Canadian Foreign Intelligence History Project

LAC ATIP A-2018-00087
LAC RG24 Vol. 20854 File 7-26-9 Part 4

JIC Assessment
The Threat to North America, 1958-1967
JIC 256/5 (57) (Final) 58-01-03
joint JIC/JPC paper

Note: Despite its designation as "Final," this paper was later revised with minor changes and published as JIC 256/6 (57) (Final) (Revised) 58-01-20.

CANADA

IN REPLY PLEASE QUOTE
NO. C86 7-26-9 (JIC)

Department of National Defence

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6 Jan 58

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DMI
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The Threat to North America, 1958-67

1. Reference is made to memorandum on this file dated 31 Dec 57.

2. Attached for information is a copy of JIC 256/5(57)(Final)/JPC 101/5(57)(Final) dated 3 Jan 58 on this subject.

3. Copies of this paper have today been forwarded to the Chiefs of Staff Committee.

(G.P. Hartling)
Major,
Secretary.

Enc.

GPH/2-5459/ff

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JIS(5)

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COPY NO. 56

JIC 256/5(57)(Final)
JPC 101/5(57)(Final)
3 January 1958

THE THREAT TO NORTH AMERICA, 1958-1967

OBJECT

1. To assess the threat to North America from Soviet aircraft and missile attack during the period 1958 to 1967, including factors related to the mounting of such attacks[1].

INTRODUCTION

2. Although limited wars fought only with conventional or small-yield nuclear weapons may take place during the period of this estimate, North America is only likely to suffer direct attack during a major war between the Soviet Union and the United States. Such direct attacks will be effective only if large-yield nuclear weapons are employed, and will therefore only take place if one side or the other is prepared to face the consequences of an unrestricted nuclear exchange.

3. Such a situation could arise in one of three ways:

(a) during a period of mounting tensions, the Soviet Union or the Western powers might miscalculate the situation to the extent of being convinced that the other side intended to launch an all-out nuclear attack;

(b) in the event of hostilities breaking out locally in which Western and Soviet forces were directly engaged, either side might believe that the other intended to launch an all-out nuclear attack;

(c) the Soviet Union might specifically plan to attack North America without warning. This alternative is considered to be highly unlikely, especially during any period when the weapons systems available to the Soviet Union are not adequate for a decisive attack directly upon North America.

4. The form and scale of the threat to North America will depend on the types of weapons systems that are available to the Soviet Union at any given date, and on the Soviet estimate of the relative effectiveness of available systems against different types of targets. The general characteristics of the aircraft and missile systems now available to the

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1 The following forms of attack are excluded from consideration in this study: attacks on shipping, airborne and amphibious operations, subversion and sabotage.

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Soviet Union are reasonably well known to intelligence, and the types of systems that are likely to become available during the next ten years are clear, although there always remains the possibility of unexpected technological breakthrough. However, although estimates of future development and availability of these systems are based on knowledge of Soviet productive capacity, developmental trends and trials and the likely evolution of Soviet armed force, these estimates must necessarily remain somewhat imprecise. This study has therefore been based both on available intelligence and on estimated Soviet requirements to attack certain target systems, taking into account the likely Soviet estimate of the relative effectiveness of available weapons systems against different types of targets.

WEAPONS SYSTEMS

5. At any given date between now and 1967, the main threat to North America will be posed by some or all the following weapons systems:

(a) bomber aircraft;

(b) air-to-surface missiles launched from long-range aircraft;

(c) surface-to-surface ballistic missiles launched from Soviet territory;

(d) missiles launched from submarines.

6. The following paragraphs briefly outline current intelligence on and estimates of the characteristics and state of development of these systems. Further details are available from intelligence agencies. It should be noted that we have no direct evidence of missile production and the missile production estimates given only present one possible and feasible Soviet programme, although they do take into account the Soviet requirement to attach high priority to anti-aircraft surface-to-air missile systems and eventually to anti-missile systems. More missiles of the offensive types mentioned could be produced, but probably only at the expense of defensive types.

Aircraft

7. The present strength of the Soviet strategic striking force is about 1,635 medium and 65 heavy bombers. The medium jet bomber (BADGER) is still in full series production at an estimated total rate of about 40 a month at three factories, although at least one of these factories may be turning over to medium transport production. The estimated rate of production of heavy bombers (BISON and BEAR) has not conformed to previous expectations. BISON production has continued at a low rate of 3 a month at one factory and BEAR production, if it has continued at all, is at the very low rate of 2 a month at one factory. It is considered probable that the Soviet Union is not building up a large heavy bomber force, at least with these types of aircraft, not because of production or design problems (which should now have been resolved after more than two years of production), but rather because these programmes are being overtaken by the development of missile systems. However, until missiles meet operational requirements in numbers, range, accuracy and reliability, the Soviet Long Range Air Force must rely on manned aircraft for an attack upon North America. As missiles meet these requirements, the manned heavy bomber can be expected to be gradually phased out of this type of service, although manned aircraft will continue to be required for reconnaissance and possibly for ECM.

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8. Soviet interest in supersonic gas turbines and Soviet attempts with the BLOWLAMP and BACKFIN to produce a supersonic light/medium bomber suggest that the Soviet Union may also be continuing with the development of a heavier supersonic bomber. The logical intermediate step in this programme would be a supersonic-dash aircraft armed with an air-to-surface missile, but such an aircraft might not be series produced if sufficient progress had been made towards a fully supersonic bomber. Although the extent of the production of either of these aircraft will be generally dependent upon the success of the development of long-range missiles, it is thought that the development of such supersonic aircraft will continue, to provide a reconnaissance vehicle pending the provision of superior forms of reconnaissance, to obtain knowledge of supersonic aerodynamics and thermodynamics and to provide a weapons carrier if the Soviet long-range ballistic missile programme fails seriously to meet the performance and availability estimates given in this paper. Recent Soviet progress tends to indicate that such an aircraft could be in operational service by 1960.

9. Previously it has been estimated that the Soviet Union could develop a subsonic nuclear-powered bomber before 1967. However, it is no longer thought that a requirement for such an aircraft exists, unless it were supersonic. It is not believed that a nuclear supersonic aircraft could be developed and produced in the period of this estimate.

10. The estimated composition of the Soviet Long Range Air Force for the years 1958 to 1967 is shown in the table below. Cumulative aircraft production up to the present can be estimated with reasonable reliability because there are three or more lines of evidence concerning most factories which can be reconciled with one another. Present Long Range Air Force order-of-battle can also be checked in a number of ways. The present composition of the Long Range Air Force shown in the table below for the beginning of the period under consideration can therefore be stated with fair to good accuracy. Estimates of future aircraft production are of a much lower order of reliability, for there is no specific evidence available to indicate what future production or composition will be. There are, however, a number of production criteria against which to judge estimates of future Long Range Air Force composition based on probable force requirements. Since World War II the aircraft industry has operated well below theoretical plant capacity and this is unlikely to be the limiting factor in the future. Production will probably be limited by budgetary considerations or by the scarcity of complex equipment such as precision mechanisms and electronics, for all of which there will be serious competition with the expanding Soviet guided missile programme. These considerations are quite apart from the question of the bomber production programme being overtaken by missile systems (see para 7 above).

Estimated Composition of Soviet LRAF (Bomber and Tanker Aircraft) 1958-1967

MID-	BULL	BADGER	BISON AND BEAR	SUPERSONIC BOMBER OR RECCE A/C[2]
1958	650	1100	100	-
1959	500	1050	150	-
1960	350	1000	195	10
1961	200	950	195	80
1962		900	180	160
1963		850	170	200[2]
1964		750	150	200
1965		650	130	185
1966		500	100	170
1967		350	80	160

2 There will be no requirement for this aircraft as a weapon carrier if the Soviet long-range ballistic missile programme generally conforms in performance and availability with the estimates in this paper. In this case, only sufficient aircraft (about 200) to perform a reconnaissance role would be produced.

In the above table, BADGER figures include aircraft in Naval Aviation (e.g., 100 in 1958 and 100 in 1959, etc). BULL figures include small numbers of aircraft in Naval Aviation (for example 20 in 1958 and 1959). For BADGERS, BISONS and supersonic aircraft used as bomb carriers against North America a percentage of jet tanker aircraft would be required. This percentage might vary from 20% to 50%.

