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5 October 1961
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NATIONAL INTELLIGENCE ESTIMATE
NUMBER 11-2-61

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THE SOVIET ATOMIC ENERGY PROGRAM

LIMITED DISTRIBUTION

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, Defense, the Army, the Navy, the Air Force, and The Joint Staff.

Concurred in by the
UNITED STATES INTELLIGENCE BOARD

on 5 October 1961. Concurring were the Director of Intelligence and Research, Department of State; the Director, Defense Intelligence Agency; the Assistant Chief of Staff for Intelligence, Department of the Army; the Assistant Chief of Naval Operations (Intelligence), Department of the Navy; the Assistant Chief of Staff, Intelligence, USAF; the Director for Intelligence, Joint Staff; the Atomic Energy Commission Representative to the USIB; and the Director of the National Security Agency. The Assistant Director, Federal Bureau of Investigation, abstained, the subject being outside of his jurisdiction.

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NATIONAL INTELLIGENCE ESTIMATE

THE SOVIET ATOMIC ENERGY PROGRAM

NIE 11–2–61

5 October 1961

This estimate supersedes NIE 11–2–60, 21 June 1960 and Annex E to NIE 11–5–61, 25 April 1961.

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, the National Security Agency, the Assistant to the Secretary of Defense, Special Operations, and the Central Intelligence Agency. See appropriate footnotes, however, for the dissenting views of the Navy and Air Force. The FBI abstained, the subject being outside of its jurisdiction.

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THE SOVIET ATOMIC ENERGY PROGRAM

THE PROBLEM

To estimate the current status and probable future course of the Soviet atomic energy program to mid-1966.

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SUMMARY AND CONCLUSIONS

NUCLEAR WEAPON CAPABILITY

1. *Weapon Capability.* We believe that nuclear weapons are available for delivery systems which we know to be in the Soviet arsenal or which we estimate to be under development. However, many of these weapons probably are not of optimum design, and serious gaps in the Soviet knowledge of weapons effects for certain military applications may exist. Based on an analysis of available data from tests conducted prior to 1 September 1961, we estimate that these weapons range from fission warhead devices yielding [redacted] to thermonuclear warheads yielding [redacted] We have reliable reports of short range army support weapons of low yield, some of which may well have been tested. We must consider also the possibility that there are larger yield bombs in stockpile although such devices have not been tested, and therefore, the Soviets would have reduced confidence in the yield. [redacted] It is estimated that by a series of tests and weapons development efforts probably requiring one year or more, the Soviets could complete the design and be prepared to fabricate a [redacted] *(Tables 6 and 7, and Paras. 99–118)*

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FISSIONABLE MATERIALS PRODUCTION

2. *Uranium Ore.* Available evidence continues to indicate that the Soviets are [redacted]

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expanding both their domestic and satellite procurement of uranium ore. We estimate that by the end of 1960 the Soviet Union had procured a cumulative total of about 130,000 metric tons of recoverable uranium. As in previous years these amounts are considerably in excess of the recoverable equivalent uranium metal required to support our current estimate of fissionable materials production. (*Table 3, and Paras. 50 to 55*)

3. *Uranium–235.* Two gaseous diffusion uranium isotope separation plants have been identified in the USSR, one at Verkh-Neyvinsk and the other at Tomsk. A probable third plant is located near Angarsk in the Lake Baykal region. However, we have been unable to confirm U–235 production in this area. We believe that no other large gaseous diffusion uranium–235 plant is currently in operation in the Soviet Union. (*Para. 57*)

4. We estimate that the Soviets produced the equivalent of 76,000 kg of weapon-grade U–235 by mid-1961 and that the cumulative total will have increased to about 285,000 kg by mid-1966.[2] (Table 4, page 21.) [redacted] A fairly good confidence level can be assigned to ±50% error range for the estimated mid-1963 value. [redacted] (*Para. 58–63*)

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5. *Plutonium Equivalent.*[3] Two major plutonium-equivalent production sites have been identified in the USSR. The earliest and largest is located near Kyshtym in the Urals and the second is north of Tomsk in Central Siberia. The atomic energy site near Krasnoyarsk, and possibly the site at Angarsk, could also include some plutonium-equivalent production facilities, but available evidence does not confirm the existence of such facilities at these sites. (*Paras. 64–67*)

6. The available evidence leads to different values of Soviet plutonium-equivalent production. [redacted]

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[2] See page 18 for the view of the Assistant Chief of Naval Operations (Intelligence), Department of the Navy.

[3] [redacted] the total reactor-products production is expressed in terms of equivalent amounts of plutonium and is termed plutonium equivalent. For planning purposes 10 grams of tritium is considered equal to one kilogram of plutonium.

[redacted]

[4] See page 21 for the view of the Assistant Chief of Naval Operations (Intelligence), Department of the Navy.

POSSIBLE ALLOCATIONS OF FISSIONABLE MATERIALS TO WEAPON STOCKPILES

10. We believe that the long-range striking forces have been given the largest allocation of fissionable materials, and that at present the Soviet weapons stockpile can support massive nuclear attacks against targets in Eurasia and North America. In view of the large allocation estimated for the long range attack forces, and the size and nature of the overall materials stockpile, limitations are imposed on the numbers of weapons available for other air, ground, and naval operations. These limitations necessarily affect military planning. However, we consider it unlikely that the availability of fissionable materials for nuclear weapons is a factor which in itself significantly limits Soviet policy. We have estimated a considerable growth in the Soviet fissionable materials stockpile which should keep pace with the estimated growth in Soviet missile capabilities for long-range attack, and also ease the limitations noted above. (*Paras. 138–161*)

NUCLEAR WEAPON RESEARCH, DEVELOPMENT, FABRICATION AND STOCKPILING

11. *Research and Development.* The Soviet nuclear weapon research and development effort has remained active since 1958, as evidenced by 1960 photography of the weapon research complex at Sarova and the Semipalatinsk proving grounds, and the resumption of an extensive test program in September 1961. Recent analysis of 1959 photography indicates that Kasli is another important

and active Soviet nuclear weapon research and development site. Other sites at which some research and development is being conducted include Nizhnaya Tura and probably Krasnoyarsk.[5] (*Paras. 88–98*)

12. *Fabrication and Stockpiling.* We have identified nuclear weapon fabrication and national stockpile sites in the Urals at Nizhnaya Tura and Yuryuzan. Krasnoyarsk in central Siberia is probably engaged in fabrication operations and may also be a stockpile site. At least three, and probably five, national assembly and stockpile sites, [redacted] storage sites for the Long Range Aviation (LRA) at arctic staging bases, and more than a dozen airfield storage sites have been identified. While we have no firm evidence of operational nuclear weapon storage facilities except at LRA and a few naval airfields, we continue to estimate that such facilities are available to the Soviet tactical and naval aviation, to the naval surface forces, and to the ground forces. (*Paras. 119–135*)

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NUCLEAR REACTOR PROGRAM

13. *Power Reactors.* The Soviets have fallen far short of their nuclear power objectives announced in 1956 and included in the Sixth Five-Year Plan. Soviet officials have stated that they have reduced the nuclear power program since their reactors were not competitive with conventional power sources. We estimate that the Soviets will have about 1000 megawatts of nuclear generating capacity installed by mid-1966. (*Paras. 32 and 33*)

14. *Marine Nuclear Propulsion Systems.* Soviet reactor technology indicates that late 1957 was the earliest date that a nuclear propulsion reactor for a submarine could have been available for installation. Pressurized-water reactors are probably being installed in all nuclear submarines currently under construction and we believe that the Soviets will continue to use this type of system for the next five years. (*Paras. 34–36*)

15. We believe that the first Soviet nuclear submarine was completed at the Severodvinsk shipyard in mid-1958 and probably went into service with the Northern Fleet in 1959. The Komsomol'sk shipyard in the Far East is estimated to have completed its first nuclear submarine in 1960. (*Paras. 37–39*)

16. Recent information on the new class of Northern Fleet submarines (H-class) indicates that some form of unconventional propulsion, probably nuclear, is employed. The size and operating characteristics of these submarines seem to be more limited than those of US nuclear submarines. (*Para. 37*)

17. Based on all available evidence, it is estimated that the Soviets had seven H-class submarines, probably nuclear powered, in service in the Northern Fleet as of mid-July 1961, and that a few additional such submarines may be undergoing trials and training. Current nuclear submarine production is estimated to be at a rate of about six submarines per year. (*Para. 39*)

18. *Reactor Systems for Aircraft.* If the Soviet aircraft nuclear propulsion (ANP)

[5] For the likelihood that the Soviets have conducted tests during the moratorium period, see SNIE 11-9-61. (~~SECRET~~).

program was initiated in 1956, was supported continuously at a high level, and progressed with no major setbacks, the Soviets could produce an aircraft nuclear power plant as early as 1963–1964. Such a program might permit a first militarily useful nuclear powered aircraft to become available in 1966. However, the lack of evidence of the program, the decreasing frequency of Soviet statements on progress, and the apparent general level of their reactor technology indicate that the effort may have encountered serious obstacles. Therefore, we believe it unlikely that the Soviets will obtain a militarily useful nuclear powered aircraft during the period of this estimate. However, at any time during the period of this estimate the Soviets, for propaganda purposes, might fly an aircraft obtaining part of its thrust from nuclear heat. (*Paras. 40–42*)

19. *Reactor Systems for Rockets and Ramjets.* We estimate that the Soviet Union is working to develop a nuclear rocket engine and will have the capability to conduct a nuclear rocket static test firing by 1965. To date there is no specific evidence to indicate that the Soviets have a nuclear ramjet under development, and we estimate that it is unlikely that the Soviets will be able to flight-test a nuclear ramjet engine before 1966. (*Paras. 43–44*)

20. *Nuclear Electrical Propulsion Systems for Space Applications.* The major Soviet effort in this field appears to be directed toward an ion propulsion system. We estimate that the Soviets could flight test a prototype system operating at a power of about 75 kilowatts possibly by 1964, if no major difficulties are encountered in developing the nuclear power source for the engine. (*Paras. 45–48*)

DISCUSSION

I. ORGANIZATION OF THE SOVIET ATOMIC ENERGY PROGRAM

21. The Soviet atomic energy program is directed primarily by two organizations. The Ministry of Medium Machine Building (MSM), headed by E. P. Slavskiy, is responsible for most of the atomic energy program in the USSR, including exploration and exploitation of ore, production of fissionable material, and, with the Ministry of Defense, development and stockpiling of nuclear weapons. The State Committee of the USSR Council of Ministers for the Utilization of Atomic Energy (ATOMKOMITET) is responsible for the application of non-military uses of atomic energy within the USSR as well as the cooperation of the USSR with countries other than European satellites in these matters. The Academy of Sciences, USSR, (AN), is apparently used to advise and conduct supporting research for both the Ministry and the State Committee. Some of the institutes playing a more prominent role in the Soviet nuclear research effort are described in Annex A.

22. Identification of the organizational relationships affecting the research, uranium mining, feed materials production, and fissionable materials production aspects of the Soviet atomic energy program has been based on relatively firm evidence. New information has improved our understanding of the organizational relationships affecting the nu-

clear weapon design, development, testing, and storage aspects of the program.

23. The nuclear weapon proving ground at Semipalatinsk and installations supporting the test area on Novaya Zemlya are probably under the operational control of the military. Test activity itself is probably a joint effort by both the military and the scientific laboratories involved, with the Ministry of Medium Machine Building exercising technical direction.

24. We believe that the Ministry of Medium Machine Building is responsible for the operation of national assembly and stockpile sites and that the weapons immediately required to implement military missions are controlled by the Ministry of Defense, probably by a specialized central element of that Ministry. (*See Paras. 136 and 137*)

25. A reorganization within the area of "peaceful uses" of atomic energy occurred in the Soviet Union on 18 May 1960, when the former Chief Directorate for the Utilization of Atomic Energy (GLAVATOM) attached to the Council of Ministers was reorganized and elevated to the ministerial level as the State Committee for the USSR Council of Ministers for the Utilization of Atomic Energy (ATOMKOMITET) with V. S. Yemel'yanov as its chairman. This State Committee has probably acquired more authority and a higher priority in carrying out its "peaceful uses" efforts. According to one source, the new organization has planned a considerable increase in the use of nuclear and thermonuclear energy and is expected to expand the whole field of nuclear research and technology. This increased emphasis on the practical application of nuclear technology by the atomic energy State Committee parallels the effort by the newly-organized State Committee of the USSR Council of Ministers for the Coordination of Scientific Research, headed by Konstantin Rudnev, which was established to introduce the newest scientific and technical discoveries into the economy. To date, we have seen no evidence that Rudnev's State Committee is connected with the Soviet atomic energy program.

26. Since July 1960, cooperation among the European satellites in the field of peaceful uses of atomic energy has been the responsibility of a Standing Committee for the Peaceful Uses of Atomic Energy created by the Council for Mutual Economic Aid (CEMA). The long range plan of the CEMA atomic energy committee will divide the various tasks among the member nations and will result in a single integrated Satellite atomic energy program. This type of inter-country collaboration will probably delay, if not prevent, the development of an independent nuclear capability by any of the participating countries.

II. THE SOVIET NUCLEAR REACTOR PROGRAM

Introduction

27. The USSR has continued to conduct a diversified and comprehensive reactor program, but the nuclear power program was further reduced during the past year. The USSR has done excellent work in the important fields of heat transfer, the superheating of steam directly in reactors, and the development of fast reactors.

28. The present Soviet reactor capacity is devoted almost exclusively to plutonium production. There is reason to believe that Soviet production reactor technology has been conventional and has shown no outstanding advances. Both graphite-moderated and heavy-water moderated types are in use. In addition, at least two dual-purpose reactors, apparently optimized for plutonium production are in operation at Tomsk.

29. While the Soviets are constructing some large-scale power reactors of different types, they have indicated that they are not committed to a specific power reactor type but instead are exploring the advantages of various types in prototype reactors and reactor experiments in an effort to obtain competitive nuclear power.

30. In the USSR, the greatest advances in power reactor technology appear to have been made in pressurized-water systems. All large power reactors which the Soviets plan to build

Figure 1

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"H" CLASS SUBMARINE (COMPOSITE PHOTOGRAPH)

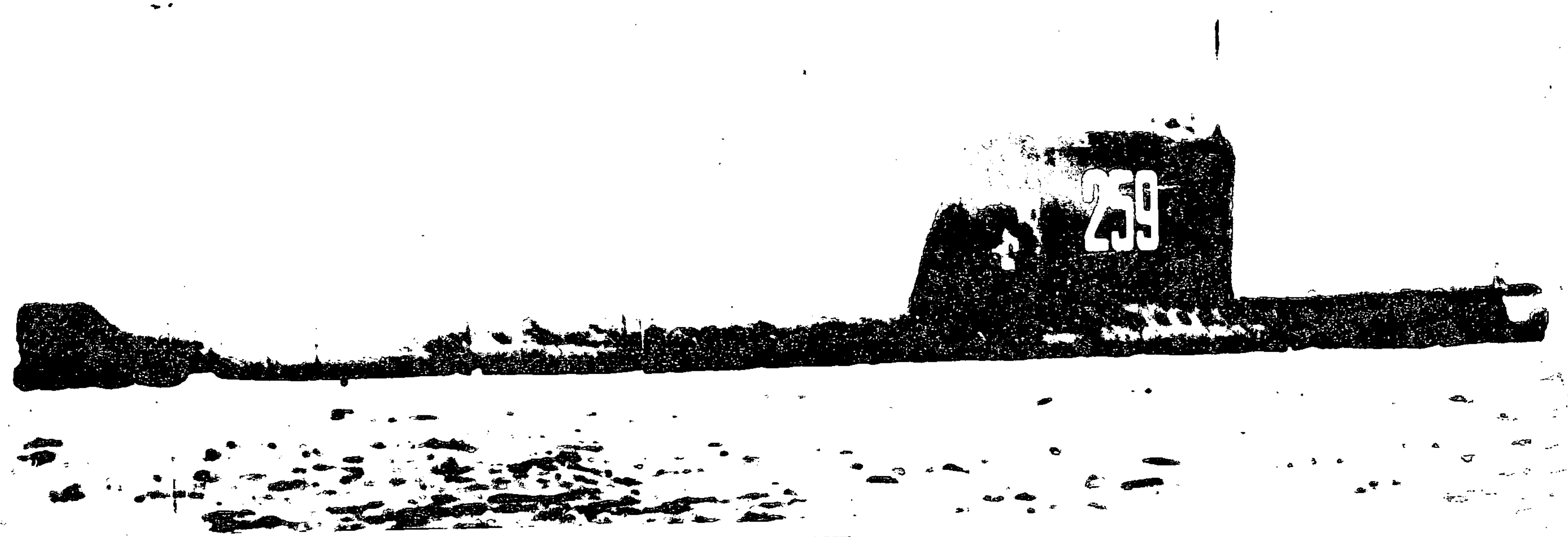

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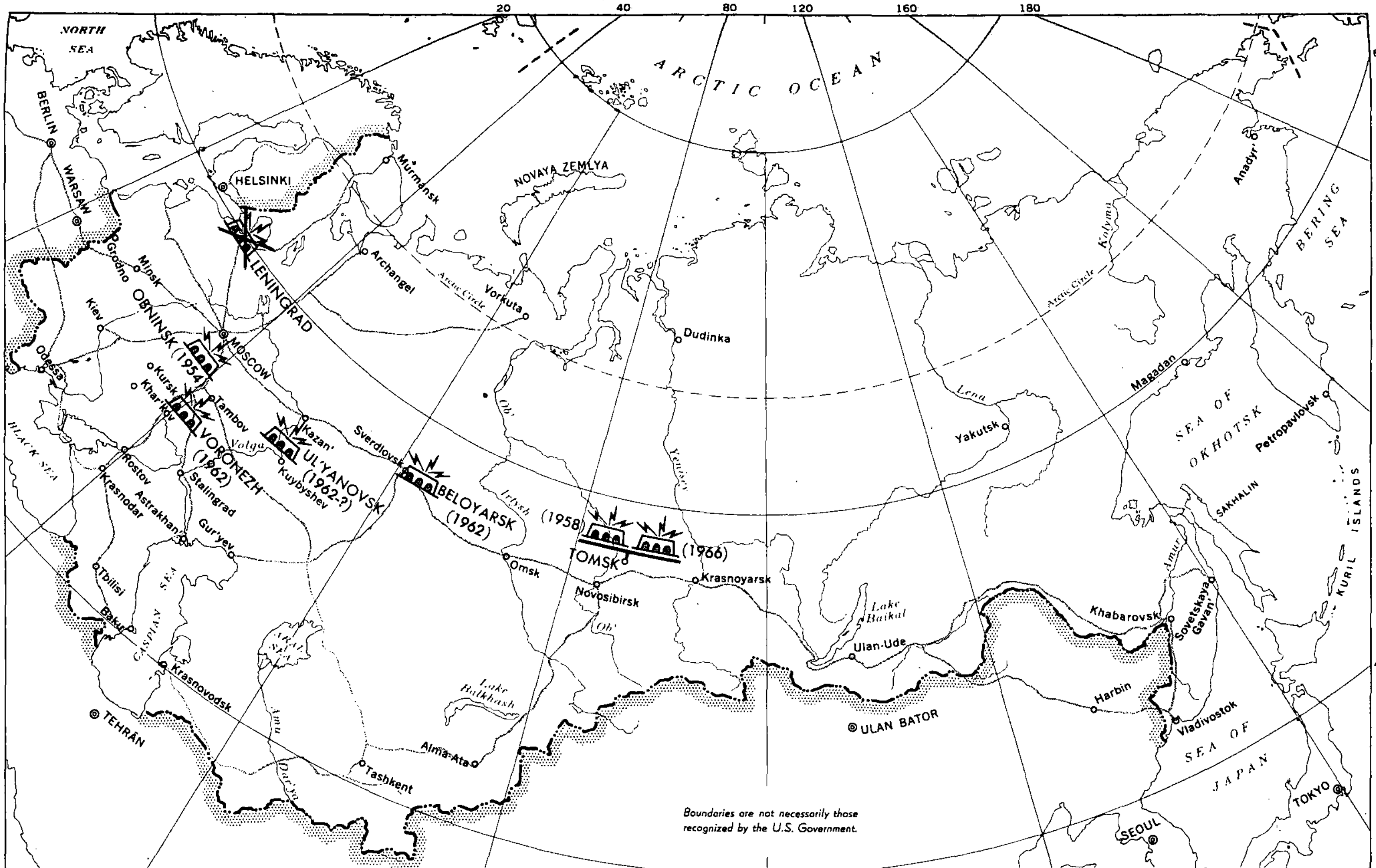
Figure 2



USSR
NUCLEAR-ELECTRIC POWER REACTOR SITES

In Operation (date of full power)

Under Construction (expected date of full power)

Indefinitely Postponed

0 250 500 1000 1500 2000 Statute Miles

0 250 500 1000 1500 2000 Kilometers

Railroad (selected)

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in the USSR in the near future employ normal water as the coolant in either the pressure-vessel or pressure-tube configuration. The Soviets are definitely interested in the bulk type boiling-water reactor, but they appear to be awaiting further development of the technology of the pressurized-water reactor (PWR)[6] and the pressure-tube boiling water reactor with nuclear superheat before extending the development of a bulk boiling-water reactor. Soviet work on organic moderation has been limited to the operation of critical assemblies. The Soviets have done little work on liquid-metal fueled reactors. Their requirements for reactor safety have not been stringent by Western standards; however, there is evidence of growing Soviet concern with reactor safety and control.

