their mid-1964 production rate. (*Paras. 30–32*)

## Nuclear Weapons

### *Weapon Improvements from 1961–1962 Tests*

8. The Soviets significantly improved their fission and thermonuclear weapon capabilities as a result of the 1961–62 test series. However, the status of Soviet nuclear weapon technology, while highly sophisticated and apparently adequate for their present needs, is such that substantial advances can still be made through further development and testing. We believe that the Soviets are continuing an active weapon development program. They will certainly have a continuing requirement to test at a greater rate[3] than has been evident since the Test Ban Treaty was initialled in July 1963. (*Paras. 42–48, 50–57 and 64*)

9. *Fission Weapons.* By 1958, the Soviets had developed implosion devices encompassing a variety of yields and physical dimensions and employing boosting techniques in some cases. The 1961–62 test series provided the Soviets with improved fission weapon capabilities. [ ] However, a large number of new devices were tested without employment of boosting. This perhaps indicates that the Soviets will limit their employment of boosting, thus, in their unboosted weapons gaining simplicity and a reduced requirement for tritium at

[2] See page 31 for the view of the Assistant Chief of Naval Operations (Intelligence), Department of the Navy.

[3] As of 1 July 1964 three tests had been detected.

the cost of some increases in vulnerability, fissionable materials, and size, and perhaps decreased yield. [

However, possible undetected tests and [ ] might have provided the Soviets with still smaller low-yield weapons. (*Paras. 41–45*)

10. *Thermonuclear Developments.* By 1958 the Soviets had tested a variety of thermonuclear devices [

] In 1961 and 1962, the Soviets greatly improved the performance of their thermonuclear weapons and extended their yield experience. [

] (*Paras. 49–52*)

[

] (*Paras. 53–55*)

Future Weapon Development and Testing

12. We have detected only three Soviet tests in the twelve months since the initialing of the Test Ban Treaty in July 1963.

There are undoubtedly a variety of useful tests the Soviets could now conduct underground both for research and development and for military purposes. We have no evidence that they have conducted tests banned by the Treaty and do not believe they will resort to such tests so long as the options of underground testing and formal treaty withdrawal are open to them. (*Para. 65*)

13. It is certain that the Soviet weapons laboratories have remained active and are creating new test requirements. The potential improvements obtainable through underground testing together with the high rate of US underground testing—43 tests between 1 August 1963 and 1 July 1964—must be generating considerable pressure on the Soviet leadership for a more vigorous test program than has been conducted to date. We do not believe, however, that research, development and military requirements alone are now so pressing as to necessitate withdrawal from the Treaty or are likely to become so in the near term. Hence, we believe that political factors will be the major consideration in reaching a decision whether or not to withdraw. If such a decision is made by the Soviets, atmospheric testing by the French or Chinese Communists might provide the pretext. (*Para. 66*)

14. If the Soviets embark on a reasonably extensive underground testing program involving yields up to about 200 KT, they could achieve, during the period of this estimate, [redacted] Improvements in Soviet low-yield devices which could occur during the period of this estimate are more likely to emphasize the development of small-diameter [redacted] warheads rather than [redacted] Such developments might include [redacted] (*Paras. 68–71*)

15. Underground testing and simulation techniques would permit the acquisition of a limited amount of weapon effects data, including the effect of ground shock upon hardened underground structure, the effects of nuclear radiation upon materials or systems components, and [ ] Other effects data related to high-altitude effects and the full effects of electromagnetic pulse could not be obtained through underground testing. (*Paras. 72–74*)

Table I

# DISCUSSION

## I. SOVIET NUCLEAR-POWERED SUBMARINE PROGRAM

16. Three basic classes of nuclear-powered submarines are known to have been constructed in the USSR and identified in an operational status. (See Figure 1). The estimated characteristics of these nuclear submarines are given in Table IV. The estimated top speed of Soviet submarines is in the vicinity of 20 knots. However, on only one occasion was a speed as high as 20 knots reported and that for only a short time. Most observations in the higher speed ranges have actually been in the vicinity of 13–17 knots. All three classes are believed to use a propulsion system similar to that used in the nuclear icebreaker, LENIN, including the turbo-electric drive system, but probably including only one reactor. It is evident that the submarines constructed prior to 1961 probably suffered from problems similar to the LENIN's. During the 1963 scientific exchanges in the field of atomic energy, the Soviets showed an extraordinary interest in US technology concerning corrosion, water purity, and leakage of reactor coolant systems, suggesting that some nuclear submarine propulsion problems may not yet be adequately solved.