11. Main characteristics of these aircraft types are shown in the tables at Appendix "A".

12. Reliability of bomber aircraft (excluding combat attrition) after a maintenance stand-down varies from about 50% for a mission staged through a forward base and also refuelled once in the air, to 90% for a mission that is not staged or refuelled. A figure of about 70% can be taken as an average for the types of missions envisaged in this paper, except that the supersonic bomber/missile combination may have a reliability of only about 50%. Bombing accuracy from an altitude of 40,000 ft. varies from a CEP of 1,000 ft. for visual bombing to 3,500 ft. for radar bombing against poorly defined targets. After 1959 considerable improvement in these figures can be expected.

Air-to-Surface Missiles

13. Although it is known that Soviet jet medium bombers have been used as carriers for air-to-surface missiles, there is no evidence that any heavy bomber has launched a missile. Nevertheless, the Soviet Union has the capability of developing and producing air-to-surface missiles for use with long-range and medium-range aircraft. Such missiles could include:

(a) a subsonic cruise-type with a range of 55nm which has been available since 1956-57, but which imposes severe limitations on the launching altitude and speed of the aircraft[3];

(b) a supersonic cruise-type with a 55nm range which could be available in 1958[3];

(c) a supersonic cruise-type with a range of 100nm which could be available in 1961.

14. Characteristics of these missiles could be as follows:

	Subsonic 55nm Available 1956	Supersonic 55nm Available 1958	Supersonic 100 nm Available 1961
Speed	Mach 0.9	Mach 1.5	Mach 2.5
Payload	3000 lbs	3000 lbs	3000 lbs
CEP	See Note No.3	See Note No.3	1-2 nm
Reliability[4] (Missile only)	75%	75%	75%

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3 The CEP of these missiles will vary with the radar characteristics of the target. Against ships and other well-defined radar targets it may be as low as 150 ft.

4 Reliability of missiles is defined as the percentage of missiles which function according to specification from take-off to detonation in the target area.

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15. Production of these missiles could be as follows:

(a) Subsonic 55nm — 250 by end of 1958. Production then ceases as supersonic missile becomes available.

(b) Supersonic 55nm — 200 by end of 1958 and 400 per year thereafter.

(c) Supersonic 100nm — 150 by end of 1961 and 200 per year thereafter.

16. It should be noted that the 100nm supersonic missile (or an improved version of it with a speed of up to Mach 3.8) could eventually be used with supersonic aircraft, if the latter are produced as weapons carriers (see para 8 and footnote to para 10 above).

Surface-to-Surface Ballistic Missiles

17. Test firings of a single-stage ballistic missile with a range of 700nm have taken place, and it is estimated that such a missile could have been available for series production since 1956. The time required to complete the development of a modified vehicle with a range of 1200nm would be short, and these could be available to operational units in 1958. Missiles of this range would if shore-based be useful only for attack on Western Europe, the United Kingdom and peripheral targets, but by 1964 a comparable vehicle could be submarine-launched (see para 20).

18. The Soviet Union is clearly capable of producing a long-range ballistic missile. The second satellite launching shows that propulsion problems have been solved, for it is estimated that the system used for this satellite could throw a payload of 1500 to 2000 lbs some 5000nm. Guidance requirements for orbiting a satellite are not so stringent as for the accuracte delivery of a long-range missile, but it is certain that the Soviet Union has at least partially solved this problem. Certain evidence suggests that this is also true of the re-entry problem. However, our present estimate of the date of the initial Soviet operational capability with a 3,500-5,000nm ballistic missile is 1960, although developments in the near future may make us bring this estimate forward. The operational missiles could have the following characteristics:

	Initial (1960)	By 1965
Range :	3500-5000 n.m.	6000-7000 n.m.
Payload :	1500 lbs	2000 lbs
CEP :	5 n.m.	3-5 n.m.
Reliability :	50%	80%

19. Production of these missiles could be such that 100 would be available at the end of 1960, and at least 200 produced per year thereafter. These figures would include improved versions as they were developed. By 1965 available missiles should be capable of high and low-angle attack at reduced ranges with an improved CEP, and a warhead should be available capable of high-speed re-entry, possibly with decoys.

Submarine-Launched Missiles

20. There is little evidence of Soviet development of missiles for launching from submarines, although the Soviet Union has the capability for producing systems of this kind. Characteristics of such missiles could be as follows:

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	500nm Cruise Available 1958	1000nm Cruise Available 1960	1200nm Ballistic Available 1964[5]
Speed :	Mach 1.5 - 2.0	Mach 1.5 - 2.0	-
Payload :	1500 lbs	1500 lbs	2000 lbs
CEP :	2nm in 1958, decreasing to 0.5-1.0nm by 1961	1-2 nm in 1960 decreasing to 1 nm by 1962	3 n.m.
Reliability : (Missile only)	60%	70%	70%

21. Production of these missiles could be as follows:

(a) 500nm Cruise — 50 by end of 1958 and 50 per year thereafter;

(b) 1000nm Cruise — 40 by end of 1960 and 80 per year thereafter;

(c) 1200nm Ballistic — This missile, if developed, would be an adaptation of the single-stage medium-range ballistic missile (see para 17 above). By 1964 production of this missile (both shore-based and submarine-launched) could be of the order of 70 to 100 per year. There will be no requirement for the submarine-launched version of this missile if the Soviet long-range ballistic missile programme generally conforms in performance and availability with the estimates in this paper.

22. It is estimated that by mid-1958 some 20 submarines equipped to launch cruise-type guided missiles could be available and that by the end of 1961 this number could have increased to nearly 50. By 1961, some of these submarines could be nuclear-powered. About six nuclear-powered submarines equipped to launch guided missiles could be produced annually after 1961. The number of cruise-type missiles carried by submarines will vary with the different types of boats, but for the purposes of this paper it is assumed that three cruise-type missiles per boat would be an average figure. These submarines could be armed and at sea before the commencement of hostilities.

Nuclear Warheads and Bombs

23. In order to reduce requirements for accuracy, warheads of the largest possible yields would be delivered, although warheads with larger yields would weigh more and thus reduce ranges of missiles. Existing weapons in the kiloton range now weigh up to 3,500 lbs; a megaton weapon now weighs 8,000-10,000 lbs. With present knowledge this figure of 8,000-10,000 lbs. can be reduced to 2,000-3,000 lbs and by 1960 a one megaton warhead will weigh about 1,500 lbs. During the early 1960's this weight will be further reduced or else yield will be appreciably increased within this weight limitation. Thus it is expected that early missiles will have warheads with yields of about one megaton. However, it is probable

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5 If the ballistic missile adapted for submarine launching does become available in 1964, underwater launching is probable.

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that weapons of 3-5 megaton yield weighing 1,500-2,000 lbs will be available for all missiles by 1965 and probably earlier. Bombs with yields of up to 5 megatons will be available throughout the period under consideration for use by aircraft[6].

24. It would be unwise to assume that availablity of fissile material will be a limiting factor in Soviet production of warheads and bombs, or that Soviet development and production of warheads and bombs will not keep pace with the development and production of weapons systems.

Logistic Considerations

25. Aircraft. Because of the range limitations of all but a few aircraft in the LRAF, it would be necessary to stage bombers through favourably-located forward bases in any large-scale attack on North America. It is estimated that there are at present in suitably-located forward areas in the Soviet Union at least 10 airfields capable of staging heavy bombers. These airfields could probably stage the present and maximum projected heavy bomber strength of the LRAF against North America. Should a part of the medium bomber force be used on one-way missions against North America, there are available sufficient suitably-located airfields. Existing rail and water facilities are probably capable of moving the required tonnages into the appropriate areas, although the seasonal nature of the water routes to certain northern bases would necessitate long-range planning and advance stockpiling.

26. Missile Sites. Although there is no firm evidence of the construction of launching sites in the Soviet Union for other than surface-to-air missiles, it is only logical to assume that sites will be ready as missiles become operational. As range increases permit, sites will probably be built further and further into the interior of the country, in order to make detection and destruction more difficult and ease logistic requirements.

SOVIET REQUIREMENTS

27. In this section is is proposed to examine target systems in North America which the Soviet Union might consider would have to be attacked in the event of a global war. By examining these target systems and estimating the forces required to attack them in terms of different types of weapons systems, a measure of the Soviet force requirements to attack North America can be estimated. Two things about this procedure should be noted. First, the defences planned for North America are based upon providing a high overall level of area defence which would provide the same measure of defence for any target system within the combat zone with, in addition, highly important targets provided with a further increment of local defence. Secondly, the Soviet Union might not consider it necessary to attack simultaneously all of the targets considered, and the Soviet estimate of force requirements might therefore be considerably lower.

