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SOVIET CAPABILITIES IN GUIDED MISSILES
AND SPACE VEHICLES

CIA HISTORICAL REVIEW PROGRAM
RELEASE AS SANITIZED

Submitted by the
DIRECTOR OF CENTRAL INTELLIGENCE

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and the intelligence organizations of the Departments of
State, the Army, the Navy, the Air Force, and The Joint Staff.

Concurred in by the
UNITED STATES INTELLIGENCE BOARD
on 9 September 1959. Concurring were the Director of Intelli-
gence and Research, Department of State; the Assistant Chief
of Staff for Intelligence, Department of the Army; the Assis-
tant Chief of Naval Operations for Intelligence, Department
of the Navy; the Assistant Chief of Staff, Intelligence, USAF;
the Director for Intelligence, The Joint Staff; the Atomic
Energy Commission representative in the USIP; the Assistant
to the Secretary of Defense, Special Operations; and the
Director of the National Security Agency. The Assistant
Director, Federal Bureau of Investigation, abstained, the sub-
ject being outside of his jurisdiction.

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NIE 11–5–59
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SOVIET CAPABILITIES IN GUIDED MISSILES AND SPACE VEHICLES

FOREWORD

This advance portion of the forthcoming national intelligence estimate on all Soviet missile development programs has been prepared to meet the immediate needs of intelligence consumers and to facilitate work by the intelligence community on certain parallel estimates and projects. It will be incorporated into the final version of NIE 11-5-58 (due in October 1959), subject to any further modification or revision which may be required by additional evidence or reanalysis in the interim. This text supersedes those portions of NIE 11-5-58 relating to the missiles discussed herein.

THE PROBLEM

To estimate Soviet capabilities and probable programs for the development of 700 nautical mile and 1,100 nautical mile ballistic missiles, intercontinental ballistic missiles, and fleet ballistic missiles, including their major performance characteristics and dates of operational availability.

THE ESTIMATE

SURFACE-TO-SURFACE BALLISTIC MISSILE SYSTEMS

1. The USSR has developed a family of surface-to-surface ballistic missiles through an intensive and well conceived program conducted at high priority since shortly after World War II. Missiles known to have been developed or to be under development at present include those with maximum ranges of about 75 nautical miles (n.m.), 200 n.m., 350 n.m., 700 n.m., 1,100 n.m., and intercontinental ballistic missiles (ICBM). We have more extensive information on the ballistic missile program than on any other Soviet missile program. We therefore estimate this program with considerable assurance, although our confidence in the details varies.

As a rule of thumb, a ballistic missile can be considered capable of firing to about one-third of maximum operational range without serious degradation in accuracy, and to even shorter ranges with degraded accuracy.
2. A substantial body of evidence supports our belief that the Soviet ballistic missile development program has for a number of years been well coordinated, extensively supported, and conducted by qualified personnel with access to excellent facilities. It has resulted in the development of operational missiles whose reliability, accuracy and other performance characteristics meet high standards.

3. We believe that in the development of longer range systems, maximum use has been made of proven components. On the basis of indirect evidence and the logic of a coordinated development program, we consider it reasonable to conclude that the two active Soviet ballistic missile test ranges (Kapustin Yar for missiles up to 1,100 n.m. range, Tyura Tam for ICBMs and space vehicles) have been mutally supporting with respect to component testing and shared experience.

4. The type of warhead employed with Soviet ballistic missiles will vary with the specific mission of the missile. In general, however, we believe that for missiles with maximum ranges of less than 700 n.m., high explosive (HE), nuclear, or chemical warfare (CW) warheads will be employed in accordance with Soviet military doctrine, depending upon nuclear stockpiles, missile accuracy, character of the target, and results desired. We estimate that for missiles with ranges of 700 n.m. and over, only nuclear warheads will be employed, although we do not exclude the possibility of CW use in 700 n.m. missiles for certain limited purposes. We believe that the USSR is capable of developing techniques for missile dissemination of biological warfare (BW) agents, although we have no specific evidence relating BW and missile research and development. In view of operational considerations we consider BW use in ballistic missiles unlikely, although possible for certain special purposes.