17. The performance of the LENIN and several of the nuclear submarines during 1963 indicates that the Soviets have probably improved the reliability of at least some of their nuclear submarines. Of major importance was the under-ice transit from Murmansk to the Pacific made by an "N" class submarine in September 1963. Based on this and other evidence, we estimate that the capability to conduct out-of-area patrols by nuclear-submarines has been improved. We believe, however, that there is a need for further improvement in their nuclear propulsion technology and operational reliability.

18. The Northern Fleet nuclear submarine force is believed to contain about two-thirds of the Soviet nuclear submarines, including both missile carrying and attack types.[1] We have estimated that the nuclear submarine force of the Pacific Fleet is composed of one "N" class and eight "E" class submarines. The Soviets are believed to be capable of fabricating the reactors needed to support the estimated construction program of eight to ten nuclear submarines per year. Not all of the Soviet nuclear submarines are operational, however, as a number are probably undergoing propulsion systems and/or other modifications. This will probably reduce the production rate of new submarines until the modification program is completed.

## II. FISSIONABLE MATERIALS PRODUCTION

### *Uranium*

19. Reports received during the past year indicate little change in Soviet mining and milling operations. We believe, therefore, that the uranium ore procurement from both domestic and satellite sources is about the same as estimated in NIE 11-2-63, and in terms of equivalent uranium metal, is now about 20,000 metric tons per year. About 210,000 metric tons have been procured through mid-1964, and cumulative production should reach 450,000 metric tons by mid-1974 if the estimated production schedule is maintained. These estimates are subject to an error of plus or minus 50 percent.

20. Uranium metal and other feed materials are produced at Elektrostal near Moscow, at Glazov, just west of the Urals, and at Novosibirsk in Central Siberia. There is no reason to believe that the rate of production has changed significantly. So-

[1] For the estimated number of Soviet submarines see National Intelligence Estimate 11-14-63, dated 8 January 1964.



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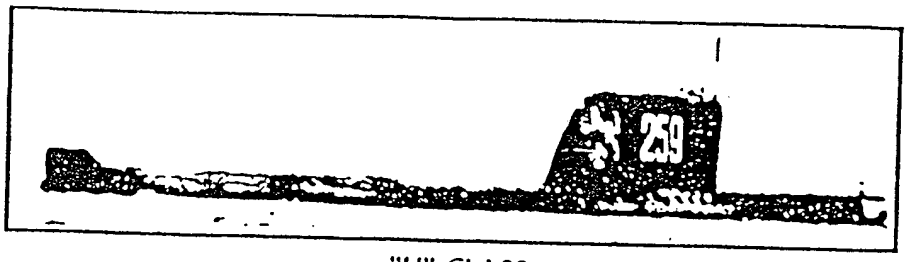
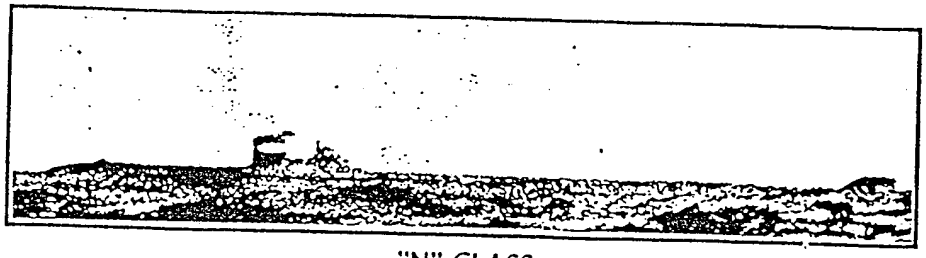
FIGURE I