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6 The Chief of Plans and Intelligence, RCAF, believes that this sentence should read: "Bombs with yields of up to 20 megatons will be available throughout the period under consideration for use by aircraft."

The Joint Intelligence Committee adds that, because of safety limitations, free-fall bombing techniques cannot be used for aircraft bombs in excess of 5 megaton yield. Consequently, if weapons of 20 megatons are used by aircraft, much less accurate bombing will result.

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North American Targets

28. Targets in North America that the Soviet Union may wish to attack can be divided into groups, with differing requirements for accuracy of delivery using a given warhead yield. These groups are: ICBM launching sites (after about 1960); nuclear weapon storage sites; Strategic Air Command bases; and area targets (population and industrial centres, ports, etc).

29. ICBM Sites. Although details of the planned United States ICBM programme are not known it is possible that by the end of 1960 there will be 10-15 "soft" surface ICBM sites in North America, with a total of 50-75 operational missiles by that date[7]. These will be located in the vicinity of SAC bases, with several sites linked to each base, but several miles distant from the base. Each site will consist of five missiles and three launchers, and sites will themselves be several miles distant from each other. After 1960, the number of sites will grow rapidly. The majority of these sites will be "hard" and underground and so dispersed as to offer 300-500 separate targets by the end of 1965. These targets will be small and difficult to locate accurately. 2-3 psi peak overpressure will be sufficient to render soft sites unusable. "Hard" sites will be able to withstand about 100 psi overpressure. Tables I and III of Appendix "B" show the numbers of weapons required "over target" to obtain a 90% assurance that "soft" and "hard" ICBM sites are so affected, for various combinations of CEP and weapon yield.

30. Nuclear weapons storage sites, protected headquarters and similar targets can be assumed to withstand 100 psi overpressure. The number of nuclear weapons storage sites may grow from 6 in 1958 to 10 in 1961, while the number of civil and military headquarters may grow from 5 in 1958 to 10 in 1961.

31. SAC Bases. There are now some 45 SAC bases in North America and it is assumed for the purpose of this paper that this number may grow to 70 by 1963. In addition a programme exists to "harden" SAC bases, and to develop dispersed satellite runways which would further increase the number of targets to about 100 by 1963. SAC's present programme envisages that by 1960 at least one third of its total force will be at 15 minute readiness. This force can be launched on a strike mission within the time which it is estimated will be available from the planned ICBM warning system in 1963. Even though one third of the strike force were launched the immediate destruction of SAC bases would be vital to the enemy to limit the weight of attack against the Soviet Union. Enough weapons must be delivered on each SAC base to ensure a large probability of destruction. It has been estimated that 8 psi peak overpressure is sufficient to destroy aircraft on the ground and render above-ground installations unusable at "hardened" bases. Table II of Appendix "B" shows the number of weapons required "over target" to obtain a 90% assurance that a single SAC base is so affected, for various combinations of CEP and weapon yield.

32. Area Targets. Although wide divergencies develop between any extended lists of likely area targets in North America, there is a very large measure of agreement between the various lists that have been examined as far as the first 20 or 30 most important targets are concerned. Further, the population and general industrial importance diminish rapidly over the first 30 or so targets, and then become fairly constant and very small compared with the first few targets (see also Appendix "C"). It is therefore to be expected that the attack may be concentrated on a limited number of important targets, because of the great amount of damage that

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7 Information available to the Superintendant, Operational Research Group, DRB, suggests to him that production of United States ICBMs is planned to start about 1 January 1959 from at least one plant, and that at least 200 operational missiles will be available by the end of 1960. This number of missiles would require 40 sites by that date.

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could be thus caused compared with the small added returns to be obtained from attack on targets further down the list. There is no objective way of determining what this number of highest priority targets might be, but for the purposes of this paper the figure of 50 targets has been taken as an arbitrary but reasonable number, although if more suitable weapons were available more such targets would be attacked. One weapon of suitable size delivered with sufficient accuracy would give an adequate level of destruction on almost all of these area targets.

Targets Outside North America

33. Targets outside North America that must be attacked at the same time as the attack on North America include SAC and RAF Bomber Command bases, SACEUR's tactical air bases, ICBM and IRBM launching sites throughout the world, carrier strike forces and probably area targets in the United Kingdom, Western Europe and elsewhere. Medium-range missiles and medium bombers could be used against these targets, assisted probably by some submarine-launched and air-to-surface missiles.

Other Considerations Affecting
Soviet Requirements

34. Reliability and Attrition. Estimates of reliability of Soviet weapons systems have been given above. For the purposes of this estimate it is assumed that the Soviet planners will consider that the attrition rate imposed by North American defences against manned aircraft and air-breathing missiles will be relatively small in 1958. As surface-to-air missile defences come into being the rate will sharply increase and by 1967 may be relatively high. It is also assumed that the Soviet planners will consider attrition rates against ballistic missiles negligible until 1965, and very small after this date.

35. Reconnaissance. Missile attacks provide no direct observation of the target area and some means of assessing the reporting results will be necessary, particularly in the case of attacks on SAC bases and ICBM sites. Until more sophisticated means of reconnaissance (satellites, reconnaissance missiles) are available, it is expected that this task will be performed by aircraft.

36. Use of Manned Aircraft Against ICBM Sites. In view of the planned ability of United States ICBM sites to launch missiles very rapidly after the receipt of warning, it would appear that attacks by manned bombers would be of little value, since sufficient warning would be available and all readily available offensive missiles would have been launched before the aircraft could be over the targets.

37. Effect of North American Early Warning Capabilities. We estimate that against the types of manned aircraft capable of attacking North America, our present early-warning facilities will be as useful up to 1967 as they are at present. The detection and tracking equipments, however, do not have, nor were they intended to have, any usefulness for warning of attack by ballistic missiles. A system which will provide warning of missile attack will probably become available by 1963, and it is unlikely that the Soviet Union will have any effective capability for countermeasures or for spoofing this anti-missile warning system without violating North American territory during the period of this paper.

NATURE OF THREAT

38. The tables at Appendix "B" show for given accuracies and warhead yields the number of weapons of any type that would theoretically be required to give 90% assurance of achieving destructive overpressures on single SAC bases and single "soft" and "hard" ICBM sites. These tables ignore degradation due to reliability and attrition and neglect cumulative weapons effects.

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39. The tables at Appendix "D" show the numbers of aircraft or missiles with the characteristics detailed in this paper that would have to be launched to give 90% assurance of destroying single targets, of the four types described in the paper, at various dates during the period, if the attack were unopposed. In the case of aircraft no allowance has been made for either reliability or attrition, as these factors are better shown on the graphs mentioned below. These tables show that, taking into account only accuracy and warhead yield, aircraft are more effective than missiles against SAC bases and "soft" and "hard" ICBM sites, and as effective as missiles against area targets. However, when account is taken of the limited or nil warning time available in the case of missile attack (about 15 minutes as compared with some hours for aircraft attack) missiles are considered preferable for attacks on SAC bases and ICBM "soft" sites, because the disparity in numbers of weapons required is offset by the greater chance of destroying aircraft or missiles on the ground. Against ICBM "hard" sites too many missiles would be required throughout the period of this estimate to make this form of attack profitable. Existing manned aircraft are not considered suitable for attack on ICBM sites for the reasons given in para 36 above. When account is taken of the reliability of Soviet aircraft and the attrition they may suffer from North American defences, it would appear that missiles would be preferred to aircraft for attack on area targets.

40. The graphs at Appendix "E" are an attempt to apply this data for single targets to those parts of the total North American target system which are considered suitable for attack. However, the Soviet Union might not consider it necessary to attack simultaneously all of the targets considered, and the Soviet estimate of force requirements might therefore be considerably lower than that suggested by the graphs. The North American retaliatory capability in "hard" ICBM sites is not included in the graphs, since these sites are not considered to be profitable targets. These graphs assume that all available Soviet long-range ballistic missiles would be used against North America, and depict the number of manned aircraft that would be required to supplement these missiles in an attack on given North American target systems at given dates. To avoid an extremely complex presentation, no allowance has been made for the use of submarine-launched missiles, which the Soviet Union is capable of employing. However, submarines used in this role will reduce the number of aircraft required for targets within range of submarine-launched guided missiles.

