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25 March 1958

SOVIET GUIDED MISSILE AND SPACE FLIGHT PROGRAMS

Congressional Briefing for the  
House Select Committee on  
Astronautics and Space Exploration

1. Mr. Chairman, the purpose of this presentation is to furnish a summary of Soviet space flight capabilities, intentions and possible programs. Inasmuch as your Committee is concerned with all vehicles moving through outer space (above roughly 100-200 miles altitude), I will also briefly cover our assessments of those Soviet long-range ballistic missiles whose trajectories pass through outer space. For example, an ICBM will reach altitudes of 500-1000 miles depending on its configuration and planned trajectory; and an IRBM will reach 300 miles altitude - near the planned orbit altitude of some of our earth satellites.

2. We believe the Soviet ballistic missile program has contributed directly to, and provided the basis for, their earth satellite activities to date. Consequently, I will cover the missile field first.

PART ONE-THE SOVIET BALLISTIC MISSILE PROGRAM

3. Background. Although the USSR had no known guided missile program at the close of World War II, we have conclusive evidence of their great postwar interest in guided missiles. Immediately after World War II, they thoroughly and systematically exploited the German guided missile program,

TS#116079 Final  
Copy/ of 10

especially their ballistic missile, the V-2, which had a range of about 200 miles and reached altitudes of about 70 miles. From this exploitation, the Soviets derived four general benefits: (1) operational and prototype missiles, with range up to 200 miles in the ballistic missile field, research and production facilities and equipment, and approximately 400 German missile specialists; (2) complete reports on German missile developments up to the war's end; (3) the familiarization of their personnel with German techniques of research, development, testing, and production of missiles and components; and (4) advanced technical studies and some development of hardware components, which German scientists performed in the Soviet Union to as late as about 1953.

4. As a result of this exploitation, the Soviet Union was able by 1948 to raise the level of its guided missile knowledge to that which existed in Germany at the close of World War II. We believe that 1948 marks the beginning of a concerted and continuing native Soviet missile research and development program.

5. General Conclusions on the Soviet Guided Missile Program:

a. We estimate that the Soviet guided missile program is extensive and enjoys a very high priority.

b. We believe that the USSR has the native scientific resources and capabilities to develop advanced types of guided missile systems, and the industrial base and related industrial experience to series produce these guided missile systems.

c. We estimate that the USSR has the capability to develop and produce the nuclear, chemical and/or high explosive warheads necessary to effective missile systems.

TS#116079 Final  
Copy / of 10  
Page 2 of 15

6. Surface to Surface Ballistic Missiles. Our best evidence on the Soviet guided missile program is on their ballistic missile flight test activities. In 1947, the Soviets established a guided missiles test range at Kapustin Yar (SEE CHART) and, with German assistance, fired about 12 captured V-2 missiles in the fall of that year. The test program has been vigorous. Since mid-1953, about 350 ballistic missiles have been flight-tested at Kapustin Yar. These flight tests have been to ranges of about 75, 150, 300, 650 and 950 nautical miles, with the majority being divided about evenly in the 150-, 300- and 650- nautical mile categories. On 22 June 1957, the Soviets fired their first missile to a 950-mile range. Between then and 29 August 1957, seven flight tests were conducted to the 950-nautical mile distance. This extensive test program provides the USSR with an unequaled experience factor in the ballistic missile field.

7. In our current estimates on the shorter-range ballistic missiles, we estimate that the USSR could now have available for operational use, surface-to-surface ballistic missiles with maximum ranges of 75, 200, 350, 700 and 1000 nautical miles. We have, however, no firm evidence of the operational deployment of any of these missiles.

8. ICBM. We have estimated for several years that an ICBM was probably a top-priority aim of the Soviet Union. A summary of evidence bearing on the ICBM question follows:

a. Soviet interest in the ICBM field has been evident since 1947 when Stalin stated that he wanted a weapon which could bombard New York.

TS#116079 Final  
Copy / of 10  
Page 3 of 15

TOP SECRET

b. In 1951, a large rocket engine of about 220,000 pounds thrust was being fabricated. This engine could have been static tested in 1952 and ready for incorporation into a missile system in 1953. The thrust rating of this engine could have been increased by now and the coupling of two or more such engines is within Soviet capabilities, although we have no evidence that either advancement has been accomplished.

c. The existence of a new 3,500 nautical mile ballistic missile test range has been firmly established. (SEE CHART) We believe that three ICBM vehicles have been flight tested on this range and that both Soviet satellites were launched from here. The official Soviet announcement on 26 August of the successful test firing of an ICBM and Mr. Khrushchev's statement to Mr. Daladier that he (Khrushchev) has personally witnessed the successful trial of the second Soviet ICBM on 7 September 1957 are further support of the ICBM vehicle flight tests.