Research Reactors

31. There are presently at least 15 research reactors available to the USSR. (Table 1.) This number and variety of reactors give the Soviets an excellent capability to study and develop materials for more advanced reactors. A particularly important new reactor is the impulse fast reactor, IBR (also called the "merry-go-round" reactor) which began to operate late in 1960 at the Joint Institute of Nuclear Research in Dubna. A neutron spectrometer with a flight path of 1 kilometer to be used with this reactor is now under construction and should be completed in 1962. This research facility will permit the Soviets to advance their understanding of neutron physics over a wide energy spectrum and could be valuable in the study of some effects of nuclear weapons on various components and systems.

Power Reactors

32. The USSR has fallen far short of the nuclear power objectives announced in 1956 and included in the Sixth Five-Year Plan. This Plan called for the installation of 2000–2500 electrical megawatts (MWe) of nuclear generating capacity by the end of 1960. The program has continued to slip since 1958, and Soviet officials have stated that they have reduced the nuclear power program for economic reasons since their nuclear reactors are not yet competitive with conventional power sources.

[6] Pressure vessel type reactor with non-boiling water as a coolant.

33. Two large reactor stations are being constructed: a pressurized-water reactor (210 MWe) at Novo-Voronezh, and a pressure-tube, graphite-moderated reactor with nuclear superheat at Beloyarsk (100 MWe). Both are expected to be completed in 1962. The experimental boiling-water, and possibly the fast reactors at Ul'yanovsk might add another 100 electrical megawatts. We estimate, therefore, that including the dual-purpose reactors at Tomsk, the USSR will have about 1000 megawatts of nuclear generating capacity installed by mid-1966. (*See Table 2 and Figure 2*)

Marine Nuclear Propulsion Systems

34. The nuclear powered icebreaker, LENIN, completed its first operational season in the Northern Sea Route in the fall of 1960. Her propulsion system has since had a major overhaul and numerous reports indicate that problems were encountered with leakage of water from the primary loop and with shielding. The Soviets may be encountering many of these problems in their nuclear submarine propulsion system.

35. Soviet reactor technology indicates that late 1957 was the earliest date that a nuclear propulsion reactor for a submarine could have been available for installation. [redacted] (b)(1)

36. Soviet preference for PWR's in marine propulsion systems can be inferred from their use on the LENIN and from statements by Soviet atomic energy and shipbuilding authorities. Pressurized-water reactors are probably being installed in all nuclear submarines currently under construction and we believe that the Soviets will continue to use this type of system for the next five years.

Table 1

USSR RESEARCH REACTORS AND REACTOR EXPERIMENTS

Operating Research Reactors

Reactor Designation	Location	Power Thermal (KW)	Max. Thermal Neutron Flux (neutrons/ cm^2/sec)	Fuel	Moderator	Coolant	Date Critical	Remarks
1. TR (rebuilt)	Moscow, Inst. of Theoretical & Experimental Physics	2,500	2.5×10^{13}	270 kg of enriched U	Heavy Water 4.5 tons	Heavy Water	June 1957	Originally a 500 kw prototype for Soviet heavy-water production reactors. Critical in Apr. 1949. Rebuilt version has 9 vertical and 52 horizontal experimental channels.
2. RPT (rebuilt)	Moscow, Inst. of AE	20,000	1.8×10^{14}	6.1 kg of 90% enriched U	Graphite and Water	Water	1957	Original version at full power in Dec. 1952. Five inpile loops, 3 water-cooled, 1 gas-cooled, 1 liquid-metal cooled. 4 vertical channels. Reconstruction accomplished during normal shutdowns. Now 11 inpile loops, 15 vertical channels.
3. VVR–2 (rebuilt)	Moscow, Inst. of AE	3,000	4×10^{13}	45 kg of 10% enriched U	Water	Water	1955	Original version critical in 1952. Tank-type reactor designed for testing of shielding materials and configuration. Now has 5 horizontal channels with choppers, 3 vertical channels, and a "neutron multiplier" (spent fuel elements in a tank adjacent to reactor).
4. VVR–S	Moscow, Moscow State Univ.	2,000	2.5×10^{13}	60 kg of 10% enriched U	Water	Water	1955	Tank-type; 10 vertical channels, 9 horizontal channels. Supplied to Rumania, Hungary, Czechoslovakia, E. Germany, Poland and Egypt.
5. VVR–S	Tashkent, Inst. of Nuclear Physics	2,000	2.5×10^{13}	60 kg of 10% enriched U	Water	Water	Late 1959	Tank-type; 10 vertical channels, 9 horizontal channels.

Table 1 (Continued)

Table 1 (*Continued*)

Reactor Designation	Location	Power Thermal (KW)	Max. Thermal Neutron Flux (neutrons/ cm^2/sec)	Fuel	Moderator	Coolant	Date Critical	Remarks
6. IRT	Moscow, Inst. of AE	2,000	3.2 x 10^{13}	40 kg of 10% enriched U	Water	Water	Nov. 1957	Swimming-pool type for use in universities and institutes. An additional reactor at Riga will probably become critical in late 1961. A 1000-Kw version, IRT–1000, will be built at Minsk (probably critical in 1961), Tomsk and Sverdlovsk.
7. IRT	Tbilisi	2,000	3.2 x 10^{13}	40 kg of 10% enriched U	Water	Water	Nov. 1959	Swimming-pool type for use in universities and institutes. An additional reactor at Riga will probably become critical in late 1961. A 1000-Kw version, IRT–1000, will be built at Minsk (probably critical in 1961), Tomsk and Sverdlovsk.
8. VVR–M	Leningrad Physical-Technical Institute	10,000	1 x 10^{14}	20 kg of 20% enriched U	Water	Water	Dec. 1959	Beryllium reflected, used for isotope production, prod. of trans-U elements also neutron diffraction studies, probably in connection with solid-state work in Leningrad.
9. VVR–M	Kiev Physical Technical Institute	10,000	1 x 10^{14}	20 kg of 20% enriched U	Water	Water	Feb. 1960	Beryllium reflected, used for isotope production, prod. of trans-U elements also neutron diffraction studies, probably in connection with solid-state work in Leningrad.
10. Intermediate Flux Trap	Maldek, Ulyanovsk, Oblast	50,000	2.2 x 10^{15}	11.7 kg of 90% enriched U	Water	Water	Probably 1960	Be or BeO reflected, central water cavity where max. thermal neutron flux is obtained.
11. IBR (Merry-go-round	Dubna Joint Inst. of Nuclear Research	1 Ave. 100,000 Max.	10^{17} during burst	Graphite impregnated with UO^2	Graphite	None	Summer 1960	To be used with a 1 km time-of-flight neutron spectrometer in 1962.
12. Isotope Reactor (IR)	Unknown – possibly Kyshtym	50,000	3–4.5 x 10^{13}	3 tons of 2% enriched U metal	Graphite	Water	1952	Experimental facility for production of isotopes.

Table 1 (*Continued*)

Reactor Designation	Location	Power Thermal (KW)	Max. Thermal Neutron Flux (neutrons/ cm^2/sec)	Fuel	Moderator	Coolant	Date Critical	Remarks
13. BR–5 Fast Reactor	Obninsk	5,000	10^{15} (fast)	50 kg Pu Oxide	None	Sodium	June 1958 (Full power—July 1959)	Uranium and nickel reflector.
14. VVR-Ts	Unknown	10,000	1 x 10^{14}	25 kg of 20% enriched U	Water	Water	Unknown	Specialized radio-chemical research reactor.
				Low Power Reactor Experiments *Now in Operation*				
1. Beryllium Physical Reactor (BFR)	Obninsk	0.05	....	U_3O_8 with 20% enriched U metal	Beryllium metal	None	August 1954	Zero-power critical assembly, bare and reflected.
2. BR–4 Fast Reactor.	Obninsk	Low	....	Pu	None	None	Fall 1959	BR–3 with modified reflector of UO_2.
				No Longer in Operation				
1. Fursov Pile	Moscow, Inst. of AE	10 (Max.)	....	45 tons of Natural U	Graphite	Air	1947	Possibly now dismantled. Similar to US CP–1, served as prototype for 1st Soviet production reactor.
2. BR–1 Fast Reactor	Obninsk	0.05	....	Pu	None	None	Early 1955	Uranium and copper reflectors. Used to make BR–3.
3. BR–2 Fast Reactor	Obninsk	100	10^{14} (fast)	Pu-U	None	Mercury	Early 1956	Uranium reflector. (Dismantled to make BR–5).
4. BR–3 Combined Fast Thermal Reactor	Obninsk	0.05	....	Pu	None	None	Mid-1957	Uranium and water reflector. (BR–1 w/modif. refl.). Used to make BR–4.
5. UF_6 Gas-Fueled Reactor	Moscow Inst. of AE	1.5	2.7 x 10^{10}	UF_6 with 90% enriched U	Beryllium metal	None	August 1957	Probably dismantled.

Table 2

SOVIET NUCLEAR POWER STATIONS AND EXPERIMENTAL CENTERS

Station Location	No. of Reactors and Type	Elec. Power Per Reactor (MW)	Thermal Power Per Reactor (MW)	Fuel Loading Per Reactor	Conversion Ratio	Annual Consumption ETP U–235 Per Reactor (KG)	Annual Production Pu Per Reactor (KG)	Fuel Lifetime	Estimated date of Full Power Operation	Remarks
Tomsk	6 Dual-purpose (planned).	100	500 (claimed) 1200 (estimated) (peak power)	200 metric tons of Natural U metal.	0.7	....	300	....	Sept 1958 1st Reactor	Plant factor of 0.75. The second reactor believed to be operational in 1960. Specific dates for the remaining reactors are unknown; estimate all in by end of 1966.
Beloyarsk	1 Graphite-Moderated, Water-cooled, Pressure Tube Configuration.	100	286	90 metric tons of 1.3% U metal	0.65 at beginning of cycle, 0.55 at end.	74	66	2 yrs.	1962	Employs nuclear superheat. Est. schedule: 1st reactor, 1962. 4 originally planned.
Novo-Voronezh	1 Water-Moderated, Water-Cooled Pressure Vessel Configuration	210	760	23 metric tons of 1.5% UO_2 and 17 metric tons of natural UO_2 (820 kg U–235 metal equivalent)	....	108	117	1.5 yrs.	1962	Zr-Nb alloy clad fuel elements. 2 originally planned.

Table 2 (*Continued*)

Station Location	No. of Reactors and Type	Elec. Power Per Reactor (MW)	Thermal Power Per Reactor (MW)	Fuel Loading Per Reactor	Conversion Ratio	Annual Consumption ETP U–235 Per Reactor (KG)	Annual Production Pu Per Reactor (KG)	Fuel Lifetime	Estimated date of Full Power Operation	Remarks
Leningrad	Same as Novo-Voronezh			Indefinitely Postponed						
Obninsk	1 Graphite-Moderated, Water-Cooled, Pressure Tube Configuration	5	30	550 kg of 5% U metal	0.3	....	3	100 days	1954	First Soviet nuclear power station. Prototype of Beloyarsk reactors. Used extensively for experiment as well as power production.
Obninsk	1 Package Power Water-Moderated, Water-Cooled, Pressure Vessel.	2	10	....	[redacted]	[redacted]	[redacted]	[redacted]	1960	Assembled for testing at Obninsk and probably moved to another location after testing.
Ul'yanovsk	1 Boiling Water Reactor.	50	240	....	[redacted]	[redacted]	[redacted]	[redacted]	1962	Same Type fuel element as large PWR's.
Ul'yanovsk	1 Fast Plutonium Breeder (BN–50)	50	200	PuO_2 or Pu-U-Mo alloy	1.6–1.8 breeding ratio claimed	....	36	....	1965 (may have been postponed indefinitely)	Designation BN–50, sodium-cooled with intermediate NaK loop; may use neutral diluents in fuel element.
Ul'yanovsk	1 Fast Plutonium Breeder (BN–50)	250	1,000	....	1.8–2.0 breeding ratio claimed	....	720–800	....	After 1965	Now in early planning stage. May never be built.
Ul'yanovsk	1 Graphite-Moderated, Sodium Cooled	50	180	....	[redacted]	[redacted]	[redacted]	[redacted]	Indefinitely postponed	Intermediate NaK Loop.
Ul'yanovsk	Homogeneous Thorium Breeder	5	35	....	[redacted]	[redacted]	[redacted]	[redacted]	After 1966	Suspension or solution of U in heavy water, boiling. Believed to have been cancelled.
Probably Ul'yanovsk	1 Graphite-Moderated, CO_2-cooled	35–50 (assumed)	170 (assumed)	....	0.8	....	50	....	Unknown	Gas cooled.

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(b)(1)

37. We believe that the first Soviet nuclear submarine was completed at the Severodvinsk shipyard in mid-1958 and probably went into service with the Northern Fleet in 1959. Recent information on the new class of Northern Fleet submarines (H-class) indicates that some form of unconventional propulsion, probably nuclear, is employed. The observed operating characteristics of these submarines seem to be more limited than those of US nuclear submarines.

38. In the Far East the Komsomol'sk shipyard is estimated to have completed its first nuclear submarine in 1960. This submarine is probably being outfitted and undergoing trials at Vladivostok. It is estimated that the Komsomol'sk yard can produce 2–3 nuclear submarines per year.

39. Based on all available evidence, it is estimated that the Soviets had seven H-class submarines, probably nuclear powered, in service in the Northern Fleet as of mid-July 1961, and that a few additional such submarines may be undergoing trials and training. Current nuclear submarine production is estimated to be at a rate of about six submarines per year.

Nuclear Propulsion Systems for Aircraft, Missiles, and Space Vehicles

40. *Aircraft.* It is estimated that a Soviet aircraft nuclear propulsion (ANP) effort may have begun as early as 1956 and that as of 1959 the Soviets were engaged in an effort to develop some type of ANP system. However, no evidence has been received which permits determination of the exact type of system under development or the status of the effort. Furthermore, since January 1959, the Soviets have given no optimistic expressions concerning the progress of their program.

41. The Soviet scientific literature reflects an extensive, but basic, research effort to develop materials suitable for high temperature reactors, including fuels, cladding, and coolants. Other Soviet work applicable to ANP developments has been noted on a more limited scale in the fields of heat transfer, shielding, instrumentation, and reactor control. The development of fissionable fuels suitable for use at high temperatures is apparently progressing at a faster rate than cladding and reactor structural materials. There is no specific evidence that Soviet efforts to produce high temperature nuclear materials have progressed from the laboratory stage to the industrial capacity for producing mill forms in quantities required for an ANP program.

42. If the Soviet ANP program was initiated in 1956, was supported continuously at a high level, and progressed with no major setbacks, the Soviets could produce an aircraft nuclear power plant as early as 1963–64. This might permit a first militarily useful nuclear powered aircraft to become available in 1966. However, the lack of evidence of the program, the decreasing frequency of Soviet statements on progress, and the apparent general level of their reactor technology, indicate that the effort may have encountered serious obstacles. Therefore, we believe it unlikely that the Soviets will obtain a militarily useful nuclear powered aircraft during the period of this estimate. However, at any time during the period of this estimate the Soviets, for propaganda purposes, might fly an aircraft obtaining part of its thrust from nuclear heat.

43. *Ramjets.* To date there is no specific evidence to indicate that the Soviets have a nuclear ramjet missile under development. Analysis of the Soviet literature indicates an excellent conventional ramjet research program, but references to nuclear ramjets can be attributed to feasibility studies. Based on this lack of evidence, and the technical complexity of such a missile, we estimate that it is unlikely that the Soviets will be able to flight-test a nuclear ramjet engine before 1966.

44. *Rockets.* Based on Soviet statements and their published research in the field, we estimate that the Soviet Union is at this time working to develop a nuclear rocket engine. Their research in high-temperature refractory compounds, high-pressure containment ves-

sels for reactor cores and their success in developing a uranium-graphite fuel element for the "merry-go-round" pulsed reactor add to their development capability in this field. In view of the above, and of the availability of unclassified Western technical information, we believe that the USSR will have the capability to conduct a nuclear rocket static test firing by 1965.

Nuclear Electrical Propulsion Systems for Space Applications

45. Electric propulsion using nuclear energy sources offers the possibility for producing a low-thrust, high specific impulse system suitable for outer space and inter-orbital applications; such systems would be useless for take-off.

46. Although the Soviets have shown interest in all forms of electric propulsion,[7] their major effort appears to be directed toward an ion propulsion system. Soviet fast reactor scientists at Obninsk were conducting cesium-ion thrust-chamber experiments as early as 1958. Such experiments have application to ion-propulsion systems.

47. It has been reported that Soviet scientists at the State University imeni Shevchenko in Kiev are developing in-flight instrumentation for an ion propulsion system to operate in a power range of 75–500 kw, and that this instrumentation contract ends in early 1962. This may indicate that an ion engine with its associated power source is expected to be available by that time.

48. It is estimated that the Soviets could flight test a prototype ion-propulsion system operating at a power of about 75 kilowatts, possibly by 1964, if no major difficulties are encountered in developing the nuclear power source for the engine. A system operating at this power level could change the original orbital inclination and spiral a satellite out to an orbit such that the satellite would remain fixed in position over a given location on the earth's surface.

[7] This includes, ionic, plasma, arc-jet and magneto-hydrodynamic propulsion systems.

Nuclear Auxiliary (non-propulsion) Power Supplies

49. We have no evidence that the Soviets have utilized nuclear heat sources for auxiliary power supplies in their space program, although their outstanding work in the development of thermoelectric materials has been well substantiated. Based on their capabilities in reactor technology, the utilization of radio-isotopes, and thermoelectric materials development, we estimate that the Soviets can develop nuclear heat sources producing in the order of several 100's of watts and suitable for use as auxiliary power supplies in missiles and space vehicles as early as 1962.