41. Graph 1 shows the most probable situation based on the successive estimates in this paper. None of the factors is known with any degree of accuracy and Graphs 2 to 6 show the effect of varying the following principal factors: the priorities the Soviet Union might attach to various components of the North American target system; the size of the North American target system that might be attacked; and the availability of Soviet long-range ballistic missiles. In addition, the graphs show the effect of varying rates of reliability and attrition on calculated Soviet requirements for aircraft.

CONCLUSIONS

42. Our conclusions are as follows.

43. Between 1958 and 1967 attacks on North America could be carried out by some or all the following weapons systems:

(a) bomber aircraft;

(b) air-to-surface missiles launched from long-range aircraft;

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(c) surface-to-surface missiles launched from Soviet territory;

(d) missiles launched from submarines.

Employment of each of these weapons systems is subject to limitations imposed by accuracy, warhead yield, reliability, attrition and availability.

44. Consideration of these weapons systems in relation to possible targets which the Soviet Union might consider it necessary to attack indicates:

(a) Soviet long-range ballistic missiles of an adequate performance, which are on the verge of achievement, possess a large margin of superiority over foreseeable defences and relative invulnerability to counter-attack. These factors suggest that there will be little justification for the Soviet Union to continue refinement and improvement of the manned bomber threat or its continued expansion in numbers after 1960.

(b) Missiles will progressively replace aircraft as the main threat to North America but aircraft will continue to be required for reconnaissance and possibly for ECM.

45. Targets in North America can be divided generally into four classes, and the nature of the threat to each is suggested in the following sub-paragraphs:

(a) North American ICBM Sites will be impracticable targets for attack by any of the weapons systems during the period of this estimate, except that "soft" ICBM sites will be vulnerable to ballistic missile attack from 1960 for as long as they exist.

(b) North American SAC Bases will be generally vulnerable to attack by any of the weapons systems that are available during the period, although range limitations may limit the employment of submarine-launched missiles.

(c) Area Targets will be generally vulnerable to attack by any of the weapons systems that are available during the period.

(d) Nuclear Weapons Storage Sites, Protected Headquarters and Similar Targets, which it is assumed will be able to withstand 100 psi overpressure, will be generally vulnerable to attack by bomber aircraft throughout the period.

46. The developing threat can be considered in three phases:

(a) Phase I: During the period 1958 to 1960, the main threat to North America will be from the manned aircraft of the LRAF and possibly from cruise-type missiles launched from submarines. Although all the manned bombers of the LRAF are not entirely suited to the task of attacking North America, there is little doubt that heavy bombers and a part of the medium bomber force on one-way missions would be employed against North America during this period.

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(b) Phase II — The period between 1960 and 1963-64 is one of transition during which the long-range ballistic missile threat will sharply increase. Long-range ballistic missiles will be suitable for attack on area targets, "soft" ICBM sites and SAC bases, but unsuitable for "hard" ICBM sites. Manned aircraft and submarine-launched missile attacks will continue to be employed, particularly during the early part of the period, as well as long-range ballistic missile attacks, but the need to employ these weapons will progressively reduce as long-range ballistic missiles become available in larger numbers.

(c) Phase III — From 1964-65 onwards the primary threat to North America will be from the improved long-range ballistic missile and sufficient of these missiles will be available to attack as many area targets as the Soviet Union needs to attack, and such SAC bases as remain. Manned aircraft as weapons carriers will continue to be available as a reserve capability. Submarine-launched guided missiles will continue to be available for attack on North America throughout the period. "Hard" ICBM sites will be unsuitable targets for attack by any weapons system.

47. It is estimated that, from the end of 1960 onwards, the Soviet Union will have enough long-range ballistic missiles to destroy 50 or more North American cities. This threat could serve as a deterrent to the West, and could provide a basis for "blackmail" in the event of severe crisis or local hostilities.

48. In spite of possessing increasing numbers of long-range ballistic missiles after 1960, the Soviet Union will not improve its capability to prevent devastating retaliation, should it launch an attack on North America. (This assumes that the United States will be successful in building up in North America a large nuclear retaliatory capability based on ICBMs in "hard" sites). The Soviet Union will therefore be extremely unlikely to mount a planned attack on North America, or to take any serious risks that might lead to such a requirement throughout the period of this estimate. The risk of attack on North America will stem from the possibility of miscalculations by either side, during a period of acute rising tension, or arising from an extension of a local war in which Western and Soviet forces were directly engaged.

ESTIMATED PERFORMANCE OF SOVIET STRATEGIC BOMBERS

I Subsonic Aircraft

AIRCRAFT TYPE	ENGINE TYPE	BOMB LOAD (LBS)	COMBAT RADIUS/RANGE (N.M.)		ALTITUDES (FT)		SPEEDS (Knots)		
			WITHOUT REFUEL	WITH ONE INFLIGHT REFUEL*	TARGET ALTITUDES ONE WAY MISSION	TARGET ALTITUDES TWO WAY MISSION	AVERAGE CRUISE SPEED	COMBAT SPEED	
BISON	4 Mikulin AM-3 Series axial flow turbojets of 21,500 lbs SLST	10,000	3,100/6,100	4,200/8,200	54,500	45,500	455	490	
		3,500	3,200/6,400	4,300/8,600	54,500	45,500	455	485	
BEAR	4 "K" turboprops of 12,100 ESHP	10,000	4,250/8,300	5,750/ -	50,500	42,100	405	450	
		3,500	4,500/8,900	6,100/ -	50,500	42,500	405	440	
BADGER	2 Mikulin AM-3 Series axial flow turbojets of 21,500 lbs SLST	10,000	1,600/3,100**	2,200/4,200**	49,000	41,500	465	490	
		3,500	1,850/3,700**	2,500/5,000**	49,000	42,000	465	490	
BULL	4 Ash 90 aircooled radial reciprocating engines developing 2,200 H.P. each	10,000	1,800/3,300	2,400/4,500	10,000***	10,000***	175	10,000' 285	30,000' 350
		3,500	2,050/3,700	2,750/5,000	10,000***	10,000***	175	280	345

*Refuelling estimates based upon use of compatible tankers which will provide approximately 35% increase in radius/range.
**Although no confirmed sightings have been made of external wing tanks on BADGER aircraft, two 1,200 Imp. Gal. tanks would increase the radius/range by about 500/1,000 n.m.
***Maximum altitude over target can be between 30,000 ft and 40,000 ft dependent on weight. The figure of 10,000 ft is economical cruise altitude.

II Supersonic Aircraft

	Radius and Speed	Missile Launch Altitude
Supersonic-Dash Aircraft	4000 n.m. with two refuels at Mach 0.95 with 200 n.m. supersonic dash near target.	60,000 ft
Supersonic Cruise A/C	4000 n.m. with two refuels at Mach 2.0 (Maximum Mach 2.5)	64,000 ft (End of cruise altitude: 72,000 ft)

Appendix "B" to
JIC 256/5 (57)
JPC 101/5 (57)
of 3 January 1958

Numbers of weapons required "over target" to obtain 90% assurance that single targets will be affected by (peak) overpressures of 2.5, 8.0 and 100.0 psi., for various CEPs and weapon yields.

(Degradation due to reliability and attrition neglected. Cumulative weapons effects ignored.)