5. Mobility appears to be a basic consideration in Soviet ballistic missile design and we have good evidence of road mobility on some systems with ranges of 700 n.m. and less. The size and weight of the 1,160 n.m. missile may be such as to limit its road mobility to selected first class road nets; in view of this limitation, we believe it may be road and/or rail mobile. In the case of road mobile systems, it is probable that missile carriers and support vehicles are readily adaptable for rail transport. Mobility as it applies to an ICBM system is discussed below in paragraphs 27–29.

700 Nautical Mile Ballistic Missile System (SS-4)

6. There is considerable evidence that a missile which would meet the Soviet requirement for a 700 n.m. range weapon has been under test at Kapustin Yar for many years. We believe that test firings began in about 1958; an average of about two per month have occurred since mid-1966. We estimate that this system has been available for operational use since about 1960, although no operational sites or units have been identified.

7. Until recently we were unable to determine whether the largest missile in the 7 November 1957 Moscow Parade (nicknamed SHYSTER for recognition purposes) was the 700 n.m. missile or the 300 n.m. missile. Evidence together with statements and photographs released by the USSR, has provided sufficient data to permit the determination that SHYSTER is probably the 700 n.m. missile. Analysis of this evidence has caused us to change our previous estimate of maximum warhead weight from 5,000–6,000 pounds to approximately 3,000 pounds.

8. We continue to estimate that prior to 1958 this missile utilized radio/inertial guidance and that commencing in 1958–1960 an all inertial system would become available. There are some indications that inertial components were being tested in late 1958. Missiles already produced and equipped with the radio/inertial system will not necessarily undergo retrofit to the all inertial system.

9. We do not believe a second generation missile of this range is yet being deve-
opined. There are indications that the 700 n.m. missile has contributed to the development of other missiles, but the exact nature of this contribution cannot be determined.

10. We estimate that this missile system is operational in production in the USSR, and that it probably has the following characteristics:

- **US Designation**: SSYSTER-SS-4
- **IOC Date**: 1950
- **Maximum Range**: 700 n.m.
- **Length**: 48 feet
- **Diameter**: Approximately 5 feet
- **Propulsion**: Single thrust chamber, jet vanes controlled (no vernier), approximately 90,000 lb. thrust, liquid oxygen/ kerosene, two step thrust cutoff.
- **Configuration/ Structure**: Single stage ballistic, integral tankage.
- **Accuracy**: 1-2 n.m. CEP at 700 n.m. under average operational conditions.
- **Maximum Warhead Weight**: Approximately 500 lbs. in a separating nosecone.
- **Ground Environment**: Road mobile
- **System (SS-S)**

\[
1,100 \text{ Nautical Mile Ballistic Missile}
\]

11. A missile of approximately 1,100 n.m. maximum range has been under test at Kapustin Yar for over two years; since mid-1957 more than 43 such missiles have been test fired. There have been periods of high firing rate as well as periods of inactivity, the latter including one as long as nine months.

\[
\text{The 1,100 n.m. missile could have become operational in late 1958 or early 1959, although no operational sites or units have been identified.}
\]

\[
\text{For estimates of reliability and reaction times under various conditions for this and other systems discussed herein, see Annexes A and B.}
\]

\[
\text{Date at which one or more missiles could have been placed in the hands of trained personnel in one operational unit.}
\]

\[
\text{There are indications of inertial components, of engine burning time, and of four combustion chambers in the engine. Like the V-2 and the 700 n.m. missile, this engine starts down in two steps. Jet vanes are probably used for missile stabilization and control. We no longer believe that the 1,100 n.m. missile is essentially a modified 700 n.m. missile, although it would be in keeping with Soviet practice for this system to make maximum usage of proven components and designs from other programs.}
\]

13. On the basis of all available evidence, we estimate that the 1,100 n.m. system is operational and in production in the USSR, and that it probably has the following characteristics:

- **US Designation**: SS-5
- **IOC Date**: Late 1958 or early 1959
- **Maximum Range**: 1,100 n.m.
- **Propulsion**: Poor combustion chambers, liquid oxygen/kerosene, two step thrust cutoff, jet vanes stabilization and control.
- **Configuration/ Structure**: Single stage ballistic
- **Guidance**: Radio/inertial or all inertial
- **Accuracy**: 1 n.m. CEP at 1,100 n.m. under average operational conditions.
- **Maximum Warhead Weight**: Approximately 500 lbs. in a separating nosecone.
- **Ground Environment**: Road and/or rail mobile.

