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SOVIET GUIDED MISSILE CAPABILITIES AND PROBABLE PROGRAMS

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Submitted by the

DIRECTOR OF CENTRAL INTELLIGENCE

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on 20 December 1955. Concurring were the Special Assistant for Intelligence, Department of State; the Assistant Chief of Staff, G-2, Department of the Army; the Director of Naval Intelligence; the Director of Intelligence, USAF; the Deputy Director for Intelligence, The Joint Staff; and the Atomic Energy Commission Representative to the IAC. The Assistant Director, Federal Bureau of Investigation, absented the subject being outside the jurisdiction of the FBI.

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SOVIET GUIDED MISSILE CAPABILITIES AND PROBABLE PROGRAMS

THE PROBLEM

To re-estimate, wherever new evidence is available, Soviet capabilities and probable programs in the guided missile field.

FOREWORD

This estimate brings up to date and supplements, wherever new evidence was available, our previous estimate on "Soviet Capabilities and Probable Programs in the Guided Missile Field," NIE 11-6-54, dated 5 October 1954. At that time, we had no firm intelligence on specific Soviet missile capabilities. Therefore we were forced to base our specific capabilities estimates entirely on: (a) the available evidence of general Soviet missile activity, including exploitation of German missile experience; (b) extrapolation from our own guided missile experience; and (c) estimated Soviet capabilities in related fields. Similarly, our estimates of Soviet intentions had to be based on probable Soviet military requirements.

Since publication of NIE 11-6-54, new intelligence has confirmed our previous estimate that the USSR has an extensive guided missile program. The new intelligence has also changed and in some particulars strengthened our estimates of Soviet surface-to-surface and surface-to-air missile capabilities.

It is emphasized that we have no new intelligence concerning Soviet air-to-air or submarine-launched missiles, and very little new information concerning air-to-surface missiles. Our estimates in these fields therefore remain based on the analysis in NIE 11-6-54 which was necessarily speculative and in many cases based primarily on estimated Soviet requirements and US missile experience. The corresponding conclusions of NIE 11-6-54 have been carried forward into this estimate for convenience of reference only.

The dates given in this estimate are the probable years during which small quantities of missiles could have been produced and placed in the hands of trained personnel of one operational unit, thus constituting a limited capability for operational employment. These dates are based on the assumption that a concerted and continuous effort began in 1948, and are those around which the missile could have been operationally tested and be ready for series production. However, an additional period (which would vary according to missile type) would be required before missiles could be produced in quantity and the necessary units trained and deployed.

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We estimate that at least an additional six months would normally be required for shift or conversion from pilot plant to series production, and an additional period to reach the planned production rate. Some 18 months to two years would probably be required for individual and unit training of each operational unit, although this period could to a considerable extent overlap the production period.

CONCLUSIONS

1. The USSR is engaged in an extensive guided missile program. We estimate that the Western Powers face a growing Soviet guided missile threat over the next several years. A threat to Western offensive capabilities is already beginning to appear in the form of increased Soviet air defense strength. This threat will probably soon be followed by improved Soviet offensive capabilities against US and Allied coastal areas and sea lines of communication, and in tactical operations. Later the threat will probably extend to all Allied base areas in Eurasia and its periphery, and ultimately to the entire US. (Paras. 9-10)

2. With the passage of time, the increasing size of the Soviet nuclear stockpile and the larger yields estimated to be available from nuclear warheads will make missiles an increasingly effective means of nuclear attack.¹ However, we believe that for the next several years the USSR would rely primarily on high performance aircraft for the delivery of nuclear weapons. Nevertheless, the advantage of surprise and other considerations might warrant earlier use of missiles with nuclear warheads for certain purposes.

SPECIFIC MISSILE CAPABILITIES

3. *Surface-to-Air Missiles.* The USSR is probably devoting very high priority to

¹See Annex A, *Restricted Data*, for estimates of time-phased warhead yields.

producing such missiles to overcome its air defense deficiencies. We believe that it now has deployed, at least in the Moscow area, operational surface-to-air missiles. Their performance characteristics are unknown, but might be superior to those previously estimated (see NIE 11-6-54).² The low yield nuclear warhead which could be available after 1958 would greatly increase their kill probability. (Paras. 11-17)

4. *Surface-to-Surface Ballistic Missiles.* Although the USSR could employ non-ballistic guided missiles from ground launchers, we believe that it would favor ballistic missiles because of their relative immunity to presently known countermeasures and their greater capability for achieving surprise. In view of growing

²The Assistant Chief of Staff, G-2, Department of the Army; the Director of Naval Intelligence; and the Deputy Director for Intelligence, The Joint Staff, believe that:

Although the performance characteristics are now unknown, they would very probably exceed those previously estimated (see NIE 11-6-54). It appears highly unlikely that the USSR would produce and employ missiles on the scale apparent from observation of the Moscow complexes without achieving, in their opinion, a substantial measure of defense against attacking aircraft.