III. THE SOVIET NUCLEAR MATERIALS PRODUCTION PROGRAM

Soviet Uranium Ore Procurement

50. We estimate that by the end of 1960 the Soviet Union had procured a cumulative total of about 130,000 metric tons of recoverable uranium (Table 3, page 16). As in previous years, these amounts are considerably in excess of the recoverable equivalent uranium metal required to support our current estimate of fissionable materials production. Nevertheless, the available evidence continues to indicate that the Soviets are expanding both their domestic and satellite procurement of uranium ore.

51. The most significant trend in the satellites is the continuing shift in East German mining operations from the largely depleted vein-type Saxony ores to the sedimentary-type Thuringia ores. A new concentration plant is being built at Seelingstadt which will use modern ion-exchange recovery methods to process up to 12,000 tons of ore daily. East German uranium production is therefore expected to increase gradually in the next five years. Reports that a new concentration plant being built near Porubka in eastern Czechoslovakia indicate an increase in Czechoslovakian uranium production is planned. While Poland discontinued shipment of ore

to the USSR after 1958, Bulgaria, Hungary and Rumania are estimated to have supplied the USSR with several thousand tons of recoverable equivalent uranium metal in 1960 and are expected to continue to do so at a slightly expanding rate during the next five years.

52. An increasing amount of evidence on the Chinese Peoples Republic uranium procurement program suggests that a fair-sized uranium raw materials base has been established. However, we believe that uranium mined in China is meant to supply the Chinese nuclear energy program and will not be shipped to the USSR.[8]

53. In the USSR, the Krivoy Rog district in the Ukraine is estimated to be the leading uranium producer. The Fergana Valley in Central Asia is believed to be the second largest producing area followed by the Frunze-Lake Issyk-Kul' district and the Pyatigorsk district in the northern Caucasus. The 1959 visit to the Krivoy Rog area by the McCone party [redacted] have supplied information indicating that yearly uranium production is on the order of 3,000 metric tons of equivalent uranium metal. Excellent 1956 and 1958 ground photography and 1957 aerial photography of the Pyatigorsk plant in the northern Caucasus leads to a fairly firm estimate of production from this area. (Figure 3.) Information received on other uranium mining sites has been more limited, but it demonstrates that the Soviets have been able to extract uranium from a variety of deposits including veins, sandstones, oil-shales, limestones and sub-bituminous coals. The last type of deposit contributes a significant percentage of uranium to their program (15 to 20 percent), and its use demonstrates an ability to develop a type of deposit largely ignored in the western world. The Soviets have matched many mining and ore concentration methods used in the US; and their recovery of uranium from coals, as well as from Krivoy Rog iron ore slags, indicates native developments requiring considerable engineering capability.

[8] See NIE 13-2-60, *The Chinese Communist Atomic Energy Program,* 13 Dec. 1960.

54. The Soviet Bloc is estimated to have reserves of at least 300,000 tons of recoverable equivalent uranium metal present in deposits similar in nature to those now mined. Of the known deposits being worked only the Thuringia deposits in East Germany and the Krivoy Rog deposits have apparent large reserves matching many uranium mining districts of the western world. Nevertheless, Soviet exploitation of numerous small-reserve deposits has supplied, and can continue to supply sufficient uranium to meet all of the requirements of the Soviet nuclear energy program. Present mining and ore concentration costs are high, but this situation can be altered quickly by the discovery of one or more large-reserve deposits similar to the Ambrosia Lake deposit in New Mexico or the Blind River deposit in Canada—deposits in which the Soviets have recently expressed considerable interest. There is a strong likelihood of such a development in view of the geological diversity of the USSR.

(b)(1)

55. We estimate that uranium production in the Soviet Bloc will expand at the rate of 400 metric tons of recoverable equivalent uranium metal a year. At this rate, approximately 250,000 metric tons of equivalent uranium metal will have been available to the USSR through 1966. (Table 3.) This figure is subject to large margins of error, however, since actual production will depend upon Soviet policies and plans.

Uranium Metal

56. Uranium metal and other feed materials are produced on a large scale at three known locations in the Soviet Union: Elektrostal, near Moscow; Glazov, just west of the Urals; and Novosibirsk in central Siberia. Production at Elektrostal reportedly increased from

(b)(1)

Table 3

ESTIMATED SOVIET BLOC RECOVERABLE EQUIVALENT URANIUM METAL PRODUCTION THROUGH 1966

(Metric Tons, Rounded)

End of Year	USSR	E. Germ.	Czech.	Bulgaria	Poland	Rumania	Hungary	China	Total Annual	Total Cumulative
Pre 1946 Stocks	20	200	70	Nominal	..	..	..	..	300	300
1946	130	60	30	Nominal	..	..	..	..	200	500
1947	200	300	50	20	Nominal	..	..	..	600	1,100
1948	630	500	150	30	20	..	..	..	1,300	2,400
1949	1,100	1,000	250	60	40	..	..	..	2,400	4,800
1950	1,300	1,300	400	100	40	..	..	..	3,200	8,000
1951	2,500	1,700	500	150	40	..	..	Nominal	4,900	13,000
1952	2,700	2,400	600	200	40	50	..	*(40)	6,000	19,000
1953	4,300	3,300	800	300	40	150	..	(40)	8,900	28,000
1954	4,600	3,800	1,000	400	40	300	..	(60)	10,000	38,000
1955	5,600	4,300	1,200	600	40	500	..	(60)	12,000	50,000
1956	6,300	4,600	1,400	800	40	600	Nominal	(80)	14,000	64,000
1957	7,100	5,000	1,600	900	40	700	100	(100)	15,000	79,000
1958	7,700	5,000	1,600	1,000	40	700	200	(200)	16,000	95,000
1959	7,800	5,000	1,700	1,000	*(40)	800	300	(400)	17,000	110,000
1960	8,100	5,000	1,700	1,000	(40)	800	400	(500)	17,000	130,000
1961	8,500	5,200	1,800	1,200	(40)	800	500	(700)	18,000	150,000
1962	8,900	5,400	1,800	1,200	(40)	1,000	600	(1,000)	19,000	170,000
1963	9,300	5,600	2,000	1,200	(40)	1,000	700	(1,200)	20,000	190,000
1964	9,700	5,800	2,000	1,400	(40)	1,200	800	(1,200)	21,000	210,000
1965	10,000	6,000	2,000	1,400	(40)	1,200	900	(1,200)	22,000	230,000
1966	11,000	6,200	2,000	1,400	(40)	1,200	1,000	(1,200)	22,000	250,000

* Not included in total annual or total cumulative production since China and Poland (after 1958) have retained their domestic production.

360 tons per year as uranium metal slugs in late 1949 to about 1500 tons per year as metal or slugs and 1500 tons per year as uranium tetrafluoride in late 1957. Production values for Glazov are unknown after late 1949 when a rate of 240 tons per year (as slugs) had been attained. Ground and aerial photography shows that the Novosibirsk plant is physically a little larger than the Fernald plant in the US. The estimated Novosibirsk production rates of 9–10,000 tons of slugs per year after 1952 have been derived from Elektrostal site and process data, making a reasonable allowance for the economy of space resulting from the use of larger buildings and equipment. Thus there appears to be sufficient feed material plant capacity in the USSR to process all the uranium ore concentrate indicated by the uranium ore estimate. (See Figure 4.)

U–235 Production

57. Two gaseous diffusion uranium isotope separation plants have definitely been identified in the USSR. Photographs of the plant at Verkh-Neyvinsk in the Urals, and of the one located north of Tomsk in central Siberia, were obtained in 1959 and 1957 respectively. A probable third gaseous diffusion plant is located near Angarsk in the Lake Baykal region (See Figure 4). [redacted] (b)(1)

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[redacted]

[redacted]

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[redacted]

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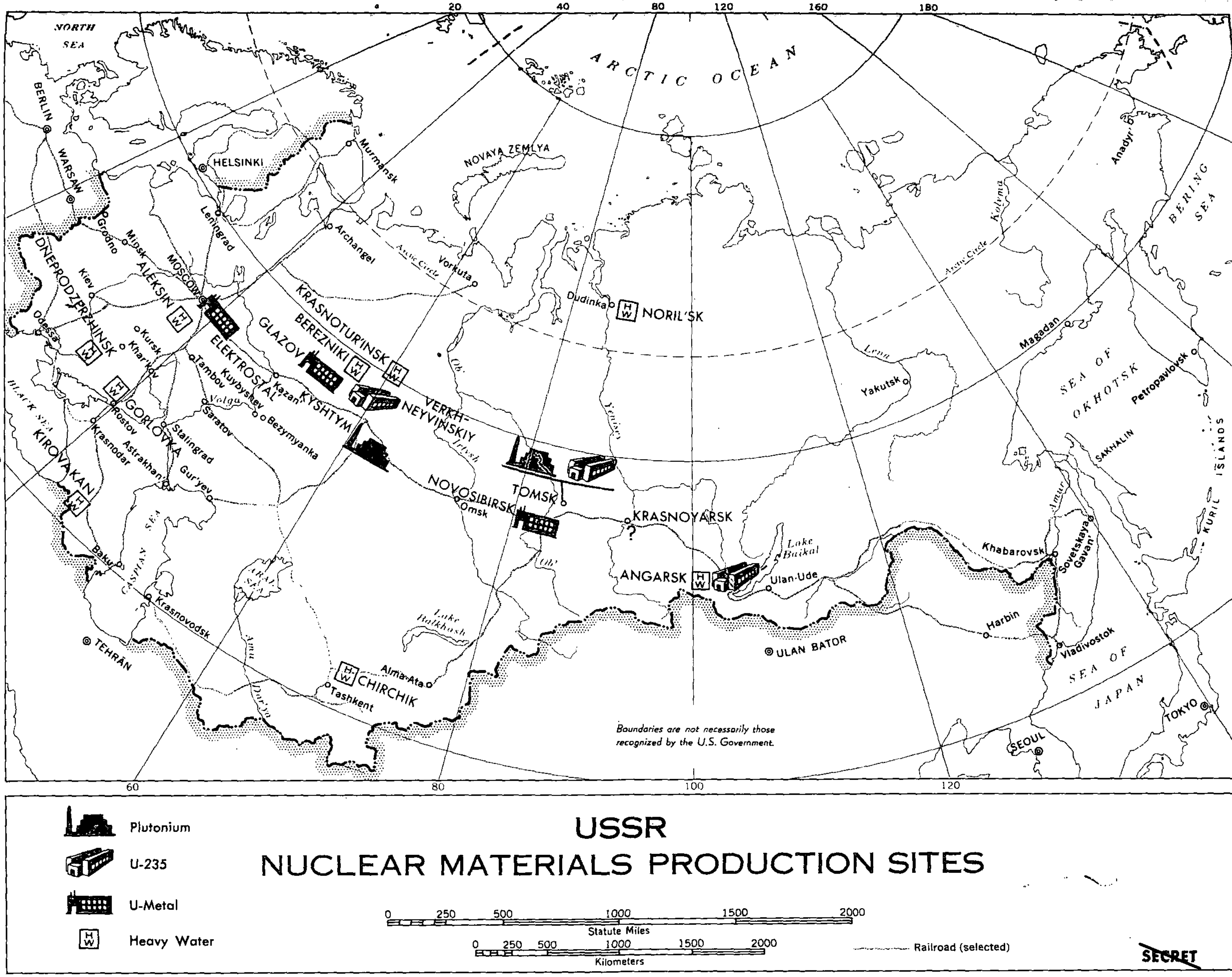
Figure 4



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[redacted] Significant cumulative Soviet U–235 production by ultracentrifuge or other methods is unlikely.

58. The photography of Verkh-Neyvinsk in June 1959 and Tomsk in August 1957 (See Figures 5 and 6) has added much to our knowledge of Soviet U–235 production. [redacted] (b)(1) Construction activity observed in the photography has furnished a good basis for estimating future additions to the production capacity of the U–235 plants for periods up to about three years after the dates of photography. An active expansion program was underway at Tomsk in 1957, with two new cascade buildings and about 500 megawatts of new electric power capacity under construction. No new buildings were under construction at Verkh-Neyvinsk in 1959, but a considerable power augmentation was underway and the oldest plant was apparently being overhauled. It is likely that the power increase is associated with the installation of a new and more efficient type of gaseous diffusion barrier in the Verkh-Neyvinsk buildings.

[redacted]

[redacted]

60. During the past year a considerable amount of information about the probable Angarsk gaseous diffusion plant has become available. [redacted] (b)(1) buildings there similar to those at Verkh-Neyvinsk and [redacted] (b)(1) one of the buildings was in operation in the summer of 1958. [redacted] (b)(1) This power plant has been expanding at a very rapid rate and will probably reach a capacity of 1,000 megawatts by the end of this year. Expansion of the gaseous diffusion plant at Angarsk will probably continue after 1961 using power supplied by the huge Bratsk hydroelectric station. This station, constructed with help from the Ministry of Medium Machine Building, is now being connected to the Angarsk site by a 500 kilovolt transmission line. The 500 Kv line and the first Bratsk generators are scheduled to go into service in late 1961 or early 1962.

61. Our estimate of Soviet U–235 production is presented in Table 4, in terms of cumulative production of uranium enriched to 93% U–235 (b)(1)

content.[9] It includes the 93% equivalent of materials produced at lesser enrichments.

(b)(1)

Future U–235 Production

[redacted]

Margins of Error

(b)(1)

[redacted]

[9] The Assistant Chief of Naval Operations (Intelligence), Department of the Navy, does not concur in the U–235 production estimate. He considers it to be based upon assumptions which are not supported by the available evidence.

An analysis of the basic technology known to have been used by the Soviets and supported by evidence as late as 1959 shows that the correct values should be materially below those given by the minimum estimate. The technology he believes to be employed is in precise agreement with the available information [redacted] The completed cost requirements are in good accord with statements in the Soviet Encyclopedia of Atomic Energy, with statements by Aleksandrov on the cost of fuel elements for power reactors and with the sale price asked by Soviets for reactors. The calculations also account for the very limited use of U–235 before late 1955.

(b)(1)

The Assistant Chief of Naval Operations (Intelligence), Department of the Navy, can find insufficient information to justify the existence of a gaseous diffusion plant near Angarsk. He does believe that heavy water is being concentrated in this area.

(b)(1)

[redacted]

Plutonium-Equivalent Production[10]

64. Two major plutonium-equivalent production sites have been identified in the USSR. The earliest and largest is located near Kyshtym in the Urals and the second is co-located with the U–235 production complex at the atomic energy site north of Tomsk in central Siberia. The large atomic energy site near Krasnoyarsk, and perhaps that at Angarsk, could also include some plutonium-equivalent production facilities, but available evidence does not confirm the existence of such facilities at these sites. It is believed unlikely that other known atomic energy sites include large plutonium production facilities, and it is very unlikely that any sites large enough to have significant plutonium production capacity would have remained wholly unassociated by intelligence with the Soviet atomic energy program. (See Figure 4.)

65. Aerial photography of Tomsk plutonium production facilities was obtained in August 1957. (See Figure 7.) A large production-reactor building has been operating there since 1955, and two dual-purpose reactor buildings and a very large chemical separation plant were under construction in 1957. All three Tomsk reactor buildings are believed to be in operation by this time and others may be under construction there. The first of the dual-purpose reactor buildings is the "Siberian Nuclear Power Station" reactor announced by the Soviets at the 1958 Geneva

(b)(1)

[redacted] the total reactor-products production is expressed in terms of equivalent amounts of plutonium and is termed plutonium equivalent. For planning purposes 10 grams of tritium is considered equal to one kilogram of plutonium.

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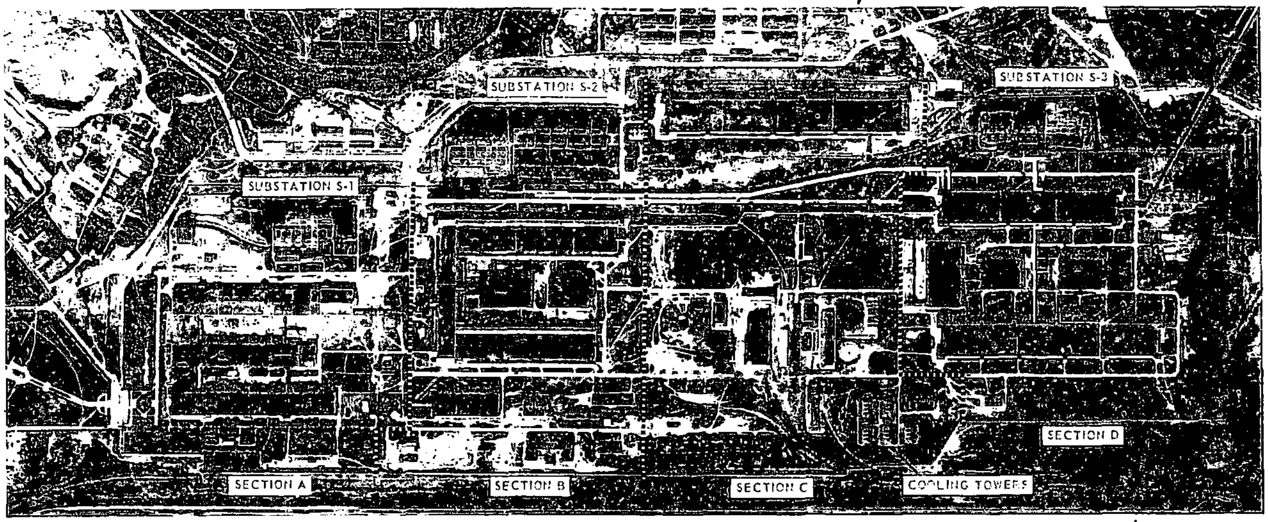
Figure 5

VERKH-NEYVINSK GASEOUS DIFFUSION PLANT, SECTIONS A-D



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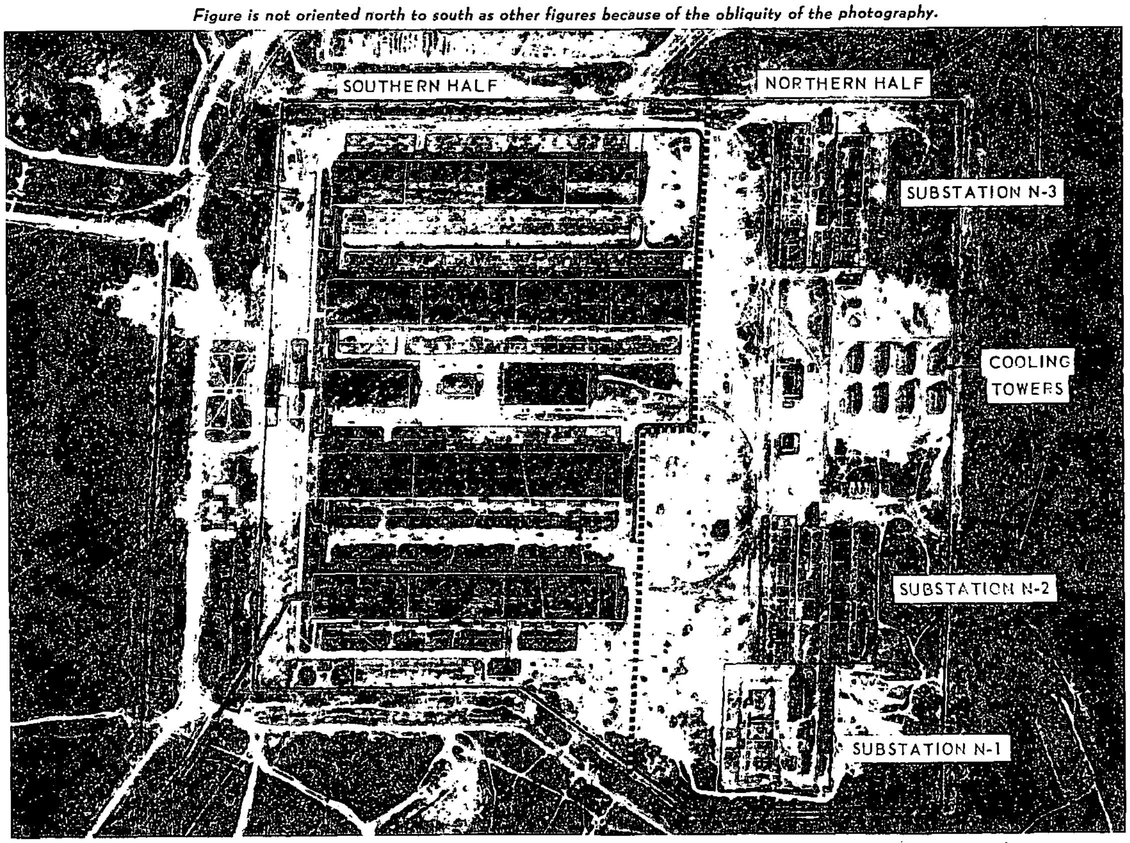
VERKH-NEYVINSK GASEOUS DIFFUSION PLANT, SECTION E

Figure is not oriented north to south as other figures because of the obliquity of the photography.