\*

\[
\text{Intermediate Missile Systems of Longer Range}
\]

\[
\text{Assuming deployment within Soviet territory, 700 n.m. and 1,100 n.m. missiles are capable of reaching a large majority of critical targets in Eurasia and its periphery. It is possible that the USSR intends at a later date to develop a ballistic missile system with maximum range of about 1,500 to 2,500 n.m. to supplement existing target coverage and to permit deployment in more secure areas. In 1949, fairly early in the USSR's ballistic missile program, the Soviets instructed German missile specialists to make design studies on missiles with ranges as great as 1,800 n.m. We know of no further developmental work}
\]
on such missiles, and we do not believe there have been any test firings or preparations for firings to intermediate ranges of greater than 1,100 n.m. We conclude that an intermediate missile of longer range has had a fairly low priority. In any case, the initiation of test firings would probably precede first operational capability by 18 months to two years.

Intercontinental Ballistic Missile System (SS-6)

15. In our most recent estimate on Soviet development of ICBMs (NE 11-4-58, paragraphs 125 and 126), we considered it probable that the USSR would achieve an initial operational capability with 10 prototype ICBMs at some time during the year 1959. We also held it to be possible, although unlikely, that a limited capability with comparatively unproven ICBMs might have been established in 1958. These conclusions rested on a variety of factors, including the estimated very high priority the USSR placed on achieving an ICBM capability for both political and military purposes, the estimated willingness of Soviet planners to accept considerable risks in initiating ICBM production and deployment, and the available evidence on Soviet test firings and capabilities in ballistic missile development.

16. We now have considerable additional knowledge of the ICBM test firing program, [This evidence shows that during 1958 the test program has proceeded in an orderly manner which we believe is effectively testing a complete ICBM system. There is good evidence that from the beginning of the test firing program in 1957 until the present there have been well over a dozen ICBM test firings, a high percentage of which have been successful in traveling from the Tyura Tam rangehead over a distance of approximately 3,500 n.m. to the terminal end of the range in the Kamchatka Peninsula area. In the test program, since its inception in August 1957, we have observed periods of launching activity and inactivity, but the evidence is not sufficient to determine whether this was due to a setback in the program. Reanalysis of test firing patterns for both ICBM and shorter range missile systems leads us to believe that this periodicity of test firing activity is the Soviet method of conducting an orderly program. In any event, both the rate and number of ICBM test firings are lower than we had expected by this time.]

17. Operational Capability Dates. Considering all the evidence, we believe it is now well established that the USSR is not engaged in a "crash" program for ICBM development. We therefore believe it extremely unlikely that an initial operational capability (IOC) was established early in the program with prototype missiles or with missiles of very doubtful performance characteristics.

18. On the other hand, we still consider it a logical course of action for the USSR to acquire a substantial ICBM capability at the earliest reasonable date. (The IOC for the ICBM marks the beginning of the planned buildup in operational capabilities and represents the date when the weapon system could be counted on to accomplish limited tasks in the event of war.) The hard evidence at hand does not establish whether or not series production of ICBMs has actually begun, nor does it confirm the existence of operational launching facilities. However, Khrushchev's statements of the winter of 1958-1959 regarding the establishment of ICBM series production are consistent with a logical decision to tool up for series production and to begin preparation of operational units and facilities before all technical aspects of the system had been fully demonstrated. Considering that production lead times are probably on the order of 12-18 months, we believe the USSR has had sufficient time to begin turning out series produced missiles.

19. In light of all the evidence, we believe that a Soviet IOC with a few—say, 10—series produced ICBMs is at least imminent, if in fact it has not already occurred. The evidence is insufficient, however, to support a precise estimate of IOC date. We believe that for
planning purposes it should be considered that by 1 January 1960 it will have occurred.