TABLE I: 100 psi. overpressure from ground burst ("hard" ICBM site)

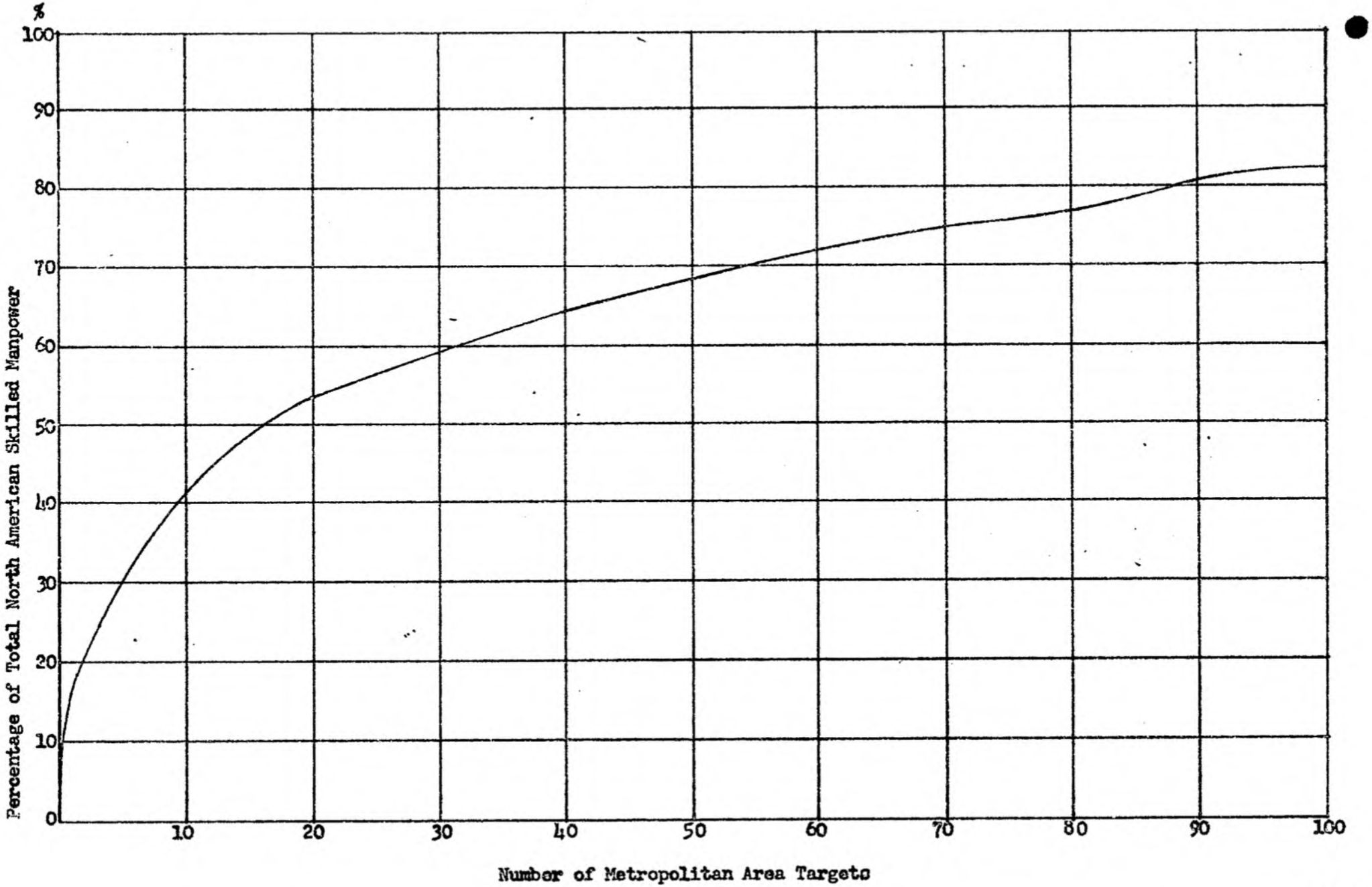
	5 n.m.	3 n.m.	1 n.m.	0.5 n.m.	1000 ft
600 KT	750	226	28	7	1
1 MT	565	188	20	6	
3 MT	305	113	13	4	
5 MT	226	84	9	3	
10 MT	151	58	6	2	
20 MT	103	40	2	1	

TABLE II: 8 psi. peak overpressure from airburst (SAC base)

	5 n.m.	3 n.m.	1 n.m.	0.5 n.m.	1000 ft
600 KT	18	7	1	1	1
1 MT	13	5			
3 MT	7	3			
5 MT	5	2			
10 MT	4	2			
20 MT	3	1			

TABLE III: 2.5 psi. peak overpressure from airburst ("soft" ICBM site)

	5 n.m.	3 n.m.	1 n.m.	0.5 n.m.	1000 ft
600 KT	5	2	1	1	1
1 MT	4	2			
3 MT	2	1			
5 MT	2				
10 MT	1				
20 MT					



APPENDIX "C"
JIC 256/4(57)
JPC 101/4(57)

TOP SECRET
CANADIAN EYES ONLY

APPENDIX "D" to
JIC 256/5(57)
JPC 101/5(57)
dated 3 Jan 58

ESTIMATED CHARACTERISTICS OF WEAPONS SYSTEMS AT GIVEN DATES, AND NUMBERS OF WEAPONS SYSTEMS REQUIRED TO GIVE 90% ASSURANCE OF DESTROYING SINGLE TARGETS OF TYPES INDICATED AT GIVEN DATES

TABLE I: Long-Range Ballistic Missiles

(Degradation due to attrition[1] imposed by North American defences neglected and cumulative weapons effects ignored)

Date	C.E.P. n.m.	Warhead Yield MT	Reliability %	No. of IRBMs Launched to Give 90% Assurance of Destroying Single Target			
				Area	SAC Base	ICBM Site Soft	ICBM Site Hard
1960	5	1	50	2	26	8	1130
1961	5	1	50	2	26	8	1130
1962	5	1	60	2	22	7	950
1963	5	3	70	2	10	4	440
1964	5	5	70	2	8	3	325
1965	3	5	80	2	3	2	105
1966	3	5	80	2	3	2	105
1967	3	5	80	2	3	2	105

1 The effect of 10% attrition rate in 1965-67 on these figures is to increase the requirement in these years against area targets, SAC bases and "soft" ICBM sites by one missile, and to increase the requirement against "hard" ICBM sites to 117.

TABLE II: Aircraft (Excluding Tankers[2])

(Degradation due to reliability and attrition[3] neglected and cumulative weapons effects ignored)

Date	C.E.P. ft	Bomb Yield (4)	No. of Bombs Dropped to Give 90% Assurance of Destroying Single Target[4]			
			Area	SAC Base	ICBM Site Soft	ICBM Site Hard
1958	1000	)	1	1	1	1
1959	1000	)	1	1	1	1
1960	1000	)Up to	1	1	1	1
1961	1000	)	1	1	1	1
1962	1000	)Several	1	1	1	1
1963	1000	)	1	1	1	1
1964	1000	)Megatons	1	1	1	1
1965	1000	)	1	1	1	1
1966	1000	)	1	1	1	1
1967	1000	)	1	1	1	1

2 For BADGERs, BISONs and supersonic aircraft used as bomb carriers against North America, a percentage of jet tanker aircraft would be required. This percentage might vary from 20% to 50%.

3 The effects of varying rates of attrition and reliability on requirements for aircraft are shown in the graphs at Appendix "E".

4 One bomb with a yield as low as 600KT will give 90% assurance of destroying SAC bases and soft and hard ICBM sites. One bomb of suitable size will give 90% assurance of an adequate level of destruction on almost any area target.

.....2

TABLE III: Air-to-Surface Missiles

(Degradation due to attrition imposed by North American defences neglected and cumulative weapons effects ignored)

Date	C.E.P. n.m.	Warhead Yield MT	Reliability % (Missile Only)	No. of Missiles Launched to Give 90% Assurance of Destroying Single Target[5]			
				Area	SAC Base	ICBM Site Soft	ICBM Site Hard
1958	SEE	1	75	SEE NOTE No. 6			
1959	NOTE	1	75				
1960	No. 6	3	75				
1961	See Note No. 7 1	5	75	2	2	2	12
1962	1	5	75	2	2	2	12
1963	1	5	75	2	2	2	12
1964	1	5	75	2	2	2	12
1965	1	5	75	2	2	2	12
1966	1	5	75	2	2	2	12
1967	1	5	75	2	2	2	12

5 These figures show the number of missiles that must be launched to obtain 90% assurance of destruction. They must be multiplied by the appropriate figures for the carrier aircraft to obtain aircraft and missile requirements for this weapons system under the stated conditions.

6 The CEP of the missiles available in these years will vary with the radar characteristics of the target. Against ships and other well-defined radar targets it may be as low as 150 ft.