9. With this brief review of our evidence and bearing in mind the extensive Soviet ballistic missile experience factor mentioned earlier, I will now turn to our current estimate of Soviet ICBM capabilities. We believe the USSR is concentrating on the development of an ICBM which, when operational, will probably be capable of carrying a high-yield nuclear warhead to a maximum range of about 5,500 nautical miles, with a CEP of five nautical miles or less at maximum range, and a system reliability of about 50 percent. Army Intelligence believes that the initial Soviet ICBM capability will be restricted to a range of about 3,800-4,500 nautical miles and that the longer range (5500 nm) will only be achieved at a later date.

TS#116079 Final  
Copy / of 10  
Page 4 of 5

10. The date at which the USSR will have a first operational capability with the ICBM will depend on many factors, apart from the over-all urgency of the program. These factors include the extent of technical success in missile testing and the availability of launching facilities, supporting equipment, and trained personnel to operate the system. We estimate that some time during the period mid-1958 to mid-1959, the USSR will probably have a first operational capability with up to 10 prototype ICBM's, with characteristics approximating those estimated above. I should like to emphasize, however, that we have no firm evidence of the construction of bases for launching ICBM's or of their deployment.

11. ICBM's could probably be produced, launching facilities completed, and operational units trained at a rate sufficient to give the USSR an operational capability with 100 ICBM's about one year after its first operational capability date (mid-1959-60), and with 500 ICBM's about two or at most three years (mid-1962-63) after first operational capability date.

#### PART TWO-SOVIET SPACE FLIGHT PROGRAM

12. Now I will turn to the Soviet space flight program. My remarks will be based on CIA's views of the Soviet space flight activities, particularly their intentions, capabilities and possible programs.

13. Background. Evidence of Soviet interest in space flight dates back to the publication in 1903 of a paper titled "Investigation of Universal Space by Means of Rocket Flight" by the eminent Russian scientist, K. E. Tsiolkovskiy. This was highly scientific treatise which, for the first time mathematically established the fundamentals of rocketry, and made a

TS#116079 Final  
Copy / of 10  
Page 5 of 5

proposal for an artificial scientific earth satellite. The first significant, coordinated and systematized rocket studies began in the USSR in 1929 when the "Group for the Investigation of Reactive Motion" was organized. In 1934, Stalin personally took a hand in the organization of a government-sponsored rocket research program.

14. In April 1955, the USSR officially announced the establishment of the "Interagency Commission for Interplanetary Communications," stating that "one of the first tasks would be to organize work on the creation of an automatic laboratory for scientific research in cosmic space and that this would be the first step in solving the problems of interplanetary travel and allow Soviet scientists to probe more deeply into the secrets of the Universe". This Commission is directly under the Academy of Sciences and is composed of some of the leading Soviet scientists in the fields associated with space research.

15. Since early 1955 there have been close to 500 articles on space research, earth satellites and manned space flight, many by high calibre Soviet scientists. Most of these articles deal with the theoretical principles of space flight. Although they do indicate the general level of Soviet knowledge, very few provide any indication of Soviet intentions and programs. All of these articles are reviewed and over 100 have been completely translated in CIA for the benefit of the intelligence community and for other interested government and non-government institutes and scientists.

TS#116079 Final  
Copy / of 10  
Page 6 of 15

16. We continually evaluate all of these articles for indications of their level of knowledge, intentions, capabilities and probable programs. From these assessments and related intelligence information, we have concluded that the USSR has a very great interest in space flight and is probably pursuing a vigorous research and development program with the ultimate goal being manned space flight.

17. Capabilities and Intentions. Available evidence bearing on Soviet activities and accomplishments in related areas of science and technology indicates that the USSR has the potential, and is currently in the midst of a large-scale effort to acquire the capabilities essential to successful unmanned and manned space flight.

18. Soviet capabilities in the development and effective utilization of high powered rocket devices were strikingly demonstrated in the successful launching of the world's first two artificial earth satellites on 4 October and 3 November 1957, reportedly weighing about 184 and 1120 pounds respectively. At present, we do not doubt the reported weights or that a dog is carried in SPUTNIK II. Our detailed calculations on what would be required, instrument and weight wise, to accomplish the experiments claimed in SPUTNIK II show that the purported weight of 1120 pounds is probably accurate.

19. Heavier and more sophisticated satellites are expected to follow as a logical part of their space flight research program. Many of these will require very large booster engines. We have good evidence that the USSR has large rocket engines capable of producing about 220,000 pounds thrust.

TS#116079  
Copy / of 10  
Page 7 of 15



These are the engines I mentioned earlier under their ICBM program.

Utilization of these engines in clusters could provide the greater thrusts (up to about 1.5 million pounds) required for manned lunar and other outer space explorations. Soviet emphasis on large rocket engines is well known, and it is likely that they are currently working on even larger engines, perhaps with thrust in the order of one-half million pounds each.