22. The rate of operational buildup subsequent to IOC date would depend not only on the priority assigned, but also to a great degree on the planned force level. This will be discussed in the forthcoming NSI 11-6-69, "Soviet Capabilities for Strategic Attack Through Mid-1964."

21. ICBM Performance Characteristics. There is no direct information on the configuration of the Soviet ICBM and no conclusive intelligence regarding ICBM component testing, although Soviet statements indicate a positive relationship between the ICBM, space vehicles, and proven military hardware. Analysis of possible vehicles used in Sputnik \(^{1}\) indicates that the ICBM could be a one and one-half stage configuration. At this time we do not believe there is sufficient evidence to permit selection of a single most probable ICBM configuration.

22. \(^{1}\) Variations in the performance of Soviet ICBMs and space vehicles could be accounted for by modifications of one basic type of vehicle to accomplish specific purposes. It is also possible that some or all of the space vehicles do not specifically represent the basic ICBM, but were special purpose vehicles. While we cannot firmly relate any of these vehicles to the ICBM, the energy they required can be correlated to alternative ICBM warhead weights. An ICBM of a size sufficient to orbit Sputnik I and II would have a gross takeoff weight of about 350,000 pounds and could carry a warhead of 2,000-3,000 pounds in a heat-sink nosecone. An ICBM of a size sufficient to propel Sputnik III or Lunik would have a gross takeoff weight of about 500,000 pounds and could carry a warhead of 5,000-6,000 pounds.

23. While the evidence is not conclusive and we cannot eliminate the possibility of a lighter warhead, we believe the current Soviet ICBM is probably capable of delivering a warhead of about 8,000 pounds to a range of about 5,500 n.m. with a heat-sink nosecone configuration. A reduction in warhead weight from that used to 5,500 n.m. would permit an increase in range. For example, a range of about 7,500 n.m. could be achieved with a warhead of about 3,000 pounds with the same nosecone configuration. Since there is no firm evidence on whether the Soviet ICBM employs a heat-sink or ablative type nosecone, it must be noted that the ablative type would permit an even heavier warhead or extended range. Although we believe them to be within Soviet capabilities, neither radar camouflage nor decoys have been detected in ICBM test firings to date.

24. We estimate ICBM guidance at IOC date to be a combination of radar track/radio command/inertial, although an all inertial system is possible (see paragraph 25). Soviet "state of the art" in precision radars, gyros and accelerometers leads us to estimate a theoretical CSP of about 3 n.m. at IOC at 1,500 n.m. range. Under operational conditions the theoretical CSP will be degraded by numerous factors, such as geodetic errors, insufficiently known weather and wind conditions in the target area, the inability of equipment to remain at peak effectiveness for prolonged periods, variations in the tolerances of components, inexperienced personnel (especially at IOC and at new sites) and the pressure of combat conditions on the personnel.

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\(^{1}\) The Assistant to the Secretary of Defense, Special Operations: the Director for Intelligence, The Joint Staff; the Assistant Chief of Staff for Intelligence, Department of the Army; and the Assistant Chief of Naval Operations for Intelligence, Department of the Navy, believe that, in view of the orderly conduct of the Soviet ICBM test program (paragraph 10), as opposed to a "crash" program (paragraph 19), and in view of the fact that both the rate and number of ICBM firings \(^{1}\) are lower than the intelligence community expected by this time (paragraph 10), the IOC will probably occur in the first half of 1960, with a possibility of its occurring in the latter part of 1959.
amount of degradation which would be introduced by such factors is unknown, but we estimate that CYP under operational conditions would be no greater than 5 n.m. at IOC date.

25. The guidance system and other factors would be improved so that under operational conditions a CYP of 3 n.m. in 1983 and 2 n.m. in 1985 is estimated as feasible. We have no knowledge as to Soviet intentions to retrofit inertial systems into ICBMs fabricated prior to operational adoption of an all-inertial system, which could probably occur in the period 1989-1992.

26. Available evidence does not support the testing of more than one basic type of ICBM at Tyura Tam—the possible variations in range and warhead weight discussed in paragraph 23 could be accomplished with one basic missile. Likewise, there is no evidence to indicate development of a second generation ICBM to replace that now being tested. If developed and tested in the future, such a missile would probably be designed to overcome certain operational difficulties and to permit simplified logistics. It might therefore be considerably smaller than the current system, taking advantage of improvements in the technology of construction, component design, warhead efficiency, fuels, and guidance.