# Soviet Nuclear Submarines

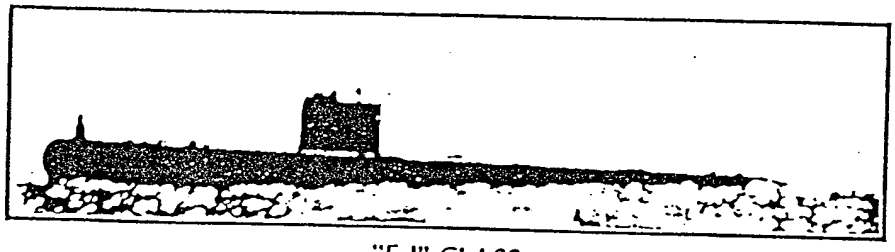


"H" CLASS



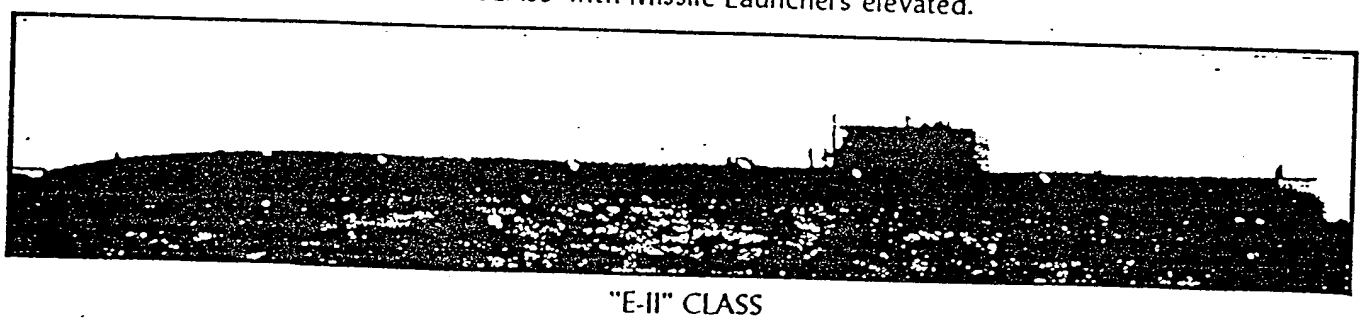


"N" CLASS



"E-I" CLASS

"E-I" CLASS with Missile Launchers elevated.



"E-II" CLASS

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Table IV

ESTIMATED CHARACTERISTICS OF SOVIET NUCLEAR SUBMARINES

| Class | Mission | Length, Over-all | Beam | Displacement in tons | Maximum Surface Speed | Maximum Submerged Speed | Normal Operating Depth Limit | Estimated Reactors Horsepower | Armament |
|---|---|---|---|---|---|---|---|---|---|
| N | A torpedo attack submarine. | 330′ | 32′ | Surfaced 4,600 Submerged 5,400 | About 20 Kts. | About 20 Kts. | 800′ | 15,000 hp probably pressurized water reactor probably two screws. | Torpedoes. |
| H | The primary mission of this submarine is probably shore bombardment. | 365′ | 32′ | Surfaced 5,000 Submerged 5,900 | About 20 Kts. | About 20 Kts. | 800′ | 15,000 hp probably pressurized water reactor probably two screws. | Torpedoes and three 300 nm ballistic missiles. Modified H may be able to launch missiles submerged. |
| E | Probably be targeted against naval surface ships. Could also attack shore targets. | 370′ | 32′ | Surfaced 5,100 Submerged 6,000 | About 20 Kts. | 18–20 Kts. | 800′ | 15,000 hp probably pressurized water reactor probably two screws. | E-I carries six 300 nm cruise missiles and E-II carries eight. Both probably also have torpedoes. |

viet uranium output is considered more than ample to meet the estimated needs of their atomic energy program.

### *Plutonium-Equivalent Production*

21. Available information since publication of NIE 11-2-63 continues to indicate that there are three plutonium production sites in the USSR; these are located at Kyshtym in the Urals, and near Tomsk and Krasnoyarsk in Central Siberia. [redacted]

22. *Kyshtym.* Additional site information, including electric power input data and general information on Soviet advances in reactor and reactor coolant system technology, indicates that current reactor power levels at Kyshtym are somewhat greater than previously estimated, the values for 1963 and 1964 being about 7500 megawatts. The estimate of plutonium-equivalent production at Kyshtym, based on this re-analysis of site data, yields a total mid-1964 cumulative value of about [redacted] Current annual production is probably [redacted]

23. *Tomsk.* The Soviet plans for the "Siberian Atomic Power Station," disclosed at the 1958 Geneva Conference on the Peaceful Uses of Atomic Energy, called for 600 megawatts of electric power generation. These plans and other information, including 1957 photography, lead to an estimate that the current total reactor power level is about 3800 megawatts. This results in a mid-1964 estimated cumulative plutonium-equivalent production from Tomsk of [redacted] Annual production of plutonium-equivalent is probably [redacted] It is likely that all the dual-purpose [6] reactors projected for the "Siberian Atomic Power Station" have not yet been completed and Tomsk may therefore be the site where the Soviet Government has decided "to discontinue now the construction of two new, big, atomic reactors for the production of plutonium," referred to in April 1964 by Khrushchev, are located.

