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Proliferation of Missile Delivery Systems for Nuclear Weapons

Submitted by

DIRECTOR OF CENTRAL INTELLIGENCE

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The following intelligence organizations participated in the preparation of this estimate:

The Central Intelligence Agency and the intelligence organizations of the Departments of State, Defense, the Army, the Navy, the Air Force, AEC, and NSA.

Concurring:

Director of Intelligence and Research, Department of State
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Assistant Chief of Naval Operations (Intelligence), Department of the Navy
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Director for Intelligence, Joint Staff
The Atomic Energy Commission Representative to the USIB
Director of the National Security Agency

Abstaining:

The Assistant Director, Federal Bureau of Investigation, the subject being outside of his jurisdiction.

CONTENTS

PROLIFERATION OF MISSILE DELIVERY SYSTEMS FOR NUCLEAR WEAPONS

THE PROBLEM

To estimate the capabilities and incentives of additional countries to acquire nuclear-capable ballistic missile delivery systems over the next 10 years.

NOTE

In accordance with the terms of the request which initiated this estimate, we discuss the possible spread of missile delivery systems in coming years, but we do not discuss in detail the spread of nuclear weapons compatible with such systems. Our most recent estimate on the latter subject is NIE 4-66, "The Likelihood of Further Nuclear Proliferation," dated 20 January 1966, the principal findings of which are still valid. The nuclear problem is considered in this estimate only in terms of the ease or difficulty with which each nation might obtain warheads compatible with missiles it might acquire, and the economic burden which a combined missile and warhead program would impose.

We consider in this estimate all countries which do not already possess missile delivery systems for nuclear weapons; the USSR, the US, Communist China, France,[1] and the UK either now have such systems or are in the process of acquiring them.

We have excluded from discussion missiles with a range of less than 200 n.m., but we consider all ballistic missiles of greater range as long as they could be used by a given nation for "strategic" objectives. The term "strategic missile" is employed in this estimate to describe

[1] French missile development programs are discussed in a separate estimate, NIE 22-67, "French Nuclear Weapons and Delivery Capabilities," dated 5 January 1967, SECRET RESTRICTED DATA.

a missile designed to strike at some enemy's homeland and not at his troops in the field or supply routes directly behind the front.

CONCLUSIONS

A. Although basic missile technology is already widely known, and many components for missile systems can be bought on the world market, the development, production, and deployment of an effective nuclear-capable ballistic missile system is a difficult and expensive undertaking which requires a sophisticated industrial base and a heavy commitment of national resources.

B. We consider that, over the next decade, there are only six nations, aside from those already having strategic missile systems, which are serious candidates for acquiring such systems. These nations either have or may come to have the requisite economic strength to produce missiles or have a strong political incentive to acquire them, or both. These countries (not in order of any priority) are Israel, India, the UAR, Sweden, Japan, and West Germany, and they are discussed in detail in Part II, paragraphs 18-47.

C. There are a number of other nations which have, or might come to have over the next 10 years, the economic strength to support a missile development program, but which lack foreseeable incentive to undertake one. These nations are discussed in Part III, paragraphs 48-50.

D. Some countries having space or military missile programs are likely to find the sale of components and even complete missiles economically or politically attractive. Few, if any, of the less developed nations, however, would be able to overcome the complexities of putting together the various elements of a workable missile system; they could obtain a meaningful capability only if they were provided with whole systems, already tested and operational.

DISCUSSION

I. GENERAL CONSIDERATIONS

A. Introduction

1. Over the coming decade, a number of nations may seek to acquire strategic ballistic missiles capable of delivering nuclear warheads. Some nations may be motivated to do so more by a desire for national prestige than by realistic military considerations. Others may come to believe that ballistic missile systems would guarantee them regional hegemony or provide them with a deterrent defense in the face of some regional threat. No other nation can hope to establish a missile system comparable in size and effectiveness to the systems of the two superpowers. Some governments, however, may believe that the possession of even a few nuclear-capable missiles would enable them to play a greater role in world affairs.

2. Ballistic missile systems are expensive, but they provide unique military advantages. They are at present virtually invulnerable to interception or, if they are hidden or deployed in hardened sites, to destruction before firing. A nation capable of deploying a missile delivery system equipped with nuclear warheads might achieve great regional strategic power with only a few missiles. Lacking nuclear warheads, a strategic missile force is little more than very expensive long-range artillery, and the strictly military justification for its deployment appears minimal. Still, nations without nuclear warheads might hope to acquire them some day, depending in the meantime on high explosive or possibly BW/CW warheads.

3. Nations wishing to acquire ballistic missile systems must determine strategic criteria in light of their own unique political and geographic situations. From these criteria, they can define their specific force objectives in light of the means likely to be available to them. Strategic requirements for a missile delivery system vary widely as between nations. A system capable of delivering a nuclear warhead 300 miles would provide India a deterrent to threats from Pakistan; it could not counter a threat from China. Such a system would form an Israeli deterrent to threat from the UAR, but it would not meet Japanese needs for a deterrent force and it would breach Sweden's self-imposed renunciation of strategic weapons which the USSR might find provocative.

