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EVALUATION OF EVIDENCE ON SOVIET ICBM PRODUCTION

8 April 1960

A Report of the Ad Hoc Working Group on ICBM Production of the

GUIDED MISSILE AND ASTRONAUTICS INTELLIGENCE COMMITTEE

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FOREWORD

The GMAIC Ad Hoc Working Group on ICBM Production has reviewed and evaluated, on an all-source basis, available data on specific industrial facilities on which there was some information suggesting possible involvement in the Soviet ICBM production program, as well as facilities which appeared particularly suited for such production. In view of the limited amount of information on Soviet ICBM production and in order to gain additional perspective on the status of ICBM production, the Working Group has also examined additional data unrelated to specific facilities from which conclusions regarding production can be drawn or which might be indicative of ICBM production activity.

The Working Group was composed of representatives of the following agencies, who have concurred in this report: Air Force, Army, National Security Agency, Navy, and CIA (Chairman).

This report presents the conclusions and a summary discussion of the principal findings of the Working Group. It will be followed by a supplementary report in which detailed supporting data will be presented, including the principal items of evidence and the Working Group's evaluation of the specific facilities which were studied.

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EVALUATION OF EVIDENCE ON SOVIET ICBM PRODUCTION

THE PROBLEM

To study and evaluate all-source information potentially relating to Soviet ICBM production; to ascertain if, on-the-whole, the implied pace of the Soviet program or the IOC is different from that contained in current estimates.

CONCLUSIONS

The Working Group has found no evidence bearing on Soviet ICBM production which, in its judgment, would warrant changing current estimates of the timing and magnitude of the Soviet program contained in NIE 11-5-59 and NIE 11-8-59. Although there is no evidence to substantiate directly the IOC date and timing of the series production* program, as estimated in NIE 11-5-59, the bulk of available information from all sources is generally consistent with this estimate and appears to support it. No evidence was found which appeared to have a direct bearing on the estimates of the magnitude and future pace of the ICBM program as contained in NIE 11-8-59.

The extensive evidence available on Plant/NII 88, Moscow/Kaliningrad over many years indicates that this facility constitutes the principal research and development center for ballistic missiles in the USSR, and that it probably fabricated developmental and prototype ICBMs launched at Tyura Tam including boosters for some of the Soviet space vehicles.

We are unable to identify from current evidence a series production facility for the Soviet ICBM, although there is strong indirect evidence that one (or more) must exist. The test program data from Tyura Tam provide strong evidence that a series production facility has been supplying missiles to the range since early 1959. This evidence is sufficient to conclude with considerable confidence that ICBMs have been produced and delivered for operational purposes during the second half of 1959 and that this activity should be proceeding at an increasing but unknown rate.

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* This paper uses the term "series production" as defined in Annex A of NIE 11-5-59. "Series production means production of missiles of like type in accordance with a planned build-up rate for delivery primarily to operational units. However, some of the series produced missiles will be allocated for test and training purposes. Series production commences with the completion of the first missile."

Sverdlovsk and Kuybyshev appear to be the most suspect locations for an ICBM series production facility. At Sverdlovsk, there is evidence pointing to an armaments Plant No. 8; at Kuybyshev, no particular facility can be singled out.

DISCUSSION OF PRINCIPAL FINDINGS

A. Introduction

Because it is not possible to identify Soviet ICBM production facilities, conclusions with respect to the location, magnitude and pace of the production program are dependent primarily on indirect and frequently ambiguous information. Certain significant conclusions can be drawn from such evidence with a relatively high degree of confidence, even though the nature of the information does not permit their validity to be demonstrated incontrovertibly. In other cases, the data are inconclusive in that they suggest a number of alternative interpretations from which the most probable cannot be selected.

The Working Group has considered several bodies of indirect evidence bearing on the problem of Soviet ICBM production. These are the significant relationships, in terms of concepts, time and organization, which are involved in an ICBM production program; the Tyura Tam Test firing data and their production implications; aircraft movements which appear to be associated with the Soviet missile program; and information on specially configured railroad cars which may be indicative of ICBM activity. The Working Group's findings and conclusions with respect to each of these types of information, as well as their limitations, are discussed below, followed by sections dealing specifically with production facilities, and Soviet statements and claims.

B. Production Relationships

There are two fundamental ways to use facilities to produce weapon system hardware for developmental and operational purposes. The first is to produce initial developmental weapons in limited quantities at a research and development facility or "experimental" plant. This is followed by production of the weapon and other elements of the system at other facilities in large quantities necessary for the operational deployment phases of the program. A second concept utilizes a single facility to produce hardware for development and operational deployment. This second concept may include the introduction of follow-on plants to assist the lead plant in fulfilling the requirements for weapons in very large quantities. There is considerable evidence that the USSR has followed the first concept in both surface-to-surface and surface-to-air missile programs.

The evidence on Soviet practices also indicates that the Soviets have adopted a system of programming in which the development and production phases of the program overlap in time to a considerable degree. This method of concurrent programming, as opposed to the practice of consecutive programming, considerably reduces the lead time from the

initiation of development to the successful deployment of the weapon system in the field. This lead-time relationship has become increasingly important for modern weapons systems because of the problem of rapid obsolescence and the fact that industrial mobilization may no longer be possible in time of war. It is known that, in several Soviet missile programs, the decision to begin preparations for series production was made before major elements of the system had been tested at the range.

The actual program scheduling of all elements in an ICBM weapon system employing the separate development and production facility concept and a concurrent programming concept demonstrates some fundamental relationships which would apply to a Soviet program. With concurrent programming, as soon as the Soviets had sufficient confidence in the basic ICBM design, a decision to initiate series production would have been made. This decision occurred possibly before the firing of the first ICBM at Tyura Tam, but probably no later than the early 1958 test firings. Following this decision, facilities for the manufacture of hardware for the complete missile system would be designated. These would include one or more plants for the manufacture of the ICBM airframe, final assembly of the missile and factory test and checkout.

Following the designation of production facilities, interim production drawings would be furnished, and the go-ahead on production tooling would be given not only to the missile airframe and final assembly plants but to the numerous smaller manufacturers of parts sub-assemblies and components for the complete weapon system. Shortly thereafter, initial production and shipment of parts and components would begin. Personnel and resources would be reallocated, tooling would be increased in preparation for quantity production and other adaptation and final production arrangements would be made.

Implicit in the initiation of tooling would have been a decision with respect to the maximum rate of output to be provided for. This rate would have been established at a higher level than actually required to provide flexibility. Prior to initial production at final assembly facilities, a rapid expansion of output would be required of component part and subassembly manufacturers in order to provide the working inventory of parts and components needed to ensure a smooth and uninterrupted build-up of production of the ICBM missile and ground support equipment. Eventually, the number of production facilities directly involved to varying degrees would be in the hundreds and possibly over 1,000 with many of these facilities working multiple shifts.