This belief is reinforced by evidence of the advanced state of Soviet developments in other missile fields, and the importance which the Soviets must attach to the development of a really effective air defense which would so greatly increase their strategic flexibility.

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Allied tactical nuclear capabilities in Europe the USSR will probably give high priority to producing ballistic missiles for support of its field forces. However, aside from these missiles the USSR will probably concentrate over the next few years more on ballistic missile development than on quantity production. We estimate that: (Paras. 18-20)

a. *Short Range.* The USSR, in addition to shorter range ballistic missiles, could have had since 1954 an operational 350 mile ballistic missile with a CEP of two miles.³ We believe that the USSR has not developed a 500 mile missile. (Paras. 21-23)

b. *Medium Range.* The USSR could have ready for series production in 1955-1956 a single-stage, ballistic missile of 850-900 miles range, with a CEP of three to four miles. However, only a low yield nuclear warhead probably would be available for the next few years. (Paras. 24-25)

c. *Intermediate Range Ballistic Missile (IRBM).* In 1958-1959 the USSR could have ready for series production a dual stage ballistic missile of about 1,600 miles range with a CEP of three to four miles. Large yield nuclear warheads would probably be available in 1959-1960. If the USSR were willing to accept a reduced range of 1,400 miles, this missile could be made ready for series production as early as 1957, but in this case only a low yield nuclear warhead would be available. (Paras. 26-27)

d. *Intercontinental Ballistic Missile (ICBM).* We now estimate that as soon

³ CEP (Circular Probable Error) means 50 percent hits within the stated radius. All CEPs and ranges are given in nautical miles.

as 1960-1961 the USSR could have ready for series production an intercontinental ballistic missile of 5,500 miles range, with a large yield nuclear warhead and a CEP of roughly five miles. Advent of such an ICBM would create an entirely new type of threat to the US. (Para. 28)

5. *Earth Satellite.* We estimate that the Soviets are attempting to develop such a vehicle at the earliest practicable date and could have a relatively uninstrumented vehicle by 1958. A vehicle which could gather and transmit upper atmosphere scientific data could be available by 1963. (Paras. 29-30)

6. *Air-to-Air Missiles.* We have no new intelligence which either strengthens or changes our estimate in NIE 11-6-54, that "because of its air defense weaknesses, the USSR is probably also assigning a very high priority to air-to-air missiles. We estimate that it could develop in 1955 a guided rocket with infrared homing and in 1955-1958 an improved version with greater range. However, their guidance system would permit only tail cone attacks under generally fair weather conditions at the engagement altitude. In 1958-1960 the USSR could probably have a new all-weather missile." (Para. 31)

7. *Air-to-Surface Missiles.* New intelligence partially supports estimates in NIE 11-6-54, but does not warrant a change therein. NIE 11-6-54 stated that "the USSR also would almost certainly seek to produce in quantity any precision weapon available for effective HE antiship attacks. For this purpose it could now have available and would probably produce a rocket-propelled glide bomb, although limited to good visibility condi-

tions. In view of its extensive bomber capabilities, we do not believe that the USSR would produce a long-range air-to-surface missile for attacks on Allied ports and bases over the next several years. In 1960, on the other hand, when we estimate that an all-weather air-to-surface missile with nuclear warhead could be ready for series production, there will probably be a high priority Soviet requirement for a weapon of this type because of the increased effectiveness of Allied air defenses around key target areas." (Para. 32)

8. *Submarine-Launched Missiles.* We have no credible new intelligence which

either changes or strengthens our estimate in NIE 11-6-54 that "the USSR will almost certainly have a requirement for submarine-launched missiles for nuclear attacks on US and Allied coastal areas. It could already have available improved V-1 types with nuclear warheads. In 1955 the USSR could have ready for series production a turbo-jet pilotless aircraft (nonballistic guided missile) with improved range, speed, and accuracy, and by 1958 its nuclear warhead yield could approach compatibility with its estimated accuracy and greatly increase its effectiveness." (Para. 33)

