MR. BUNDY

SECRET

[redacted]

NIE 4-66
20 January 1966

[redacted]

NATIONAL INTELLIGENCE ESTIMATE

NUMBER 4-66

The Likelihood of Further Nuclear Proliferation

Submitted by

DEPUTY DIRECTOR OF CENTRAL INTELLIGENCE

Concurred in by the

UNITED STATES INTELLIGENCE BOARD

As indicated overleaf

20 JANUARY 1966

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[redacted]

No. 1

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WARNING

TABLE OF CONTENTS

THE LIKELIHOOD OF FURTHER NUCLEAR PROLIFERATION

THE PROBLEM

To estimate the capabilities of additional countries to acquire nuclear weapons, and the likelihood that such countries will do so.

CONCLUSIONS

A. Beyond the present five nuclear powers, only India is likely to undertake a nuclear weapons program in the next several years. Israel and Sweden might do so. (*Paras. 19-25, 34*)

B. We do not believe that West Germany or Japan will undertake national nuclear weapons programs for at least the next few years even if India, Israel, or Sweden does so. (*Paras. 26-27, 35*)

C. Pakistan and the UAR, and perhaps South Africa, are likely to want nuclear weapons in the next decade, but could obtain them only with substantial outside help. (*Paras. 30, 32-33*)

D. Present safeguard systems are likely to detect any significant diversion to unauthorized uses of nuclear materials or equipment which they cover. However, there are gaps and limitations in the system. In the future, competition among the major nations supplying nuclear materials and equipment may erode the effectiveness of safeguards. (*Paras. 10-15*)

E. Multilateral treaties against testing or nuclear proliferation would impose legal, moral, and political restraints of some consequence. But if a country came to the conclusion that possession of nuclear weapons was required by its vital interests, international treaties would be unlikely to prevent it from taking such action. (*Para. 17*)

F. It is technically possible for a country to conduct a small covert nuclear weapons program at least up to a test. The chances of warning would depend on the extent to which our suspicions had been aroused and the methods available or used to acquire information. (*Paras. 36-38*)

DISCUSSION

I. THE DIMENSIONS OF THE PROBLEM

1. Many nations in addition to the present five nuclear powers have a potential to develop nuclear weapons. Each year the technical problems and costs of making small numbers of plutonium weapons decrease.[1] This trend will continue. By the late 1970s, there will almost certainly be widespread use of nuclear power reactors which will produce, as a by-product, large amounts of plutonium. Although there will be industrial uses for this plutonium, its availability will reduce further the technical problems and costs of weapons production and increase the temptation to enter the nuclear weapons field. The decisions of the potential nuclear powers as to whether to acquire nuclear weapons will depend increasingly upon military, psychological, and political motivations and restraints.

2. Within a few months to a year, Canada could, without outside assistance, test a first device, and could produce weapons relatively shortly thereafter. Either alone or with some outside assistance, a number of nations could produce a few weapons in the next 10 years; Belgium, Denmark, Italy, the Netherlands, Norway, Portugal, Spain, Argentina, Brazil, Czechoslovakia, and East Germany are in this group. However, we believe that none of the nations mentioned in this paragraph will undertake a nuclear weapons program in the foreseeable future. Their motivations to do so are not strong, while the factors which would act to restrain them are numerous and compelling.

3. On the other hand, there are several nations—India, Israel, Sweden, Japan, West Germany, Switzerland, Australia, South Africa, Nationalist China, United Arab Republic, Pakistan, and Indonesia—whose possible incentives to acquire nuclear weapons during the next 10 years are sufficient to warrant more detailed discussion. Their incentives vary widely, as does their need for outside aid. The following Table I (page 3) indicates their capabilities; the likelihood of these nations developing nuclear weapons is considered in Section IV, pp. 7-11.