Based on Soviet past performance and what is known about the technical problems of an ICBM program, a nine to twelve month lead time is required before the first Soviet ICBM would become available from the production facility.

The planned rate of ICBM output at the production facility would be a function of the urgency of the program and confidence in the basic missile design. In the case of an unproven vehicle with the likelihood of frequent changes, the rate of output might be limited. On the other

hand, if an early decision was made on an operational configuration, both the tooling and production engineering could proceed at a more rapid rate, especially if there was an exceptional urgency to have ICBMs deployed.

3. Production Implications of Tyura Tam Test Firing Program

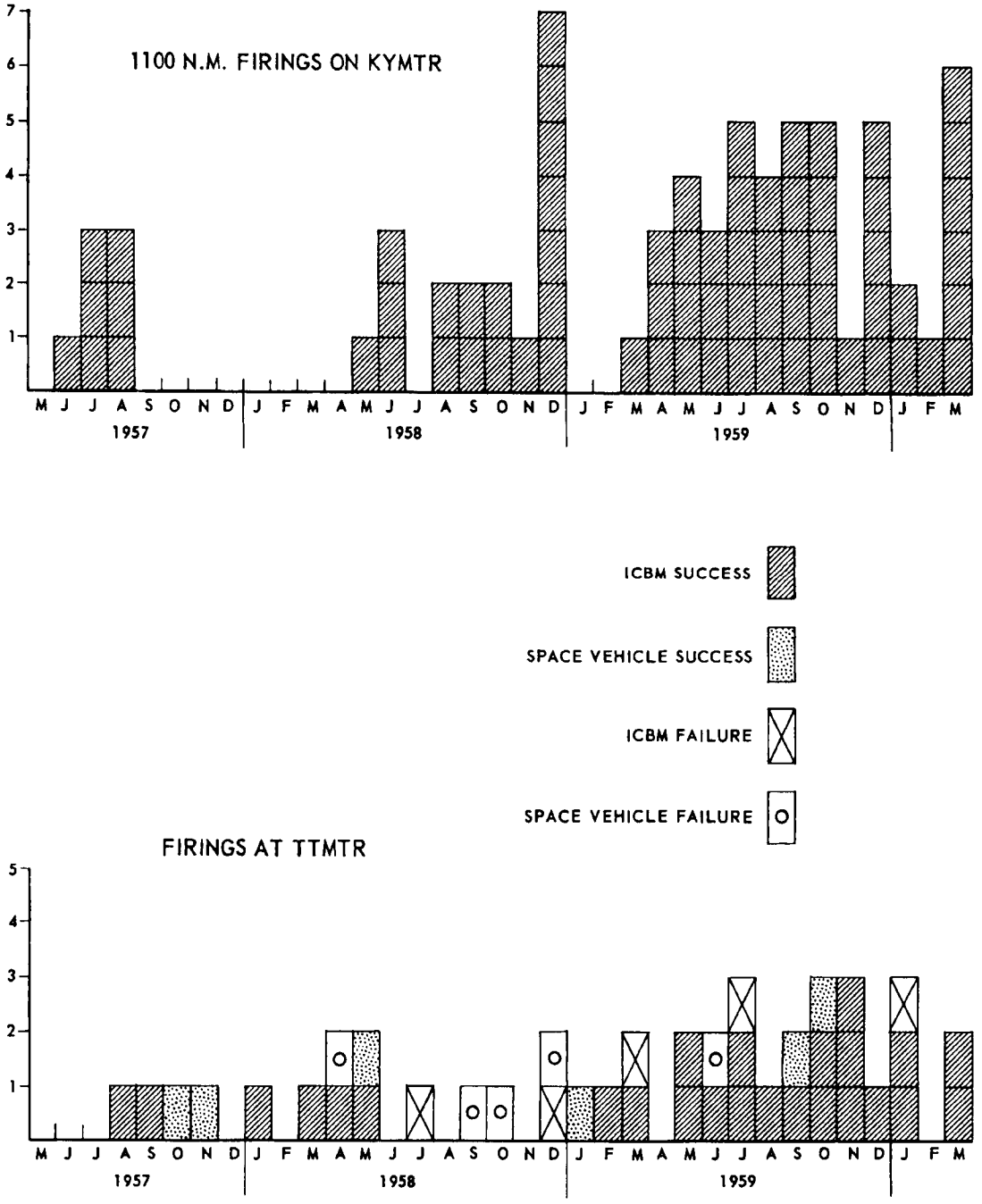
The status and probable organization of the Soviet ICBM production program can be inferred from the pattern and rate of testing activity at Tyura Tam, although the test program does not indicate the total rate of production or the number of facilities.

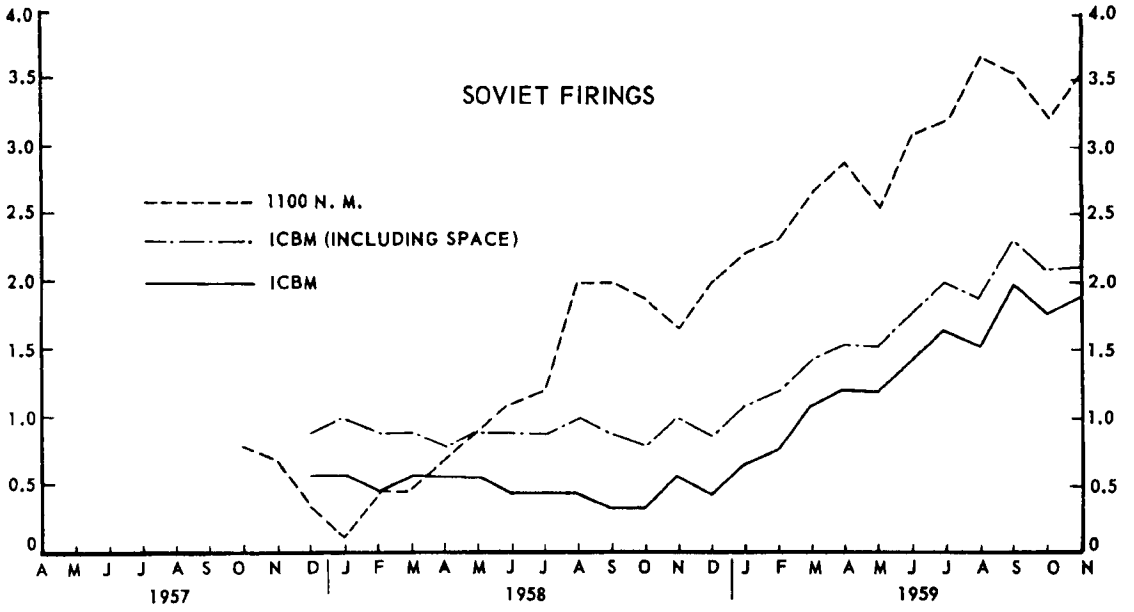
As of 1 April 1960, there had been a total of 41 (possibly 42) firings at Tyura Tam, including 25 successful ICBM launchings and 5 failures, and 6 successful space vehicle launchings with 5 (possibly 6) failures. As shown in Figure 1, the number of firings in the 15 months since the beginning of 1959 is considerably greater than the number in the preceeding 17 month period from the first firing in August 1957. The activity since January 1959 has consisted principally of ICBM firings (22 of 26 events), whereas activity prior to that time was about equally divided between ICBM and space vehicle launchings (8 ICBMs, 7 space vehicles). Moreover, the earlier period includes 7 months from June 1958 through December 1958 in which all 5 attempted launchings were failures. This contrasts sharply with the high proportion of successful firings during all other portions of the program.