DISCUSSION

9. In NIE 11-6-54 (dated 5 October 1954) we estimated that the strategic requirements of the USSR would dictate a major effort in the field of guided missiles, and that the USSR has the basic scientific and technical capabilities to support a comprehensive research and development program. We also estimated that the USSR has an adequate economic base for a sizeable production program; however, because of the limited capabilities of the Soviet electronics and precision mechanisms industries and other competing demands for their output it would almost certainly be unable to produce in the desired quantities all of the missiles for which it has an estimated military requirement, except over an extended period of years. Finally we estimated, on the basis of the large number of personalities and activities believed to be involved in the Soviet missile program and our knowledge of the extensive Soviet exploitation of German missile experience, that the Soviet program was an extensive one. However, we had no firm intelligence on what specific missiles the USSR was actually developing or might already have in operational use.

10. The intelligence which has become available subsequent to NIE 11-6-54 generally substantiates the above conclusions and reinforces our estimate that an extensive Soviet missile program is underway.⁴ In the category of surface-to-surface ballistic missiles we now believe that Soviet progress has been somewhat more rapid than previously estimated and that such missiles, up to and including an ICBM, will become available at somewhat earlier dates. Moreover, new evidence indicates that the USSR has already embarked on series production of surface-to-air missiles.

I. SURFACE-TO-AIR MISSILES

11. The most significant development in this field is the extensive reporting on what appear to be air defense missile sites around Moscow. Allowing for probable duplication in reporting we estimate that approximately 40 complexes actually have been observed. The earliest observation of one of these sites was in mid-1953, with the majority being observed in late 1954 and 1955. Of these 40 sites, about 12 have been located with sufficient accuracy

⁴ Annex B (limited distribution) contains additional background information.

to indicate that they are eight to nine nautical miles apart, and are located on two circles approximately 25 and 45 nautical miles from the center of Moscow. Observation in all sectors surrounding Moscow has not been possible, but, by calculation based on the above information, the defenses might consist of 55 to 60 sites. We estimate that about 25 sites are now operational, with the others in various stages of construction. At the present rate of progress, this entire Moscow guided missile defense system could be operational in late 1956. A few sightings of similar installations in the initial stage of construction were also reported in the Leningrad area in the summer of 1955.

12. Each site measures approximately one mile by one-half mile with three longitudinal and about 11 transverse concrete roads, and has approximately 60 launching positions. Each apparently has an associated building complex of sufficient size to house some 400 personnel. From available evidence, it is readily apparent that these sites, including associated installations and roads, are well constructed, permanent type installations, such as would form a part of a fixed air defense system. The dimensions, configuration, disposition, and quality of construction of these installations appear compatible with their use as guided missile launching sites.

13. Certain equipment, commonly known as "YOYO," has been reported as a part of 25 of the sites and probably exists at every site. In each case the "YOYO" is located approximately one mile from the site on the Moscow side, and is generally aligned with the center longitudinal road. Available information suggests that the "YOYO" could be a radar for use in a surface-to-air missile guidance system. Its antenna configuration and the fact that so many missiles are deployed in each associated site suggest that such a radar would have a high traffic handling capability.

14. Recent observations indicate that missile-like objects, about three feet in diameter and 20 to 35 feet in length, were present at some of the Moscow sites. At one site about 60 missile-like objects were seen standing, one in each of the recesses along the transverse

roads. The observations also indicate the existence of an extensive newly-constructed facility believed to be a partial fabricator and final assembler of surface-to-air guided missiles for the missile defense system ringed Moscow. Its identification as a missile supplier is based on the presence of more than 450 missile-like objects which are similar in size to missiles reported at air defense missile launching sites being constructed around Moscow. The facility is located approximately three to four miles south of Istra, some 25 nautical miles west-northwest of the center of Moscow.

15. We conclude that the Moscow installations are surface-to-air guided missile launching sites in support of the defense of Moscow and that the USSR now has an air defense missile system in at least limited operational use.

16. We still have no firm evidence as to the specific characteristics of the missile-like objects observed. A type of command guidance system probably would be employed, possibly augmented by terminal homing. Alternatively, a guidance system involving track-illumination type radars, a computer system, and a semiactive homing head might possibly be employed. The missile could have a payload of 600 pounds if terminal homing were not employed. This weight might be reduced by about 100 pounds to make room for the homing head, but this would be compensated for by the increase in accuracy.

17. Because of its air defense deficiencies, the USSR is almost certainly continuing to give very high priority to developing improved surface-to-air missiles. By 1957-1958 we estimate that a new missile could be ready for series production incorporating terminal homing. By 1958 at the earliest, the USSR could develop low yield nuclear warheads suitable for this missile which would greatly increase its kill probability. Beyond this, we believe that the Soviets will endeavor to develop improved missiles with ranges on the order of 100 nautical miles. However, owing to the many technical difficulties involved, it is highly unlikely that the USSR could develop such missiles until some time after 1960.