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TOMSK GASEOUS DIFFUSION PLANT

Figure 6

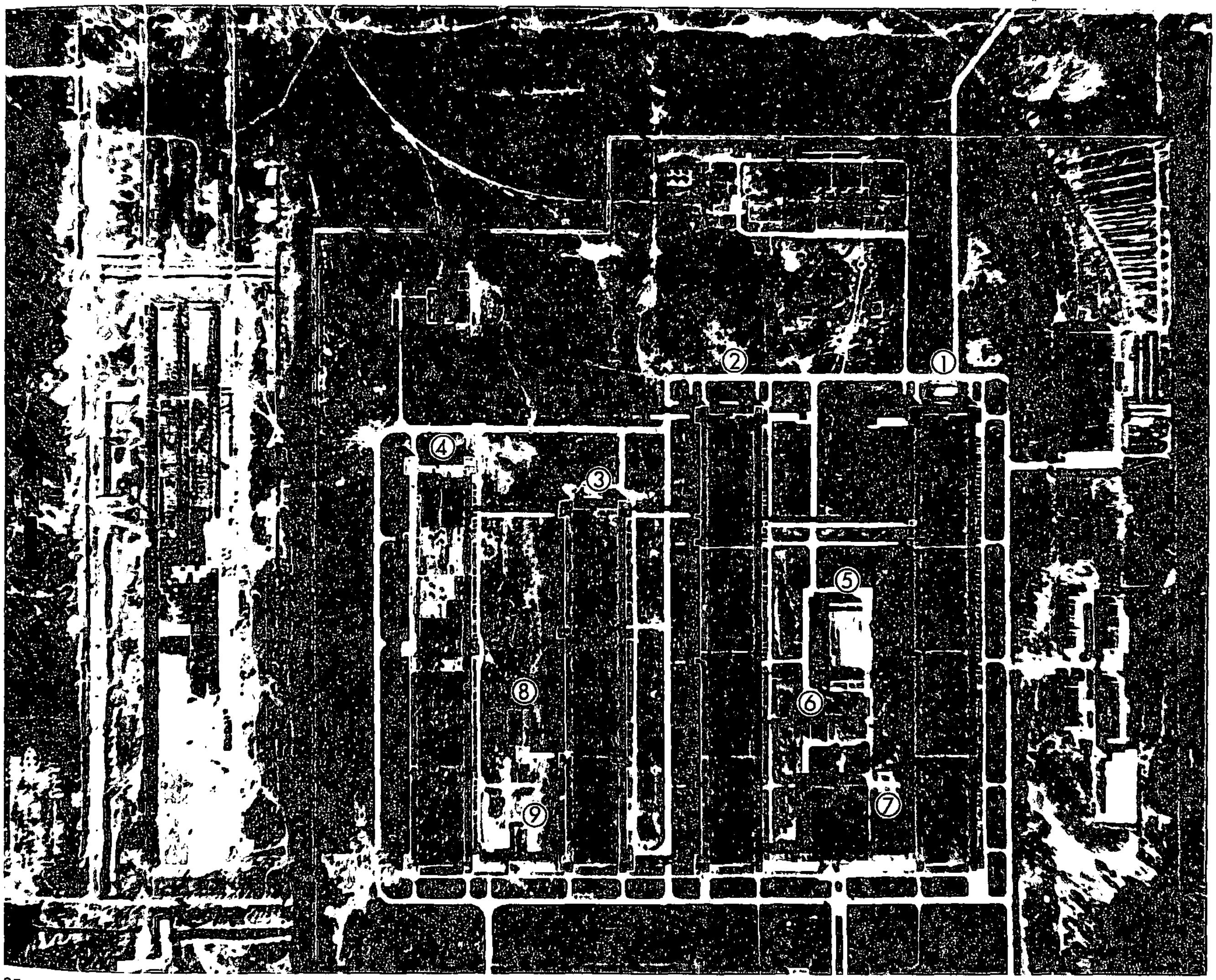

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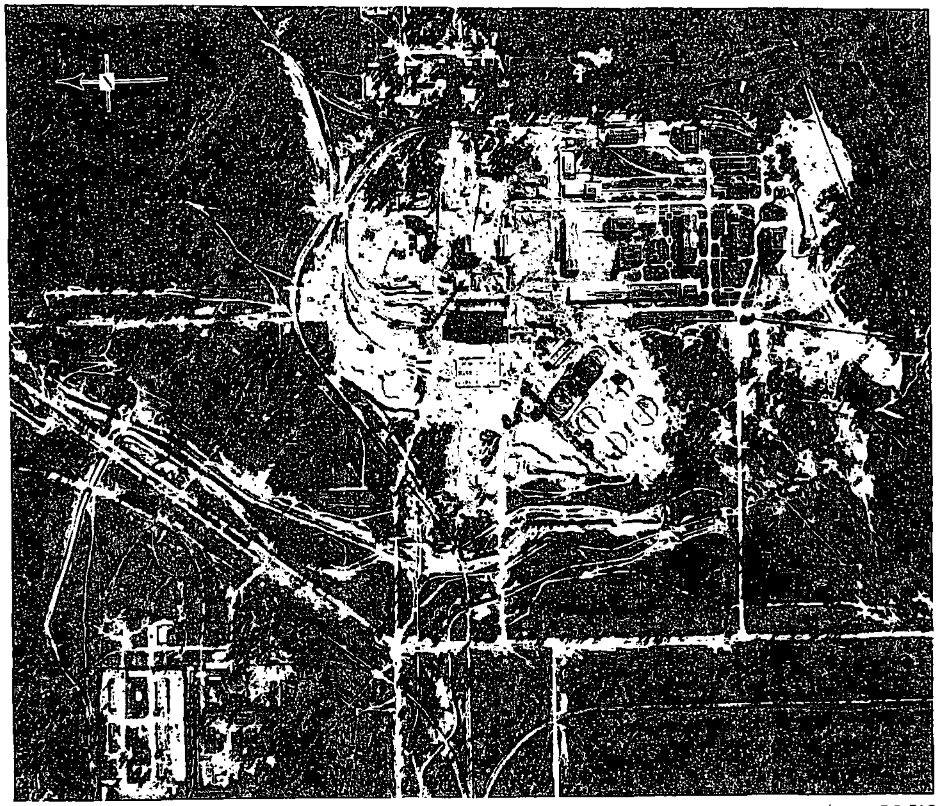
Figure 7

TOMSK REACTOR AREA



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[redacted] (b)(3)

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Conference on Peaceful Uses of Atomic Energy. At this time they also announced plans to build six such dual-purpose reactors at this station.

66. Less is known about the earlier plutonium production site near Kyshtym. Construction started at that site shortly after World War II, and a small production reactor went into operation in 1948. Others have been added since, but their number, type, and sizes are not known. [redacted] The Kyshtym site may also include one or more dual-purpose reactors in addition to those built only for plutonium-equivalent production.

67. The large atomic energy site near Krasnoyarsk is especially secret and secure and much of the early construction there was underground. While the complex functions of the site remain largely unidentified, we believe that weapon development and fabrication is a major purpose of the enterprise. [redacted] Available evidence is insufficient to identify the existence of plutonium-equivalent production at the Krasnoyarsk site.

68. Soviet plutonium-equivalent production can be estimated on the basis of Tomsk and Kyshtym information, assuming that these sites include all Soviet production capacity. Because of uncertainties in these data, particularly at Kyshtym, site-based estimates are subject to wide margins of errors. [redacted]

[redacted]

[redacted]

72. The USSR normally maintains large state reserves of a wide variety of strategic materials. Such reserves are considered a high-priority necessity in the Communist philosophy. A large warehouse area noted in the 1957 photography of the Novosibirsk uranium metal plant and another reportedly adjacent to the Glazov uranium metal plant suggest that these reserves include uranium. However, we lack specific information indicating the magnitude of uranium reserves, if any, or of the magnitude of reserves of comparable strategic materials.

73. A very large reserve and pipeline would be required to account for the discrepancy between our estimates of uranium procurement and use. Even if early uneconomical production practices had been continued, about ⅓ of the total estimated uranium procured would be needed to produce the amounts of U-235 [redacted] we estimate, and the present delay between uranium procurement and use would amount to more than four years. There is evidence that more economical production practices, i.e., feeding reactor tails and utilization of higher MWD/T, were at least partially employed in the 1957 and 1958 periods. These practices, if generally adopted, would indicate a still larger discrepancy between our estimates of uranium procurement and use.

(b)(1)

74. The maintenance of a large uranium reserve must be assumed for any estimate of cumulative Soviet plutonium equivalent to date which lies within the limits imposed by site information even assuming that some production capacity has remained undetected.

(b)(1) [redacted]

[redacted]

(b)(1)

[redacted]

Table 4

ESTIMATED SOVIET FISSIONABLE MATERIALS PRODUCTION [a]

(Cumulative Production in Kilograms, Rounded)

Mid Year	U-235 (93%) [b] [11] Total	U-235 (93%) [b] [11] Available for Weapon Use	Plutonium Equivalent [c] [12]
1950	25	..	90
1951	160	..	300
1952	600	500	550
1953	1,550	1,400	1,000
1954	3,350	3,000	1,500
1955	6,300	6,000	2,000
1956	10,500	10,000	2,700
1957	16,500	16,000	3,400
1958	24,000	23,500	4,200
1959	34,500	34,000	5,600
1960	51,000	50,000	8,000
1961	76,000	74,000	11,000
1962	110,000	105,000	15,000
1963	145,000	140,000	20,000
1964	190,000	180,000	25,000
1965	235,000	225,000	31,000
1966	285,000	275,000	38,000

[a] See paragraphs 63 and 82 for the uncertainties and ranges of error in these estimates.

[b] Production of less highly enriched uranium is included as equivalent quantities of 93% material.

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

(b)(1)

[redacted]

[11] See page 18 for the view of the Assistant Chief of Naval Operations (Intelligence), Department of the Navy.

(b)(1)

[redacted]

(b)(1)

[redacted]

Margins of Error

82. It is very improbable that actual mid-1961 Soviet cumulative plutonium-equivalent production is more than 35% below the estimated krypton-based value. On the other hand, information on known plutonium production sites as well as on possible additional unidentified facilities makes it very improbable that actual production is more than twice the estimated value. No meaningful margin of error can be assigned to post-1961 estimates. Actual future production will depend on Soviet plans and policies, particularly those regarding the stockpiling of small-yield tactical and air defense weapons.

Other Nuclear Materials

(b)(1)

83. *Lithium.* [redacted]

84. It is probable that the USSR has been producing enriched lithium isotopes in quantity since at least 1954, although locations and capacities of Soviet lithium isotope separation plants are unconfirmed. Substantial increases in the production of lithium compounds within the USSR have occurred in recent years and we estimate that sufficient amounts of both natural and enriched lithium have been available to the USSR since 1953 to meet the requirements of the Soviet nuclear weapon program.

85. *Heavy Water.* We estimate that the heavy water production of the nine known Soviet heavy water plants is about 100 metric tons per year. (See Figure 4 for plant location.) This amount is believed to be ample for the needs of the Soviet nuclear program.

86. *U–233.* The Soviets showed moderate interest in the procurement of thorium-bearing minerals between 1946 and 1952. [redacted] (b)(1)

(b)(1)

87. *Tritium.* [redacted] production of tritium up to 1961 is probably not more than 20% of the total cumulative plutonium equivalent. It is probable that in the period from 1957 on something less than 20% of plutonium-equivalent production capacity would be required to create the amount of tritium needed for the more recent weapons. Thus a small amount of U–235 will probably be diverted from weapon uses to support a tritium production program. However, it is unlikely that the diverted U–235 will exceed 2% to 5% of estimated annual U–235 production in any one year.

IV. THE SOVIET NUCLEAR WEAPON PROGRAM

Nuclear Weapon Research and Development Installations

88. The Soviet nuclear weapon program has undoubtedly been supported by research conducted at a number of institutes and laboratories in the USSR, probably including the Institute of Atomic Energy of the Academy of Sciences (formerly Laboratory II), Moscow; the fast reactor installation at Obninsk; and the Institute of Chemical Physics, Moscow.

Of these, the last probably has the most important role of the three in Soviet nuclear weapon development. (See Figure 8 for locations.)

89. *Sarova.* The principal Soviet center specifically concerned with nuclear weapon research, design and development is located at Sarova (5457N, 4325E), about 250 miles east of Moscow. Good quality photography (Figure 9) of this site obtained in February 1960 revealed a large and elaborate nuclear weapon research and development complex comparable in size to the combined facilities of the Los Alamos Scientific Laboratory and the Sandia Corporation at Albuquerque. The photography revealed signs of current and continuing activity at the complex [redacted] Some expansion of both operational and support facilities was also under way at the time of photography.

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90. *Kasli.* Recent analysis of July 1959 photography (Figure 10) of an installation near Kasli (5612N, 6038E) indicates that it is probably concerned with nuclear weapon research and development. Certain areas in the complex under construction in the summer of 1959 resemble areas at Sarova and at the Nizhnyaya Tura nuclear weapons fabrication site. We estimate that the Kasli installation became operational during the latter half of 1959 and that it represents a major addition to the Soviet nuclear weapon development potential.

91. *Kerch/Bagerovo.* July 1956 photography of an airfield near Kerch/Bagerovo (4521N, 3629E), although of poor quality, suggests that the airfield and its associated facilities are a research and development establishment or a test installation, rather than an operational base. Recent reports of the function of the base indicate that it is a research installation concerned with nuclear weapon systems development, particularly those involving aircraft. This airfield probably provided the aircraft and crews for the weapon tests at Semipalatinsk and Novaya Zemlya.

92. *Semipalatinsk.* The Semipalatinsk proving ground, located in northeastern Kazakhstan about 100 miles west of Semipalatinsk, has remained active since the nuclear tests detected there in 1958.

93. Comparison of two sets of photography obtained in August 1957 and April 1960 clearly shows this activity, and a review of all the available evidence suggests that the Soviets have kept a technical staff and appropriate support personnel in place at the proving ground. Maintenance of such an in-place staff would also provide the Soviets with a capability to perform research and development work related to military nuclear programs not involving testing, or to other sensitive research and development activities.

94. Three facilities were constructed outside the fenced shot area since 1957. They consist of a new research facility located northwest of the main shot test area, a rectangular grid pattern about 3 miles by 5 miles in size west of the shot area, and an apparent ground zero located north-northwest of the shot area, consisting of an excavation surrounded by concentric rings of structures. (Figures 11 and 11A (April 1960 photography).)

95. The new research facility (See Figures 12 and 13 (April 1960 photography)) most probably is concerned with laboratory experiments relating to nuclear weapon development, although other functions, such as nuclear propulsion development or controlled thermonuclear research, cannot be excluded.

96. Several explanations, such as agent dispersal studies, have been advanced for the function of the large rectangular grid (See Figure 14). [redacted] Older grid structures north of the shot area are believed to have been used for studies in decontamination methodology, probably utilizing the fallout from weapon tests.

(b)(1)

97. The apparent ground zero which was being constructed north of the enclosed shot area in April 1960 consists of numerous heavy concrete structures, revetments, bunkers, buried buildings, and above-surface structures arranged in a semicircular pattern (See Figures 15 and 16 (April 1960 photography)). The structures in the inner ring (300–500 foot radius) are heavily constructed and will probably be earth covered when completed. The larger rings (1000-foot and 1500-foot radii) contain revetments and lighter structures. The area appears to be intended for use with a venting explosion, either HE or nuclear.

(b)(1)

[redacted]

Weapon Development Program

99. *Soviet Nuclear Test Program, 1949–1958.* The Soviets conducted nuclear tests at four separate locations in the USSR during the 1949–1958 period. [redacted]

(b)(1)

Capabilities Prior to Resumption of Testing [13]

100. We believe that nuclear weapons are available for all delivery systems which we know to be in the Soviet arsenal or which we estimate to be under development. However, many of these weapons probably are not of optimum design, and serious gaps in the Soviet knowledge on weapons effects for certain military applications may exist.