4. In order to determine what sort of a missile force it should seek, a country would have to decide on what warheads were likely to be available and the distances over which these warheads would have to be delivered; the numbers of missiles in combination with available warheads which would provide adequate target destruction or credible deterrence; the levels of accuracy needed for attack on military targets or on enemy population centers; the characteristics of missile and launcher which would provide a suitable reaction time; and finally, the form of deployment which would best reduce the vulnerability of the missiles

to enemy attack. There may be some nations, however, which will minimize strictly military considerations and undertake the acquisition of a crude missile force for purely political purposes.

5. Whatever combination of range, payload, and accuracy may be dictated by strategic considerations, there remains a wide choice of specific hardware. Delivery vehicles may be single or multiple stage, their propellants solid, liquid, or combinations of the two. Each type of propellant presents both advantages and disadvantages. If liquid, propellants may be cryogenic [2] or storable. Cryogenic propellants are difficult to handle, require elaborate production, transportation, and storage facilities, and increase the reaction time of the system. Although some storable liquids are also difficult to handle because of their toxicity or corrosiveness, they can provide shorter reaction time. Solid propellants require advanced technology to produce and present formidable design problems in flight control, but solid propellant rockets can be stored for a long time and fired with very little preparation.

6. A similar range of choices exists for guidance and control systems. Radio or radar guidance is cheaper and more readily obtainable than inertial guidance and cuts down on total vehicle weight since much of the navigation and computation equipment stays on the ground. But guidance antennas are difficult to protect against enemy attack. Furthermore, missiles guided by radio or radar must be fired sequentially rather than in salvo, unless duplicate guidance installations are provided for each missile, a very expensive solution to the guidance problem. Some nations might attempt to devise guidance systems adapted from readily obtainable aircraft autopilots, but the Circular Error, Probable (CEP) [3] of a missile guided by this means might be on the order of 5 or 10 n.m. at a range of 500 n.m. Whatever guidance system is used, a country deploying missiles would need precise geodetic data for effective targetting. In general, any nation undertaking the development of an effective missile capability would probably find the achievement of satisfactory accuracy to be one of the most expensive and time-consuming aspects of its program.

7. Finally, nations which undertake the development of medium or longer range missiles [4] would face the problem of designing a reentry vehicle (RV) capable of surviving the heat of high-velocity atmospheric reentry and maintaining the accuracy of its trajectory during its high-stress transition from flight in vacuum to flight in the atmosphere. RV design and construction is a difficult matter, and although the technology involved is becoming more widely known,

[2] Cryogenic fuels are gaseous at normal temperatures. In order to remain liquid, they must be kept at very low temperatures prior to ignition.

[3] Expressed as the radius of that circular area within which 50 percent of those missiles which are successfully launched and which do not malfunction in flight will strike.

[4] Ballistic missile ranges are commonly categorized as follows:
Short Range (SRBM)—under 600 n.m.
Medium Range (MRBM)—600-1,500 n.m.
Intermediate Range (IRBM)—1,500-3,000 n.m.
Intercontinental Range (ICBM)—more than 3,000 n.m.

the RV problem is likely to present another obstacle to the success of domestic missile development programs.

8. It is clear, then, that some components of missile systems (e.g., propellants, guidance, RV design) require higher orders of technology than others. The ability of a nation to acquire these key components from foreign suppliers could weigh heavily in its initial decision to undertake a domestic missile development program and could have much to do with subsequent choices of specific hardware and the tempo and cost of the program.

9. It is unlikely that any nation set on acquiring a strategic ballistic missile system would be forced to design and manufacture the whole system itself. Some nations may find it possible to purchase complete systems, as Israel is now doing. Some—like the UAR—may depend heavily on the wholesale importation of scientists and technicians from more highly developed nations. Any nation with sufficient cash can purchase a good deal of advanced technology in the form of finished missile components, specialized machine tools, and advanced computation and testing equipment. Nations with adequate indigenous scientific capability can take advantage of the great amount of technical information in open literature. Some may obtain key technology through espionage. Germany, France, the UK, and to a lesser extent, Japan have access to US missile technology through normal channels established between US aerospace contractors and their foreign subsidiaries and licensees. Many foreign technicians have benefitted from their nations' cooperative programs with the US; some have been trained in US plants and at US launch facilities.

10. If US contributions to such regional space research groups as the European Launcher Development Organization (ELDO) and the European Space Research Organization (ESRO) increase, participating nations will enjoy greater access to US technology, even if at second hand. Air defense missiles and sounding rockets, although without direct strategic missile significance, are already widely available, and many nations have acquired basic technical experience in the production (usually under license), testing, and maintenance of these devices. Through the process of "reverse engineering," i.e., the careful disassembly of a missile and analysis of its component parts, many nations could shorten research and development time in their own missile programs. We will discuss the contributions to national programs of each of these sources of missile technology in subsequent sections of this estimate.[5]

11. The costs of, and time needed for, acquiring strategic missile systems would vary considerably from nation to nation with differences in strategic requirements, hardware choices, and domestic cost structures. Long-range missiles cost more than short-range missiles; accurate missiles more than inaccurate ones; nuclear warheads much more than high explosive or CW/BW

[5] Exports of US equipment and technology relating to ballistic missiles are subject to various US controls. US nonproliferation policy provides guidelines applicable to military sales and to cooperative defense projects as well as to international arrangements entered into by NASA. Detailed discussion of these domestic matters, however, is not within the scope of this estimate.

warheads. Some nations, such as Germany and Japan, possess advanced industrial bases readily adaptable to fairly rapid missile production. Others, such as India and the UAR, lack such bases, and their total missile development costs would include considerable investment in time-consuming basic industrial development. Variations in the domestic cost structure would also affect missile development costs; Japan, for example, might be able to develop a given missile system more cheaply than West Germany. Finally, the pace of missile development would play a sizable role in determining eventual costs. Crash programs are very expensive, as is the rigid adherence to ambitious development and production schedules and performance criteria.