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II. SURFACE-TO-SURFACE BALLISTIC MISSILES

18. Information on Soviet activities at the Kapustin Yar guided missile test range has improved since the publication of NIE 11-6-54. A detailed sketch of the launching area was prepared in October 1954 by five Germans who had visited the range in the fall of 1947. During early 1955 the British prepared a mosaic of the area utilizing 1942 German aerial photographs and maps. By comparing the sketch with the mosaic, locations of the rocket engine static test stand, assembly area, launching platform, and railroad lines have been determined as they existed in 1947. Study of Soviet activities at Kapustin Yar also indicates an increase in missile testing in 1955 over 1954. Our information indicates that considerable numbers of ballistic missiles are being tested. Although the information so far available does not permit accurate assessments of the actual ranges involved, it indicates the scale of the program and strengthens some aspects of our ballistic missile estimates.

19. Recent Soviet technical articles indicate that the Soviets have an excellent understanding of inertial guidance systems and associated problems. Soviet interest in inertial guidance systems is also apparent from projects assigned the Germans in 1948-1950 and from various Soviet inquiries into such systems. Inertial guidance systems are secure from detection and jamming, and are ideally suited to maximize the surprise factor and offensive potential of ballistic missiles. We believe the USSR has considered the utilization of inertial guidance in its ballistic missile program.

20. Aside from tactical missiles for support of its field forces, we continue to believe that for the next few years the Soviet surface-to-surface ballistic missile effort will probably be concentrated more upon development of improved missiles than upon quantity production of interim types. By 1958-1960 the estimated growth of the Soviet nuclear stockpile and the larger warhead yields probably available would have reduced the significance of any limitations which the accuracy or reliability

of such missiles systems might have placed upon their earlier production.

21. *Short Range.* The following new information strengthens our short range ballistic missile estimates in NIE 11-6-54. German engineers in the USSR worked on the plans for a large rocket-engine test stand facility during the period 1946-1950. This test facility was being designed for the Zagorsk area (38 nautical miles north-northeast of Moscow), and one German actually went to survey the site in the fall of 1947. Plans for this project indicated that several rocket-engine test stands would be constructed and that two of them would be capable of testing rocket engines with thrust ratings up to 50 tons. Complete measuring equipment, fuel preparation facilities, and a liquid oxygen installation were planned. Although no positive identification of this facility has been made to date, we believe a rocket engine static test facility possibly exists in the Zagorsk area. This location is conveniently accessible to a major Soviet missile propulsion development center at Khimki (11 nautical miles north-northwest from Moscow), where 25, 35, and 100 ton thrust engine developments have taken place.

22. New intelligence strengthens our estimate that the USSR is interested in developing a 350 mile missile but does not substantiate a program for development of a 500 mile missile. We have no evidence of any ballistic missiles available for operational use, but we continue to estimate as in NIE 11-6-54 that the USSR could now have operational a 350 mile missile with a nose cone weight of 3,000 pounds, including a 2,000 pound payload, and a CEP of two miles. However, for the next few years only low yield atomic warheads would be available. Alternatively the USSR could now have available a shorter-range missile capable of carrying larger warheads. Such a missile could have a somewhat smaller CEP than the one above.

23. To counter growing Allied all-weather nuclear capabilities in Europe, the USSR will probably give high priority to a missile system for support of its field forces. The short-range missiles estimated to be now available might satisfy this requirement.

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24. *Medium Range.* The chief designer at Plant #456, Khimki, was reportedly elected a corresponding member of the Department of Technical Sciences of the Academy of Sciences in October 1953. His selection to this position, a high honor in the USSR, may indicate the successful development of the 100-ton thrust engine with which he was associated at plant #456. Earlier reports containing information dating back to 1948 indicated that this person would be awarded some honor if the development of the 100-ton thrust engine was successful.

25. Based on new information and reassessment of Soviet capabilities in the light of US missile experience, we estimate that a single stage missile using the 100-ton thrust engine, with a range of approximately 850-900 miles, a nose cone weight of 3,000 pounds, including a 2,000 pound payload, and a CEP of three to four miles could be ready for series production sometime during 1955-1956. However only low yield nuclear warheads would be available for a few years after these dates.