II. DECISIONS TO ACQUIRE NUCLEAR WEAPONS

4. The factors which determine whether or not a nation will seek to acquire nuclear weapons differ widely from country to country. National needs and interests vary from case to case, as do systems of government and decision-making. Some governments have to take public opinion into account far more fully than others; in the case of some, a decision can be made by one or a very few leaders, while in others it is a matter of weighing conflicting interests or reckoning with divided counsels within the government, parliamentary bodies, or the public at large.

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[1] See Annex for a discussion of the prerequisites for a nuclear weapons program and other technical and economic considerations facing nations which might embark on such a program, and for a list of the larger nuclear reactors in countries other than the present five nuclear powers.

TABLE I

NATIONS WITH POSSIBLE INCENTIVES TO ACQUIRE NUCLEAR WEAPONS

Country	Estimated time required to produce and test first device*	Comments
India	One year if general agreements with Canada and US violated.	Has domestic supplies of uranium.
Israel	Two years	Has imported and stockpiled sufficient unsafeguarded uranium for a few weapons.
Sweden	Two years	Has domestic supplies of uranium.
Japan	Two years if safeguards on present reactors violated.	Would probably have to import uranium without safeguards.
West Germany	Two years if safeguards on present reactors violated.	Would probably have to import uranium without safeguards; is forbidden by treaty to produce nuclear weapons on its own territory.
Switzerland	More than six years	Would have to import uranium without safeguards.
Australia	More than eight years	Has domestic supplies of uranium.
South Africa		Outside aid required. Has domestic supplies of uranium.
Nationalist China		Outside nations would have to provide almost all facilities and materials, although sufficient trained technical manpower is probably available. Would have to import uranium without safeguards.
United Arab Republic, Pakistan, and Indonesia		Outside nations would have to provide almost all facilities, materials, and technical manpower, or the finished weapons themselves.

* Assuming that the decision were made now, and no further outside help were obtained. As time passes and further work under existing peaceful programs is done, these time periods may decrease. In all cases except India, the time includes that needed to build an adequate plutonium separation plant and a metal reduction facility. Also see Annex.

5. In addition, levels of sophistication in nuclear matters and the bases of political thinking and military doctrine vary considerably from state to state and within states. What may appear to the US or to other experienced countries as critical deficiencies in a projected nuclear weapons program may not appear as such to the government considering the program; the latter may feel, for a mixture of political, military, and other reasons, that a given program would be a good investment.

6. Despite these variations, certain common motivations figure in the calculations of all potential contenders. The first and most compelling is that of national security. A nation may believe that it needs nuclear weapons as a

deterrent or for use in war if deterrence fails. The question may arise both in nations which are without close allies and in others which, though members of an alliance system, do not feel fully protected by it. In general, once a nation has concluded that nuclear weapons are vital to its security, no outside restraint other than force is likely to prevent it from trying to acquire them.

7. Another significant motivation—partly psychological and partly technical—to acquire nuclear weapons is to avoid being left behind. Nations dislike the idea that others of equal or less importance might move ahead of them. The more nations acquire weapons, the more others can find reasons to do likewise. Thus nuclear proliferation could have a snowball effect. Moreover, in some nations it is argued that entering the nuclear weapons field is necessary to keep abreast of technological and scientific developments.

8. Finally, there is the incentive of national prestige and political leverage. This motivation runs through all other calculations but, in the modern world, the feeling has grown that nuclear weapons are essential to front rank status—the French *force de dissuasion* being the prime example. De Gaulle, his supporters in France, and like-minded people elsewhere do not maintain that a nation must have a nuclear force rivaling that of the US or the USSR, but argue that even a small force enhances their opportunities for independent action by giving them leverage *vis a vis* the super powers.