12. Nations undertaking the domestic development, production, and deployment of a strategic missile force would probably have to invest heavily in specialized test equipment. As soon as a research and development effort reaches the hardware stage, individual components must be exhaustively tested with specialized facilities, some of which must approximate the harsh environment within which a missile must operate. Such facilities are expensive, but nations which forego testing with wind tunnels, vacuum and low temperature chambers, vibration tables, and so forth would run serious risk of failure.

13. The successful flight testing of a prototype missile and subsequent production models requires an instrumented test range. The development of high degrees of accuracy, reliability, and readiness requires extensive testing over a long period. Some nations might be able to test their missiles on ranges established by friendly countries, as the British have used the Woomera range in Australia. Those nations which—like Israel—purchase complete missile systems from more advanced nations might try to include in the transaction provisions for the periodic use of a test range for postdeployment testing and crew training. But nations desiring freedom from any dependence on other nations would be forced to build and instrument their own test ranges.

14. However it is acquired, a missile system must be maintained in readiness. Missiles are complex; individual components can deteriorate in time, and they must be tested and replaced on some sort of regular schedule. In addition, most nations would make periodic firings in order to train firing crews and to demonstrate the system to potentially hostile powers. Insuring a continuing supply of replacement components to maintain readiness and to support a regular test and demonstration firing program can be a major problem for even a modest missile force.

B. Specific Nations

15. For purposes of convenience, we have divided all nations other than the US, USSR, UK, France, and Communist China, into three categories. The first group consists of those nations whose capabilities for producing missile systems or whose incentives for acquiring them over the next decade appear to be strongest. These nations (not in order of any priority) are: Israel, India, the UAR, Japan, Sweden, and West Germany. In the second group are those nations

with some ability to produce strategic missiles but little or no incentive to have them. These nations are: Australia, Belgium, Canada, Czechoslovakia, East Germany, Italy, the Netherlands, and Switzerland. All other nations fall into the third group: those nations with neither an appreciable capability of producing a missile system nor a foreseeable prospect of acquiring one.

16. Obviously, adjustments may be expected in these groupings in years to come, some of them sudden. Capabilities can change only slowly, but incentives and intentions can change over night with the fall of a government or a new estimate of an external threat. Likewise, as missile technology spreads, advanced nations may find missile sales a lucrative form of foreign trade. We cannot exclude the possibility that nations which do not now appear to be candidates for acquiring a missile system may develop a strong desire to have one and may find an advanced country willing to provide a system by sale or gift.

17. In the following discussions of specific countries, missile cost estimates are gross approximations. There are many variables involved in the determination of such costs, and figures are given only to indicate relative orders of magnitude and the likely economic burden of missile production or procurement. They do not include postdeployment operating and maintenance costs. [redacted] Naturally, costs vary greatly with the numbers of missiles, their performance characteristics, and the modes of their deployment, although there is no great difference in cost between mobile deployment of a system and deployment in hardened sites. In addition, costs for roughly equivalent missile systems can vary considerably from nation to nation with differences in industrial base, prior progress in missile or space launcher development, and presumed sources of supply. In all cases, we assume that missile components and specialized tools and testing equipment will continue to be as readily available from advanced nations as they now are. In the discussion of individual countries, the size of a possible missile force is generally hypothetical. We believe the estimated force levels used are based on realistic assumptions concerning such factors as strategic requirements, mode of deployment, possible availability of nuclear warheads, etc.

II. SIGNIFICANT CANDIDATES FOR THE ACQUISITION OF STRATEGIC MISSILE SYSTEMS OVER THE COMING DECADE

Israel

18. Shortly after the UAR put on display its prototype Victor and Conqueror missiles in July 1962, the Israeli Government contracted for the design, testing, and production by the French firm Avions Marcel Dassault of the nuclear-capable MD-620 missile. [redacted] The first missiles will be delivered to Israel within the next two years.

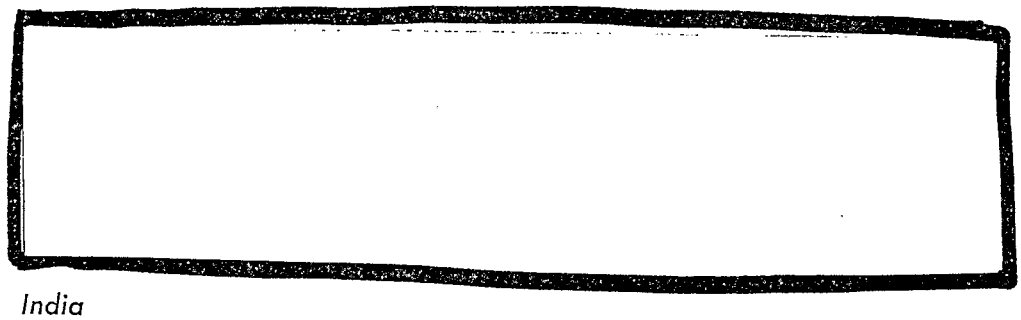
19. [redacted] If for some reason the Israelis were not to receive the MD-620 missile system from the French and were to attempt to produce such a system on their own, it would probably take them at least five years to do so and cost considerably more than the Dassault contract price of $400 million.