24. *Krasnoyarsk.* Site data on the Krasnoyarsk atomic energy complex indicates slightly higher reactor power levels there than previously estimated. The re-analysis, [redacted] is consistent with a current total reactor thermal power level of 3,000 to 4,000 megawatts. The mid-1964 cumulative production of plutonium-equivalent is estimated to be [redacted] and current annual production is probably [redacted]

25. [redacted]

26. [redacted]

27. *Future Production.* Future production estimates have taken into consideration Khrushchev's statement in April 1964 that the Soviet government had decided "to discontinue now the construction of two new, big, atomic reactors for the production of plutonium." We cannot identify with certainty the two reactors to which Khrushchev referred, although they may be located at Tomsk. If these reactors are not completed, the

[6] Dual-purpose reactor—A production reactor which is also designed and equipped for the utilization of the by-product heat, generally in the form of electric power generation.



[redacted]

resulting future plutonium-equivalent estimate, which includes allowance for improved reactor operation, is the lower figure shown in Table VI for the years 1967–74. However, if the Soviets complete and operate these two reactors, expand production with additional reactors and accomplish normal process improvements, we believe their cumulative production will reach the higher value shown in Table VI. Plutonium produced as by-product from operation of nuclear power and propulsion reactors is included in the estimate. We expect that this will amount to [ ] by mid-1965 and will increase to [ ] by mid-1974.

28. It is estimated that even if reactor construction is discontinued, improvements in reactor operation will lead to increases in future annual plutonium-equivalent production rates. [ ]

[ ]

*U–235 Production*

29. Four large gaseous diffusion isotope separation complexes are in operation in the USSR: one at Verkh-Neyvinsk in the Urals, one north of Tomsk in Central Siberia, a third at Angarsk in the Lake Baykal region, and the fourth north of Zaozerniy near Krasnoyarsk. [ ]

[ ] The present size of the Soviet gaseous diffusion complex also tends to indicate that significant U-235 production by the ultracentrifuge and other methods is unlikely.

30. We estimate that by 1967 [ ] will increase the Soviet U-235 production capacity 60 percent over their mid-1964 production rate. [ ]

[ ]

31. It is not known how the Soviets have arranged the cascades at each of their gaseous diffusion plants and whether or not a given site actually produces 93 percent U-235 enriched uranium. We estimate the 1964 annual production of each site in terms of 93 percent U-235 (equivalent top product, ETP) as shown in Table V.

TABLE V

1964 ANNUAL SITE PRODUCTION
U-235 EQUIVALENT TOP PRODUCT, 93% ENRICHED

| Site | Kilograms |
|---|---|
| Verkh-Neyvinsk | 13,800 |
| Tomsk | 7,200 |
| Angarsk | 17,300 |
| Zaozerniy | 380 |
| Total | 38,680 |

32. Available information leads to a U-235 production estimate which is essentially the same as that made in NIE 11–2–63. The estimate of total Soviet cumulative production of uranium enriched to 93 percent U-235 content includes the 93 percent equivalent of materials produced at lesser enrichments. Estimated weapon test and non-weapon uses of U-235, especially for nuclear powered submarines, have been subtracted from the estimated cumulative production to give the amount of 93 percent equivalent U-235 available for weapons use as shown in Table VI. It is estimated that Soviet cumulative U-235 production for mid-1964 is 170,000 kilograms. It is unlikely that actual Soviet mid-1964 cumulative U-235 production could

be less than 100,000 kilograms or more than 220,000 kilograms.[6]

### Future U-235 Production

33. In April 1964, Khrushchev stated that "The Soviet Government took the following decisions . . . in the next several years to reduce substantially the production of U-235 for nuclear weapons." There is no valid means short of on-site inspection of determining whether or not or by how much the USSR will carry out the announcement by Khrushchev. The estimate of future production at the four gaseous diffusion plants is based on gradually increasing efficiencies as older plant sections are modified, and on estimates of future power use as deduced from reports of power plant construction and published Soviet plans and statistics. We have assumed that no new Soviet gaseous diffusion plant construction would be started in the future, but the pre-1958 plants at Verkh-Neyvinsk and Tomsk would be modified to improve efficiencies. Available evidence indicates that the gaseous diffusion plant at Angarsk will attain full capacity in 1964 and the plant at Zaozerniy would reach full capacity in 1967. There is no basis for estimating whether or not post-1967 expansion will occur at any of the four locations, although Soviet plans call for increased electric power production in these geographical areas.

34. If a cutback does occur, we believe that a large proportion most probably would be taken in the shutdown of the oldest buildings at Verkh-Neyvinsk and in a uniform reduction of process pressure in the older, less efficient equipment at both Verkh-Neyvinsk and Tomsk. Production at the more efficient Angarsk plant will probably remain unchanged. If the entire Zaozerniy plant becomes operational, there would be a net increase in annual production even though the older sections at Tomsk and Verkh-Neyvinsk were shutdown.