III. RESTRAINTS ON THE ACQUISITION OF NUCLEAR WEAPONS

9. A wide range of domestic and international restraints operates to prevent further nuclear proliferation. There is, of course, the restraint of cost—not only of producing weapons but more importantly of acquiring a delivery system. Within every nation that is a potential addition to the nuclear ranks there are strong political and psychological forces working against proliferation. The major nuclear powers—the US, the USSR, and the UK—oppose the spread of nuclear weapons. They do so through both bilateral and multilateral arrangements. However, these nations may not be willing in all circumstances to give non-proliferation priority over other policy objectives. The attitudes of France and Communist China toward proliferation are ambiguous; it is possible that either might help certain other nations toward a nuclear capability. A number of industrialized but non-nuclear nations—West Germany, Japan, and Sweden, for example—are becoming major suppliers of nuclear equipment. The policies they follow in the sale of reactors, nuclear equipment and technology will influence the rate and extent of nuclear proliferation even if they themselves do not develop weapons. Although the foreign policies of the major powers tend to limit further proliferation, there is no certainty that they will prevent it.

A. Present Safeguard Systems

10. An elaborate restraint on nuclear proliferation is a system of "safeguards," or controls designed by international bodies or by nations exporting nuclear materials and equipment to detect any diversion of such products to unauthorized

purposes.[2] While the objective is to prevent diversion, safeguards *per se* are concerned more with detection than prevention. Like other international agreements, safeguard agreements could be abrogated or violated. The sanctions imposed on offenders would depend ultimately on the amount of political, economic, or military pressure which other countries were willing to bring to bear. In the case of recipients who are dependent on continuing supplies of materials, e.g., those using enriched uranium in reactors, the need to avoid alienating suppliers acts as a sanction to ensure compliance with safeguards.

11. We believe that the inspection and verification provisions of broad safeguards such as those administered by the IAEA and EURATOM are generally effective in fulfilling their limited function; i.e., they are likely to detect any significant diversion of materials or equipment from the uses intended by the supplier. In addition, the risk of detection is itself a deterrent of some importance against the unauthorized use of materials and equipment covered.

12. However, there are certain gaps and limitations in the safeguard systems. For example, some of the earlier transactions in nuclear material and equipment were under no safeguards or under agreements of limited scope. Norway has supplied heavy water to Israel and a number of other countries with only general understandings as to use and no provision for inspection. The US provided heavy water to India under an agreement that specifies only that it will be used for peaceful purposes. France has provided technology, materials and other ~~help to Israel~~ to build the Dimona reactor, probably without safeguards though with an agreement that the fuel elements provided by France would be returned to France for reprocessing. The CIR reactor built by Canada for India is under no specific safeguards, though India agreed that it would be used only for peaceful purposes. The safeguards system is not applicable to materials or equipment produced in a country for its own use. Thus, Sweden has built a reactor at Agesta without incurring any safeguard obligations because the reactor and fuel were produced domestically. Aside from the reactors mentioned in this paragraph, and several reactors in Canada, we do not know of any reactors,

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[2] Generally, safeguards consist of an agreement between the supplier and the recipient country under which the latter promises to use the imported goods only for specified purposes. In addition, the recipient often agrees to keep detailed written records of all activities involving the material and equipment, and to allow the supplying country to check these records as well as make on-site inspections to assure their accuracy. Such controls may be exercised over supplies of natural uranium, fissionable materials (principally plutonium and uranium enriched in U-235), heavy water and other scarce or expensive commodities associated with production of fissionable materials, tritium, reactors, components of reactors, and neutron generators. Safeguards may be administered by various bodies. The US, British, and Canadian governments, for example, place bilateral safeguards on their exports of nuclear-related products. EURATOM supervises safeguard arrangements on many nuclear facilities in the Common Market countries. The International Atomic Energy Agency (IAEA) administers safeguards on materials and equipment supplied by it and also under agreements in which it has been specified as the administering agency by the US and other countries. Some member nations have voluntarily submitted themselves to IAEA safeguards. Efforts are being made to bring more facilities of various countries under IAEA safeguards.

outside the present five nuclear powers which are now capable of producing enough plutonium for even one weapon a year and are not under safeguards.