20. The MD-620 missile is a two-stage, solid fuel missile which can probably carry a 3,000 pound RV about 250 n.m. with an estimated CEP of .5 n.m.[6] While this range is sufficient to threaten most Egyptian targets, the important Aswan Dam is beyond it. The proposed range of the MD-640 would be about 500 n.m. with the same RV weight. The MD-620 nosecone has been designed to accommodate a nuclear warhead, but in the absence of such a warhead, the Israelis will have to depend upon conventional explosive or, possibly, BW/CW warheads.

21. [redacted] If the original contract did not cover the cost of missiles for deployment, a force of 250 missiles and about 50 mobile launchers would probably cost something over $100 million more. Construction and instrumentation of test and some fixed launch sites, presumably in the Negev, might cost some $20 million, and with $20 to $40 million for command and control systems, the total cost of the MD-620 system would be about $450 to $550 million. [redacted] In any case, Israel's foreign exchange position is strong, and we do not believe the costs of the missile program—while undoubtedly burdensome—are beyond Israeli means.

22. [redacted]

[6] See Annex for the specifications of this and other missiles mentioned in this estimate.



India

23. India's growing concern about its security prospects was undoubtedly given added urgency by the 27 October 1966 detonation of what we believe to have been Communist China's first missile-delivered nuclear weapon. Although New Delhi has explored the possibility of some sort of joint or parallel security guarantee from the US and the USSR, none which would satisfy India seems to be in prospect, and the cessation of US military assistance during the 1965 Indo-Pakistan war has probably strengthened the arguments of those Indians who advocate national self-reliance in defense matters. In addition, India almost certainly estimates that Communist China cannot be persuaded to join in a meaningful disarmament treaty. In the face of the Chinese threat, traditional Indian moral arguments against the acquisition of nuclear weapons are becoming relatively less important than economic and strategic considerations.

24. Arguing against India's acquisition of a strategic missile system would be the great cost involved. Its development would require the commitment of large quantities of scarce trained manpower and foreign exchange, would divert resources destined for the conventional forces favored by most Indian military men, and would seriously impair progress in India's industrial development. Some Indians fear, too, that attempts to acquire a missile system would trigger a similar Pakistani attempt—helped, perhaps, by Communist China—and involve India in a heightened and prohibitively expensive regional arms race. In addition, some Indians have argued that India should forego a strategic missile delivery system, that Indian nuclear weapons, should they be developed, could be delivered in adequate force by cheaper and more readily available aircraft.

25. For use against Pakistan, a missile of modest range—no more than 300 n.m.—would do. The French MD-620 (250 n.m.) would barely meet this Indian requirement; the French MD-640 (500 n.m.), if developed, would fully do so. We have no evidence that the French and the Indians have ever discussed the sale of the MD-620. In any case, India already has military superiority over Pakistan; its real problem lies with China. We believe a credible deterrent to Communist Chinese attack would have to consist of intermediate range missiles (IRBMs), capable of carrying a nuclear warhead 1,500 to 2,000 n.m. India may have sent delegations to Paris to inquire about such a system.

26. In contrast with its considerable accomplishment in nuclear technology, India's capability in missilery is slight. However, Indian scientists have undoubtedly acquired some knowledge of rocket technology from their dealings with the Soviet SA-2 and, to a lesser extent, with the Atoll air-to-air missile which India expects to produce under license in the near future. In addition, India has signed an agreement with France for the domestic production of the unsophisticated *Centaure* sounding rocket, and technicians at India's modest Thumba Test Range have probably learned much about test and launch procedures from their participation in US and French scientific rocket firings. Finally, the Indian aircraft industry affords the nation a basic capability in airframe and metal-working technology. On the other hand, Indian experience in the fields of propellants, electronics, and aeronautical design is slim. A fully indigenous ballistic missile development program would probably involve a long cycle of preliminary research and basic industrial development before a meaningful research and development effort could be launched. Consequently, if India were to undertake a missile program within the next decade, New Delhi would have to depend very heavily on outside aid.

27. We estimate that even with extensive outside aid (including the importation of both technicians and finished components) it would take India at least 10 years and cost about $2 billion (excluding warhead costs) to produce and deploy a nuclear-capable ballistic missile force of 30 to 50 solid or liquid propelled IRBMs in hardened sites. As much as $500 million would have to be spent during the first five years for basic research and development and the construction of specialized industrial facilities. Follow-on research and development, testing, serial production, and deployment would require annual expenditures thereafter on the order of $300 million. In addition, the services of a large number of scientific and technical personnel would be required. Since most of the expenses associated with a missile development program would be payable only in foreign exchange, of which India is chronically and critically short, the impact on the Indian economy of such a program would be considerable. We believe it doubtful that India could foot the bill without either a sizable cutback in conventional weapons procurement (also a major consumer of foreign exchange) or increased foreign financial aid. The diversion of large amounts of capital and numbers of technicians would probably also curtail Indian progress in overall economic development. India might be able to reduce the cost of acquiring a missile system by buying it from some other country.