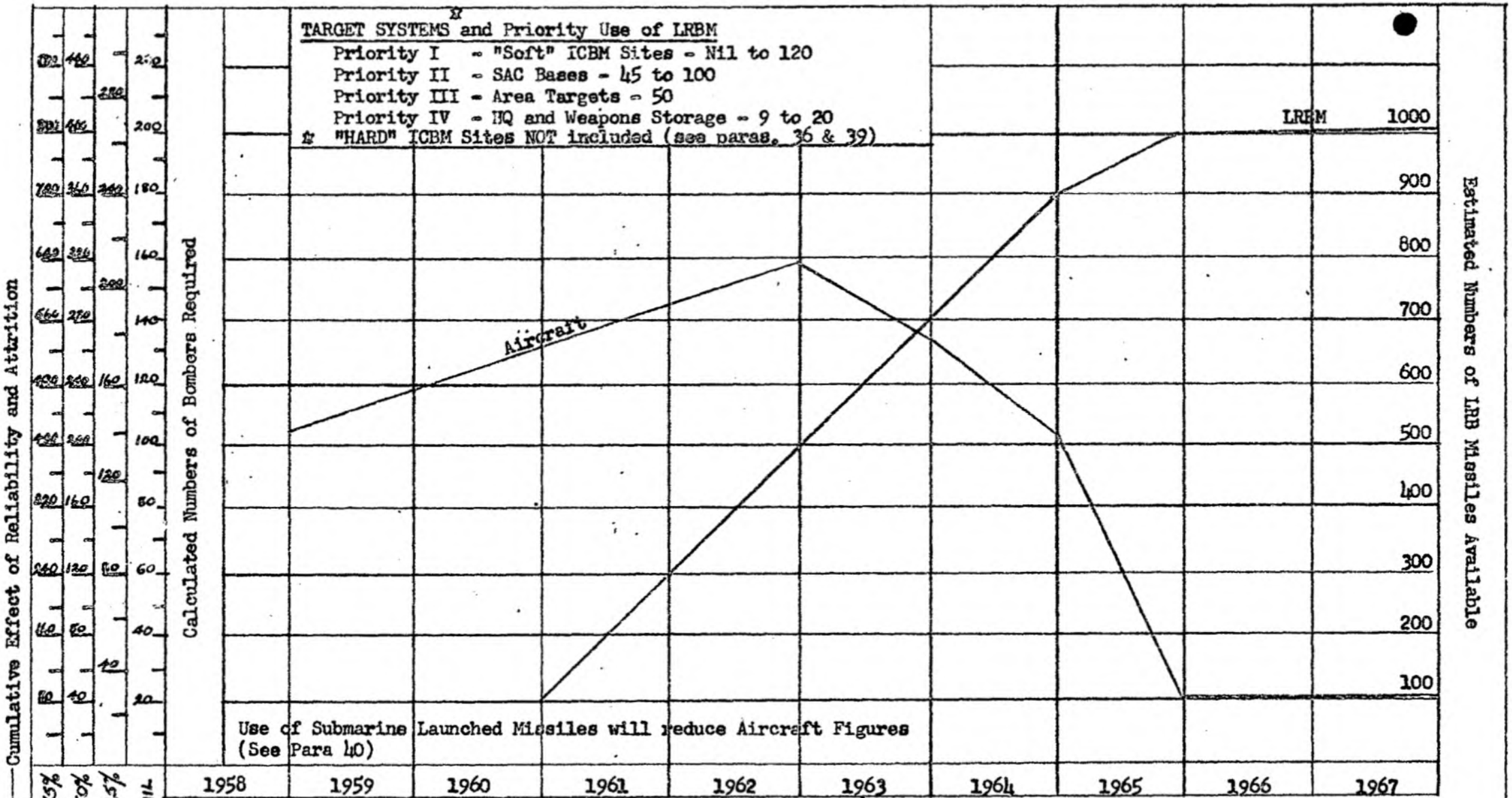
7 Missile in these years is supersonic with range of 100 n.m.

TABLE IV: Submarine-Launched Missiles (Cruise-Types Only)

(Degradation due to attrition imposed by North American defences neglected and cumulative weapons effects ignored)

Date	C.E.P. n.m.	Warhead Yield MT	Reliability % (Missile Only)	No. of Missiles Launched to Give 90% Assurance of Destroying Single Target			
				Area	SAC Base	ICBM Site Soft	ICBM Site Hard
1958	1	0.6	60	2	2	2	45
1959	1	0.6	60	2	2	2	45
1960	1	1	70	2	2	2	29
1961	1	1	70	2	2	2	29
1962	1	1	70	2	2	2	29
1963	1	3	70	2	2	2	19
1964	1	5	70	2	2	2	13
1965	1	5	70	2	2	2	13
1966	1	5	70	2	2	2	13
1967	1	5	70	2	2	2	13

SECRET

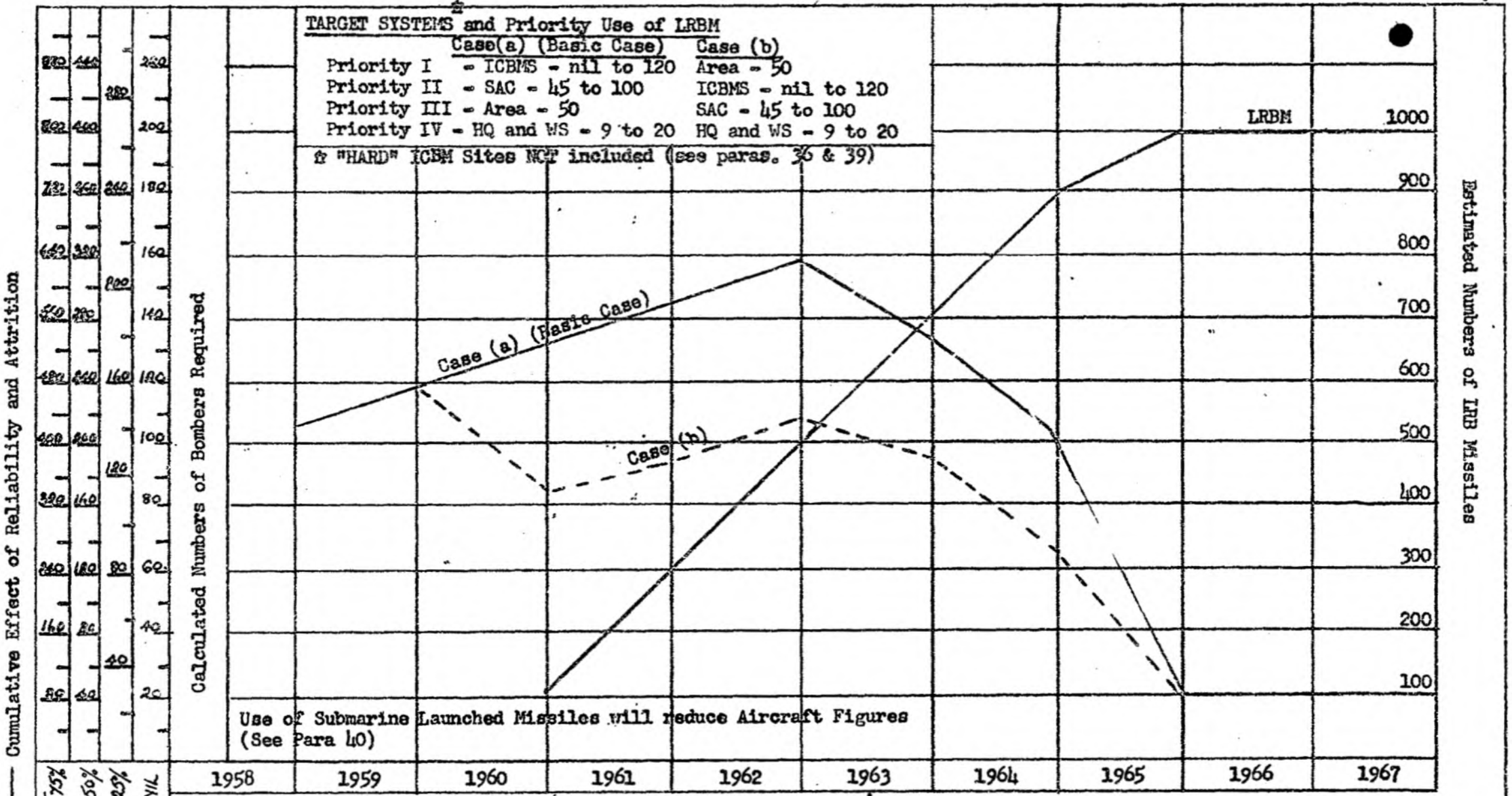


Calculated Soviet Bomber Requirements to Supplement Estimated Available Long Range Ballistic Missiles in an Attack on Estimated North American Target Systems ☆

Graph No. 1 - Basic Case, i.e. - Calculations based on estimated values quoted in paper

☆ "HARD" ICBM Sites NOT attacked (see paras. 36 & 39)

APPENDIX "E" JIC 256/8(57) JPC 101/8(57)