20. It is believed that current Soviet propulsion systems for launching satellites and space craft are based on chemical systems featuring pairs of liquid propellants. SPUTNIKS I and II could have been launched using conventional liquid fuels, such as kerosene and liquid oxygen. However, higher energy producing fuel combinations will be needed for the launching of larger payloads. We have evidence of Soviet research in this field, but no firm evidence of their application of high energy fuels to their earth satellite program.

21. Solid propellants are also important to a space research program in that they provide reliable propulsion units capable of ignition at high altitudes. Such units are needed for the third and fourth stages of space vehicles. We have very little evidence of Soviet work on solid propellant suitable for space flight programs. However, based on the high calibre of their small-grain solid propellant work during and after World War II, we believe their knowledge of solid propellant technology to be generally equal to that of the West.

TS#116079 Final  
Copy / of 10  
Page 8 of 15

22. Nuclear propulsion systems offer a much greater potential as far as space vehicle weights and flight duration times are concerned. However, such systems involve very high temperatures (about 3-5000°C) requiring the development of structural materials which can accommodate these temperatures without melting. We believe that the USSR may be able to solve these problems and achieve a nuclear rocket propulsion system in about 1965.

23. Turning now to the field of guiding an earth satellite or space vehicle; the Soviets are currently considered capable of controlling unmanned space vehicles in orbital or directionally programmed space flight trajectories with accuracies sufficient to achieve near circular orbits of the earth, lunar impacts and lunar probes. The specific guidance system or combination of systems used in the Soviet Space Flight Program is not known. The open Soviet literature contains ample evidence of native competence in the basic aspects of guidance of space vehicles. Soviet capabilities in the various other electronics areas supporting an extensive space research program are believed to be generally comparable with those of the West.

24. Soviet research in space medicine <sup>probably</sup> leads that of the West, particularly in rocket flight physiology, space flight equipment and pre-conditioning for gravitational stress. It is this area of Soviet research which provides definite indications of their intent to put man into space. The Soviets have emphasized research related to extremely high altitudes and

TS#116079 Final  
Copy / of 10  
Page 9 of 15

have developed basic research techniques applicable to aeromedicine. This research includes significant work in acceleration, weightlessness, bio-engineering, forced breathing, "sealed cabins" and many other medical aspects directly and solely related to the launching of manned satellites or space vehicles.

25. The successful orbiting of SPUTNIK II as a biological experiment, preceded by many high altitudes (30-120 mile) rocket experiments, has greatly advanced Soviet knowledge and capabilities in aeromedical research; they are able to apply aeromedical research to actual conditions. A careful assessment of our evidence indicates that there is no aeromedical obstacle which prevents the Soviets from orbiting a human being for a period from hours to days within the next year.

26. Soviet research activity in the complicated field of celestial mechanics is also very high. Celestial mechanics is that field of astronomical research which deals with the motions of two or more bodies in space under the influence of their mutual gravitational attractions. Our evidence indicates that they are in a position to make substantial advances in the "state of the art." The Soviet Institute of Theoretical Astronomy, founded in 1923, is the largest of its kind in the world devoted almost exclusively to celestial mechanics research. There is no specialized facility in the West to compare with this establishment. A recent disclosure in connection with Soviet Space Flight activities is a paper summarizing the results of a systematic investigation, undertaken from 1953 to 1955, to find solutions

TS#116079  
Copy / of 10  
Page 10 of / 5

for the fundamental problems posed by a flight to the moon. More than 600 trajectories involving various types of lunar flights were calculated in this study.

27. Space vehicles require an internal power source to operate the various equipment carried therein. Without an adequate internal power supply most scientific experiments and any manned flights would be impossible. These power sources are separate from and in addition to the propulsive power needed to place the vehicle into space. Internal power supply sources involving nuclear-electric plants are within Soviet developmental capabilities, but their considerable weight would permit their use only in very large space craft. We believe it unlikely that the USSR would utilize such power sources within the next 5 to 7 years. In other forms of power sources such as chemical, solar and atomic, the Soviets are considered to have a competence equal to that of the West.

28. My remarks so far have dealt primarily with ballistic configurations. There is another technique for getting man into space which I want to mention before going into our estimates. This involves the use of rocket-powered, winged aircraft, such as the US X-15 project. Soviet activity in this field should therefore be mentioned. Since the flight of their first rocket-powered aircraft in 1940, the Soviets have displayed strong interest in this type of aircraft, and are known to have had an organized program for the investigation of a rocket-propelled, skip-type, intercontinental bomber as early as 1946-47. In recent months, the Soviets have stated on a number of occasions that a manned space vehicle is feasible in the near

TS#116079 Final  
Copy 1 of 10  
Page 11 of 15

future and is one of their prime objectives. It is possible that they recognize in the winged, rocket-powered vehicle, similar to the US X-15, a practical method for the safe return of a man from an initial, limited test flight in outer space. Although direct supporting evidence is lacking, it is believed that the Soviet Union has in being an active and continuous research program involving these type vehicles, and that research prototypes are now or soon will be flying in the USSR.