28. India could produce compatible nuclear warheads more easily and quickly, and at far lower cost, than it could acquire an IRBM force such as that outlined above. We estimated in NIE 4-66 that India could detonate a nuclear device about a year after the decision to do so, if it were willing to violate the safeguards associated with the Canada-India Reactor. Using plutonium produced in this reactor, India could probably develop a warhead for an IRBM in about four years after the first test. If India honored the safeguards on the Canada-India Reactor, it could probably construct a wholly indigenous reactor and produce missile warheads by the time it developed an operational IRBM.

If India used the plutonium from the Canada-India Reactor, it could produce 10 to 20 weapons over a 10 year period at a cost of $200 to $300 million. If the Indians built a new and larger reactor not subject to safeguards, they might produce 50 to 60 weapons over a 10 year period at a cost of about $400 million.

The UAR

29. The UAR's decision in 1960 to try to develop a strategic missile system was probably made as much for political and propaganda reasons as for the military usefulness of the system. Although the UAR development program has failed—after the expenditure of some $50 million—to produce much hope for a deployable system in the foreseeable future, the very existence of prototype weapons, the Victor and the Conqueror, has been a distinct propaganda asset for Nasser. So long as the UAR program remains active at any substantial level, Nasser can claim primacy among Arab nations in scientific endeavor and help to maintain the status of the UAR as the strongest Arab nation. Israel's acquisition of the MD-620 system, however, will undoubtedly bring new urgency to Nasser's efforts to acquire an operational missile system.

30. Of the two types of surface-to-surface missiles under development in the UAR, only the Conqueror may be considered as foreshadowing a strategic weapon capable of transporting a nuclear warhead. The Conqueror is a storable liquid-propelled, single-stage missile with a designed range of about 200 n.m., and a payload capacity of 2,000 pounds. There have been a number of flight tests of the Conqueror on the Egyptian missile test range, but the program has been largely unsuccessful. There is no indication that Egyptian technicians have made any progress in solving the serious guidance and propulsion problems which have so far crippled the development program. There is some evidence the UAR may now be prepared to abandon the Conqueror and take up new efforts in solid-propellant boosters. But almost all the foreign technicians in the UAR program have been replaced by Egyptians, and Cairo appears to have cut back program financing by about 60 percent. Thus, unless the UAR receives considerable outside help, the prospects for deploying this missile system will continue to be remote. [redacted] If the Soviets provided substantial help, the UAR might be able to produce a ballistic missile system well within the 10 year term of this estimate.

31. On the other hand, if Soviet aid is not forthcoming or is insufficient, Cairo may be spurred by Israeli missile deployment to seek the importation of some complete system from abroad. It is highly unlikely that the French would sell the MD-620 to the Egyptians. We cannot exclude the possibility that Nasser might persuade the USSR to furnish him with a complete missile system in order to restore military balance in the Middle East, although the Soviets would almost certainly not give him control of nuclear warheads.

32. If the Soviet Union is unwilling to provide Nasser with a complete missile system or to aid the UAR's domestic development program, it still might be possible for the UAR—with massive injections of money and imported scientific talent—to produce an operational missile within the next decade. We have estimated in NIE 4-66 that the UAR could not produce nuclear warheads without substantial aid in virtually all phases of a nuclear program and that none of the present nuclear powers is likely to give such aid. A missile force employing high explosives equal to the possible Israeli force would consist of some 250 missiles, which might cost the Egyptians as much as $800 to $1,000 million to produce. The impact of these expenditures on the UAR economy, which chronically suffers from serious shortages of foreign exchange, would be severe. On balance, we think it unlikely that the UAR will be capable of undertaking an all-out missile development program unless some foreign power is willing to underwrite the cost and give massive technical aid.

Sweden

33. Sweden's military leaders have been calling since 1954 for the acquisition of nuclear weapons and appropriate tactical delivery systems. At present, three of the four non-Communist political parties—the Social Democrats and the opposition Center and Liberal Parties—appear to be split internally on the issue of nuclear weapons and unwilling to take a position on it. Only the Conservative Party currently advocates a nuclear weapons program. The matter will come up for discussion in early 1967 when the next four-year defense policy agreement between the four non-Communist political parties must be renegotiated. Arguing against the acquisition of nuclear-capable missiles is the Swedish policy of avoiding the acquisition of weapons which the Soviets could consider provocative. A ballistic missile with a range of 200 n.m. could reach important targets in the USSR from Swedish territory. On balance, we doubt that Sweden will seek missile delivery systems of even the minimum range considered in this estimate, even if it should decide to produce nuclear weapons in coming years.

34. Should the Swedes nonetheless decide to develop and deploy a ballistic missile force, they would need substantial outside aid to do so. Although Swedish industry is sophisticated, and the Swedes are producing small tactical rockets, they are producing no ballistic missiles. For a ballistic missile program, Sweden would probably be forced to import technology and components on a large scale. More attractive alternatives would probably be either the purchase of a complete missile system or the domestic manufacture, under license, of a system developed and tested elsewhere. Since the French have already undertaken to develop for the Swedes a subsonic cruise missile (a version of the French CT-20 target drone), Sweden might be able to come to some arrangement with the French for the acquisition of the MD-620.