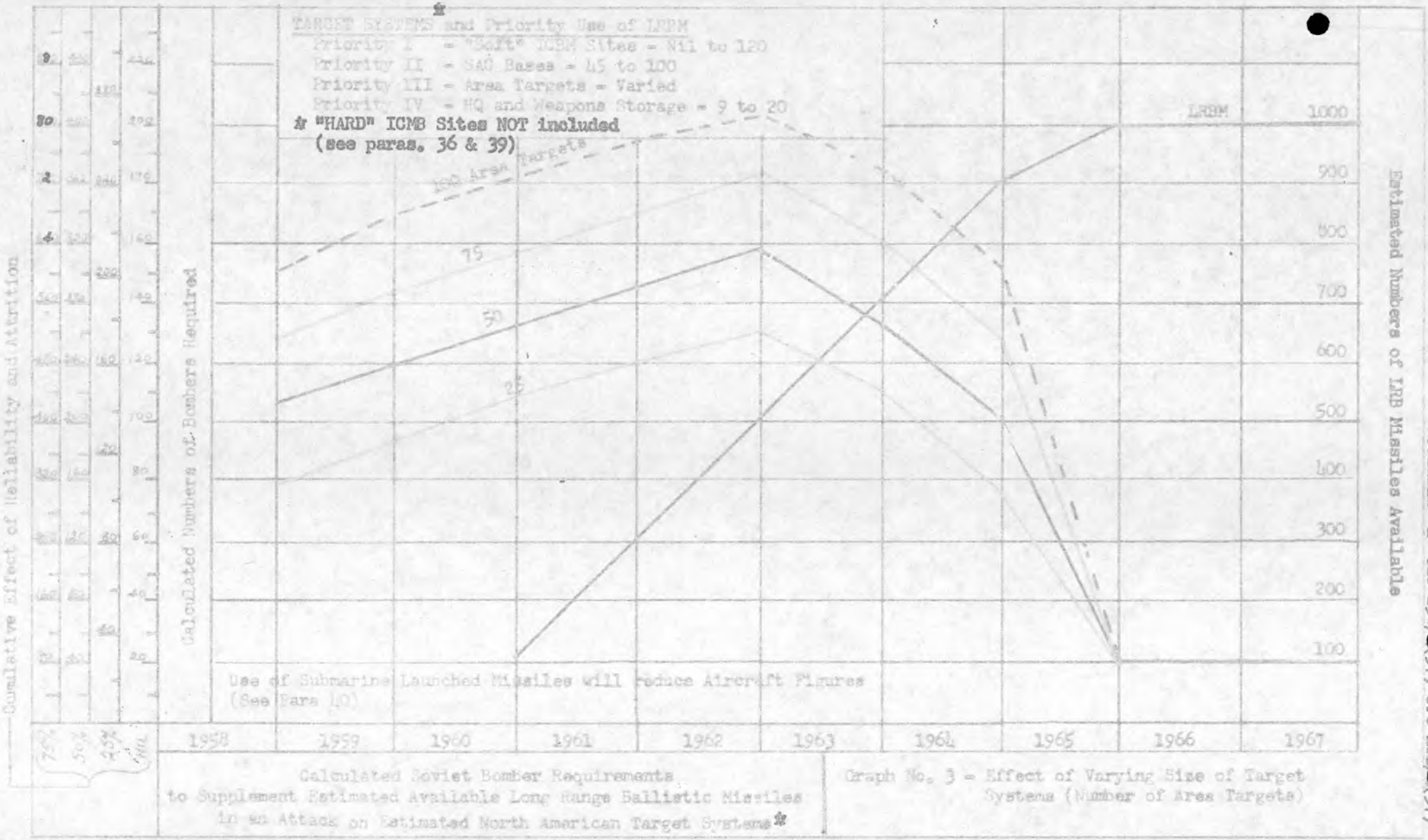
Calculated Soviet Bomber Requirements to Supplement Estimated Available Long Range Ballistic Missiles in an Attack on Estimated North American Target Systems *

Graph No. 2 - Effect of Varying Priorities of North American Target Systems

APPENDIX "E" JIC 256/8(57) JPC 101/8(57)

* "HARD" ICBM Sites NOT attacked (see paras. 36 & 39)

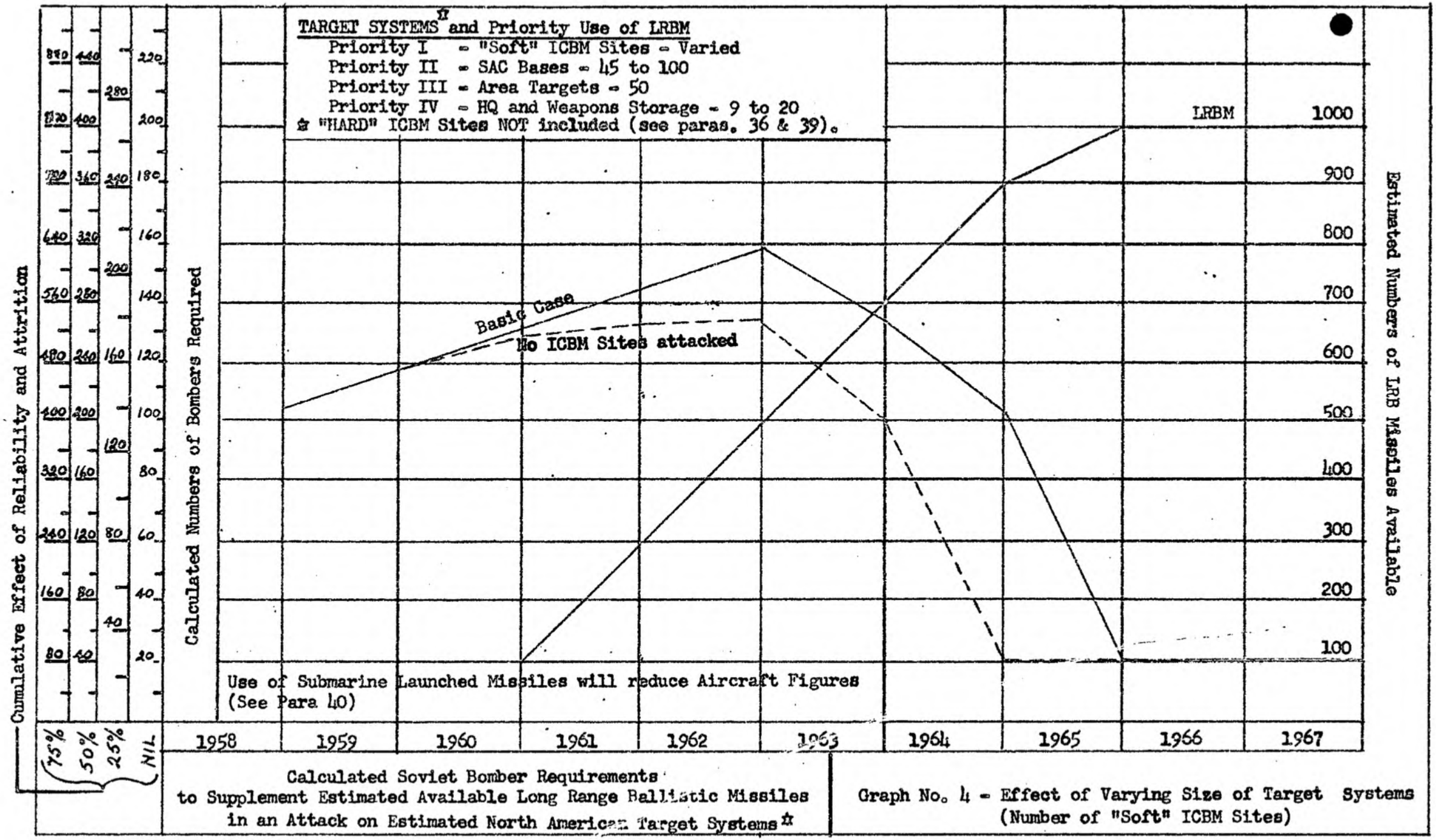
APPENDIX "E" JIC 256/5(57) JPC 101/5(57)



Calculated Soviet Bomber Requirements to Supplement Estimated Available Long Range Ballistic Missiles in an Attack on Estimated North American Target Systems*

Graph No. 3 - Effect of Varying Size of Target Systems (Number of Area Targets)

* "HARD" ICBM Sites NOT attacked (see paras. 36 & 39).