Table VI

ESTIMATED SOVIET FISSIONABLE MATERIALS PRODUCTION

(Cumulative Production in Kilograms, Rounded)

| Mid-Year | U-235 (93%) Total | U-235 (93%) Available for Weapon Use | Plutonium-Equivalent |
|---|---|---|---|
| 1950 | 25 | 25 | [redacted] |
| 1951 | 160 | 160 | |
| 1952 | 600 | 600 | |
| 1953 | 1,550 | 1,550 | |
| 1954 | 1,350 | 3,350 | |
| 1955 | 6,300 | 6,300 | |
| 1956 | 10,500 | 10,500 | |
| 1957 | 16,500 | 16,000 | |
| 1958 | 24,500 | 24,000 | |
| 1959 | 36,500 | 35,500 | |
| 1960 | 53,000 | 51,000 | |
| 1961 | 73,000 | 71,000 | |
| 1962 | 99,000 | 95,000 | |
| 1963 | 130,000 | 125,000 | |
| 1964 | 170,000 | 165,000 | |
| 1965 | 215,000 | 205,000 | |
| 1966 | 265,000 | 255,000 | |
| 1967 | 320,000 | 310,000 | |
| 1968 | 380,000 | 370,000 | |
| 1969 | 435,000 | 425,000 | |
| 1970 | 495,000 | 480,000 | |
| 1971 | 555,000 | 540,000 | |
| 1972 | 615,000 | 600,000 | |
| 1973 | 670,000 | 655,000 | |
| 1974 | 730,000 | 710,000 | |

### Margins of Error

35. [redacted]

[6] The Assistant Chief of Naval Operations (Intelligence), Department of the Navy, believes that the lower limit of the estimated value for the cumulative production of U-235 is more nearly correct. He believes that the evidential base is insufficient to support the production efficiency which a higher cumulative total would require.

### Other Nuclear Materials

36. *Lithium.* Available information indicates that the main domestic Soviet sources of lithium concentrates are Zavatinsk near Shilka in Chita Oblast, the Tadzhik SSR and the Kazakh SSR. Chinese Communist exports to the USSR of lithium ore concentrates through 1962 have accounted for an estimated one-half of the total lithium available to the Soviet atomic energy program. Soviet literature indicated discovery of important lithium-bearing ore deposits in 1957 on the Kola Peninsula between Lake Porosozero and Voron'ye, but their precise locations are unknown.

37. [ ] From Soviet literature and samples of enriched lithium, we believe that the Soviets had lithium-6 with various enrichments up to about 92 percent from 1953 onward. Production scale recovery of lithium-6 using the lithium amalgam-lithium hydroxide process may have started at a suspect lithium plant at Nizhnyaya Tura between 1951 and 1955. Additional production of lithium-6 may have become available between late 1957 and early 1959. [ ] It is estimated that the cumulative production of highly enriched lithium-6 could have been about 100,000 kilograms by the end of 1963. This value could be as low as 50,000 kilograms or as high as 200,000 kilograms.

## III. SOVIET NUCLEAR WEAPONS PROGRAM

### Weapon Development Program

38. Since publication of NIE 11-2-63, final analyses of low-yield devices tested in 1962 have become available. Moreover, continuing analysis has resulted in some changes in previous estimates of the characteristics of a number of other Soviet test devices, both fission and thermonuclear. All of these changes are reflected in the following discussion, as well as in Tables I, II, and III and Annex A.

39. Since the Test Ban Treaty was signed, the USAEDS has detected only three probable Soviet nuclear explosions; these occurred at the Semipalatinsk underground test site on 15 March, 16 May, and 5 June 1964. If the test devices were tamped in granite, the first two would have had yields of about 50 KT and the third a yield of about 2 KT. [ ]

### Fission Devices

40. [ ]

41. *Fission Weapon Developments Through 1958.* By 1958 the Soviets had developed implosion devices encompassing a variety of yields and physical dimensions, employing boosting techniques in some cases. [ ] These probably would have been all-U-235, gun type weapons, but no tests of such designs have been detected and these [ ] are not known to be presently in the Soviet active inventory.

42. *Fission Weapon Tests in 1961-62.* Of the tests detected by the USAEDS during 1961-62, about half (at least 24 in 1961 and 31 in 1962) are believed to have been tests of fission devices. It is probable that some additional low-yield tests at Semipalatinsk were not detected by the USAEDS.