13. There is no formal agreement in existence among all potential suppliers that safeguards will be applied to reactors or nuclear materials or equipment; such safeguards as are applied result from the unilateral decisions of the suppliers. While it is present practice for the UK and Canada to require safeguards like those imposed by the US, France has rejected the policy of automatically requiring safeguards in connection with sales. Soviet and Chinese policy with regard to safeguards is unclear. The USSR as well as most East European countries are active members of the IAEA and approve the principle of safeguards, but no reactors in existence or under construction in the Sino-Soviet area have been placed under IAEA safeguards. Neither the USSR nor China has to date provided any other country with a reactor able to produce plutonium in quantities sufficient for weapons, except that the Soviets may have furnished the Chinese prior to 1960 with equipment and technology for building such a reactor. Nevertheless, reactors now under construction in Czechoslovakia and East Germany with Soviet assistance will be capable of producing enough plutonium for weapons. We do not know whether any safeguards are applicable to these reactors but almost certainly these countries will not undertake independent nuclear weapons programs.

14. There are no comprehensive controls over world trade in natural uranium, although there is an informal arrangement between the principal Western suppliers of uranium and some other materials to keep each other informed as to sales. It has been possible for both Israel and India to buy unsafeguarded uranium. Furthermore, there is no standard policy regarding the provision of technical information or specialized equipment.

15. There will be a substantial increase in the number of nuclear power reactors in operation in coming years; a considerable number are now under construction in India, Sweden, Japan, West Germany, Italy, and other countries.[3] All will produce some plutonium or other fissionable materials, many will produce large quantities. To the extent that these reactors are under safeguards, the country or agency administering the safeguards will have a means of knowing what use is made of the plutonium. However, competition in the sale of reactors already exists and is likely to grow. Such competition may erode the effectiveness of safeguards, particularly if the competitors include suppliers from countries which have no policy of strict safeguards. Such erosion would be most likely in the fields of equipment and ancillary technology.

B. Nuclear Sharing

16. It is possible that a nation which wanted nuclear weapons might have its aspirations satisfied, at least for some time, and be restrained from undertaking a national weapons program, by an arrangement under which it had a share in

[3] See Tables V and VI of Annex for major reactors now in operation or under construction in countries other than the five nuclear powers.

the control of weapons belonging to an existing nuclear power. We do not believe that useful generalizations can be made in this field. In each hypothetical case, a great variety of factors would bear on the effect of a sharing arrangement; e.g., the degree of control which the non-nuclear power had over weapons, the prospects for future greater control, the level of confidence between the sharing partners, the domestic and foreign incentives and restraints bearing on the non-nuclear power, etc. So far as the matter of proliferation is concerned, the effect of an offer to share could be judged only in terms of the particulars of the offer and an analysis of the individual case.

C. International Agreements

17. If the US and the USSR agreed on multilateral treaties further limiting or prohibiting testing, or prohibiting further nuclear proliferation, they could bring considerable pressure to bear on other nations to sign such treaties. More nations would probably sign a further treaty on testing than would sign a non-proliferation treaty, since this latter kind of treaty is considered by many countries as discriminatory in favor of the present nuclear powers. Such treaties would impose legal, moral, and political restraints of considerable consequence on the signatory nations. The 1963 partial test ban already constitutes some political and psychological curb on proliferation. However, most countries would sign such treaties only provided that they could withdraw if they later felt they must. We believe that if a country came to the conclusion that possession of nuclear weapons was required by its vital interests, international treaties would be unlikely to prevent it from testing or producing them.

D. Unilateral Measures

18. Various unilateral measures by the US or the USSR might restrain further proliferation. For example, the US or the USSR could cut off economic and military aid, e.g., to India or Israel, or disavow their alliances with any nation which began to develop nuclear weapons. In areas where US or Soviet political and economic leverage is strong, even threats or partial steps in this direction would constitute a significant restraint. In particular, any country dependent on continued imports of nuclear materials, e.g., those having reactors needing enriched uranium, would hesitate to disregard the pressures of its supplier. It is also possible that a potential nuclear power could be dissuaded from developing nuclear weapons on its own by a firm security guarantee or other inducements from the US or USSR. There are, of course, limitations on the willingness of the major powers to take such steps as discussed in this paragraph and they may not be prepared to give non-proliferation priority over other policy objectives.