35. If the Swedes could buy MD-620s from the French, they could deploy a force of 100 missiles and 25 mobile launchers for about $80 million, depending on the profits charged by Dassault. The manufacture of this number of mis-

siles in Sweden under French license might cost about $20 million more. If the Swedes attempted to develop a system similar to the MD-620 on their own, they might have to spend several times as much, and they would have no assurance of success. The commitment of resources, manpower, and money would probably seriously disrupt on-going programs of conventional weapons development. In light of the Swedish Government's heavy political and financial commitment to the success of the Viggen J-37 aircraft project, which is expected to cost about $2 billion by the end of the 1970s, it is unlikely that Stockholm would be able to devote large funds to a missile development program until the Viggen costs were out of the way.

36. It is doubtful that Sweden would undertake to acquire ballistic missiles without certain prospects for a compatible nuclear warhead. We estimated in NIE 4-66 that the Swedes could produce their first nuclear detonation in about two years after a decision to undertake a program. Given the advanced state of Swedish nuclear research, we believe they could produce a missile-compatible warhead 2 to 3 years thereafter. A program to produce 20 to 35 warheads over the period 1970-1976 would cost the Swedes about $250 to $350 million, a sum which includes the cost of building a chemical separation plant, the only facility lacking in Sweden for nuclear weapons production. This cost, if coupled with the expense of a simultaneous missile program, might require cutbacks in conventional weapon procurement and work hardship at a time when the Swedish economy is harassed by inflation.

Japan

37. Although there is widespread opposition among the Japanese to the idea of possessing nuclear weapons, memories of Hiroshima are likely to fade with time, and the prospect of a belligerent Communist China, equipped with nuclear weapons and a strategic missile delivery system, may lead to a Japanese decision to procure an effective deterrent. Major opposition to such a course would continue to come from the Socialists and other leftist parties, but the Liberal-Democratic government now in power could carry Japan well along the road toward the acquisition of advanced weapons within the context of peaceful nuclear and space research programs.

38. Despite China's great land mass, Japan might consider that not many missiles were needed in order to establish a deterrent. The areas of heaviest Chinese population, industry, and agriculture are concentrated within the Peking-Shanghai-Hankow triangle and in Manchuria, all within 1,500 n.m. of Japan. By choosing targets judiciously, the Japanese could threaten very substantial damage in these areas with a force of about 50 to 75 MRBMs. The fact that such a missile force could reach a number of important targets in the USSR would be taken into consideration by the Japanese.

39. The Japanese are capable of developing and starting to deploy an MRBM force within about five years of the decision to go ahead. If the Japanese satellite launch vehicle, the Mu, were reengineered into a missile system, it could probably deliver a 3,000 pound payload about 1,500 miles with acceptable

accuracy. The first stage of the Mu, which was successfully flight-tested on 31 October 1966, has been developed without substantial outside aid, although Japanese scientists have taken full advantage of open literature, their access to US missile technicians and facilities, and their possession of US Hawk and Nike surface-to-air missiles. Japan has the necessary industrial base, specialized technology, and trained manpower to convert the Mu into an MRBM. The Japanese already have flight test facilities which could be used for testing such a missile.

40. Difficult tasks in any attempt to convert the Mu to a nuclear-capable missile would be the design and construction of the RV and the guidance and control system. There is no evidence that the Japanese have undertaken research in RV design as yet, but they have built some of the components of an inertial guidance system and have investigated associated problems. While the Japanese have not had experience in manufacturing complete inertial guidance systems, their competence is such that, given four years of determined development, they probably could do so.

41. If the Japanese were to build 100 missiles, 40 for test and training, 60 for deployment in hardened silos, we estimate the total cost, exclusive of warheads, would be about $550 to $700 million in addition to the amount already spent on developing the Mu. Over the coming decade, the average annual cost of such a program would amount to only $50 to $70 million, a relatively small sum in terms of the Japanese economy.

42. While it remains Japanese policy not to produce or acquire nuclear arms, several Japanese leaders have expressed the opinion that Japan may have to change this policy. Japan's extensive nuclear energy program has been under full safeguard controls from its inception. We have estimated in NIE 4-66 that should Japan violate these safeguards, it could test a first device about two years after the decision to go ahead. We believe the Japanese could develop a nuclear warhead compatible with a missile based on the Mu some 3 to 5 years after the first device and have a stockpile of 75 to 100 warheads within 10 years at a total program cost of $500 to $600 million. It would take them about two years longer to test their first device if they established domestic facilities for producing fissionable materials not subject to safeguards, but they could still produce 75 to 100 warheads by 1977, and the cost would be only some $50 million greater. The total expenditure for such a military nuclear program is roughly equivalent to the planned peaceful nuclear energy program of the government alone, and is well under the cost of the combined programs of government and private industry. These costs, as well as those of a missile system, are clearly within the capability of the Japanese economy, and would cause at most some slight slowdown in the development of nuclear energy for peaceful purposes.

West Germany

43. There are several inhibitions and prohibitions against West Germany's producing nuclear-capable ballistic missiles. Bonn specifically renounced the

manufacture of such weapons on German soil in the 1954 West European Union Treaty. Furthermore, most German leaders are aware of the profound consternation German acquisition of such weapons would occasion in both the East and the West. Still, there are German leaders who cautiously advocate the acquisition of advanced weapons systems, perhaps in cooperation with the French. Only if there were a major shift in European and Western Alliance politics, however, is it conceivable that West Germany would feel so isolated that the development of a wholly domestic missile system would appear worth the political risks it would entail.