[ ]

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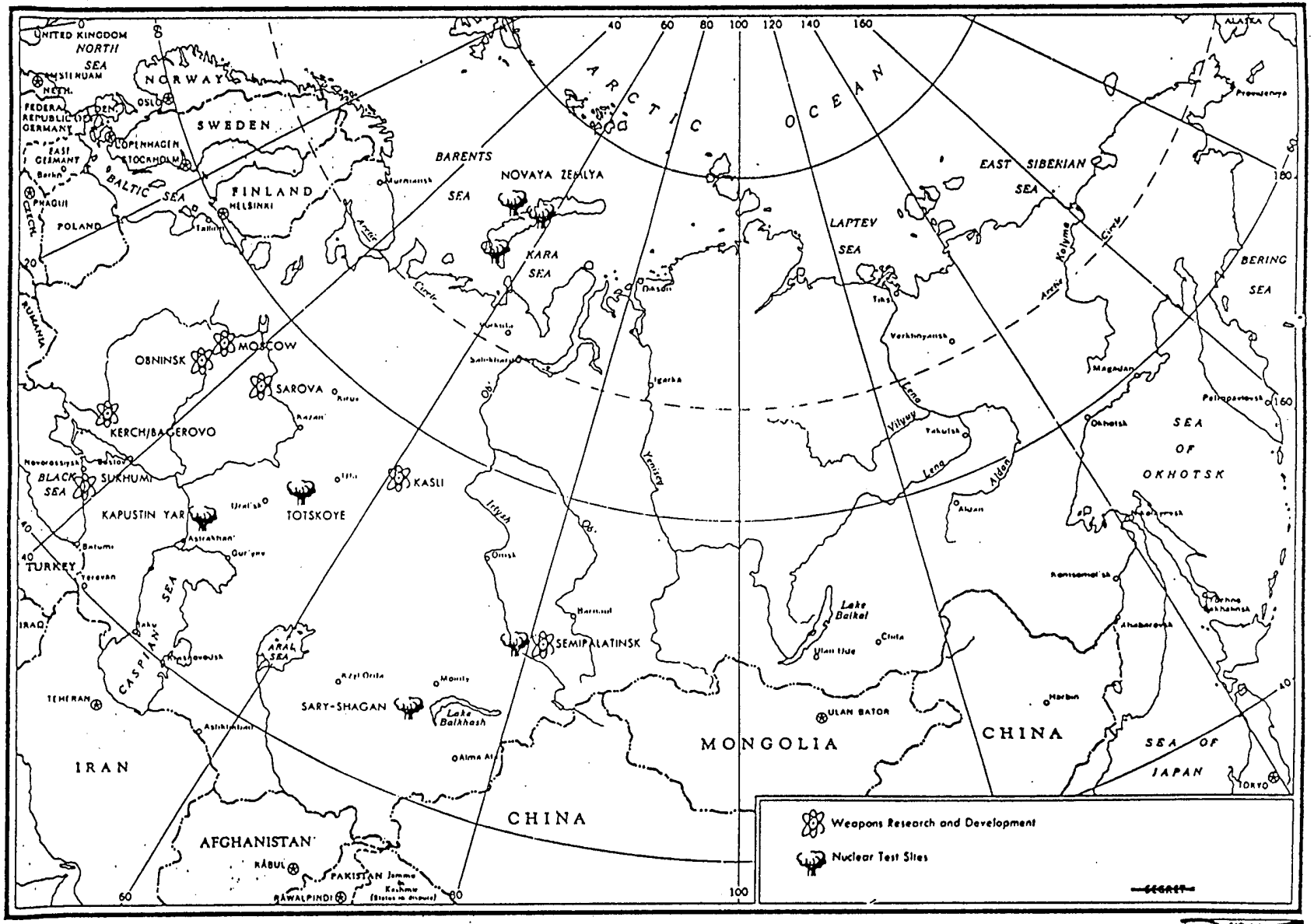
# USSR: NUCLEAR WEAPON RESEARCH AND TEST AREAS

Figure 3

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We believe that the Soviets probably have developed small fission weapons of very low kiloton and possibly sub-kiloton yields.

43. The 1961–62 test series generally provided the Soviets with improved fission weapon capabilities; the series also included some repetitions, perhaps with moderate improvements, of designs tested in previous series. There was a considerable emphasis on testing new devices [ ] It is significant to note that although boosting was used extensively in these tests, a large number of new devices were tested that did not employ boosting. This perhaps indicates that the Soviets will limit their employment of boosting, thus, in their unboosted weapons gaining simplicity and a reduced requirement for tritium at the cost of some increases in vulnerability, fissionable materials, and size, and perhaps decreased yield. It is difficult to assess the purpose of some of the tests involving older designs [ ] some may have been tested to satisfy unidentified development requirements or as physics experiments; and some were proof or effects tests.