IV. LIKELIHOOD OF PROLIFERATION BY SELECTED NATIONS

A. India

19. India has the capability to produce nuclear weapons, and we believe could test a first device within a year of a decision. To do so in the near future, India

would have to use plutonium from the CIR reactor, which now has heavy water supplied by the US as a moderator, and would violate its agreements with Canada and the US. India's adherence to the partial test ban treaty would still permit underground tests. The key leaders of the Congress Party supported Prime Minister Shastri's publicly announced policy of not producing nuclear weapons, and we believe that, irrespective of who is the next prime minister, this policy will not be reversed in the near future. Any Indian leader would be reluctant to disregard US pressures against proliferation, particularly at a time when India is so dependent on the US to help alleviate India's critical food situation. Until such time as the new prime minister consolidates his power and the current critical food situation is alleviated, major policy alterations are unlikely. Furthermore, given India's present and prospective economic difficulties, the costs of more than a token nuclear weapons program, and particularly of a delivery system, would be an important limitation.

20. On the other hand, India's decision would be based as much on factors of prestige and strengthening its bargaining position as on the idea of establishing a realistic deterrent, and pressures in India to develop nuclear weapons for these purposes are likely to grow in the future. Considerations of national security are also likely to become increasingly important in India's deliberations. China's growing nuclear strength and the specter of Pakistani-Chinese cooperation against India will make it more difficult for the major powers to restrain India or to offer guarantees which the Indians would accept as adequate to their security needs. On balance, we believe that within the next few years India probably will detonate a nuclear device and proceed to produce weapons.[1]

21. New Delhi will almost certainly not accede to a non-proliferation treaty which fails to restrict Communist China's further development of nuclear weapons, and we see no chance that Peking will accept such restrictions. A comprehensive test ban agreement—even without China—would be more difficult for India to reject, particularly one endorsed by the US, the USSR, and the majority of non-nuclear nations. However, India would count on an escape clause to preserve its options.

22. India is also unlikely to be restrained from producing nuclear weapons by its present lack of a delivery system able to reach major Chinese targets. Indian officials probably believe that they could acquire such aircraft as the Soviet Badger medium jet bomber, which has been sold to several other non-Communist countries and has a combat radius sufficient to reach many parts of China. New Delhi might, during the next 10 to 15 years, even be able to purchase or assemble a missile delivery system. India might also find a use for nuclear weapons without requiring new delivery systems. Short range aircraft with low yield bombs could be used against Chinese forward bases and troop concentrations, and terrain and population conditions would allow use of relatively unsophisticated prepositioned atomic demolition munitions to restrict military movement in the mountain passes along the Chinese border.

[1] For a more detailed discussion of India and nuclear weapons, see SNIE 31-1-65, "India's Nuclear Weapons Policy," dated 21 October 1965, SECRET.

B. Israel[5]

E.O. 13526, section 3.3(b)(1)

23. With French help, Israel already has many of the basic requirements for a nuclear weapons program and further French aid is possible. The Israelis have contracted to purchase from a French firm the MD-620 missile, whose range of 250-300 n.m. makes it a strategic delivery vehicle for Israeli purposes, [redacted]

24. A variety of incentives and restraints are at work on Israel, but we believe that in the final analysis Israel's decision on developing nuclear weapons will depend primarily on its judgment concerning trends in relative military strength between it and its Arab neighbors. For the next few years, at least, Israel will probably judge that it can maintain its security through acquisition of conventional weapons from the US and other Western sources. However, Israel probably would develop nuclear weapons if it came to believe that the threat from the Arab states could no longer be contained by conventional means. In this situation even a combination of international agreements, pressure from the US, and explicit US security guarantees might not restrain the Israelis.