101. We estimate that at present the Soviets have the capability to produce thermonuclear (TN) weapons in the following yield and weight classes (See Table 6):

(b)(1)

[redacted]

103. We believe that the Soviets also have the capability to produce fission weapons in a variety of types and yields (See Table 7). [redacted] We estimate that at present the Soviets have the

(b)(1)

[13] The following estimates of present Soviet capabilities for weapon development do not take into consideration the 1961 test series. Only preliminary data on these tests are now available. (See Table 5A on page 31)

(b)(1)

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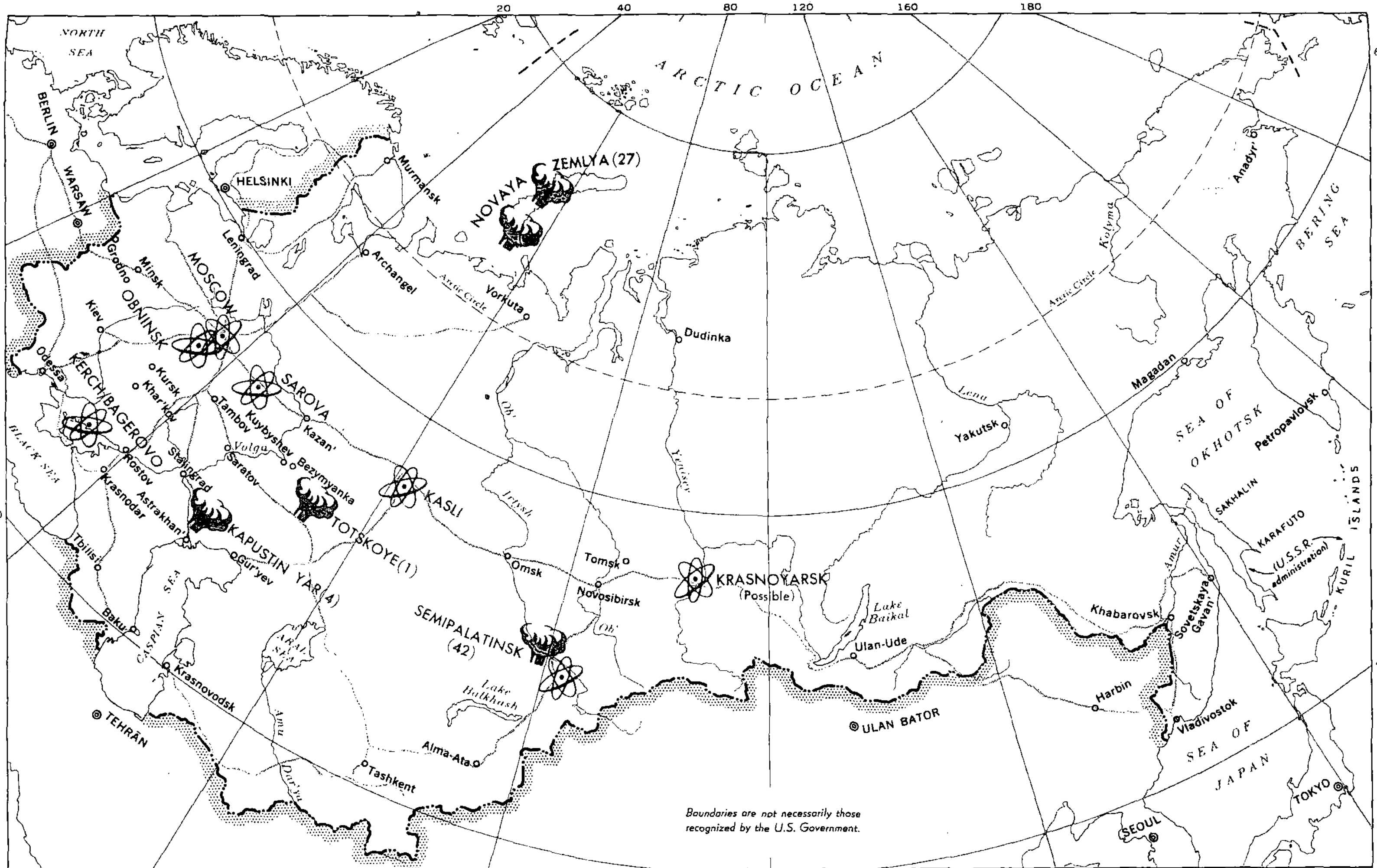
Figure 8



Weapons Research and Development

Nuclear Test Site
(Number detected at each area shown in parenthesis)

USSR
NUCLEAR WEAPON RESEARCH AND TEST AREAS

0 250 500 1000 1500 2000 Statute Miles

0 250 500 1000 1500 2000 Kilometers

Railroad (selected)

SECRET

35326 8-61

SECRET

(b)(1)
(b)(3)

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Figure 9

~~SECRET~~

SAROVA NUCLEAR RESEARCH AND DEVELOPMENT INSTALLATION

CIA/NPIC DG-1450

35331.6 8-61

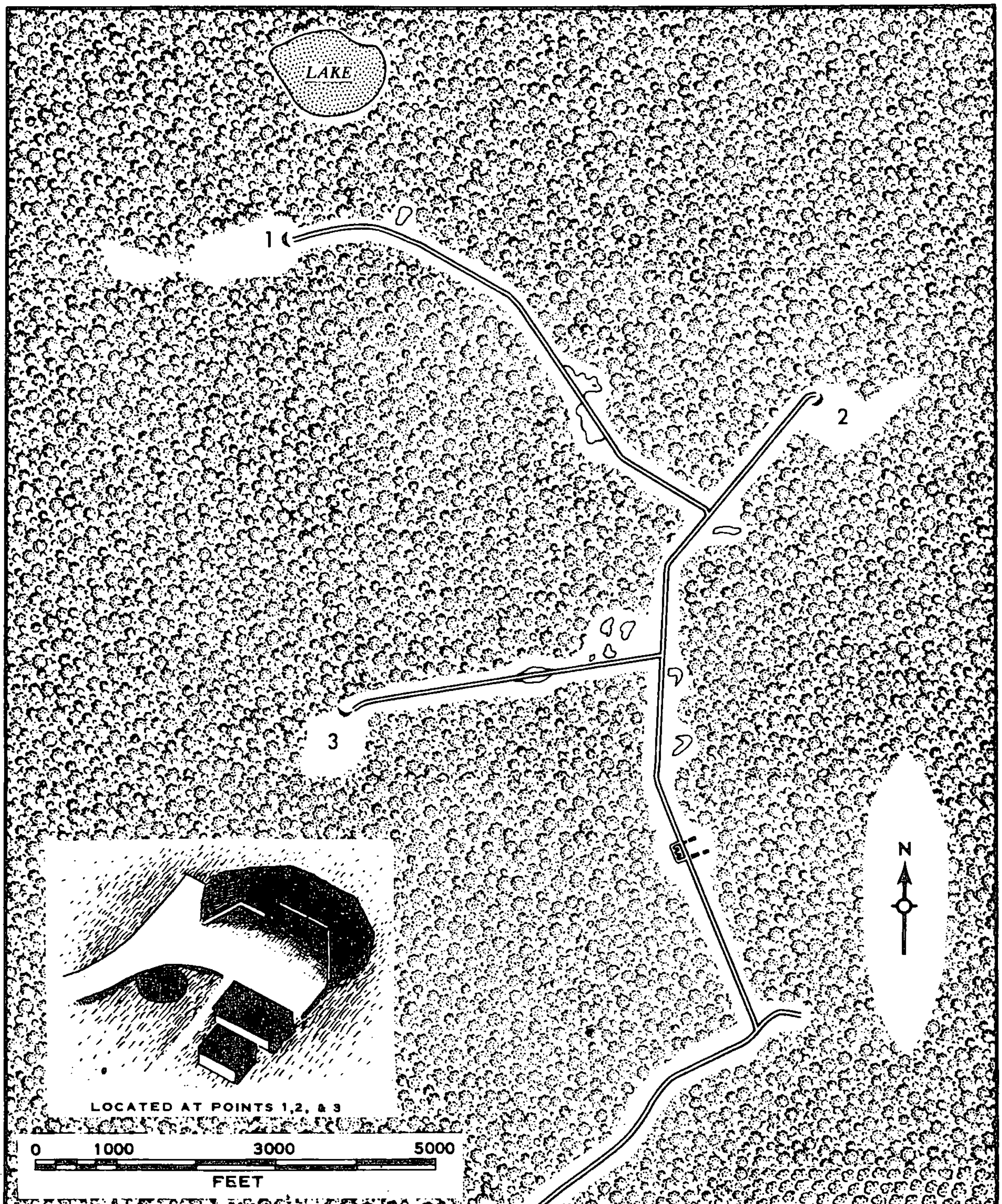
~~SECRET~~

(b)(3)

~~SECRET~~

PROBABLE TEST AREA AT KASLI

Figure 10



CIA/NPIC DG-3845

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[redacted]

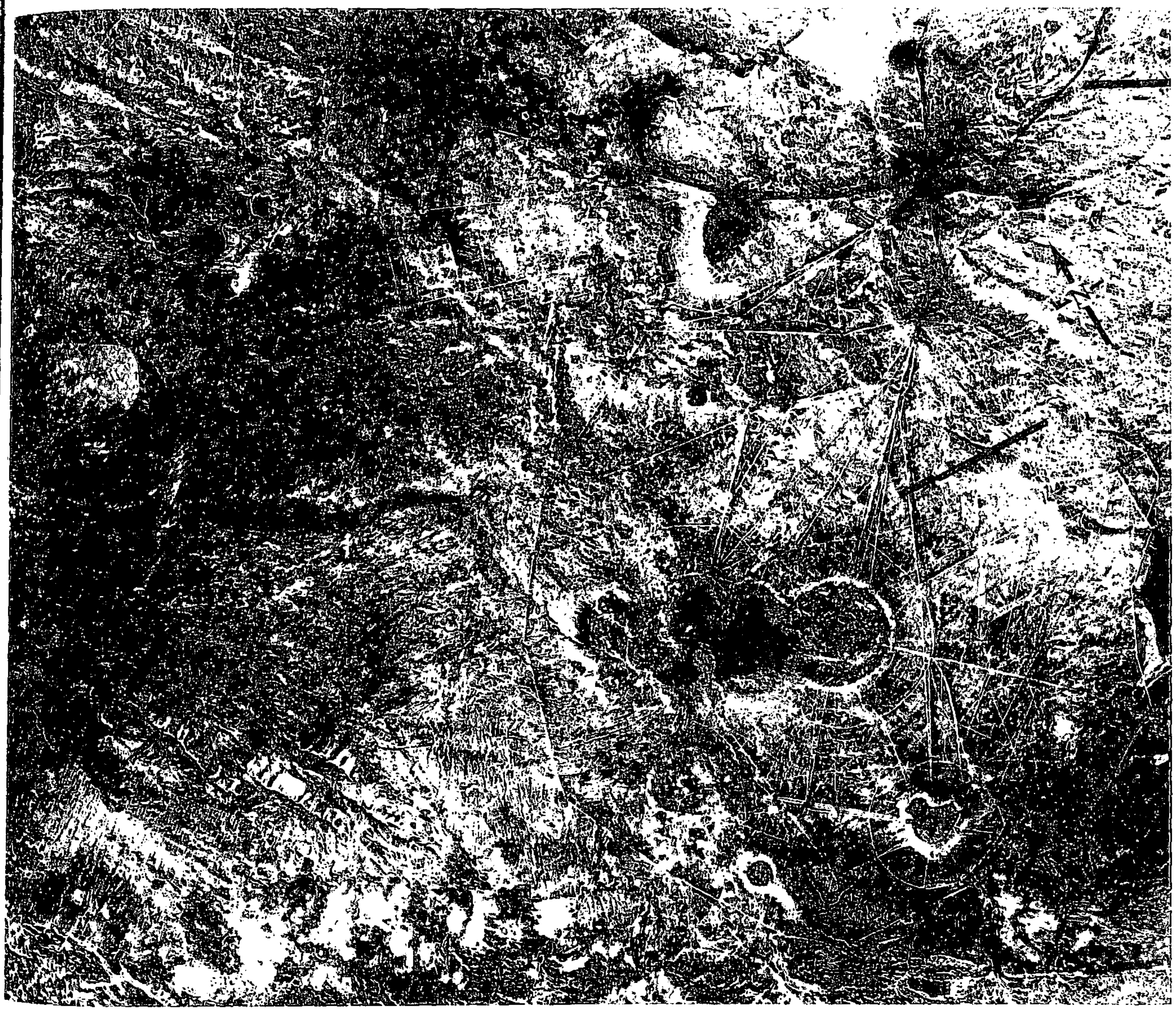
35331.7 8-61

(b)(3)

SECRET

Figure 11

SEMIPALATINSK NUCLEAR WEAPON PROVING GROUND



35331.8

CIA/NPIC DG-3653

SECRET

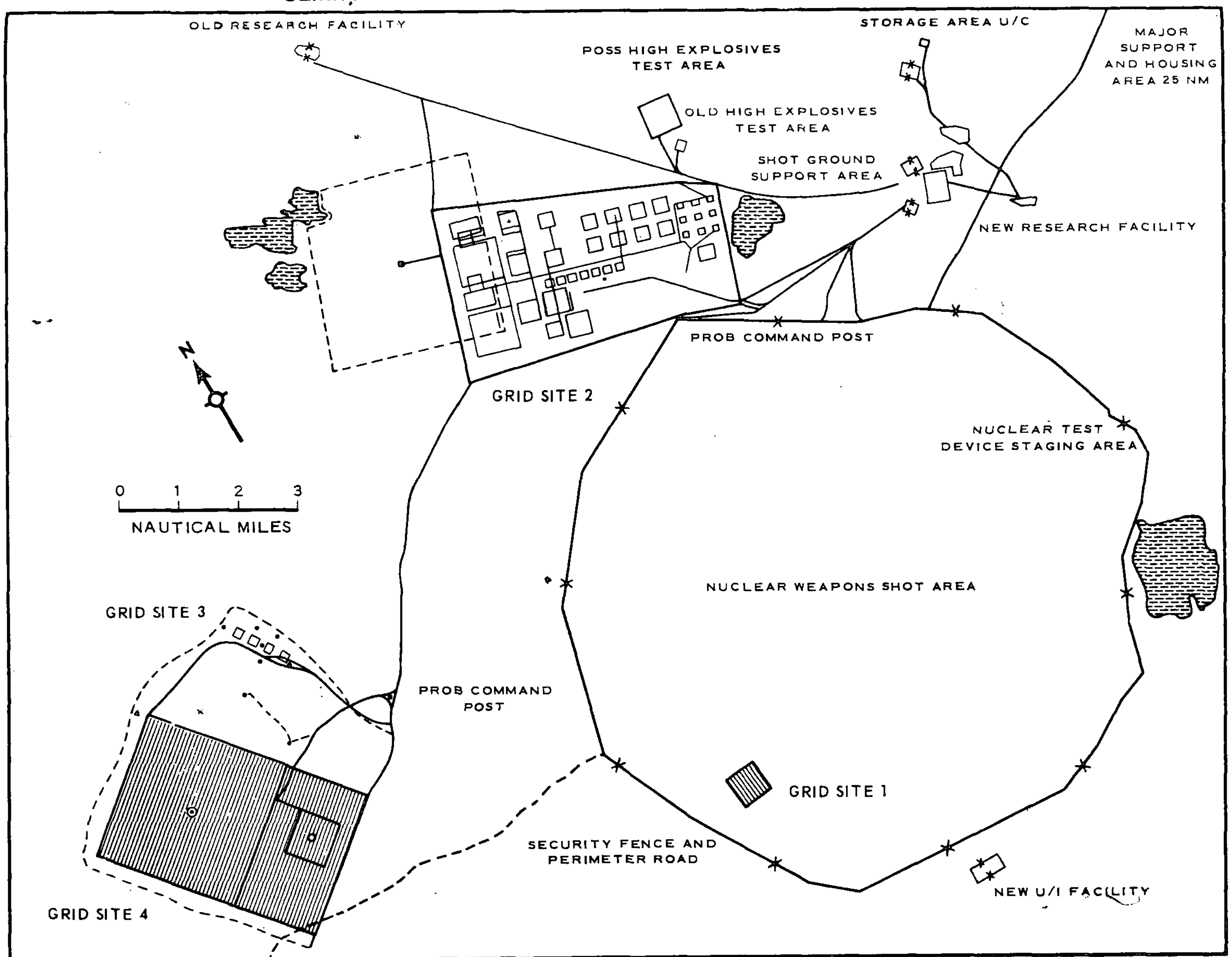
[redacted]

(b)(3)

SECRET

Figure 11 A

SEMIPALATINSK NUCLEAR WEAPON PROVING GROUND



35331.9 8-61

CIA/NPIC DG-3909

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(b)(3)

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SECRET

NEW RESEARCH FACILITY AT SEMIPALATINSK

Figure 12

35331.10 8-61

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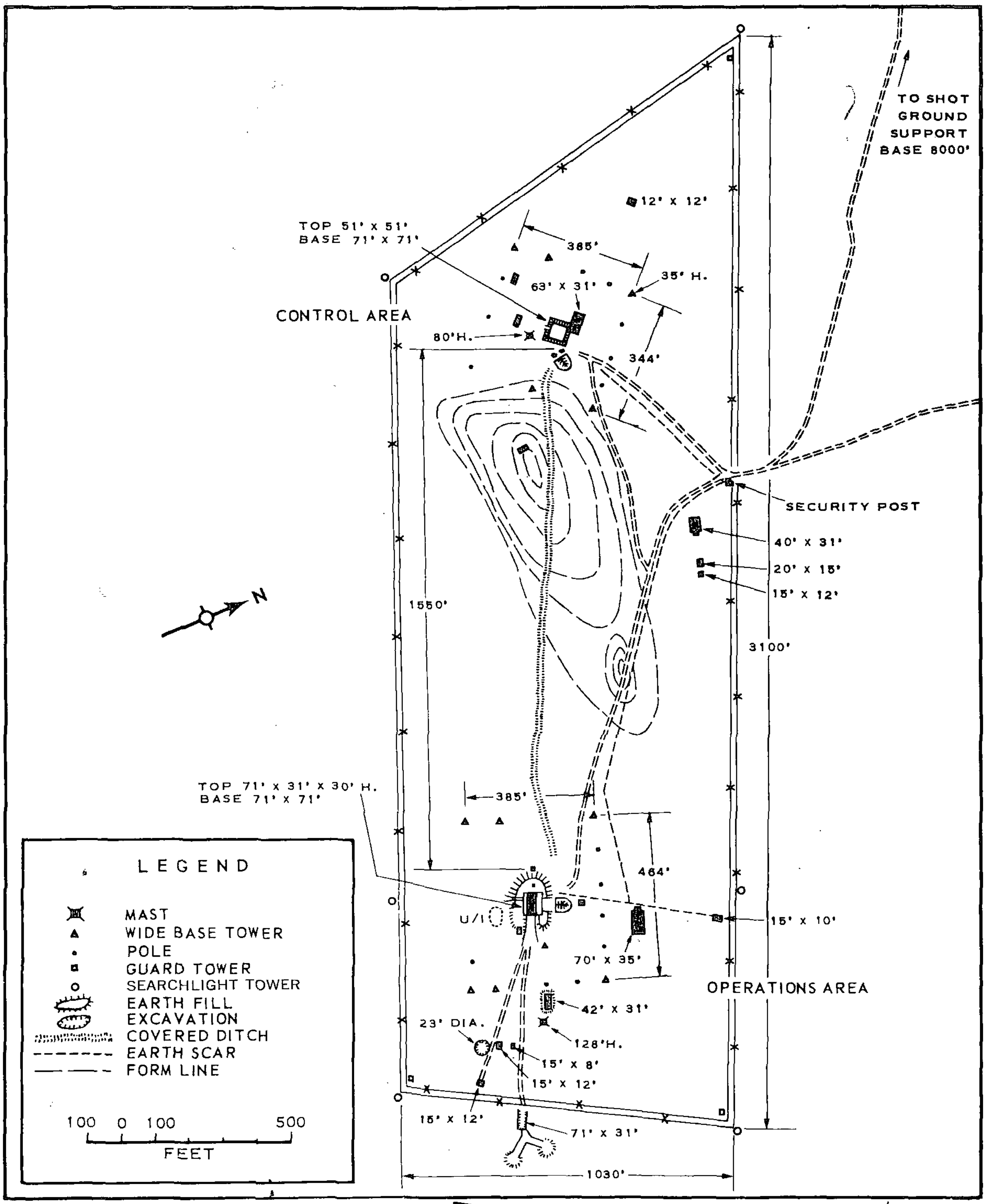
NEW RESEARCH FACILITY AT SEMIPALATINSK