44. *Devices with* [ ] Prior to 1961 only one Soviet device with [ ] had been identified. [ ] devices. [ ] Four devices tested in 1961 and 1962 were similar in design. [ ] The fourth, detonated on the surface of the water in the traditional naval test area south of Novaya Zemlya, was probably an effects or weapons system test.

45. Probably the greatest advance in fission weapon technology identified in the test series appeared in a number of boosted, [ ]

46. *Devices with Uranium Tampers.* During the 1961–62 test series, the Soviets exhibited a continued interest in unboosted, [ ] These would be applicable primarily to weapon systems where simplicity and tritium savings are more important than reductions in weight and diameter. It should be noted that plutonium of fairly recent manufacture was used in some of these tests, suggesting that design improvements rather than proof tests of stockpiled devices was the intent.

47. The Soviets also displayed a continuing interest in developing boosted, [ ]

*Thermonuclear Devices*

48. *Thermonuclear Weapon Primaries.* The Soviets have developed [ ] both boosted and unboosted, with a variety of tamper sizes. It is difficult to identify specific fission tests as prototypes of the thermonuclear primaries. [ ]

49. *Thermonuclear Developments, 1955–1958.*

50. *Thermonuclear Weapon Tests in 1961–62.* Of the 112 tests detected during the 1961–62 series, about half were thermonuclear devices with yields ranging from about 150 kilotons to 55 megatons. Analysis indicates that the Soviets have developed a highly competent thermonuclear weapon technology which, in some areas, differs markedly from that of the US.

59. We have no evidence to determine whether the Soviets have ever used ground-based instrumentation for the air-burst tests at Novaya Zemlya. It is likely that they rely on airborne instrumentation. We have no evidence of the type of instrumentation used for the underwater tests in the area.

60. *Weapons Effects.* Despite the limitations on our knowledge of Soviet instrumentation practice, we know from analysis of their effects manuals that they have acquired effects data of sufficient scope and quality on air, surface, underwater and underground bursts to be adequate for planning and executing most military operations.

*Test Instrumentation and Nuclear Effects Data*

58. Photographic coverage through April 1960 of the Semipalatinsk Proving Ground revealed bunkers, evidence of tower shots and ground-burst craters indicating that a number of the tests held there have been instrumented for weapons diagnostic information and for weapon effects. Some of the craters may have been directly or indirectly associated with possible instrument arrays, further indicating Soviet interest in low-yield effects testing.

61. A few air burst weapons in the yield range of 1–3 MT tested at Semipalatinsk in 1955–57 were used to obtain direct information on the effects of high-yield weapons on emplaced military equipment and structures. Since September 1957, they have conducted a large number of airburst tests with yields up to 55 MT at Novaya Zemlya. Despite the limitations on instrumentation at Novaya Zemlya, it is likely that from these tests the Soviets obtained measurements of basic blast, thermal, and nuclear radiation effects which would enable them more accurately to scale up the lower yield effects data obtained at Semipalatinsk. They probably still need additional data on certain special areas such as high-altitude effects and effects of high-yield near-surface bursts.

62. In 1961 and 1962 the Soviets conducted seven nuclear tests at high altitudes. These tests ranged in yield from about one KT to 1.8 MT and in burst altitude from about 15 kilometers to 325 kilometers. Two of these events (both in 1961) were prob-

ably vertical launches from the Kapustin Yar rangehead. The others (two in 1961, three in 1962) involved complex multiple-missile launchings from Kapustin Yar into the Sary Shagan area.

63. Analysis of the 1961 and 1962 multiple-missile tests indicates that they were directly related to development of an anti-missile system. We do not believe that they were designed to obtain information on nuclear kill mechanisms on nosecones under conditions of re-entry; rather, the location of the various missiles relative to the nuclear detonations suggests that they were intended primarily to obtain data on the effects of fire-ball and nuclear debris cloud blackout on radar and communication systems. In addition, instrumentation associated with these tests, as well as the instrumentation on the vertical firings from Kapustin Yar, probably permitted the Soviets to collect data on the phenomena resulting from high-altitude nuclear explosions, including some information applicable to nuclear kill mechanisms.

*Future Weapon Development and Testing*

64. The status of Soviet nuclear weapons technology, while highly sophisticated and in most respects apparently adequate for their present needs, is such that significant advances can still be made through further development and testing. We believe that the Soviets are continuing an active weapon development program. In the course of this program they will certainly have a continuing requirement to conduct tests at a greater rate than that demonstrated since the Test Ban Treaty was initialed.

65. *Current Test Status.* We have detected only three Soviet tests in the twelve months since the initialing of the Test Ban Treaty in July 1963. There are undoubtedly a variety of useful tests the Soviets could now conduct underground both for research and development and for military purposes. We have no evidence that they have conducted tests banned by the treaty and do not believe they will resort to such tests so long as the options of underground testing and formal treaty withdrawal are open to them.