A nine-month moving average of the Tyura Tam firings, which smooths out short-term fluctuations and irregularities in the activity, indicates a generally constant rate of firings of ICBMs of well below one per month until about the end of 1958 (ICBMs and space vehicles together consistently averaged about one per month during the same period), following which there was a distinct and continuing upward trend in the rate of activity, reaching an average rate of between 1.5 and 2 ICBM firings per month in the last half of 1959. (See Figure 2). This implies either increased output at the facility which supplied the original Tyura Tam missiles or the activation of a second source of supply.

The 1,100 nm missile test program resembles the Tyura Tam ICBM/space firing program in several respects, although the rate of activity has been somewhat higher (See Figure 1). Since the first 1,100 nm firing in June 1957, there has been a total of 70 firings. After an initial period in which 7 successful firings occurred in 3 months, there was a period of 8 months of complete firing inactivity, followed by a highly active firing program averaging close to 3 missiles per month for a period of more than 20 months. Both the Tyura Tam and 1,100 nm programs are thus characterized by an initial period of a limited number of highly successful firings and a later period of substantially increased and largely successful firing activity. These periods are separated in each program by a period of radically different character. There is also a striking time correlation between the major portions of the two programs. The initial period of 1,100 nm firings preceded the initial Tyura Tam activity by about 2 months

FIGURE 1. SOVIET LONG-RANGE MISSILE AND SPACE VEHICLE FIRINGS.





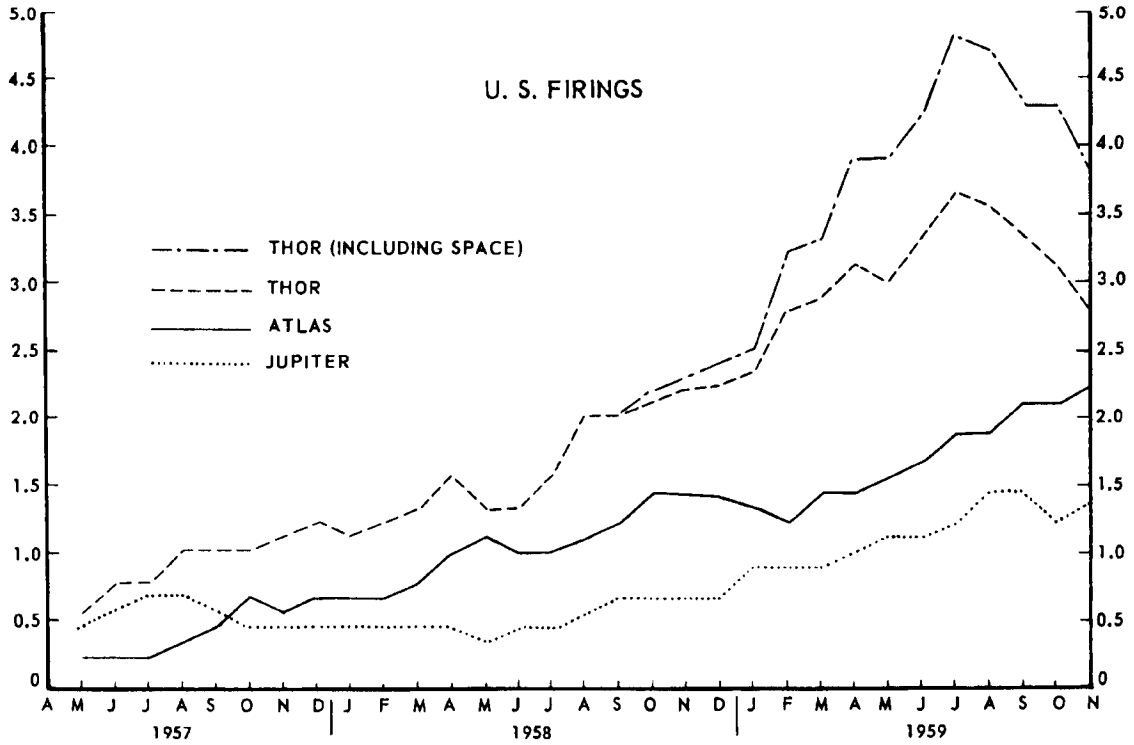


FIGURE 2. COMPARISON OF SOVIET AND U. S. LONG-RANGE MISSILE AND SPACE VEHICLE FIRINGS.
(9-Month moving average)

and was virtually completed by the time of the first ICBM launchings. The initial portion of the Tyura Tam program coincides almost identically with the period of 1,100 nm inactivity.

The most likely explanations of an extended period of inactivity in the early stages of a missile program are technical difficulties or the initiation of a new phase of production and testing. Since there is no evidence of technical difficulties in the 1,100 nm program, the gap in testing probably reflects the lead time between fabrication of the initial development missiles at a development facility and subsequent output of production engineered missiles at a separate series production facility, with the eight month period representing part of the time devoted to production engineering, tooling, and start-up for the production facility. This implies, of course, a decision to establish a quantity production facility prior to the first test firing.

The sustained high rate of 1,100 nm firing since resumption of testing in May 1958 clearly exceeds the output which normally could be supplied by the fabrication methods of a development facility and must have been produced for the most part, by a more advanced production organization, particularly in view of the probable requirement for additional missiles allocated to purposes other than test firing. Furthermore, the gap in firings would almost certainly not have occurred had the initial development missiles, as well as those fired after the gap, all been produced at the same facility, since there would be no logical reason (other than technical difficulties) for such a delay in further testing.

Analysis of the Tyura Tam firing program is complicated by a number of additional factors. One of these is the possibility, which is consistent with the observed firing activity, that the Soviets have been testing two different ICBM vehicles at Tyura Tam. Another consideration is whether the space vehicles launched from Tyura Tam are special purpose vehicles or have a common stage with the ICBM, and whether the same or different production facilities are involved. Although present evidence is inconclusive on these points, it is nevertheless possible to draw some general conclusions about the organization and status of the production program supporting the Tyura Tam test firings.