29. Specific Soviet Space Flight Capabilities and Possible Programs.

Based on demonstrated and estimated Soviet capabilities in the ballistic missile field, their acknowledged interest and intent in the space flight field, and their performance to date, we in CIA have prepared a tentative estimate of Soviet Space Flight capabilities and possible programs. We believe they can pursue this program without seriously interfering with their high priority ICBM program. In fact, many of these early earth satellite firings will provide valuable test data to their ICBM program.

30. The official Soviet News Agency TASS, announced on 20 March that SPUTNIK II was nearing the earth's atmosphere and was expected to "end its existence" between 5 and 15 April. Calculations made by US scientists at the Smithsonian Astrophysical Observatory indicate that the end of SPUTNIK II will occur about 14 April. As you remember, SPUTNIK I made its final orbit on 1 December 1957 and its carrier rocket on 4 January 1958, leaving only SPUTNIK II "representing" the USSR in outer space. Soviet recognition of this fact, together with their predicted "death" of SPUTNIK II

TS#116079 Final  
Copy 1 of 10  
Page 12 of 19

and their awareness of the tremendous psychological effects of their satellite venture, could be a very disturbing factor to their claims of Soviet superiority in this space era.

31. Although we have no evidence indicating the exact date when SPUTNIK III will in fact be placed into orbit, we are expecting an attempt most any day now, and probably before the death of SPUTNIK II in mid-April. We are also expecting something unusual or spectacular. Soviet articles and announcements indicate an interest in many different type of space research programs. Although we can not predict precisely what they may try, we believe they are currently capable of accomplishing one or more of the following type earth satellites - we doubt they will successfully accomplish all of them this year. All of these steps are based on use of the propulsion units of their ICBM as the launching vehicle.

- (1) Orbiting an earth satellite weighing 4000 to 5000 pounds.
- (2) Impacting an object of up to 500 pounds weight on the moon with suitable dye markers or other discernible features to assure that the world will be aware of the event.
- (3) Placing another animal bearing satellite into orbit and attempting recovery thereof.
- (4) Orbiting an optical reconnaissance satellite with a limited resolution possibly capable of detecting fleet movements, large airfields and other large installations, and making weather observations.
- (5) Making a solar probe (shooting an instrumented satellite towards the sun), or creating an artificial asteroid (minor planet

TS#116079  
Copy 1 of 10  
Page 13 of 15

similar to the thousands of small worlds revolving around the sun, mainly between the orbits of Mars and Jupiter).

32. Looking forward into the near future, (a year or so from now, >) we have estimated additional space flight achievements which the Soviets have shown an interest in and are believed to be within their capabilities still using their basic ICBM propulsion units in vehicle.

(1) Making a soft landing on the moon with up to 150 pounds of instrumentation.

(2) Placing an instrumented satellite into orbit around the moon.

(3) Orbiting and recovering a manned satellite; we would expect this event to be preceded by recovery of several animals from satellites. The date the Soviets choose to attempt this feat will depend largely on how certain of success they feel they have to be.

(4) Probing our neighboring planets, Mars and Venus. This might be tried on or about the respective confluence dates (dates at which the planet is in the most favorable position for a space flight to leave the earth). Mars - 20 August 1958 and 15 October 1960; Venus - June 1959 and January 1961.

33. As your committee may have to look far into the future, we have also looked farther ahead. Any estimates of Soviet space flight capabilities in this period must be considered as highly speculative. We have reached some very tentative guesses which you may be interested in.

TS#116079 Final  
Copy of 10  
Page 14 of 15.

TOP SECRET

TOP SECRET

34. If the Soviets are to actively pursue manned interplanetary space flight as they have indicated, the following steps are considered possible courses of action within their capabilities:

(1) If development of the new larger booster mentioned earlier is successful, the USSR could orbit an earth satellite weighing up to 25,000 pounds in 1960. Such a satellite could provide the basic vehicle for further space ventures.

(2) A recoverable manned circumlunar flight in 1961.

(3) Using these large satellites to construct a space platform weighing up to 300,000 pounds in 1963-65.

(4) By 1965-70 landing a man on the moon with a reasonable chance that he could return.

35. Gentlemen, I would like to close my presentation with a few sobering remarks. The USSR is engaged in extensive high priority ICBM and space flight programs. They have demonstrated to the world the highest competence in these fields, ~~(and I doubt that they will easily relinquish this position.)~~

TS#116079 Final  
Copy of 10  
Page 15 of 15