27. ICBM Ground Environment. There is no firm evidence to indicate the Soviet concept of ICBM deployment or the nature of operational launching sites. From other ballistic missile systems it appears that mobility is a basic Soviet design consideration. The site, weight, complexity and mission of the ICBM, however, bring new factors to bear on launching system and site parameters.

28. As opposed to the advantages of hard or soft fixed site systems, a mobile system can reduce vulnerability by masking site location and identification more difficult. Eliminating road mobile systems as being intangible for the Soviet ICBM, we believe a rail mobile system, using special railroad rolling stock and presurveyed and preconstructed sites, to have certain advantages and disadvantages. So long as a multiplicity of sites existed, a rail mobile system would increase flexibility, decrease vulnerability and reduce the opportunity for enemy knowledge of occupied sites.

On the other hand, missile system reliability might be reduced and stable special trains would be required. The number and type of cars would depend on the size and configuration of the missile and the amount of fixed equipment installed at each of the prepared sites. The permanent installation at the launching site in such a rail system could be no more than a concrete slab on a special spur, but might include other facilities such as a small liquid oxygen facility, missile checkout building, missile erecting equipment, etc.

29. The available evidence suggests that the Soviet ICBM could be rail mobile; it is insufficient to establish whether the system as a whole will consist of rail mobile units, fixed installations, or a combination of the two. Whatever ground environment is selected, however, the Soviet rail network will play a central role in the operational deployment and logistic support of the ICBM system.

30. ICBM System Summary. In summary, we estimate that an ICBM is probably now in
series production in the USSR, and that an IOC with a few—say, 10—series produced missiles is at least imminent. Probable characteristics of the system are estimated as follows:

**US Designation** ........ SS-5

**IOC Date** ............... See Paragraph 10

**Maximum Range** ........ 5,500 n.m. with 6,000 lb. warhead

**Propulsion** .............. Liquid oxygen/locomotive, single-step final stage shutdown, and large re entry.

**Configuration** ............ One and one-half or parallel staging

**Guidance** ............... Probably radar track/radio command/inertial. All inertial could probably be available in 1960-1962.

**Accuracy** ............... CEP not greater than 2 n.m. at 5,500 n.m. under average operational conditions at IOC date; improvable to 3 n.m. in 1963 and 2 n.m. in 1968.

**Maximum Warhead** .. Probably 6,000 lbs. at 5,500 n.m. range

**Ground Environment** .... Rail mobile and/or fixed installations

**SUBMARINE-LAUNCHED MISSILE SYSTEMS**

31. There is little evidence of research and development associated with specific missile systems for Soviet naval application, although there have been sporadic reports of possible launchings of missiles or rockets in the various Soviet fleet areas.

32. Since 1956 there have been sightings of "W" class submarines with capsules and/or launcher-like structures on their decks. These included an excellent sighting in Leningrad in 1956 of a submarine with a capsule and launching ramp. It is probable that a few "W" class submarines have been converted to carry subsonic cruise type missiles having a maximum operational range of 150-200 n.m. and a low altitude cruise capability. Some smaller submarines have possibly been converted as well. Two such missiles can be carried in a deck capsule and launched from a ramp. Characteristics of the system are approximately as follows:

**US Designation** ........ SS-7

**IOC Date** ............... 1955-1956

**Maximum range of missiles** 150-200 n.m.

**Number per sub** ........ 2

**Launching condition** .... Surfaed

**Guidance** ............... Programmed with doppler assist, possibly with homing

**Accuracy** ............... 1-4 n.m. CEP under operational conditions; 150-500 feet with homing.

**Maximum Warhead** ........ 2,000 lb.

**Weight** ............... 33. Since 1956 there have been a few sightings and photographs of "Z" class submarines with greatly enlarged sails. Since 1956, three such submarines have been observed with two dome-shaped covers in the after portion of the enlarged sail. These submarines may have been modified for carrying and launching ballistic missiles. If so, an initial operational capability with at least three submarines has existed since mid-1956. Small numbers of modified "Z" class submarines are now in both the Northern and Pacific Fleet areas. Such submarines could carry two missiles each, but could probably launch them only while surfaced. The missile might have a range of about 300 n.m., a warhead weighing about 1,000 pounds, and a CEP under average operational conditions of 2-4 n.m. at maximum range.