If space launchings are excluded, the Tyura Tam firing program since January 1959 consists of 22 ICBM firings, of which 19 were successful. The average rate of firing for the period as a whole was about 1.5 per month and the rate increased steadily during the period. There were three months in which as many as three ICBM firings occurred, whereas prior to January 1959, not more than one ICBM had been fired in any month. Inclusion of space shots does not change the trend of the rate curve as shown in Figure 2. (The Soviet ICBM firing rate since the beginning of 1959 is almost identical to the Atlas rate during the same period.)

This sustained high rate of firing could only have been accomplished with the output of a serial production facility which probably produced some or all of the 9 ICBMs fired in the six months from February through July 1959. This rate of firing implies production of at least 3 missiles

per month, including some allocations for other purposes, but without regard to the possible use of the ICBM in the Soviet space program or deliveries to operational units. This rate of output, in turn, indicates a level of production organization and engineering normally characteristic only of a quantity production process, with organized channels of supply and material flows, production tooling and skilled labor force. Moreover, the timing of the increase in the firing rate, which began a full year and a half after the first ICBM firing, indicates that the Soviets would have had ample time to establish a series production facility. The fact that only 2 ICBMs were fired in the last half of 1958 may therefore reflect the final preparation of the series production facility during this period, as in the case of the similar period of inactivity in the 1,100 nm missile program.

Although the evidence from Tyura Tam is insufficient to determine whether separate development and production facilities are involved in the Soviet ICBM program, past Soviet practice suggests that there are separate facilities, as do the periods of relative inactivity in both the ICBM and 1,100 nm test programs. In fact, the timing of the initial phases of both programs suggests that the two missiles may be closely related and that the initial development lots of both missiles could have been fabricated at the same development facility.

The evidence of Soviet firings gives no indication, other than the probable activation of series production facilities, of the volume and rate of missile production beyond that required for testing purposes. Moreover, it cannot be determined whether more than one series production facility is involved in either the ICBM or 1,100 nm program.

In the absence of direct evidence on the Soviet program, the known relationships between test firing and total production have been examined for the Atlas, Thor and Jupiter programs. The ratio of firings to production, on a quarterly basis, fluctuates irregularly throughout all three programs. This is a result of time lags between allocation and usage of missiles, as well as of irregularities in allocations between test firings and other purposes. On a cumulative basis, the ratio of missiles fired to missiles produced also fluctuates substantially in all three U.S. programs. During the third year of each program, however, as the production program becomes more stable, the cumulative ratio of firings to total production also tends to stabilize at around 1:2.5. During the fourth year, according to present U.S. plans, the ratio will tend toward 1:3, as production rates increase faster than firing rates. This reflects the programmed increases in allocations to operational inventory during 1960 in all three programs. The timing of the first allocation to operational inventory, in terms of number of missiles fired and total number produced, is also roughly similar in the three U.S. programs, occurring after about 15-20 missiles have been test fired and about 40-50 produced.

These similarities between the three programs obscure the very substantial differences which exist in their organization, pace and objectives, and do not necessarily apply to other missile programs, either U.S. or, especially, Soviet. Although it is probably generally true that the ratio

of firings to total production tends to stabilize on a cumulative basis as a missile program progresses through the series production phase, it does not appear possible to predict the amount by which production will exceed firings at any given time unless factors other than the firing rate are known.

D. Air Movements

One potential means of locating the areas in which missile production may be taking place is by analyzing the movements of certain specific aircraft believed to operate primarily in support of missile activities. In addition, it appears likely that the total volume of air movements between individual cities and the missile test ranges will reflect the extent to which activity is taking place at these cities which is related to the test range program.

Among the specific aircraft associated with the Soviet missile program, two groups have been identified as serving missile production facilities. These are Moscow/Kaliningrad - based transports and certain transports of the Ukrainian Territorial Directorate (UTU) of the Civil Air Fleet, based at Stalino, but operating primarily out of Dnepropetrovsk.

The Moscow/Kaliningrad - based transports are believed to be assigned to serve a missile development authority in the Moscow area. The specific authority is not identified. These aircrafts probably support Plant/NII 88, but their operations may not be limited to serving the 88 complex.

The missile-associated UTU aircraft are believed to operate primarily in support of Plant DAZ in Dnepropetrovsk.

Other groups of aircraft operating in part in support of missile production organizations include Moscow/Khimki - based transports of the State Committee for Aviation Technology (GKAT) and GKAT aircraft based at the locations of factories contributing to the missile production program. Transports of the Civil Air Fleet and of Military Transport Aviation (VTA) are also available to various missile organizations, but except as specific aircraft or flights are identified, their operations cannot be considered related to missile production.

Due to the nature of the available information on air movements, there are many uncertainties in the interpretation of the data. With few exceptions, the organization concerned with a flight is not specified; only the cities or airfields are indicated. In some instances a single organization stands out as the one most probably concerned with a given pattern of flight activity. In other cases no clear choice is evident. Flights may occur in connection with any aspect of the program; consequently the specific nature of an association usually cannot be determined from air traffic. Locations noted in aircraft itineraries frequently are only routing information. Often, what appears as a destination on an airflight schedule is determined by analysis of the following day's schedules to have been a stop en route having no determinable significance. While deviations

from established routes may in some instances be significant, deviations sometimes occur that are attributable to weather conditions or airfield closure for other reasons. For these reasons, reliable interpretation of air movements requires a sufficient depth of information to establish normal patterns of operation. Isolated peculiarities cannot be confidently interpreted.

The pattern of air activity most clearly identifiable with missile production is that involving Dnepropetrovsk. The clear link between Dnepropetrovsk and Kapustin Yar, and the absence of such a link with Tyura Tam, indicates that the Dnepropetrovsk Plant is probably involved in production of a missile of shorter range than the ICBM.

Since 1957, Moscow/Kaliningrad - based missile-associated transports, although continuing to visit Kapustin Yar, have traveled more frequently to Dzhusaly/Tyura Tam. Since 1957, the industrial cities most prominent in the itineraries of these aircraft have been Kuybyshev and Sverdlovsk.

Flights by Military Transport Aviation aircraft to and from Tyura Tam indicate significant participation in the ICBM and/or space program by organizations at Kuybyshev, Omsk, and possibly Novosibirsk and Sverdlovsk. The specific organizations are not identified.

The gross number of air movements to or from Tyura Tam and Dzhusaly for the years 1957 - 1959 was examined to determine which Soviet cities have the closest association with the ICBM test range. Only those flights were considered which had Tyura Tam or Dzhusaly as one terminal and the particular city in question as the other. Some of the 1959 data are preliminary.