44. If the West Germans were to decide to develop a missile capability, they would probably want MRBMs or IRBMs of 1,500 to 2,500 n.m. range in order to reach the major population centers of the Western USSR. Given time, they would be fully capable of developing and deploying a sizable force of such missiles without outside aid. The German industrial base is strong and diversified; its aircraft, electronics, chemical, and metal-working industries are sophisticated and staffed with highly skilled technicians and artisans. The Germans pioneered missile development, and they have gained much experience from their role in the production of Hawk and Sidewinder missiles and from their maintenance of US-supplied advanced tactical missile systems. A German subsidiary of a US firm is manufacturing an inertial navigation system for the F-104.

45. German work on the third stage of the ELDO system has provided German scientists with first-hand experience in advanced liquid-propelled rockets, and there has been considerable German progress recently in solid-propellant technology; experimental engines are under development with a thrust suitable for MRBM range boosters. German familiarity with the Pershing Missile has undoubtedly been instructive: the process of "reverse engineering" of the Pershing would shorten the development time for a German missile system. The establishment of a test range for IRBMs from German territory, which could only be over the North Sea, would, however, raise formidable political as well as practical problems.

46. We estimate it might cost the Germans about $800 to $1,000 million to develop, test, and produce a force of 100 IRBMs with fixed or mobile launchers, and that it would probably take them at least five years from the decision to go ahead. We believe these costs are easily within the capacity of the German economy to absorb.

47. The same political factors which restrain the Germans from undertaking strategic missile development also restrain them from developing nuclear warheads. Should the Germans violate safeguards and their treaty obligations and undertake nuclear warhead development, we have estimated[7] that they could test a first device within a year, using safeguarded plutonium already

[7] See NIE 23-66, "West German Capabilities and Intentions to Produce and Deploy Nuclear Weapons," dated 28 April 1966, SECRET.

on hand. To build weapons with unsafeguarded material, the Germans would have to acquire unsafeguarded uranium and make sizable investments in new production facilities, but within the next 10 years they would easily be capable of producing about 120 nuclear warheads at a cost of $650 to $750 million. Neither warhead nor missile costs would cause significant economic dislocation in Germany.

III. LESS SIGNIFICANT CANDIDATES FOR THE ACQUISITION OF STRATEGIC MISSILE SYSTEMS OVER THE COMING DECADE

48. A number of nations—Australia, Belgium, Canada, Italy, the Netherlands, Switzerland, East Germany, and Czechoslovakia—have a basic industrial and scientific competence which might enable them, with extensive outside aid, to develop strategic missile systems over the coming decade. Belgium, Italy, and the Netherlands are participants in the NATO Hawk production program and hence have access to short-range missile technology. As national and multilateral space programs, e.g., ELDO and ESRO, develop, these three nations will acquire experience in more advanced technology, some of which would be helpful in military missile development programs. However, only Italy is currently undertaking a wholly domestic missile research and development program, and it is a very modest one. Italy's overall competence in missilery will probably continue to increase slowly, but it is unlikely that Italy would undertake a major missile development program unless, perhaps, there were a breakup of NATO or a German missile development program. By the same token, Belgium and the Netherlands are unlikely to undertake domestic missile programs so long as they feel adequately protected by the NATO and US defensive umbrellas.

49. Canada clearly has the capability of developing a missile system, perhaps one in the ICBM category. But recent Canadian governments have firmly renounced any interest in acquiring either nuclear weapons or advanced delivery systems, and in light of the special relationship between the US and Canada in the area of continental defense, it is unlikely that the Canadians would undertake the development of a strategic missile force. Australia, although less capable than Canada of developing a missile system, might feel more incentive to do so should the US drastically reduce its strategic role in Asia and leave Australia to face Communist China in isolation. Even then, Australia would probably seek first to purchase a missile system from the US rather than incur the great expense and uncertainty of a domestic development program.

50. If left to themselves, East Germany and Czechoslovakia might eventually be able to develop nuclear-capable ballistic missiles; both have adequate industrial bases, and both have access to some technology by virtue of their possession of Soviet short-range tactical missiles. But it is not likely that the Soviet Union would permit them to do so in the foreseeable future. Switzerland, too, is sufficiently industrialized to undertake a missile development program, although testing of even a short-range system would presumably have

to take place outside Swiss territory. In any case, the Swiss probably would not want missiles of strategic range, and there is no indication they plan to undertake the development of even short-range weapons.

IV. ALL OTHER NATIONS

51. No other nation is likely to acquire strategic ballistic missiles over the coming decade no matter how great its incentive might be or how large the amount of outside aid available to it. While some of these nations may be able to purchase substantial portions of a missile system (perhaps boosters from one source, redesigned sounding rockets for upper stages from another source, and an inertial guidance system from yet another source), none is probably capable of mating disparate elements into a working missile or of developing the necessary ground-support, test, and launch installations.

52. Some of these countries, however, could conceivably go to great length in attempting to obtain a whole missile system, already tested and operational, from one of the more advanced countries. Pakistan, for instance, would feel great pressure to acquire missiles if the Indians were to do so, and might try to get them from Communist China. As Communist China builds its own missile force, the Nationalist Chinese might attempt to acquire some sort of missile system, [redacted] Even South Africa, if its policies lead it into increasing isolation in coming years, might react irrationally and attempt to reach some agreement with France for the delivery of a missile system, perhaps bartering South African uranium for it. We do not believe that any of these eventualities is likely; we cannot exclude them as remote possibilities.