C. Sweden

25. The Swedish Government has repeatedly deferred a decision to develop nuclear weapons. Many governmental leaders are sympathetic to military arguments that tactical nuclear weapons would be essential for defense against invasion, and appear to believe that possession of such weapons would buttress Sweden's policy of non-alliance and neutrality. Public opinion, however, has been consistently against acquisition of nuclear weapons. The government follows a policy of keeping its hands free to take action should Sweden's security position deteriorate, while working actively for effective international disarmament. Military planners have apparently considered in some detail the types of weapons which would be most effective against landing forces (prepositioned demolition weapons and low yield warheads for delivery by tactical aircraft or short range missiles). Sweden will probably continue to postpone a decision for the next several years. If no progress is made toward disarmament and if further proliferation occurs, the chances will increase that the government will authorize production of nuclear weapons.

D. Japan[6]

26. Public resistance to nuclear weapons is still so strong in Japan that no Japanese government is likely to begin a weapons program in the near future. In the course of the next few years, however, these domestic pressures are likely

[5] For a more detailed estimate of Israel's nuclear weapons policy, and more information on the MD-620 missile, see NIE 30-65, "The Arab-Israeli Problem," dated 10 March 1965, SECRET.

[6] For more details see NIE 41-65, "Japan," dated 26 November 1965, SECRET.

to diminish. If Communist China demonstrates a developing weapons capability, or if India should develop nuclear weapons, the feeling is likely to grow in Japan that it too, as a major Asian power, should have a nuclear capability. Pressures for greater military autonomy from the US may also grow, along with other nationalistic urges. Nevertheless, US treaty guarantees and pressures will probably dissuade the Japanese from acquiring nuclear weapons during the next few years. If Japan did develop nuclear weapons, it could also produce a strategic missile delivery system without major difficulty, since it already is engaged in a fairly advanced space program.

E. West Germany

27. There is strong domestic opposition to development of nuclear weapons in West Germany, and there are also treaty prohibitions which the Germans could not easily breach. Germany would not only face intense opposition from the USSR if it embarked on a national nuclear weapons program, but would also severely damage its relationship with the Western Alliance, including the US. Except for a fringe of extremists, Germans of all political leanings are unwilling to do this. They will increasingly demand greater influence in Western nuclear councils and will favor joint projects designed to give them such influence. But whether or not such projects come to fruition, and whether or not major changes in the Alliance occur, we believe that a close US-West German relationship will continue and that West German incentives to acquire nuclear weapons will not outweigh the restraints upon them in the next few years.

F. Switzerland

28. Some Swiss military leaders argue that the nation should have at least a few tactical nuclear weapons to protect Swiss neutrality. This is an extension of traditional attitudes; the Swiss concept of neutrality has always included the idea of an active military defense of the nation. Though Switzerland has an active nuclear power and research program, we believe there is very little likelihood that the Swiss will initiate a nuclear weapons program during the next few years.

G. Australia

29. Australia probably would seek nuclear weapons only if it felt seriously threatened by Communist China and was no longer willing to place its confidence in guarantees of protection from the US and the UK. A major determinant of Australia's attitudes on these two points will be its estimate of the US position in Southeast Asia. If Australia came to believe that the US was being gradually pushed out of Southeast Asia, the chances are about even that Australia would begin to develop its own nuclear weapons. Although Australia has no sizable reactor in operation or under construction, it has had an active nuclear research program for a number of years.

H. South Africa

30. South Africa will face in coming years increasingly hostile political pressures and perhaps economic sanctions, not only from black Africa but from much of the rest of the world as well. We cannot exclude the possibility that South Africa might, for psychological rather than military reasons, respond by attempting to acquire nuclear weapons, though we do not consider this likely. South Africa would need a good deal of outside help to develop nuclear weapons; we believe it unlikely that any country would provide such aid, but there is some possibility that France might do so. France is today one of the few countries willing to provide South Africa with conventional military hardware, and might be induced to provide nuclear assistance in return for a stable supply of unsafeguarded uranium, of which South Africa has large reserves.