As expected, Moscow had by far the heaviest volume of traffic for all three years. The number of Moscow flights increased from about 275 in 1957 to 650 in 1958. In 1959, however, the year of heaviest test firing at the range, this traffic dropped to about 450 flights, a decline of about 30%. This decrease may reflect a declining interest in the ICBM firing program by the Moscow development centers occasioned by the activation of a series production facility in another city.

Other than Moscow, the cities which display an unusually heavy volume of traffic are Kuybyshev and Omsk. A very high proportion of the approximately 240 flights between Kuybyshev and the range over the three year period have Dzhusaly as a terminal rather than Tyura Tam, which is also true of the Moscow flights. On the other hand, of about 110 flights between Omsk and the range, about 70 had Tyura Tam as the range terminal. This is a much higher level of association with Tyura Tam (as opposed to Dzhusaly) than maintained by any city other than Moscow. This, together with other characteristics of the Omsk activity, suggests that these aircraft are concerned primarily with range operations. A considerably lower level of airflight association exists between the Tyura Tam range area and the cities of Novosibirsk and Stalingrad.

E. Rail Transport

The Soviet rail network provides the major means of long-haul transport and has historically been the transportation means for medium and short range missiles to the test ranges in all instances where evidence is available. Examination of photographic intelligence clearly indicates that rail transport is the primary means of supply for the Tyura Tam Test Range. Thus, Soviet rail transport may provide positive information on ICBM production, if the type of rolling stock required can be identified.

Although the configuration and dimensions of the Soviet ICBM are not known, it must be assumed that line clearances and the types of rolling stock will be adequate.

In the past, the Soviets have made maximum use of existing rail equipment where practical and modification where necessary. Figure 3 shows the implementation of this practice through time at Plant/NII 88, where transportation of known and probable medium and short range missiles was involved. The passenger and baggage cars shown in Figure 3 are compatible with the measurements of the long cars* seen in the TALENT photography of Tyura Tam. The freight carrier configuration of the long car in Figure 3, however, is purely speculative. There is no specific evidence from open or covert sources which supports the existence of a freight carrier approximately 80 feet long.

The rail pattern within the Tyura Tam range indicates that the missile and space hardware is also transported and handled by rail after arrival at Tyura Tam. This flow takes the hardware through the range support area, where no facilities for assembly or other preparation work are in evidence, out to a rail drive-through building which is ostensibly for any necessary assembly, test and checkout, and finally to the launch stand for firing. The limited space in the rail drive-through building which accomodates three tracks suggests that the missile hardware arrives in pieces that require relatively simple assembly procedures or even as a complete vehicle (minus nose cone).

Photographic coverage of Tyura Tam in 1957 and 1959, in each case taken nine days prior to a launching, shows a number of different types of rolling

* The phrase long cars refers throughout this section to cars approximately 80 feet in length.

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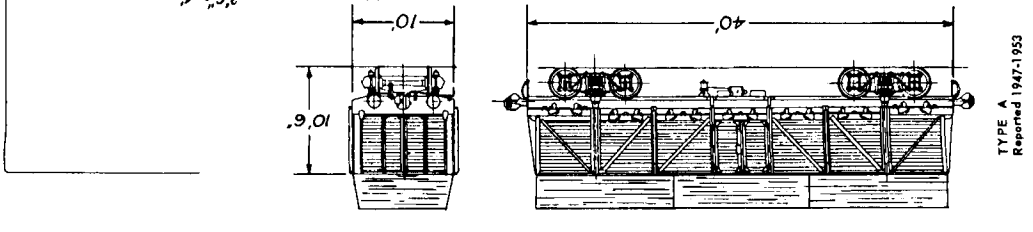


TYPE A
Reported 1947-1953

FIGURE 3. SELECTED SC

stock throughout the rangehead and checkout area. Although the quality of the photography in both instances precluded the positive identification of the specific types of cars, it was possible to determine that in most cases the cars were of standard dimensions, including a number of cars which measured approximately 80 feet in length.

Analysis of the photography failed to indicate the specific use of any of the rolling stock at Tyura Tam. The long cars were considered in detail in an attempt to determine whether they could be isolated as transporters for ICBM hardware. A number of indications suggested this emphasis. First, the length of the largest segment of any estimated Soviet ICBM was likely to exceed the length of a standard 45 foot freight car. Second, Attache reports during the 1956-1958 period at Plant/NII 88 indicated an increase in the length of the rolling stock observed. In 1956, two fifteen foot long car body sections were observed which appeared to have been removed from each end of a standard car, suggesting an intention to lengthen the remainder of the car. In 1957, five cars of freight type, approximately 65 feet in length and uniquely painted with green bodies and gold tops, were seen in the plant area. In 1958, an Attache saw a long passenger car with all window openings blanked off from the inside by sheets of metal in the yard area of the plant.

In the 1957 Tyura Tam photography, a total of 14 long cars were found in the range area, seven of them located at the rangehead in the vicinity of the launch pad. Considering that the first Soviet ICBM vehicle was fired that month, it is doubtful that each car contained a complete ICBM or even the stages of a parallel configured vehicle. The inability to determine whether these long cars were passenger or freight cars is particularly critical to the problem. The removal of the spur in the rangehead area on which seven of these long cars appeared in the 1957 coverage when the range was still under construction would tend to suggest that the cars and the spur were associated with range preparation rather than range operations. The transportation of personnel thirteen miles from support area to rangehead is not unlikely.

Comparison of the 1957 and 1959 coverage also showed two pieces of 80 foot long rail equipment and a single short car positioned nearly identically on two launch area spurs. However, unlike the other long cars in the area, the 80 foot objects appear to be tapered at one or both ends. The identical positioning might suggest some association with operations.

Concentrations of rolling stock in the test and checkout area and a small rail classification area approaching it are evident in both the 1957 and 1959 photography. In the older coverage, seven of the long cars are present, while 27 long cars can be seen in the newer coverage. The presence of two of the long cars in the launch area end of the test and checkout building in 1959 would tend to suggest that these long cars are associated with the transport of missile hardware, since the location would not be one in which passenger cars would be likely to be found, and as previously the assembly processes in this building are likely to be limited to nosecone

or staging type activity.

Sufficient evidence is not available from the photographic coverage of the Tyura Tam Test Range to draw a firm conclusion with respect to any of the rolling stock. It is not possible to conclude whether the long cars in the 1957 and 1959 coverage were passenger or freight types. In addition, it is considered most unlikely that all of the long cars were exclusively devoted to the carrying of missile hardware, if indeed any were.

Photographic coverage provides only four instances of long rail car sightings which have not been definitely associated with passenger cars. All of these instances involve TALENT in which the quality of the coverage precludes the identification of the type of car. These long car locations were at Nizhniy Tagil, Kharkov, Saratov and Kuybyshev.