Figure 13



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SECRET

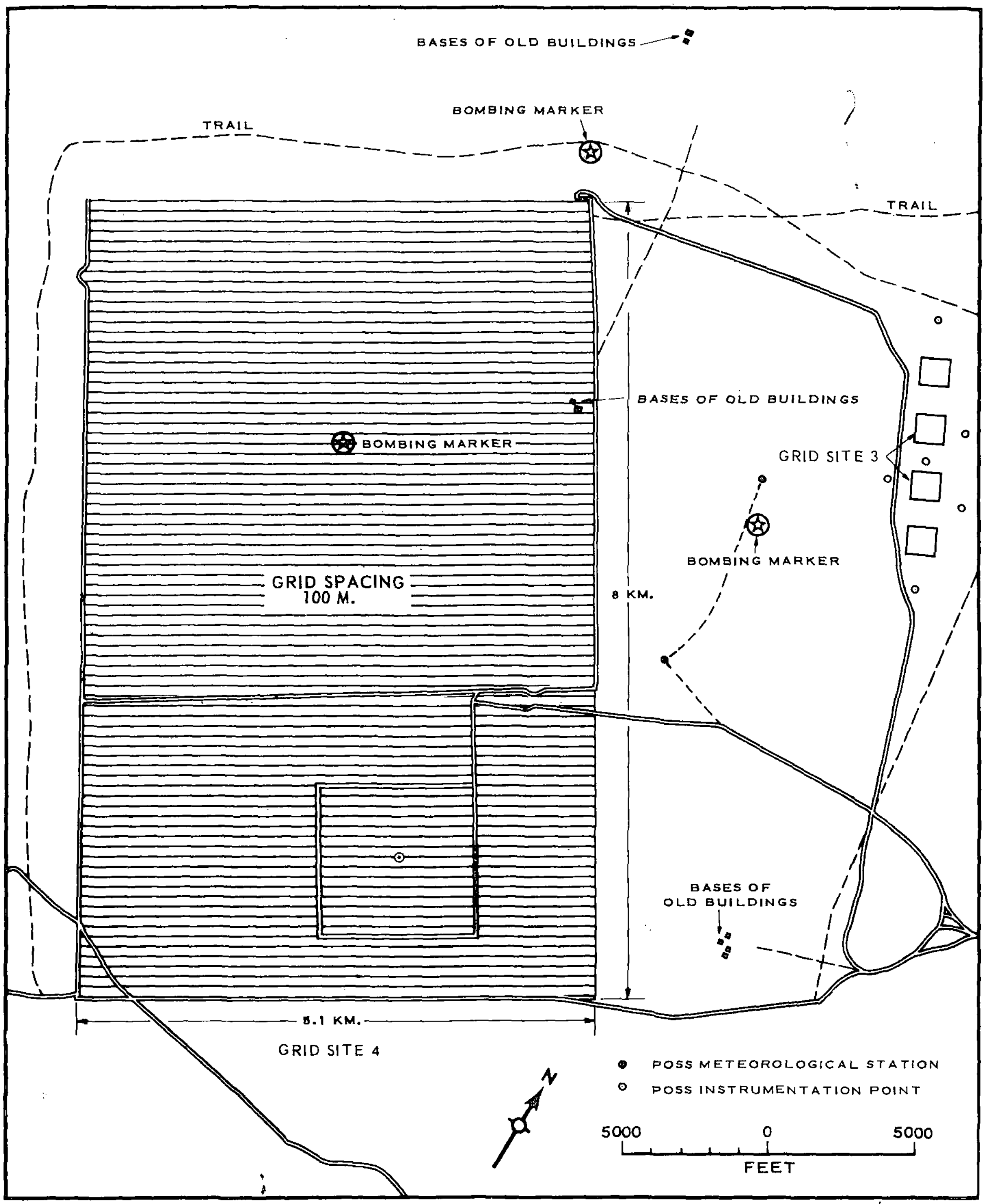
CIA/NPIC DG-3911

(b)(3)

~~SECRET~~

GRID SITES AT SEMIPALATINSK

Figure 14



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CIA/NPIC DG-3920

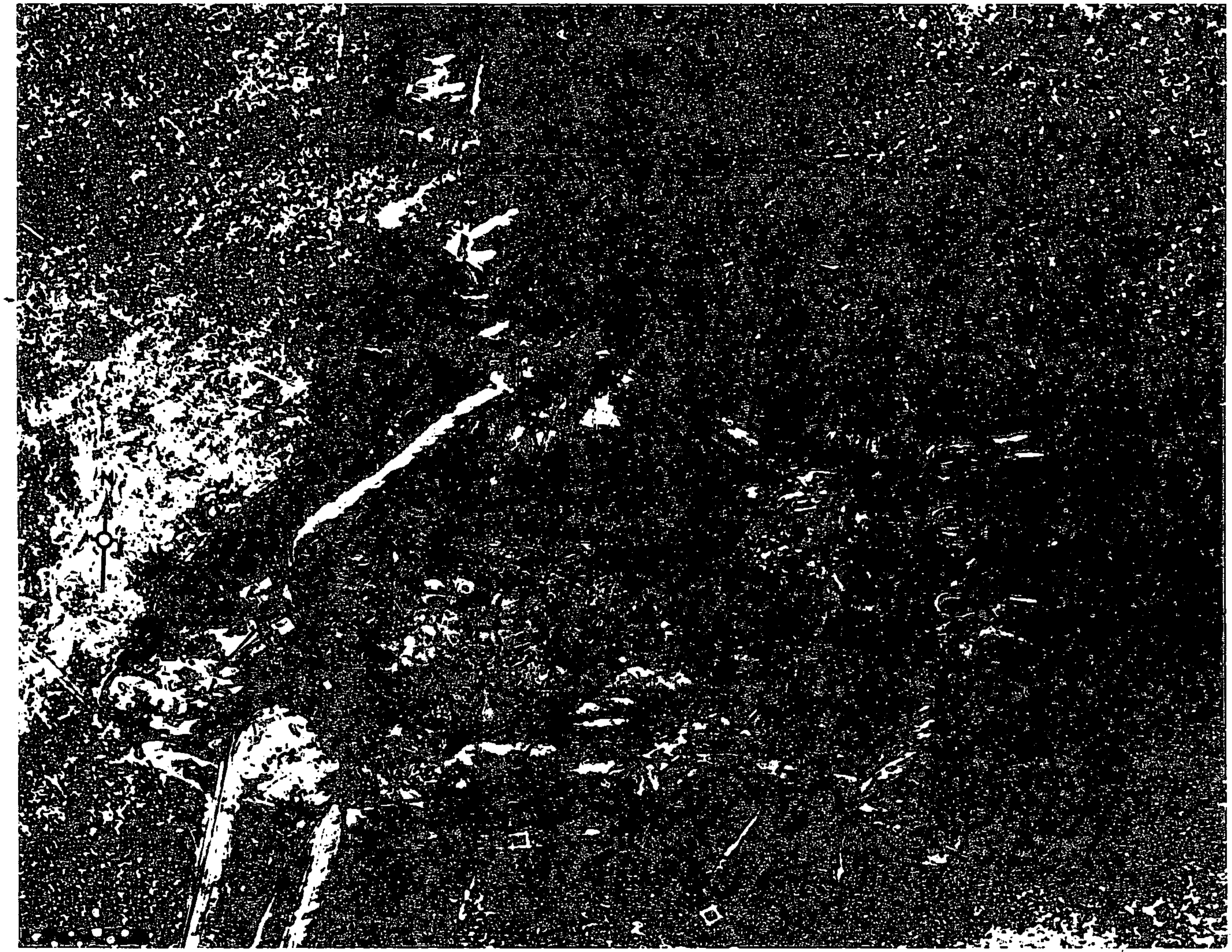
[redacted]

(b)(3)

SECRET

APPARENT GROUND ZERO AT SEMIPALATINSK

Figure 15



35331.13 8-61

SECRET

CIA/NPIC DG-3916

(b)(3)

Approved for Release: 2020/07/29 C06851104

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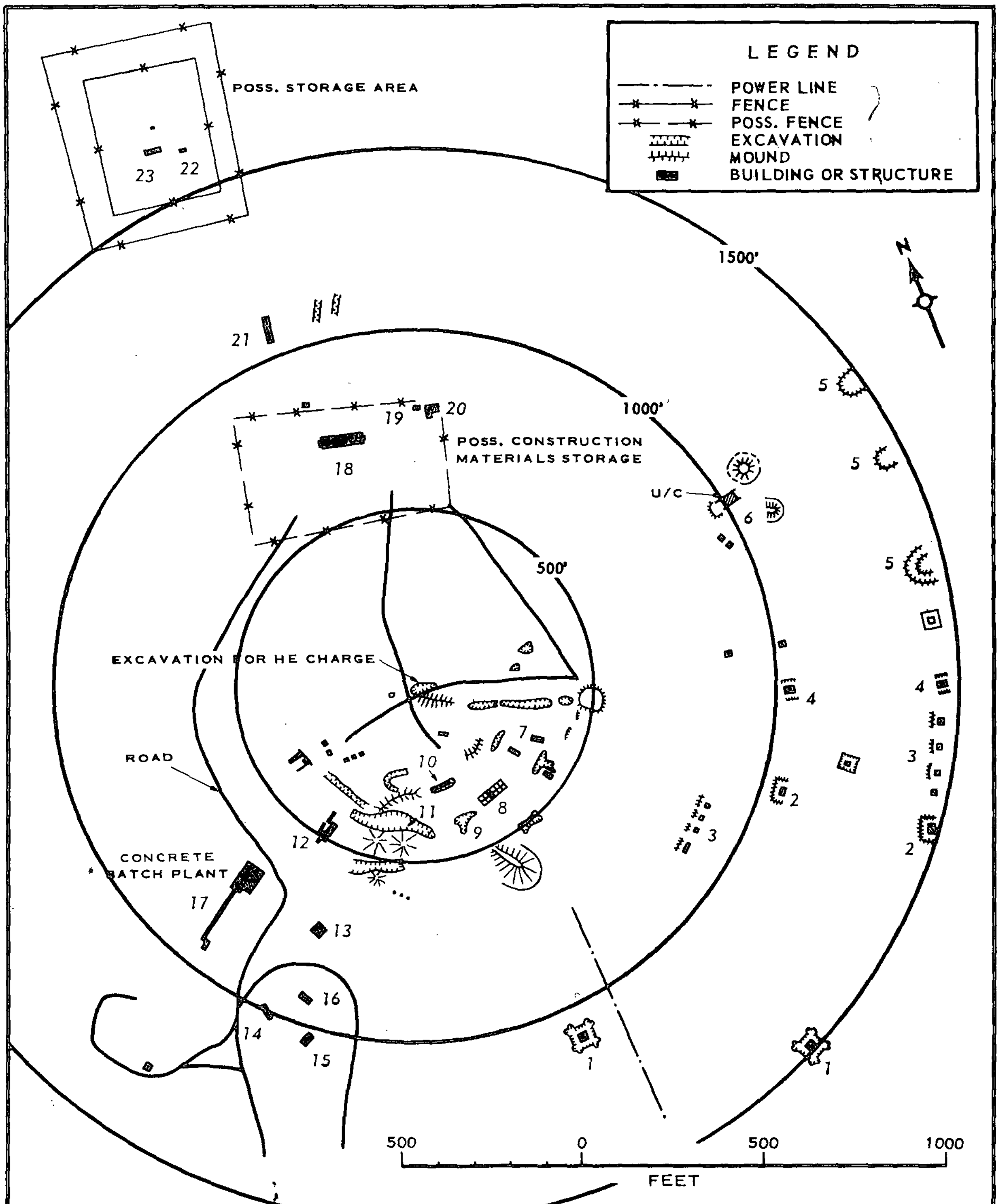
APPARENT GROUND ZERO AT SEMIPALATINSK

Figure 16



35331.14 8-61

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CIA/NPIC DG-3917

[redacted]

(b)(3)

Table 5

EVALUATION OF SOVIET NUCLEAR TESTS (1949–1958)

JOE No.	Date	Location [1, 2]	Burst Height (ft) [3]	Yield (KT) [3]	Dimensions [4] Est Wt (lbs)	Est Dia (in)	Approximate Total Materials [5]	Remarks
1	29 Aug 49	Semi	Surface					
2	24 Sep 51	Semi	Surface					
3	18 Oct 51	Semi	Air					
4	12 Aug 53	Semi	Surface					
5	23 Aug 53	Semi	Air					
6	3 Sep 53	Semi	Air					
7	10 Sep 53	Semi	Air					
8	14 Sep 54	Totskoye 53.1N, 51.9E	1,000/1,500					
9	3 Oct 54	Semi	Air					
10	5 Oct 54	Semi	Air					
11	8 Oct 54	Semi	[7] <few 1,000					
12	23 Oct 54	Semi	Air					
13	26 Oct 54	Semi	Air					
14	30 Oct 54	Semi	Air					
15	29 Jul 55	Semi	Surface					
16	2 Aug 55	Semi	Air					
17	21 Sep 55	NZ 70.6N, 54.2E	Underwater					
18	6 Nov 55	Semi	3,500					
19	22 Nov 55	Semi	4,500					

(b)(1)

See footnotes at end of Table 5A.

Table 5 (*Continued*)

JOE No.	Date	Location [1, 2]	Burst Height (ft) [3]	Yield (KT) [3]	Dimensions [4] Est Wt (lbs)	Est Dia (in)	Approximate Total Materials [5]	Remarks
20	2 Feb 56	Caspian Sea	Air					
21	16 Mar 56	Semi	Surface					
22	25 Mar 56	Semi	Surface					
23	24 Aug 56	Semi	Tower					
24	30 Aug 56	Semi	3,300					
25	2 Sep 56	Semi	>1,500					
26	10 Sep 56	Semi	1,500 / 3,000					
27	17 Nov 56	Semi	7,800					
28	14 Dec 56	Semi	Air					
29	19 Jan 57	Kapustin Yar 49.5N, 48.0E	Air					
30	8 Mar 57	Semi	Air					
31	3 Apr 57	Semi	Air					

See footnotes at end of table 5A.

(b)(1)

(b)(1)

Approved for Release: 2020/07/29 C06851104

(b)(1)

Table 5 (*Continued*)

JOE No.	Date	Location [1], [2]	Burst Height (ft) [3]	Yield (KT) [3]	Dimensions [4] Est Wt (lbs)	Est Dia (in)	Approximate Total Materials [5]	Remarks
32	6 Apr 57	Semi	Air	[redacted]				
33	10 Apr 57	Semi	6,800					
34	12 Apr 57	Semi	Air					
35	16 Apr 57	Semi	5,000/7,000					
36	22 Aug 57	Semi	>2,000					
37	7 Sep 57	NZ 7036N, 5412E	Surface					
38	13 Sep 57	Semi	Unknown					
39	24 Sep 57	NZ 7348N, 5524E	7,000/10,000					
40	26 Sep 57	Semi	Air					
41	6 Oct 57	NZ 7348N, 5500E	7,000					
42	10 Oct 57	NZ 7036N, 5412E	Underwater					
43	28 Dec 57	Semi	Air					
44	4 Jan 58	Semi Unknown	Unknown					
45	17 Jan 58	Semi	Unknown					
46	23 Feb 58	NZ 7418N, 5348E	10,500					
47	27 Feb 58	NZ 7418N, 5400E	10,300					

(b)(1)

See footnotes at end of table 5A.

Table 5 (*Continued*)

JOE No.	Date	Location [1, 2]	Burst Height (ft) [3]	Yield (KT) [3]	Dimensions [4]		Approximate Total Materials [5]	Remarks
					Est Wt (lbs)	Est Dia (in)		
48	27 Feb 58	NZ 7424N, 5336E	10,800					
49	13 Mar 58	Semi	Air					
50	14 Mar 58	NZ 7415N, 5420E	Air					
51	14 Mar 58	Semi	Air					
52	15 Mar 58	Semi	Air					
53	20 Mar 58	Semi	Air					
54	21 Mar 58	NZ 7400N, 6000E	>7,500					
55	22 Mar 58	Semi	Unknown					
56	30 Sep 58	NZ 7345N, 5445E	6,800					
57	30 Sep 58	NZ 7324N, 5500E	8,500					
58	2 Oct 58	NZ 7345N, 5430E	Air					
59	2 Oct 58	NZ 7338N, 5730E	Air					

See footnotes at end of Table 5A.

(b)(1)

(b)(1)

Table 5 (*Continued*)

JOE No.	Date	Location [1], [2]	Burst Height (ft) [3]	Yield (KT) [3]	Dimensions [4] Est Wt (lbs)	Est Dia (in)	Approximate Total Materials [5]	Remarks
60	4 Oct 58	NZ 7037N, 5445E	Air					
61	5 Oct 58	NZ 7037N, 5445E	Air					
62	6 Oct 58	NZ 7042N, 5455E	Air					
63	10 Oct 58	NZ 7338N, 5415E	Air					
64	12 Oct 58	NZ 7330N, 5500E	4,500					
65	15 Oct 58	NZ 7400N, 5500E	7,600					
66	18 Oct 58	NAZ 7342N, 5454E	6,500					
67	19 Oct 58	NZ 7350N, 5735E	Air					
68	20 Oct 58	NZ 7335N, 5418E	Air					
69	21 Oct 58	NZ 7038N, 5445E	Air (?)					
70	22 Oct 58	NZ 7348N, 5506E	7,000					

See footnotes at end of table 5A.

(b)(1)

Table 5 (*Continued*)

JOE No.	Date	Location [1, 2]	Burst Height (ft) [3]	Yield (KT) [3]	Dimensions [4] Est Wt (lbs)	Dimensions [4] Est Dia (in)	Approximate Total Materials [5]	Remarks
71	24 Oct 58	NZ 7400N, 5800E	7,600					
72	25 Oct 58	NZ 7400N, 5500E	Air					
73	1 Nov 58	Kapustin Yar 4930N, 4800E	Air (?)					
74	3 Nov 58	Kapustin Yar 4930N, 4800E	Air (?)					

See footnotes at end of table 5A.

Table 5A

Table 5A

PRELIMINARY EVALUATION OF SOVIET NUCLEAR TESTS IN 1961*

No.	Date	Location [1, 2]	Burst Height (ft)[3]	Yield (KT)	Remarks
75	1 Sept 61	Semi	Below tropopause	[redacted]	[redacted]
76	4 Sept 61	Semi	Below tropopause	[redacted]	[redacted]
77	5 Sept 61	Semi	Below tropopause	[redacted]	[redacted]
78	6 Sept 61	Semi	Air	[redacted]	[redacted]
79	6 Sept 61	Kapustin Yar	Air	[redacted]	[redacted]
80	10 Sept 61	NZ	7,000	[redacted]	[redacted]
81	10 Sept 61	NZ	Below tropopause	[redacted]	[redacted]
82	12 Sept 61	NZ	4,000	[redacted]	[redacted]
83	13 Sept 61	Semi	Below tropopause	[redacted]	[redacted]
84	13 Sept 61	NZ	Below tropopause	[redacted]	[redacted]
85	14 Sept 61	NZ	5,500	[redacted]	[redacted]
86	16 Sept 61	NZ	3,000	[redacted]	[redacted]
87	17 Sept 61	Semi	Below tropopause	[redacted]	[redacted]
88	18 Sept 61	NZ	5,000	[redacted]	[redacted]
89	19 Sept 61	Semi	Below Tropopause	[redacted]	[redacted]
90	20 Sept 61	NZ	4,500	[redacted]	[redacted]
91	21 Sept 61	Semi	Air	[redacted]	[redacted]
92	22 Sept 61	NZ	4,000	[redacted]	[redacted]
93	2 Oct 61	NZ	Air	[redacted]	[redacted]
94	4 Oct 61	Semi	Below Tropopause	[redacted]	[redacted]
95	4 Oct 61	NZ	7,000	[redacted]	[redacted]
96	6 Oct 61	NZ	8,000	[redacted]	[redacted]
97	6 Oct 61	Kapustin Yar	Air	[redacted]	[redacted]
98	8 Oct 61	NZ	Air	[redacted]	[redacted]
99	11 Oct 61	Semi	Sub-surface	[redacted]	[redacted]
100	12 Oct 61	Semi	Air	[redacted]	[redacted]

[redacted]

capability to produce fission weapons in the following yield and weight classes (See Table 7).