I. Nationalist China

31. Chiang Kai-shek, shortly after the first Chinese Communist nuclear detonation in October 1964, set up a scientific research institute; there is some evidence that one of its purposes is to study the possibility of Nationalist China's acquiring its own nuclear weapons. Although there are a number of US-educated Nationalist Chinese scientists with a high degree of competence in the nuclear field, the Chinese Nationalists do not have the capability to produce such weapons domestically. They would have to import unsafeguarded uranium, a suitable reactor, and almost all other necessary equipment. For the next few years at least, we believe that Nationalist China would have great difficulty in obtaining such unsafeguarded materials and equipment.

J. The UAR, Pakistan, and Indonesia

32. The UAR would probably seek to acquire nuclear weapons if it believed Israel was developing such weapons. Pakistan would try to get nuclear weapons if it became convinced India was developing them. Indonesia—prior to the recently attempted coup—had publicly proclaimed an intent to acquire such weapons.

33. Each of these countries would need substantial aid in virtually all phases of a nuclear program and we believe none of the present nuclear powers is likely to give such help. However, we cannot exclude the possibility that Communist China might do so at some time in the future. Communist Chinese statements have implied that it would be a good thing if more "anti-imperialist" nations had nuclear weapons. For the next several years, at least until their own capability passes the embryonic stage, we believe that the Chinese will not transfer control of nuclear weapons to other nations.

V. THE SNOWBALL EFFECT

34. The above survey indicates that very few nations are likely to emerge as new nuclear powers in the next several years. India and Israel are the only serious contenders for nuclear status. In the longer run, however, Indian or

Israeli possession of nuclear weapons would cause Pakistan and the UAR to seek them. It would also increase doubts in other nations about the feasibility of non-proliferation or comprehensive test ban treaties. This in turn would tend to weaken some of the restraints presently operating in other countries such as Sweden.

35. In West Germany and Japan, close alliance ties and security guarantees with the US would probably outweigh for at least the next few years the snowball effect of weapons programs elsewhere. We do not believe that even the development of nuclear weapons by India, Israel, and Sweden together would cause West Germany or Japan to follow suit, if the US remained strongly opposed. However, either of these two countries would be strongly motivated to develop nuclear weapons, if the other did so with US acquiescence.

VI. DETECTION OF COVERT PROGRAMS

36. It would be technically possible for nations capable of developing nuclear weapons to do so covertly, up to the test of a first device. The facilities needed to produce fissionable materials could be built and operated without detection, albeit with considerable difficulty, either underground or disguised as other types of plants. Once the fissionable material was available, the clandestine design and fabrication of a device could be done relatively easily. Materials and equipment for those nations which would need large scale outside help probably could be shipped clandestinely by an outside supplier.

37. Under cover of a peaceful purposes program, a country could go far toward a weapons program. Most of the facilities needed to produce plutonium—reactors, fuel fabrication plants and chemical separation plants—are also used in peaceful nuclear programs and could be so justified. Furthermore, a country able to produce plutonium could fabricate a device and detonate it underground, claiming that the purpose was peaceful, i.e., for excavation or other "Plowshare" purposes. Such a device could be a step toward a weapon, and it would be difficult for the nation involved to prove otherwise.

38. The likelihood that the US would receive timely information on foreign nuclear weapons programs varies from country to country. [redacted]

39. Israel would have more incentives than most other countries to undertake a covert nuclear weapons program. An openly announced program would raise

E.O. 13526, section 3.3(b)(1)

the danger of preemptive Arab action against Israel's nuclear facilities, and would sharply stimulate Arab efforts to acquire nuclear weapons. It would also provoke intense opposition from both the US and the USSR, and Israel knows from its Suez experience in 1956 how difficult it is to withstand threats or sanctions from these two sources at the same time. France probably would not want to bear the onus of assisting Israel in an overt program, but it might be willing to extend further assistance covertly.