34. There is inconclusive evidence that the Soviets are developing an advanced submarine/ballistic missile system. None of the small amount of evidence available concerns development of an associated missile itself. Based mainly on estimated Soviet requirements and technical capabilities, we believe
the USSR will probably develop a submarine/ballistic missile system having the following characteristics:

**US Designation**: SS-3  
**IOC Date**: 1961-1962  
**Maximum range of**: 560-1,000 n.m. missiles

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
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<tr>
<td>Number per submarine</td>
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</tr>
<tr>
<td>Launching condition</td>
<td>Submerged or surfaced</td>
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<tr>
<td>Propellant</td>
<td>Solid or storable liquid</td>
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<tr>
<td>Guidance</td>
<td>All inertial</td>
</tr>
<tr>
<td>Accuracy</td>
<td>2-4 m.n. CEP under operational conditions</td>
</tr>
<tr>
<td>Maximum Warhead</td>
<td>About 1,000 pounds</td>
</tr>
<tr>
<td>Weight</td>
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ANNEX A

ESTIMATED MISSILE RELIABILITIES

For several years after an IOC, the reliability of a missile system will probably improve, and then level off. Although we have little information on which to base an estimate of the operational reliability of Soviet missiles, the following are considered reasonable estimates.

<table>
<thead>
<tr>
<th>US DESIGNATION</th>
<th>IN-COMMISSION RATE</th>
<th>RELIABILITY</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>On launcher</td>
</tr>
<tr>
<td>SS-4</td>
<td>85</td>
<td>90</td>
</tr>
<tr>
<td>SS-4 at IOC</td>
<td>75</td>
<td>85</td>
</tr>
<tr>
<td>IOC plus 3 yrs</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>SS-4 at IOC</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>IOC plus 3 yrs</td>
<td>Not applicable*</td>
<td>80</td>
</tr>
<tr>
<td>SS-3 at IOC</td>
<td>Not applicable*</td>
<td>80</td>
</tr>
<tr>
<td>IOC plus 3 yrs</td>
<td></td>
<td>90</td>
</tr>
</tbody>
</table>

* Percentage of national operational inventory considered "good enough to try" to launch at any given time.
** Percentage of those missiles in operational units considered "good enough to try" to launch that will actually get off the launcher when fired.
*** Percentage of those missiles that get off the launcher that will actually reach the vicinity of the target, i.e., perform within the designed specifications of the missile system.

* In these categories, only those missiles considered "good enough to try" to launch will be loaded on submarines.
ANNEX B

ESTIMATED REACTION TIMES

The reaction times of Soviet missile units would vary according to the type of missile, the location (on or off site), and degree of alert. In the absence of information we consider the following are reasonable estimates:

Reaction Times, Ground-launched Systems

a. For units in transit at the time of alert, the following times are estimated for the launching of the first missile after the unit has arrived at the prepared launching site:

- SS-4—SS-5: 2-4 hours
- SS-6: 4-12 hours

b. The following reaction times are estimated for the SS-4 through SS-6 when the missile unit is in place at a launching site under the alert condition indicated:

Case I—Crews on routine standby, electrical equipment cold, missiles not fueled but could have been checked out recently.

Reaction time 2-4 hours

Case II—Crews on alert, electrical equipment warmed up, missiles not fueled.

Reaction time 15-30 minutes

Case III—Crews on alert, electrical equipment warmed up, missiles fueled and occasionally tipped. This ready-to-fire condition probably could not be maintained for more than 16-15 hours.

Reaction time 5-15 minutes

Naval Systems—While on station the reaction time for shipboard surface-to-surface missiles would be short. We estimate about 15 minutes for a submarine that must launch surfaced (SS-7), with an additional 7 minutes to launch a second missile, about 15 minutes or less for a submarine that can launch submerged (SS-8).
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