The sightings at Nizhniy Tagil and Kharkov are apparently associated with known rolling stock producers and no connection can be established with the Soviet ICBM program. At Saratov, the presence of two long cars on a spur leading to the hard stands at the southwest end of the runway of the Engels airfield also provides no indication of an association with the Soviet ICBM program.

The significance of the 15 long cars in the area of Plants 1 and 18, Kuybyshev cannot be determined. It seems unlikely, in view of their location, that these are passenger cars. Although it can be reasoned that these cars could transport equipment associated with aircraft production at these plants, it is not possible to determine conclusively that they are not associated with missile transport.

Until more information is available on Soviet use of eighty foot rail cars, particularly their function at Tyura Tam, they will continue to be potential, although not conclusive, indicators of missile transport activity. Each observation of such cars must be evaluated in terms of the specific circumstances and location of the sighting.

F. Production Facilities

Almost nothing is known directly of Soviet ICBM production facilities, the methods used to produce systems equipment, or the configurations and types of equipment being produced. However, the industrial processes involved in producing the required types of equipment are known, as are Soviet practices in production programs for other weapon systems, which may be applicable to analysis of their ICBM production program.

Production of the missile, ground guidance, support equipment, and test and checkout equipment requires a production organization with a large subcontracting structure and supply base. The organization consists of a few producers of principal system components such as the missile, propulsion system, nosecone, guidance radars and computers, and unique support items such as erector-carriers. However, there is no basis at present for judging that a given principal system component in the ICBM

system would be produced by any particular type of industrial facility in the USSR. Other Soviet missiles have been produced in an armaments plant, an automobile plant, and an airframe plant. Electronic equipment and instrumentation requirements appear to come from producers normally associated with such equipment. In the case of ground support equipment, the Soviets have produced launcher-erector type equipment in a heavy machinery plant and in an airframe plant which still produced fighter aircraft.

All of the producers of principal system components would be engaged in activities with three basic types of supply: raw stock, purchased items (bits and pieces), and subcontracted sub-assembly components. In every case, suppliers of bits and pieces are likely to number in the upper hundreds. Subcontract suppliers for complex guidance and missile sub-assemblies will probably number one hundred or more.

An indication of manpower requirements is available from U.S. data. The principal contractors in the U.S. Thor, Atlas and Titan programs accounted for approximately 90,000 workers of all types by the end of 1959. The relationship between monthly output of weapons and manpower is presented for Atlas and Titan in the following table:

	End of Year		
	1955	1957	1959
Atlas:			
Missiles produced per month	0	2	7
Manpower	6,300	26,000	34,000
Titan:			
Missiles produced per month	0	0	2
Manpower	2,000	14,000	22,000

The 34,000 people in the Atlas program at the end of 1959 were allocated 45 percent to airframe and assembly, 25 percent to propulsion, 23 percent to guidance and some 8 percent to the reentry vehicle. The manpower figures given above include only those employed in these major types of manufacturing activity; many more are required to produce other components and parts of the weapon system and to provide launching facilities.

An ICBM may be assembled and/or checked out in either a vertical or horizontal position. In the case of vertical assembly, this method facilitates to some degree vertical alignment of major assemblies in the complete stage. It also reduces the square footage requirements in the final assembly area. A major disadvantage is that accessibility of workers and machinery to the missile is restricted since numerous scaffolds and catwalks are required. Vertical assembly also requires a high-bay area with a hook height compatible with the tallest stage.

Horizontal assembly is used in the assembly of all U.S. ballistic missiles and was the method employed by the Germans in production of the V-2 during World War II. Soviet practice at the present time has not been

determined. However, reported horizontal assembly of V-2 missiles at Plant 88 in the immediate postwar period and construction since that time tends to support the conclusion that horizontal assembly is still practiced. There are many advantages to horizontal assembly of missiles. First, essentially all work is performed at one level with accessibility of workers and machines. Second, if during final checkout work inside tanks is necessary, this can be accomplished better in a horizontal position. Finally, if assembly is horizontal, tooling is more flexible for possible future growth of the missile.

Test and checkout of the completed missile at the final assembly facility may be entirely "cold" and "dry" in nature, involving purely electromechanical simulation techniques, or it may include hydrostatic testing, environmental testing and even static firing of the missile in an area close to the plant.

The choice between horizontal and vertical checkout of the missile is in large part dependent upon the testing techniques employed. Test and checkout of Thor and Atlas missiles in the production plant is carried out horizontally. In the case of Titan, the test and checkout is accomplished in a separate building with the missile in a vertical position. The wartime German V-2 practice was a vertical one. Although no direct information is available on Soviet practice, construction at Plant 88 since World War II and recent photography of the DAZ facility suggest that the Soviets are employing a vertical checkout procedure.

The rate of production and the build-up to rate in a given ICBM production facility are functions of the in-process time. For example, the in-process time for three U.S. ballistic missiles is as follows:

Thor	75 working days
Atlas	87 working days
Titan	110 working days

This time represents the period from the start of structural assemblies to the completion of the final test and checkout and acceptance by the user. Additional time is required in every case for fabrication of raw stock to begin structural work. Fabrication time varies not only between different missiles but also because of the amount of work assumed by the production facilities.

It can be generalized that the capacity of a given facility will vary inversely with the length of in-process time. The variation of in-process time for different production operations and the size of the members on the floor will both affect the over-all floorspace requirement for production operations and inventory and feed areas.

Thus, without any knowledge of the configuration or structure of the Soviet ICBM, any attempt to estimate the capacity of a Soviet ICBM facility would require a number of assumptions with respect to the general characteristics of the vehicle and the utilization of the facility. Even