V. THE ADVANCED NATIONS AS SOURCES OF SUPPLY

53. As time goes on, missile systems, or major components thereof, may become widely available for sale by such producing nations as Japan, Germany, the UK, and France. While the producers of most systems or components would be private manufacturers, such sales would be unlikely without government participation or consent. If manufacturers were to enter this trade, missile systems might eventually become as readily available as high-performance aircraft, with the selling nation providing the buyer with crew training and other support services along with operational hardware. Furthermore, if countries with space programs, e.g., France and Japan, enter into cooperative arrangements with other countries, missile-related technology could become more widespread.

54. France has already demonstrated willingness to sell a complete missile system to Israel. Competent in most fields of missile development, France would probably be one of the first nations approached by others for missile technology. India and Japan may have already done so. A considerable portion of the French capability in missilery was acquired from the US, and some of the US components being produced under license in France may be restricted

by agreement from sale to other countries. While we do not believe that the French would readily violate reexport agreements with the US, they may come in time to consider that their improvements and alterations of US components render those components free of restrictions. In addition, the French are undoubtedly developing a considerable technology of their own. Whether France would sell to other countries would probably depend mainly on political considerations at the time.

55. While the UK has not demonstrated willingness to sell missile technology abroad, British competence in most areas of missilery is high. The UK could be particularly helpful to other nations in the critical problem of guidance. While some of the key components of the UK's most advanced guidance systems are produced under license from US firms and may be restricted from reexport, adequate components of purely British design could be combined into a workable system for sale abroad.

56. Neither Germany nor Japan has yet entered the commercial market with ballistic missile or space launcher components, but both might do so within the next 10 years. The Japanese in particular show signs of interest in marketing missile-related hardware; they have sold sounding rockets to Indonesia and provided consultative services to India. As Japan's space program progresses and Japanese manufacturers gain more experience in component production, they may become a major source of supply.

57. The Soviet Union has supplied to several Eastern European countries, and to Cuba, short-range tactical ballistic missile systems which are capable of delivering nuclear weapons, and the Soviets may provide the Warsaw Pact countries with longer range systems. Likewise, there is evidence that prior to 1960 the Soviets furnished some strategic missiles to Communist China. (These missiles are in addition to the surface-to-air weapons that have been supplied to a number of countries.) [redacted] Thus we cannot exclude the possibility that the Soviets might be willing to furnish a political protégé with missiles to offset those being deployed by a potential or actual regional enemy, e.g., the UAR when faced by missiles in Israel. In no case, however, has the Soviet Union provided the recipients of missiles with nuclear warheads, and the Soviets would almost certainly retain full control of nuclear warheads matching any missiles they might supply.

VI. DETECTION OF MISSILE PROGRAMS[8]

58. We do not believe that any nation undertaking the production of nuclear-capable ballistic missiles could long keep its intentions secret. Those nations heavily dependent upon outside aid would be likely to reveal their plans through their interest in the purchase of components or the employment of foreign

[8] This section deals with missiles only. [redacted]

technicians. Although Germany and Japan are probably capable of producing missiles without extensive outside aid, both nations are relatively open to outside observation, and it is unlikely that any substantial reallocation of men and material to a missile production program would go undetected. Both these nations, and perhaps others, could make major progress toward the development of an operational missile under the guise of space research. However, a program which involved heavy investments for tooling and serial production, construction of instrumented test ranges, and periodic test firings would probably provide indications that missile production was under way, although we might not know what kind of warheads would be available. On the other hand, should some nation find it possible to purchase outright a complete operational missile system from some advanced nation, the transaction might remain secret until the purchaser chose to rattle its new acquisitions for political gain.

ANNEX

SPECIFICATIONS OF SELECTED BALLISTIC MISSILES[a]

Country and Designation	Range/ Payload (nm) (lbs)	Propellant Type	Type of Guidance	Stages	Comments
France					
MD-620	250/3,000 500/1,500	Solid-composite	Inertial	2	Under development for Israel. Complete system successfully flight-tested. Initial operational capability in Israel estimated for 1968.
MD-640 (proposed)	500/3,000	Solid-composite	Inertial	2	Now in preliminary design phase.
Saphir	800/3,000	Storable liquid first stage; solid second stage.	Inertial	2	Has been extensively tested and used as test bed for SSBS guidance system. Has not been designed as operational weapon, but could be readily converted for that purpose.
SSBS	2,200/3,000	Solid-composite	Inertial	2	First stage successfully tested; could be deployed by 1969.
MSBS	1,450/2,000	Solid-composite	Inertial	2	Submarine-launched version of SSBS. First stage static tested; first stage with dummy second stage to be test launched from submarine Gymnote in spring 1967.
UAR					
Conqueror	200/2,000	Storable liquid	Inertial(s)	1	Yet to be successfully flight-tested.
Japan					
Mu	1,500/3,000	Solid-composite	Attitude control.	3	Space launch vehicle. Range and warhead weight are hypothetical, based on analysis of Mu without fourth stage satellite vehicle.
US					
Pershing	400	Solid-composite	Inertial	2	Short-range ballistic missile.

[a] While this annex includes all ballistic missiles mentioned in the estimate, it does not include all missiles developed or under development by the nations listed in column one.

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