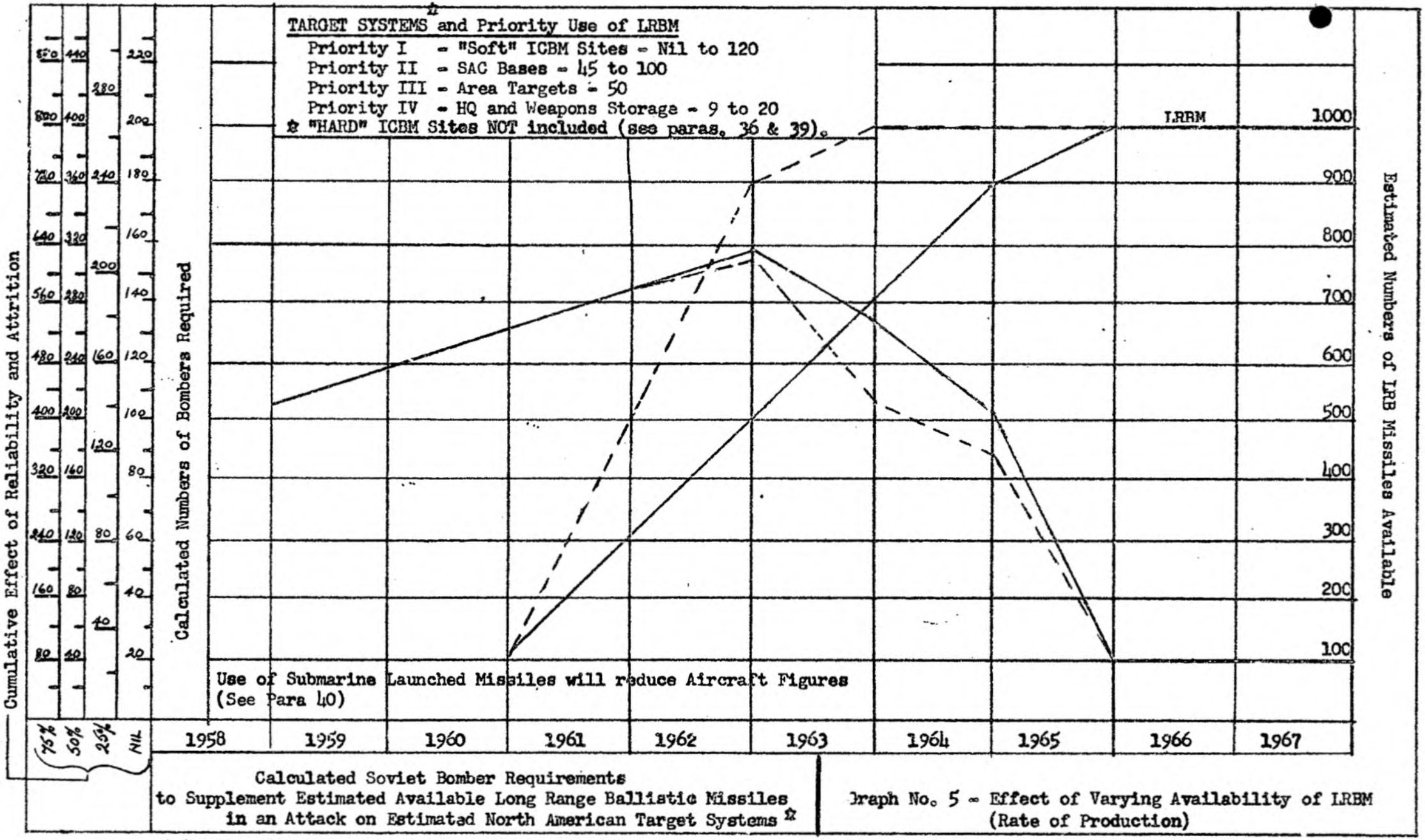


Calculated Soviet Bomber Requirements to Supplement Estimated Available Long Range Ballistic Missiles in an Attack on Estimated North American Target Systems ☆

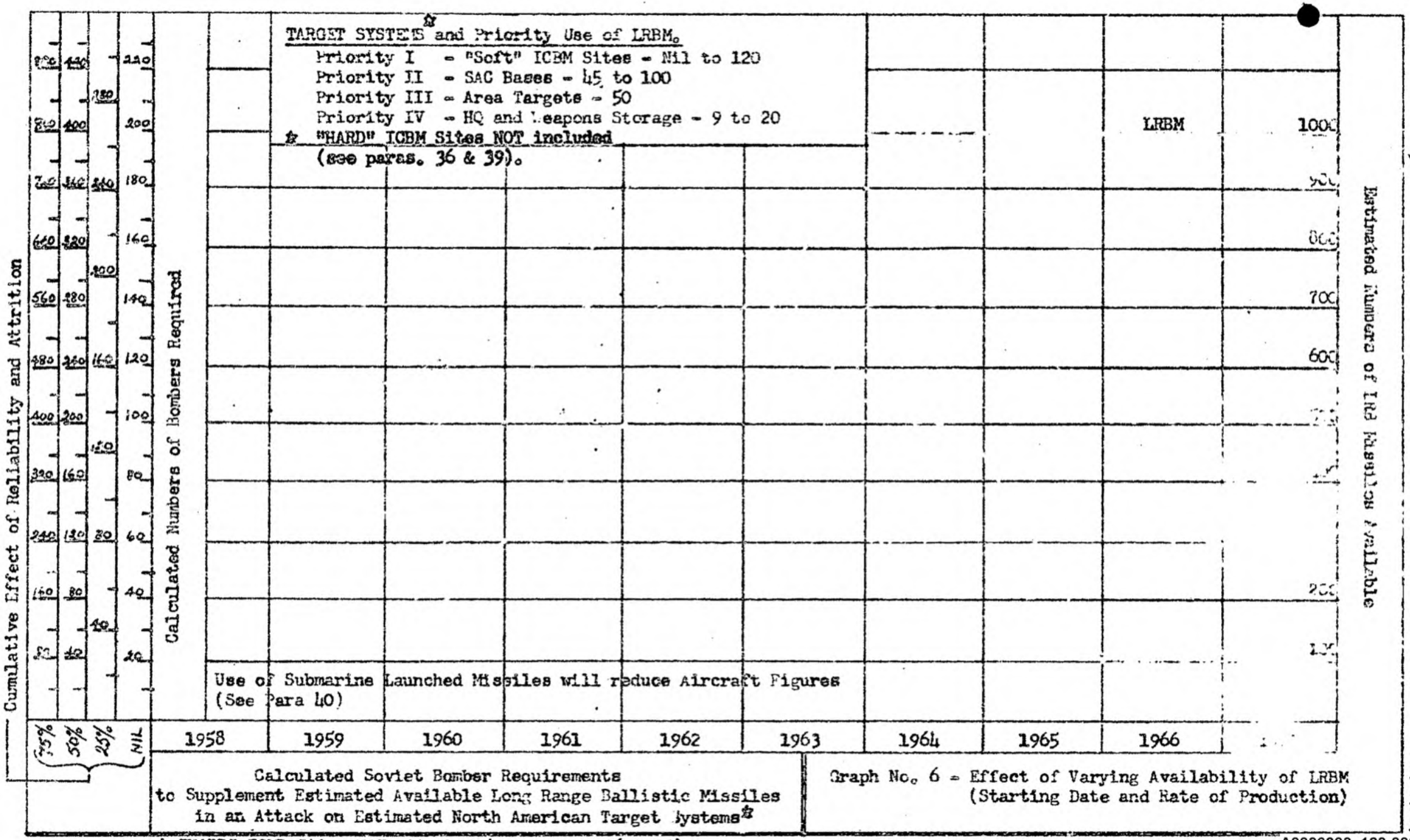
Graph No. 4 - Effect of Varying Size of Target Systems (Number of "Soft" ICBM Sites)

☆ "HARD" ICBM Sites NOT attacked (see paras. 36 & 39).

APPENDIX "B" JIC 256/5(57) JPC 101/5(57)



"HARD" ICBM Sites NOT attacked (see paras. 36 & 39).



Calculated Soviet Bomber Requirements to Supplement Estimated Available Long Range Ballistic Missiles in an Attack on Estimated North American Target Systems☆

Graph No. 6 - Effect of Varying Availability of LRBM (Starting Date and Rate of Production)

☆ "HARD" ICMB Sites NOT attacked (see paras. 36 & 39).

APPENDIX "B" JIC 256/5(57) JIC 101/5(57)