66. It is certain that the Soviet weapons laboratories have remained active and are creating new test requirements. There are undoubtedly a variety of useful tests the Soviets could now conduct underground both for research and development and for military purposes. This fact, together with the high rate of US underground testing—43 tests between 1 August 1963 and 1 July 1964—must be generating considerable pressures on the Soviet leadership for a vigorous test program. Nevertheless, we do not believe that research, development and military requirements alone are now so pressing as to necessitate withdrawal from the Treaty or are likely to become so in the near term. Hence, we believe that political factors will be a major consideration in reaching a decision whether or not to withdraw. Although an atmospheric test by the French or Chinese Communists would not be likely in itself to lead to withdrawal, it might provide the pretext. We believe that the Soviets can be in a technical and operational state of readiness to resume atmospheric nuclear testing soon after making a political decision to do so.

67. We have no firm intelligence on current Soviet activities related to the use of nuclear explosions for peaceful purposes, nor have we been able to identify any Soviet tests held for this purpose. Soviet work with massive conventional high explosive charges would provide data applicable to a peaceful uses program, and it is possible that some of the Semipalatinsk tests also provided such data if they were not, in fact, held primarily for that purpose.

68. *Possible Developments Through Underground Testing.* If the Soviets embark on a reasonably extensive underground test program involving yields up to about 200 KT, [redacted]

69. Improvements in Soviet fission devices which could occur during the period of this estimate are more likely to be in the direction of developing small diameter warheads than

71. Further developments might also occur in the area of The characteristics of such weapons are difficult to assess at present. However, the tactical requirements would probably limit development to the sub-kiloton or low kiloton yield range.

72. *Possible Developments with Unrestricted Testing.* Probably one of the strongest requirements for further Soviet nuclear testing is in the area of high-altitude effects of nuclear weapons. Previous Soviet high-altitude tests, while highly sophisticated in their missile involvement and probably well instrumented, lacked some of the characteristics of tests designed to give detailed information on warhead kill mechanisms and on communications-blackout effects.

73. The Soviets have had no high-yield, near-surface testing experience since 1956. We have no specific knowledge of Soviet low-yield atmospheric tests designed to provide information about the effects of electromagnetic pulse or ground shock on hardened missile launch sites.

74. None of the weapon effects tests discussed above could be conducted legally under the current Test Ban Treaty. However, a limited amount of data related to some of these problems can be obtained by underground tests. For example, the effect of ground shock upon hardened underground structures, the effects of nuclear radiation upon materials or system components, and the nuclear radiation spectra of various weapons designs could all be measured by underground testing.

75. We believe the Soviets probably would want to have operational weapon tests of new delivery systems which incorporate nuclear designs developed during the 1961–62 test series. Nuclear delivery system tests could not be conducted under the restrictions imposed by the Test Ban Treaty.

76. With unrestricted testing the Soviets could Specifically, assuming developments of their present basic designs, they might be able to achieve, during the period

of this estimate, [redacted] If limited to underground tests, no significant improvements could probably be achieved for the thermonuclear weapons in Table I having yields greater than a few megatons.

*Weapons Systems and Deployment*

77. Our estimate of the fission and thermonuclear warheads which the Soviet Union may have in stockpile now and in the immediate future is presented in Tables I and II. Table III presents estimates of the warheads which we believe are currently assigned to the various Soviet missiles and indications of potential warheads which might be assigned to these missiles on the basis of the 1961 and 1962 test series.

78. We believe that most of the nuclear weapons in the current Soviet stockpile are based on designs subjected to prototype testing in 1958 or earlier. [redacted] most of the new weapons based on the 1961 tests are probably only now beginning to enter stockpile.

79. *Nuclear Storage in East European Satellites.* We still have no firm evidence of nuclear warhead storage facilities in the east European Satellites, although persistent reports of the presence of nuclear weapons, particularly in East Germany, have been received. Such storage would be commensurate with the factors of stockpile growth, systems deployment, and readiness requirements. In addition to tactical aircraft capable of carrying nuclear weapons, Soviet forces in Eastern Europe are equipped with free rockets and short-range missiles which are known to have a nuclear capability, and there is evidence that exercises involving simulated nuclear strikes have been conducted by these forces. If permanent nuclear storage facilities do not exist in Eastern Europe, units assigned a nuclear strike role would have to be supplied from forward stockpile sites or from the regional military stockpile sites along the western border of the USSR.

Annex Deleted in its Entirety
(Pages 31 through 63)

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