26. *Intermediate Range Ballistic Missile (IRBM).* Reanalysis of a Soviet demand on a group of German engineers in the spring of 1949 to design a missile capable of carrying a warhead of 6,600 pounds to a range of 1,600 miles leads us to the conclusion that the Soviets have probably established a requirement for an intermediate range ballistic missile with this range rather than the 1,300 miles estimated in NIE 11-6-54. In the light of more recent nuclear warhead developments, we believe that the warhead weight requirement would be reduced without change in range requirements. Ballistic missiles with ranges of 1,600 miles would be capable of reaching all vital targets in Europe, North Africa, Japan, and Alaska from launching areas within the USSR itself.

27. By utilizing the 100-ton engine as the booster together with the 35-ton thrust engine the USSR could develop a two-stage missile with a range on the order of 1,600 miles, a 3,000 pound nose cone weight, including a 1,650 pound payload, and a CEP of three to

four miles. Assuming development was initiated in 1948, the earliest probable date at which this missile could be ready for series production would be 1958-1959. We estimate that a large yield nuclear warhead could be available for it in 1959-1960. Such a missile could also provide a research vehicle for obtaining data pertinent to an intercontinental ballistic missile. We also estimate that the above missile, with the same payload, but with the range reduced to 1,400 miles, could be ready for series production as early as 1957.

28. *Intercontinental Ballistic Missile (ICBM).* We believe an intercontinental ballistic missile would be within Soviet capabilities and is probably being undertaken on a very high priority. Much of the data and experience gained by the USSR in its mid-range missile program is applicable and necessary to logical step-by-step progression to an ICBM. Such missile could have an estimated range on the order of 5,500 miles, a 3,000 pound nose cone weight, including a 1,500 pound payload, and a CEP of roughly five miles. Based on information acquired on the Soviet missile program since publication of NIE 11-6-54, we now estimate that the first operational model could be ready for series production by 1960-1961, and that large yield nuclear warheads would be available by this time.

29. *Earth Satellite Vehicles.* Some time prior to November 1954, a Permanent Interdepartmental Commission for Interplanetary Communications was established in the Soviet Academy of Sciences. The stated purpose of this Commission is to "coordinate work on the solution of the problems of mastering cosmic space." One of its first tasks reportedly will be "organizing work for the creation of an automatic laboratory . . . which could revolve around the earth . . . over a long period of time . . . as a satellite." Formation of this Commission is the first known official indication of a coordinated survey of the theoretical problems involved in establishing a space satellite or in space travel, although many individual Soviet scientists have shown considerable interest in these fields. In addi-

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tion, recent statements by Soviet officials and scientists indicate a high degree of interest in earth satellites and a Soviet intention to launch one or more such vehicles at the earliest practicable date. We believe that the USSR would place considerable emphasis on such a vehicle, primarily to achieve psychological effect.

30. We estimate that the USSR possesses the basic scientific capabilities, technical skills, and other resources required to build and launch an unmanned earth satellite vehicle. A relatively uninstrumented vehicle could probably be orbited by 1958. A satellite vehicle which could be used to gather and transmit upper atmosphere scientific data would probably be within Soviet capabilities by 1963. We believe that the majority of the work of designing, fabricating, testing, and launching an unmanned satellite could be accomplished without significant interference with high priority Soviet guided missile work.

III. AIR-TO-AIR MISSILES

31. No significant intelligence on air-to-air missiles has become available since the publication of NIE 11-6-54. However, we know that Soviet fighter aircraft now carry airborne intercept radar, which could be used in conjunction with air-to-air missiles.

IV. AIR-TO-SURFACE MISSILES

32. In addition to the evidence presented in NIE 11-6-54, Design Bureau 2 (KB-2), Moscow, is known to have engaged in research and development work from 1947 to 1951 on a guidance system for a Soviet designed air-to-ship missile system designated KOMET. There are some indications that this missile system would have a maximum guidance range of approximately 55 nautical miles. The KOMET's X-band guidance system was designed to use mid-course beam-riding and semiactive radar terminal homing. Prior to 1951, approximately six sets of guidance equipment suitable for flight testing were fabricated by the German group involved. The guidance system under development could be applicable to higher performance air-to-surface and surface-to-air missiles. This evidence, however, is not considered sufficient to cause us to change our estimate in NIE 11-6-54.

V. SUBMARINE-LAUNCHED NONBALLISTIC GUIDED MISSILES

33. We have received some additional information concerning Soviet activities in submarine launched missiles; however, the information is of such doubtful credibility as to preclude its use in either supporting or changing the estimate in NIE 11-6-54.