[redacted] (b)(1)

104. The USSR has demonstrated at least one preinitiation-proof, boosted weapon of high performance [redacted] (b)(1) and which we estimate the most likely candidate for some Soviet thermonuclear primaries.

105. *Gun-Assembly Weapons.* [redacted] (b)(1) it is considered that, because of the simplicity of design, weapons of this type are probably available in stockpile. These weapons would, however, require large amounts of fissionable materials. Therefore, we estimate the Soviets would stockpile only small quantities of these weapons. Versions could be available for their 310 mm gun and 420 mm mortar. [redacted] (b)(1)

Table 6

SOVIET THERMONUCLEAR WEAPONS

[redacted] (b)(1)

(b)(1) (b)(1)

[redacted]

107. No direct information is available on the specific nuclear weapon types in the USSR stockpile. [redacted]

(b)(1)

Table 7

SOVIET FISSION WEAPONS

[redacted]

[redacted] (b)(1)

Development Capabilities Prior to Resumption of Testing[14]

(b)(1) [redacted] Such changes would require at least a mock-up test.

111. The Soviet capability to improve their present weapons designs is probably more limited than that of the US because their primary reliance on air drops and airborne diagnostic instrumentation would necessarily result in less detailed diagnostic data on weapon performance. While it is conceivable that the Soviets could stockpile weapons (b)(1) [redacted] without benefit of tests, we believe this unlikely in view of the ample multi-megaton capability they already possess and which they can readily accommodate in existing ICBMs. Moreover, the additional few megatons would be obtained at a cost of 100 kilograms of U–235 per megaton. The Soviets would be hard pressed to improve in the light-weight TN class without tests because of their limited experience in this area.

[redacted]

(b)(1) [redacted]

113. We believe that there could be only limited improvement in fission weapons to be stockpiled without further nuclear testing. (b)(1) [redacted] (b)(1)

[14] This section does not consider improvements resulting from tests beginning in September 1961.

(b)(1) (b)(1)

[redacted]

Improvements with Unrestricted Testing

115. With continued unrestricted testing, the Soviets could approach the theoretical limits of performance in all yield-to-weight classes.

(b)(1)

116. *Fission Weapons/Primaries.* We estimate that the Soviets could develop light-weight, low-yield fission devices equalling our own capability. [redacted] weight primaries would be a necessary part of an effort to develop light-weight thermonuclear weapons in the few hundred pound category. In addition, if they have not already done so, they could develop tactical weapons of reduced fission yield and fractional-kiloton weapons where, at least conceptually, it appears possible to detonate sub-kilogram quantities of plutonium. The Soviets may also attempt to develop tactical warheads with particularly enhanced radiation yields. (b)(1)

117. *Thermonuclear.* [redacted]

118. The Soviets have recently stated that they "have worked out designs for creating a series of super-powerful nuclear bombs of 20, 30, 50, and 100 million tons of TNT." The statements further assert a capability to deliver such warheads to any point in the world with rockets similar to existing space boosters. [redacted]

(b)(1)

(b)(1) [redacted]

Fabrication and Stockpiling (See Figure 8A)

119. For some years, there had been indications that a large industrial installation at Nizhnyaya Tura (5845N, 5955E) in the north central Urals was involved in some way in the Soviet atomic energy program. Analysis of photography of this installation obtained in July 1959 confirmed that a major nuclear weapon complex involving facilities for the fabrication, assembly, and stockpiling of nuclear weapons existed at this location (See Figure 17). Other significant facilities within the complex include a high-explosive test area and a possible lithium-isotope separation plant. (b)(1) [redacted] is clearly a nuclear weapon stockpile site and is probably the first Soviet national stockpile. (See Figure 18.) We believe that the earliest series-produced weapons in the Soviet program were fabricated and stored at the Nizhnyaya Tura complex in 1951.

120. A second Soviet nuclear weapon fabrication, assembly, and stockpile complex is located about 240 n.m. south of Nizhnyaya Tura in the vicinity of Yuryuzan. Unfortunately, the quality of the photography (obtained at the same time as the Nizhnyaya Tura coverage) is poor. From what can be discerned, however, the installation at Yuryuzan appears generally to duplicate parts of the Nizhnyaya Tura complex. [redacted] We are uncertain as to the date of initial operation of this complex, but we believe it was constructed at a substantially later date than the Nizhnyaya Tura installation.

121. Another atomic energy site, part of which may be associated with the nuclear weapon program, is located north of Krasnoyarsk in central Siberia. This large, early site is characterized by extensive tunnelling and many of its facilities are probably underground. The probable weapons functions of this site include research and development, fabrication, and possibly stockpiling. The extensive security and underground nature of the site is difficult to explain, but indicates an unusual Soviet sensitivity about this site.

National Assembly and Stockpile Sites

122. In addition to the national stockpile sites at Nizhnyaya Tura and Yuryuzan, national assembly and stockpile sites have been photographed (b)(1) [redacted]

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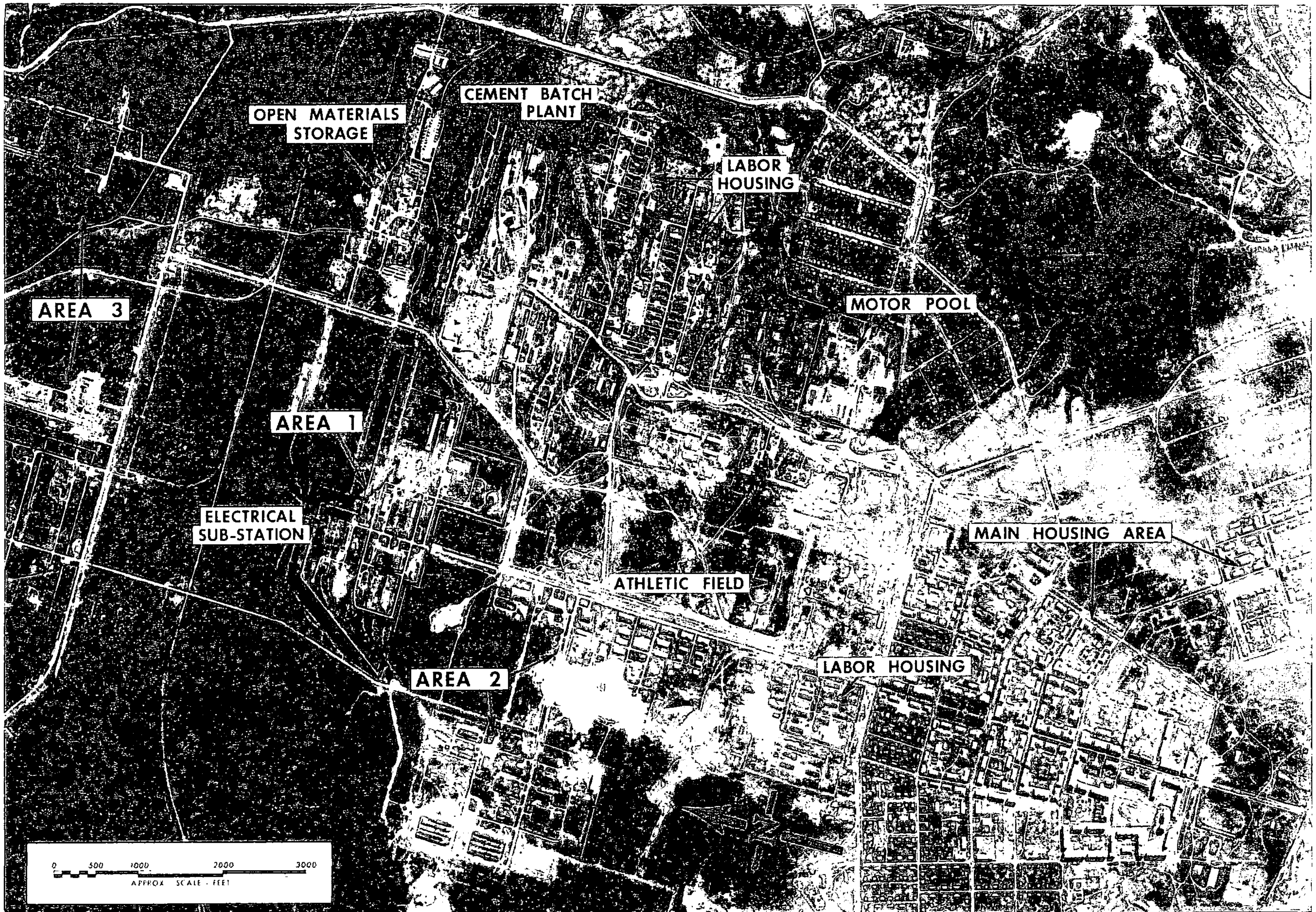
NIZHNYAYA TURA NUCLEAR ENERGY COMPLEX

Figure [redacted]



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(b)(3)

(b)(1)

[redacted]

(b)(3)

[redacted]

Storage Sites at Arctic Staging Bases

125. [redacted] nuclear weapon storage facilities are believed to be located in the vicinity of probable major Long Rang Aviation staging airfields in the Arctic. [redacted]

Soviet Airfield Storage Sites

126. We have photographic evidence that operational storage sites for nuclear weapons are associated with certain airfields in the Soviet Union. [redacted]

(b)(1)

(b)(1)

[redacted]

130. All of the above airfield sites are home bases for Soviet Long Range Aviation units except two which appear to serve Naval Aviation. There are indications that similar storage sites exist at other Soviet airfields and we estimate that all primary LRA bases have a nuclear weapon storage capability.

Other Operational Storage Facilities

131. We have no firm evidence of the existence of operational storage facilities specifically designed for nuclear weapons other than those at LRA and naval airfield sites. However, the Soviets may well have a nuclear storage capability at a number of tactical and naval airfields. Soviet tactical doctrine and training, and nuclear testing specifically oriented to ground and naval requirements, indicate that

nuclear weapon storage sites are probably also available to units of the Soviet ground forces and to certain naval surface and submarine forces.

132. The Soviet guided missile program has clear requirements for nuclear warheads, particularly in strategic attack and certain air defense applications. Although there is to date no confirming evidence, we would expect to find special security arrangements and provisions for check-out and storage of nuclear warheads for all deployed surface-to-surface and air-to-surface missile units having missiles of 100 n.m. range or greater. Although we estimate that the Soviets have tested at least three nuclear warheads in surface-to-air missiles, available photography on surface-to-air missile sites has not as yet revealed any characteristics associated with nuclear weapon handling and storage at operational sites.

133. While there is no direct evidence to indicate that the Soviets have selected nuclear warheads for their Anti-Ballistic Missile (ABM) system, photography of the Sary Shagan ABM research and development site reveals a "high-hat" shaped building [redacted] A nuclear warhead would be particularly attractive to the Soviets for use in an ABM system because it would provide large lethal radii against light-weight re-entry vehicles, particularly at high altitudes.

134. The Soviet nuclear weapon logistics system, although it reveals effective planning for and implementation of the dispersal concept, does not appear to have a capability for rapid movement or preparation of weapons for operational use in a compressed time period. The national sites do not have easy access to an airfield. In order to move weapons from the national sites to the operational storage sites, it is necessary to carry them 15–20 miles by truck from the site over good, all-weather roads, to the railroad, by rail to the airfield and then again by truck to the airfield storage site.

135. At the operational sites, at least until 1958, the requirement for assembly operations to prepare weapons for strike [redacted] (b)(1) the apparent reliance on pit-loading of the aircraft confirm our general impression that the Soviet system was a slow, cumbersome and inefficient one by US standards. We believe that the Soviets had not yet generally adopted the practice of storing their weapons in an operational configuration, although there is some indication that they are concerned with this problem and are taking corrective action.

Control of Nuclear Weapons

136. There are two distinct categories of nuclear weapon storage in the USSR, each separately administered and controlled. The first consists of national storage facilities at the national assembly and stockpile site. We believe that these sites are operated by the Ministry of Medium Machine Building. The second class of storage houses those weapons immediately required to implement military missions. These weapons are stored at military bases in sites corresponding approximately to Service Storage Facilities in the US program and include the arctic storage bases and the Types I and II airfield sites. We believe these weapons are controlled by the Ministry of Defense, probably by a specialized central element of that Ministry. (b)(1)

137. The authority to decide whether or not to employ nuclear weapons in a given situation is probably vested specifically in the Military High Command, which in peacetime comprises the Minister of Defense and his immediate subordinates. Major operational commands in the field are believed to have a specified number of nuclear weapons, and the field commanders probably have some discretion in determining how the weapons are to be employed. From the standpoint of rapid and effective response to various military contingencies, it is quite logical for the Ministry of Defense to provide the command mechanism for controlling the release of weapons in operational storage as well as for deciding

(b)(1)

[redacted]

[redacted]

(b)(3)

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(b)(1)

[redacted]

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(b)(3)

whether or not employment of nuclear weapons might be militarily desirable in given situations. It is virtually certain, however, that any decision made within the Ministry of Defense to employ nuclear weapons would require ratification by the top political leadership, and that the ultimate decision on whether or not to initiate a nuclear attack would be made by the Presidium of the Central Committee of the Communist Party.

V. POSSIBLE SOVIET ALLOCATIONS OF FISSIONABLE MATERIALS TO WEAPON STOCKPILES

138. Sufficient information is available to estimate the major characteristics, i.e., weights, yields and materials composition, of nuclear weapons available to the Soviet arsenal. In addition, broad judgments can be made as to Soviet plans for the employment of nuclear weapons, the relative emphasis on types of weapons for various missions, and general Soviet nuclear capabilities. These judgments are derived from a number of considerations: the Soviet nuclear test program through 1958; estimated availability of fissionable materials; evidence on stockpiling practices; Soviet doctrine on the use of nuclear weapons; Soviet strategy and military policy; and estimated Soviet development and deployment of weapons systems. Our information is sufficient to delineate, within broad limits the general size and composition of the Soviet nuclear stockpile, but it is not of sufficient quality to permit detailed allocations.

139. Future projections of the Soviet nuclear weapon stockpile are highly tentative. Our estimates of the present materials stockpile are subject to margins of error which become greater over the next few years (See paragraphs 63 and 82). No meaningful margin of error can be stated after 1961 for the estimate of plutonium equivalent, or after 1963 for the estimate of cumulative U–235 production. Therefore, this section is addressed primarily to a consideration of the Soviet nuclear weapon stockpile in the current period.

The Soviet Test Program

140. We estimate that the present Soviet stockpile consists primarily of weapons developed from nuclear tests conducted prior to November 1958. New weapon designs being tested in the current series which began on 1 September 1961 probably would not enter the stockpile for about one to two years. However, the current tests may also have the objective of proving some previously untested weapons from the present stockpile. If the Soviets engaged in clandestine testing, some of the current tests would be designed to exploit the results achieved. Further analysis will be required to determine the design of recently tested devices and to establish the objectives of the current test series.

141. The Soviet test program over the years has reflected the development of nuclear weapons to meet a wide variety of military requirements. The 74 Soviet tests detected through 1958 were almost evenly divided among the low-yield, medium-yield and high-yield tests.[20] Some of the low- and medium-yield tests probably related to the development of thermonuclear weapons. Likewise, some of the high-yield shots may have contributed to the improvement of the lower yield weapons. However, beginning in November 1955, when the Soviets tested their first two-stage thermonuclear weapon, greater emphasis was placed on the high-yield category. Of the 31 tests detected during 1958, about one-half were high-yield shots, and 10 of these were in the megaton range.

142. Tables 6 and 7 present weapon designs which we estimate to be available to the present stockpile. These designs are based on specific Soviet tests detected through 1958 and represent a selection of the best of the weapons tested in various weight classes. The listing in these tables, however, is probably not complete. [redacted] (b)(1)

[redacted] In addition, the listing does not contain any untested weapons, developed or extrapolated from tested devices, which the USSR may have stockpiled. [redacted] Even with these omissions, however, it is evident that a wide spectrum of fission and thermonuclear weapon designs is now available to the Soviets.

(b)(1)

Availability of Fissionable Materials

143. We estimate that the total amount of fissionable materials available for fabrication into weapons increased considerably during the past year. We estimate that production in this period has increased total Soviet stocks of U–235 by about 45 percent, and of plutonium-equivalent by about 30 percent. [redacted]

(b)(1)

Soviet Military Doctrine and Policy

144. Although the Soviets cannot be certain as to the nature and duration of a general war, they appear to assume that it would commence with massive nuclear attacks upon the homelands of the opponents. Nuclear weapons would also be employed in the subsequent struggle which would be characterized by a total commitment of remaining forces and weapons. In any future conflict short of general war we have estimated that the Soviets probably would seek to exclude the use of nuclear weapons because of their superiority in conventional forces. At the outset of such a conflict they would probably make a considerable effort to avoid being the first to use nuclear weapons, but would undoubtedly respond, in kind, to Western use of nuclear weapons, if they considered it militarily necessary.[22]

145. We believe that the Soviets will continue to maintain substantial forces in being and that, insofar as is appropriate to their missions, these forces will be dual purpose, capable of employing nuclear or nonnuclear weapons. If as we estimate, the Soviets have not yet achieved a state of "nuclear plenty," the various missions necessarily have to compete for allocations of fissionable material. Considering our estimates of Soviet strategy, we believe that the USSR has given the largest allocation of fissionable material to its long-range attack forces. Using as a basis the estimated characteristics and numbers of available delivery vehicles, we believe it possible to make a rough judgment concerning the amount of material involved in this allocation. There are so many possible combinations of requirements and allocations for Soviet air defense forces, theater field forces, and naval forces that we have not attempted to assess the amount of material allotted to each of these forces.

Long Range Striking Forces

Long Range Aviation

146. There is ample evidence that the Soviets, early in their nuclear weapons program, decided upon the extensive deployment of nuclear weapons to Long Range Aviation. The Soviets probably began construction of the nuclear storage sites which have been identified at numerous Long Range Aviation bases in 1952, and we estimate that all primary LRA bases have nuclear weapon storage. In their test programs, the Soviets clearly stressed the rapid development of thermonuclear weapons suitable for delivery as bombs and selected weapons for air-to-surface missiles. We believe that the Soviets have provided nuclear weapons for the bombers of Long Range Aviation intended for weapons delivery in the event of general war. They may have pro-

[21] For the view of the Assistant Chief of Naval Operations (Intelligence), Department of the Navy see pages 18 and 21.

[22] For a full discussion of this subject, see NIE 11–4–60, "Main Trends in Soviet Capabilities and Policies," Paras. 91–94, T.S., dated 1 December 1960.

vided a certain number of weapons for multiple bomb loads and for restrikes by surviving aircraft. Virtually all of these weapons would probably be high-yield types, and many would probably be in the megaton range.

147. The numbers of weapons allocated to Long Range Aviation could vary widely depending upon operational planning, the size of weapons employed and other factors. Long Range Aviation could now have on the order of 1,000 nuclear weapons. This number of weapons might require about 40 percent of the estimated U–235 stockpile and about 35 percent of the estimated stocks of plutonium equivalent. In view of the growing demands of Soviet missile forces and our estimate that the long range bomber force will decrease somewhat, we do not foresee any increase in the number of nuclear weapons allocated to Long Range Aviation.[23]

Missiles

148. Included in the long range attack forces are ICBMs, medium range (700n.m. and 1,100 n.m.), and submarine-launched ballistic missiles. Missiles employed in an initial attack on land-based retaliatory targets and on urban-industrial centers would probably be equipped with thermonuclear warheads at or near the maximum yields available. [redacted]

(b)(1)

149. We estimate that the Soviet long range attack forces now have some 10–25 ICBM's and 250–300 medium range missiles available for launching in an initial salvo.[24] The 28 Soviet missile submarines estimated to be in service probably carry a total of about 80 short-range (150 or 350 n.m.) ballistic missiles. Assuming a present ICBM inventory of about two missiles per launcher and an MRBM inventory of about three missiles per launcher, the Soviets would have an operational inventory of 800 to 1,000 missiles in all these categories. We believe that nuclear warheads would be provided for all these missiles.