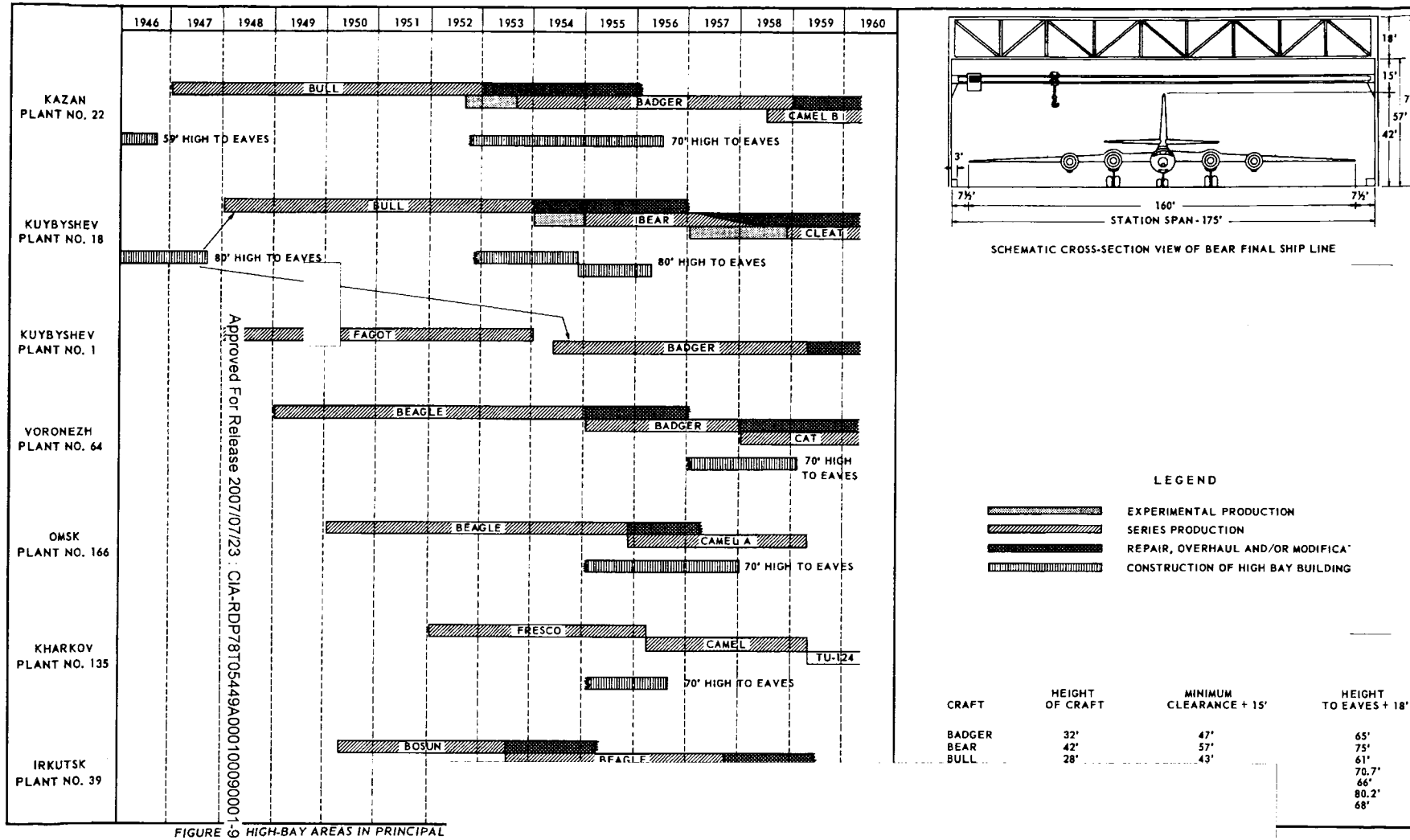
if the size of the over-all facility were known and the Soviet missile characteristics were available, the problem would still require a number of critical assumptions with regard to administrative area, fabrication responsibilities, degree of sub-contracting, structural assembly requirements, and test and checkout procedures. A reasonably accurate estimate of plant capacity for ICBM production could be made only with known missile characteristics (or even the general configuration) and a production facility in which the final assembly area could be effectively isolated for measurement. In this case the problem could be reduced to estimating in-process time from work positions based upon missile size and configuration and available floorspace. The resulting statistic would represent the upper limit of plant capacity.

In spite of its disadvantages, vertical assembly of ICBMs cannot be excluded. The Working Group therefore examined the relationship of high-bay buildings to aircraft production in the principal Soviet airframe palnts. If orthodox final assembly methods are used, high bay area is required for all final assembly stations after and including the station in which the tail assembly is mated to the fuselage. Figure 4 illustrates in a frontal cross-sectional view the span and height characteristics of the high-bay area required for the BEAR, a turboprop heavy bomber aircraft. The internal clear height of the building housing the final assembly line of the BEAR aircraft would have to be [redacted] in order to include a crane and materials handling space. Assuming a truss type roof support, as shown, the external height would have to be about 75 feet. The heights of the final assembly buildings required for other Soviet bomber and transport aircraft are also shown in Figure 4. 25X1

In 1945, the Soviet airframe final assembly buildings lacked the height and/or width for the construction of aircraft as large as the BULL medium bomber, the first large aircraft to be series produced in the USSR. The experimental series of the BULL were produced at Moscow/Fili Airframe Plant No. 23. Insufficient lateral clearance in the final assembly building necessitated that the final assembly of the BULL take place in the flight hangar.

The decision appears to have been made at this time to construct high-bay buildings at various airframe plants. Construction of high-bay area began approximately in mid-1945 and continued to about mid-1958. High-bay buildings have been constructed at 8 airframe plants: Gorkiy Airframe Plant No. 21, Irkutsk Airframe Plant No. 39, Kazan Airframe Plant No. 22, Khar'kov Airframe Plant No. 135, Kuybyshev Airframe Plants No. 1 and No. 18, Omsk Airframe Plant No. 166 and Voronezh Airframe Plant No. 64. In every case except Gorkiy Airframe Plant No. 21, the construction of high-bay buildings has preceded the production of large aircraft requiring such facilities. The relationship between the time of availability of high-bay areas and production of these large aircraft is shown in Figure 4. The obvious reason for the construction of these high-bay areas was to facilitate the production of the newer aircraft.

With respect to the individual facilities studied by the Working



CRAFT	HEIGHT OF CRAFT	MINIMUM CLEARANCE + 15'	HEIGHT TO EAVES + 18'
BADGER	32'	47'	65'
BEAR	42'	57'	75'
BULL	28'	43'	61'
			70.7'
			66'
			80.2'
			68'

FIGURE 9 HIGH-BAY AREAS IN PRINCIPAL

Group, there appears to be sufficient evidence to identify the facilities in the Moscow area which have probably developed and fabricated the initial Soviet ICBM vehicles and the ICBM propulsion system. A few localities or specific facilities can be selected which may be engaged in some aspect of the series production of ICBMs, but the evidence on these is inconclusive. Sufficient information is available on the current activities of many of the facilities reviewed to indicate that they probably are not engaged in final assembly of ICBMs.

The extensive evidence available on Plant/NII 88, Moscow/Kaliningrad over many years indicates that this facility (possibly together with the nearby NII 4, Bolshevo) constitutes the principal research and development center for ballistic missiles in the USSR. Although we have little direct knowledge of the specific activities of this facility in recent years, external evidence indicates that the facility prepared in 1956 for manufacture and/or test of a very large vehicle and that large rocket engines have been static fired at a relatively high rate for the past several years at this facility. This evidence, supported by the known flight activity of Kaliningrad - based aircraft to the Tyura Tam range head, leads to the conclusion that Plant 88 probably fabricated the developmental and prototype ICBMs fired at Tyura Tam, including boosters for some of the Soviet space vehicles.