150. We estimate that maximum yield warheads would be used in ICBM's, submarine-launched missiles, and MRBM's for an intial salvo, and that the remaining MRBM's would be equipped with nuclear warheads of varying yields. Such an allocation would consume between 30 and 40 percent of the estimated stock of plutonium equivalent, and 25 to 35 percent of the U–235 stockpile. Thus, considering also the possible allocations to Long Range Aviation, Soviet long-range attack forces may consume about 65–75 percent of the plutonium equivalent stockpile and about 65–75 percent of the U–235 stockpile.[25]

151. Soviet missile strength will continue to grow over the next few years. We have estimated that in mid-1963 the Soviets will have some 75–125 ICBM's and about 350–450 MRBMs/IRBMs on launcher.[26] In the same period, we have estimated only a modest in-

[23] The Assistant Chief of Naval Operations (Intelligence), Department of the Navy, does not concur in these implied allocations because he believes the availability of Soviet fissionable material to be materially below that given in the majority estimate, as pointed out in the footnotes on pages 18 and 21. In addition, he feels that the insufficiency of evidence on actual Soviet weapon apportionment and the wide margins of error inherent in fissionable material estimates are such that these estimated allocations are only possibilities.

[24] The representative of Assistant Chief of Staff, Intelligence, USAF believes that Soviet long range attack forces now have about 60 ICBM's on launcher. (See the Assistant Chief of Staff, Intelligence, USAF footnote to NIE 11–8/1–61: "Strength of Soviet Long Range Missile Forces" for his views on this subject.)

[25] See footnote 23 for the view of the Assistant Chief of Naval Operations (Intelligence).

[26] The representative of the Assistant Chief of Staff, Intelligence, USAF believes that in mid-1963 the Soviets will have about 250 ICBM's on launchers. (See the Assistant Chief of Staff, Intelligence, USAF footnote to NIE 11–8/1–61: "Strength of Soviet Long Range Missile Forces" for his views on this subject.)

crease in the number of missile submarines and a gradual decline in Long Range Aviation strength. Thus we believe that the future nuclear material requirements of Soviet long-range attack forces will be largely a function of the Soviet ballistic missile buildup.

Air Defense

152. A few Soviet nuclear tests appear to have been related to the development of nuclear warheads for employment in air defense. This evidence does not indicate that the Soviets have developed a nuclear warhead suitable for use in an air-to-air missile. However, [redacted] the possibility that the Soviets have developed such warheads cannot be excluded. We continue to estimate that the Soviets have available nuclear warheads suitable for use in surface-to-air missiles, although there is no evidence of their deployment to SAM sites.

(b)(1)

153. The rapid and extensive deployment of surface-to-air missile sites in the USSR is indicative of the high priority accorded the air defense mission. Of the three SAM systems now believed to be operational, deployment of the SA-2 is by far the most widespread. We estimate that 350–400 SA-2 sites are now operational at about 70 urban-industrial areas in the USSR, others have been deployed for defense of military installations and field forces. We believe that within the next few years the Soviets will have deployed roughly 500 SA-2 sites at some 100 urban-industrial areas, possibly 80–120 SA-2 units for defense of field forces, and an unknown additional number for defense of such military installations as ballistic missiles sites.

154. Although Soviet SAM systems are designed to be effective with HE warheads against aerodynamic targets, nuclear warheads would be required to give a significant probability for destruction of the nuclear weapons themselves. Such warheads would also increase the kill probability for the destruction of the delivery vehicles. We believe these considerations would impel the Soviets to provide some portion of their surface-to-air missiles with nuclear warheads. [redacted]

(b)(1)

[redacted] we doubt that the Soviets have equipped a large percentage of their surface-to-air missile force with nuclear warheads. However, some nuclear warheads have probably been provided for the defense of Moscow and perhaps for other major urban-industrial centers. Allocation of nuclear warheads for surface-to-air missiles will probably increase over the next few years, but we consider it unlikely that the Soviets will seek to provide such warheads for all missile units or sites.

155. We have estimated that the Soviets will probably begin at least limited deployment of an antimissile system in the period 1963–1966. Several of the thermonuclear devices tested in 1958 might lend themselves to such application. We believe that the Soviets have not conducted nuclear tests in space or above about 30,000 feet and that they probably lack basic effects data on high altitude and space detonations. The lack of such data probably would hinder, but not prevent, Soviet development of a suitable nuclear warhead. There is some evidence that the Soviets intend to use nuclear warheads within the atmosphere and fragmentation warheads outside of the atmosphere. [redacted]

(b)(1)

156. We have no estimate as to the magnitude of a projected Soviet antimissile deployment program. However, if such a system were to be widely deployed, it might place new and heavy demands upon Soviet stocks of fissionable materials which would be felt even before actual deployment.

Support of Ground Operations

157. There is ample evidence in current Soviet military doctrine and training that the Soviets contemplate the use of nuclear weapons on the battlefield in support of ground operations. This doctrine envisions delivery of nuclear weapons by a variety of methods including rifled artillery, free rockets, guided missiles, and aircraft. [redacted]

[redacted] The larger medium- and high-yield weapons could be delivered by aircraft or by the types of surface-to-surface missiles now believed available for ground support. We have estimated that the Soviets could now have large numbers of short range missiles (up to 350 n.m.) but we believe that only a small portion of the total inventory would now be equipped with nuclear warheads. However, substantial numbers of the 150 n.m. and 350 n.m. missiles actually deployed probably have nuclear warheads available. Virtually all medium-range missiles (700 and 1,100 n.m.) available for support of field forces would be equipped with nuclear warheads of varying yields.

158. We believe that the present Soviet materials stockpile does not permit the allocation of very large numbers of low-yield nuclear weapons for tactical uses. Within the next few years, the limitations imposed by the availability of fissionable materials will have eased considerably, and Soviet nuclear ground support capabilities will be greatly improved.

Naval Operations

159. There is firm evidence supporting the development of nuclear weapons for naval missions. Of the weapons tested by the USSR, a number of medium- and low-yield weapon types would be suitable for use against naval targets. There have been nuclear tests in the Novaya Zemlya area which almost certainly relate to naval effects or to the development of naval weapons. We have evidence of nuclear weapon storage facilities at naval airfields and believe that nuclear weapon storage sites are probably also available to certain naval, surface, and submarine-launched missiles.

160. The allocation to Soviet naval forces almost certainly is being increased with the growth in the numbers of guided missiles available to naval units. We have estimated that all submarine-launched ballistic missiles probably will be equipped with thermonuclear warheads. Nuclear warheads probably have also been provided for some portion of the air-to-surface missiles employed by Naval Aviation, and for some of the cruise-type missiles now employed by a few surface vessels. Limited numbers of nuclear bombs, depth charges, torpedoes, and mines are probably available for direct support of naval operations. The growing requirement for more effective anti-submarine weapons to meet the threat posed by US missile submarines probably will result in increased allocations to naval forces.

Summary

161. We believe that the long-range striking forces have been given the largest allocation of fissionable materials, and that at present the Soviet weapons stockpile can support massive nuclear attacks against targets in Eurasia and North America. In view of the large allocation estimated for the long range attack forces, and the size and nature of the overall materials stockpile, limitations are imposed on the numbers of weapons available for other air, ground, and naval operations. These limitations necessarily affect military planning. However, we consider it unlikely that the availability of fissionable materials for nuclear weapons is a factor which in itself significantly limits Soviet policy. We have estimated a considerable growth in the Soviet fissionable materials stockpile which should keep pace with the estimated growth in Soviet missile capabilities for long-range attack, and also ease the limitations noted above.

ANNEX A

ANNEX A

RESEARCH LABORATORIES SUPPORTING THE SOVIET ATOMIC ENERGY PROGRAM

1. Although many laboratories throughout the Soviet Union are engaged in the development of various aspects of the atomic energy program, only a few, aside from those directly under the Ministry of Medium Machine Building (MSM), have borne the main weight of the basic nuclear research effort. The Institute of Atomic Energy of the Academy of Sciences in Moscow (formerly Laboratory II) is undoubtedly the leading institute in this field, and is presently a center for heavy-isotope separation, reactor development, and controlled thermonuclear research. (See Annex A, Figure 2.)

2. The Institute of Chemical Physics (ICP) in Moscow was, and probably still is, closely associated with the development of nuclear weapons. This association is not unexpected in view of this institute's long history of investigations in the various phases of chemical explosives and chemical chain reactions. Several of its scientists have been directly connected with nuclear weapon developments. Moreover, according to repatriated German scientists, the responsibility for implosion systems of nuclear weapons during the mid-1940's was assigned to a committee made up of ICP personnel and headed by N. N. Semenov, the director of ICP.

3. The Physics Institute located in Obninsk, which is believed to be under the administration of the State Committee of the USSR Council of Ministers for the Utilization of Atomic Energy (ATOMKOMITET), is responsible for the development of fast breeder reactors and a power reactor employing nuclear superheat. The institute has recently undertaken research which could lead to the development of an ion propulsion engine and possibly a nuclear power source for space applications.

4. The Leningrad Radium Institute of the Academy of Sciences is a leading institute for basic research pertaining to reactor fuel processing and has contributed to other important phases of the program, such as the measurement of neutron cross sections.

5. The Moscow Institute of Theoretical and Experimental Physics of the Academy of Sciences (previously called Laboratory III and the Thermotechnical Laboratory) has pioneered the development of heavy water reactors in the USSR and has obtained much of the fundamental nuclear physics data required by the Soviet atomic energy program.

6. The Moscow Metallurgical Institute imeni Baykov appears to be the center for the development of metals resistant to high temperature, while the development of ceramics and cermets for high temperature reactors is being conducted in Kiev at the Institute of Metallic Ceramics and Special Alloys of the Ukrainian Academy of Sciences.

7. The State Institute of Rare Metals (GIREDMET) in Moscow and the Moscow Institute of Non-ferrous Metals and Gold imeni Kalinin are active in the study of the metallurgy of thorium, beryllium, zirconium, niobium, molybdenum and other non-ferrous metals necessary to the atomic energy program. Recently an affiliate of the latter institute has been established at Krasnoyarsk where it appears to be conducting the same type of research, but probably with more emphasis on the classified aspects of the Soviet atomic energy effort.

8. The Joint Institute of Nuclear Research at Dubna is partially manned and financed by Satellite countries and Communist China. Though it is concerned primarily with basic research in high-energy nuclear physics, a fast pulsed reactor ("Merry-go-round"), which could be important to future atomic energy programs, was put into operation in its Laboratory of Neutron Physics in June 1960.

9. Besides these institutes, the USSR Academy of Sciences and its affiliates operate a vast network of research institutes and laboratories which are engaged in the broad field of science and technology. At these institutes, such as the Tomsk Polytechnical Institute and Kharkov Physico-Technical (see annex A Figure 1), some basic research pertaining to nuclear energy is conducted, generally in a specialized field.

10. The leading educational institutes under the Ministry of Education perform contract research for ATOMKOMITET and the MSM and are used to train the technicians for the operation of such installations as atomic power stations. The development of these large research and training centers are now beginning to strengthen the Soviet capability in the field of atomic energy. (See Annex A Figure 2.)

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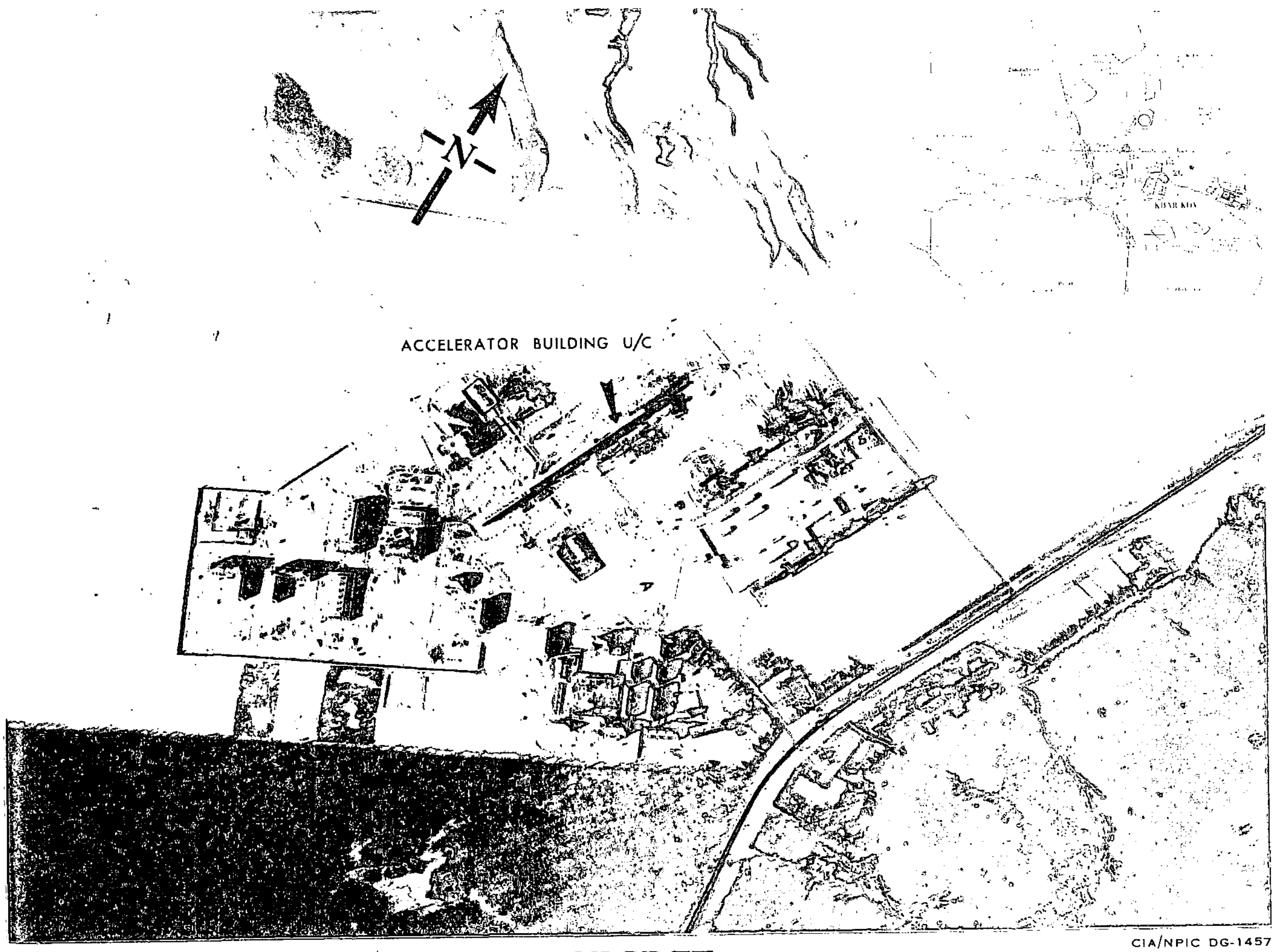
ANNEX A Figure 1

KHARKOV LINEAR ACCELERATOR



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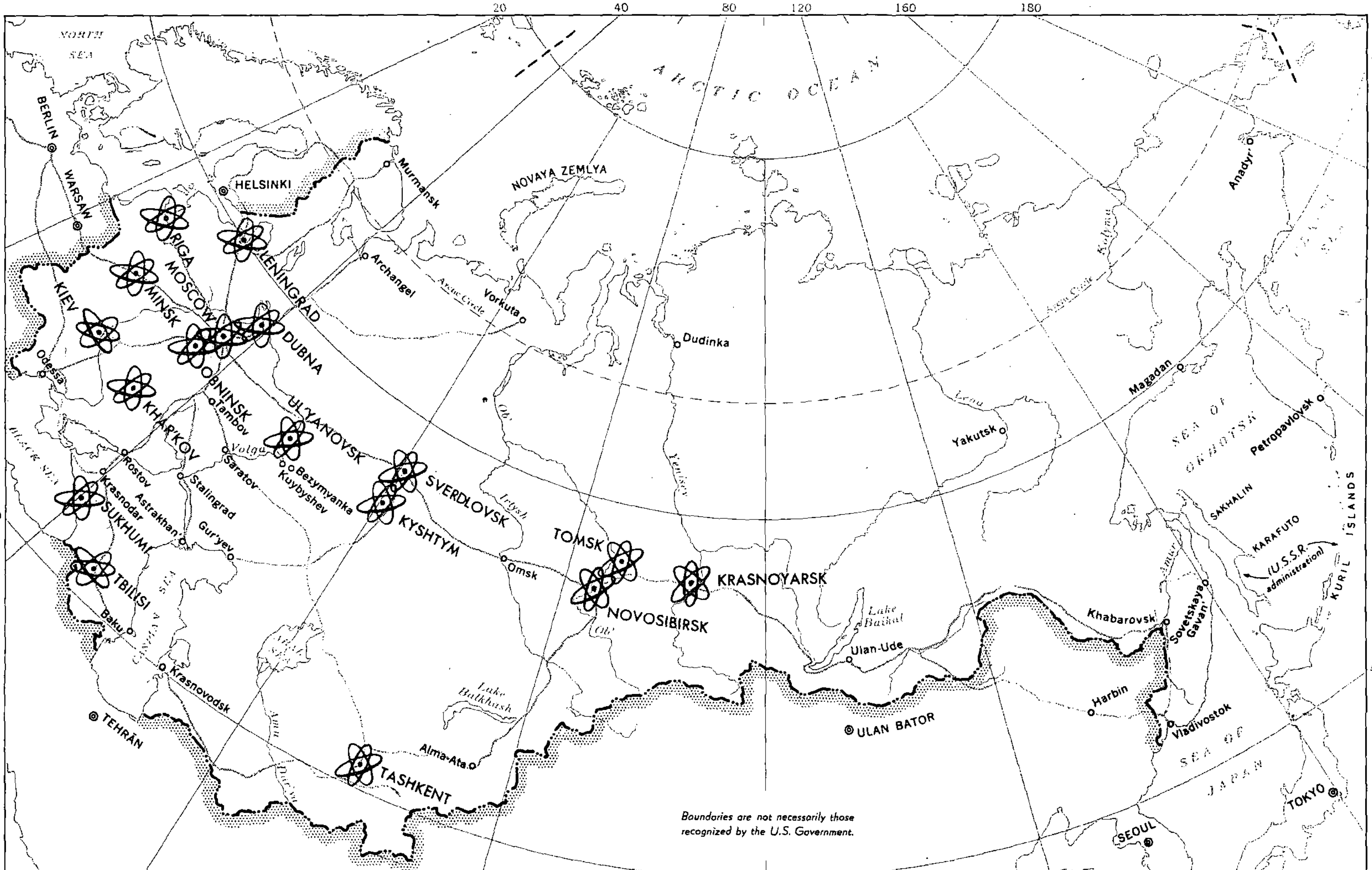

USSR
MAJOR NUCLEAR RESEARCH CENTERS

Present

Future

0 250 500 1000 1500 2000
Statute Miles

0 250 500 1000 1500 2000
Kilometers

Railroad (selected)

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