Sufficient evidence is available to indicate that ICBM engines were probably developed and tested at Plant 456, Khimki/Moscow, although it appears unlikely that this facility is engaged in series production. Extensive static testing of rocket engines is also known to take place at Plant/NII 88, Kaliningrad, and there is unconfirmed information that other rocket engine test facilities are located near Zagorsk. Taken together, these activities indicate that the central industrial region near Moscow is the location of major rocket engine developmental and static testing activity. The only known series producer of rocket engines is the former automotive Plant (DAZ) in Dnepropetrovsk; however, this plant appears to have no direct connection with the ICBM program.

Aside from the Moscow region, the two areas which appear most likely to be involved in the ICBM production program are Sverdlovsk and Kuybyshev. There is specific information from two independent clandestine sources that Plant No. 8 in Sverdlovsk was producing ballistic missiles in 1958, although these were reportedly medium range missiles. Markings information from the LUNIK vehicle exhibited in New York and Mexico City in late 1959 indicates that Plant No. 8 was probably the producer of the last stage of the LUNIK, and that this was the fifth such vehicle produced. The pattern of movement of missile-associated aircraft between Sverdlovsk and Moscow/Kaliningrad, Dnepropetrovsk, and, to some extent, Tyura Tam indicates that some facility in the Sverdlovsk area is engaged in the ballistic missile program, although the identity and functions of the facility cannot be determined. 1959 TALENT photography revealed no observable indication of missile manufacture at Plant 8 or elsewhere in the city. The Working Group believes that Plant No. 8 probably produced the last stage of the LUNIK vehicle and may also be engaged in some aspect of ICBM

production. However, it is not possible to determine the full scope of missile or space flight activity taking place either at Plant No. 8 or in the Sverdlovsk area.

In the case of Kuybyshev, there are relatively strong indications of ICBM activity in the area, as well as a number of suspect individual facilities. The Kuybyshev area is suspect because there has been a higher total volume of airflight activity between Kuybyshev as one terminal and Tyura Tam or Dzhusaly as the other than for any other city in the USSR except Moscow.

The complex composed of Airframe Plants No. 1 and No. 18, Kuybyshev, is suspect because of the appearance there in 1959 TALENT photography of 15 eighty-foot railroad cars similar to those seen at Tyura Tam. There is no indication that the cars are at the plant complex to transport ICBMs or components, but it can be reasoned from photography that they could transport components or materials associated with aircraft production. Although no other evidence is available to link these plants with missile production, there is considerable information from a variety of independent sources on their aircraft production activity. Plant No. 1 is known to have produced BADGER aircraft until March 1959 and to have been engaged in BADGER overhaul and repair since that time. Plant No. 18 is currently producing the TU-114 (CLEAT) and overhauling BEAR aircraft. TALENT coverage in December 1959 revealed two large revetments, one of which was still under construction, similar to the one at Kazan Plant No. 22. Since these revetments are not required for testing engines of BADGER, BEAR or CLEAT, they may indicate preparation for production of a new aircraft at this complex. While the weight of the evidence indicates continued aircraft activity at both plants, the Working Group does not believe the possibility of missile production can be excluded until there is a better understanding of the nature and function of the eighty-foot Soviet railroad cars.

Another suspect facility in the Kuybyshev area is an unidentified metallurgical plant about two miles north of Plants No. 1 and No. 18. TALENT photography indicates that the plant has two large buildings, one of which contains considerable high-bay area. The plant is reportedly making aircraft fuselages and parts, and there is no direct evidence linking it to the missile program. It appears to have the capability to produce missile airframes as well as component parts of aircraft.

The third facility in the Kuybyshev area possibly related to the missile program is an apparent rocket engine test facility under construction 24 nm northwest of Kuybyshev. However, there do not appear to be any buildings under construction which would be large enough to permit engine production. This suggests that a nearby plant in the Kuybyshev area may be in preparation for engine production.

G. Soviet Statements

Although there were references by Soviet leaders to the ICBM as early as 1955, the first statement which gave a clear indication of the status of production was made by Khrushchev in November 1958 in his "Theses" on the

Seven Year Plan when he stated that "production of ICBMs has been successfully set up". This statement, if interpreted in the normal context of the Russian words used, would imply that initial tooling of ICBM production facilities had been recently completed, that the technology of production was considered mastered and probably had been demonstrated, and that initial delivery of production ICBMs was about to begin.

Interpretation of Khrushchev's statement depends to some extent on various words which could have been selected, but were not, to convey other meanings. For example, Khrushchev did not use the present tense, which would have indicated that the activity was still in process, nor did he state that ICBMs "are being produced successfully" which would have implied that production ICBMs were already being delivered to the military user. It must be assumed that, in as important a report as the "Theses", which had wide circulation within the USSR as well as abroad, the wording of any statement on ICBMs would have been chosen with care. Consequently, the phraseology which Khrushchev actually employed appears to indicate that he intended to state quite explicity that all preparations for production had been completed but that deliveries had not yet commenced.

In January 1959, Khrushchev in a speech to the Supreme Soviet stated that "the serial production of intercontinental ballistic missiles has been organized". Since that time, he has repeatedly referred to the "serial" or "assembly line" production of ICBMs in the USSR. Moreover, in November 1959 he indicated in a speech to a group of Soviet journalists that the January 1959 statement in fact signaled the beginning of serial production.

> "A few years ago I said in a speech that an intercontental ballistic missile had been developed in our country. Then, many, many public leaders in capitalist countries stated that probably Khrushchev was just boasting. When we started production of these rockets, I said that in our country intercontinental missiles were on the assembly line. Again they began to say that this could not be, that Khrushchev was boasting again. . . . .and so this is no empty boast, these are real facts. I think, dear comrades, members of the Presidium, that I will let out no secret, and at the same time I want to be understood correctly: We do not want to frighten anyone, but we can tell the truth, namely that now we have such a stock of missiles, such an amount of atomic and hydrogen warheads, that if they attack us we could raze our potential enemies off the face of the earth."

Khrushchev's most recent comment on production of ICBMs in January 1960, includes his only known reference to "mass production". Since late 1959, his public references to ICBMs have increasingly emphasized possession of ICBMs in quantity by the Soviet armed forces, rather than the status of production.

In its assessment of these statements, the Working Group considered it important to note that while some statements may have been coincidental with the achievement of significant program milestones, others may have been delayed until a particularly opportune moment with respect to some important international situation or event, or advanced in anticipation of an accomplishment.

Nevertheless, the widespread publicity given the statements in the USSR suggests that they may accurately represent the timing and status of the Soviet program. The major statements appear generally consistent with the conclusions drawn by the Working Group with respect to the probable timing and status of the Soviet ICBM production program.