40. Israel agreed several years ago to permit US scientists to examine the Israeli reactor facilities at Dimona. There have been a few visits, the last having been in January 1965. At that time the Dimona reactor had not produced plutonium. [redacted] Physical and personnel security measures are very tight in Israel's nuclear program, [redacted]

E.O. 13526, section 3.3(b)(1)

ANNEX

TECHNICAL AND ECONOMIC CONSIDERATIONS FACING NATIONS WHICH MIGHT EMBARK ON A NUCLEAR WEAPONS PROGRAM

A. Technical Problems

1. Deposits of uranium, the basic raw material for nuclear weapons, are widespread throughout the world. In addition to the US, the USSR, and probably Communist China, at least two other countries—Canada and South Africa—have extensive high grade ore reserves. India, France, the Congo (Leopoldville), East Germany, Australia, and Spain each have substantial though smaller reserves. Other lesser deposits are located in Sweden, Finland, Portugal, Argentina, Brazil, Greenland, several East European countries, and some of the underdeveloped African and Asian states. Japan and West Germany also have small reserves, but they are of low grade ore difficult to process economically. Many countries are not now exploiting their uranium reserves because the present demand is more than adequately supplied by the US, Canada, and several other producers, at fairly low prices. As the use of nuclear power increases, however, and the demand for uranium rises, most of the countries with domestic reserves could easily expand their production and exports of uranium.

2. There are three fissionable materials which a nation may use to produce fission weapons—plutonium, uranium-235, and uranium-233. Most nations could acquire plutonium most easily, since the technical information necessary to produce plutonium is openly available. Moreover, plutonium is produced in various types of nuclear reactors, of which the natural uranium-heavy water reactor and the natural uranium-graphite reactor are now quite common. To run such reactors, a nation must have or acquire uranium, and either heavy water or graphite of adequate purity. Uranium metal must be fabricated into fuel elements for the reactor. In the reactor the fuel elements become in part transformed into plutonium. Plutonium separation facilities are needed to extract the plutonium from the fuel elements, and other facilities are required to reduce the separated plutonium to its metallic form. The metal may then be fabricated into components for weapons. None of the non-nuclear powers except India is known to have plutonium processing facilities, except on a very small scale for laboratory purposes. Japan and Sweden, however, both plan to build plutonium separation plants, and other nations could do so fairly easily, since the technology required is generally available.

3. The technical difficulties of the plutonium route to nuclear weapons are continuing to decrease. Much of the knowledge needed for the design of relatively simple weapons is now generally available, as is enough information to

make unnecessary a full series of tests to determine weapons effects. An increasing number of countries have or soon will have natural uranium reactors, installed either for research purposes or to generate electric power, but capable of producing plutonium for weapons.

4. U-235 can also be used in an initial fission weapons program. In both the USSR and the US, the way chosen for producing this material from natural uranium has been the very expensive and technically difficult gaseous diffusion process. England also has, and France is building, a gaseous diffusion plant to produce the U-235 needed for a large and sophisticated weapons program. For various reasons, a gaseous diffusion plant is feasible only when built on a scale to produce fairly large quantities of U-235. The non-nuclear countries which might initiate a weapons program in the next decade would probably regard the gaseous diffusion process as an overly long and expensive road to a modest capability. Another method of obtaining U-235 is the electromagnetic process. Built on a large scale, an electromagnetic separation plant would be as expensive as a gaseous diffusion plant. However, an electromagnetic plant is technologically somewhat easier to construct, and it can be built on a smaller scale. Communist China may have obtained its U-235 through a combination of the gaseous diffusion and the electromagnetic processes. Various other nations may have the technical capability to use the electromagnetic process.

5. The ultracentrifuge process may eventually provide a quicker and less expensive method of producing moderate amounts of U-235 than either the gaseous diffusion or electromagnetic processes, though both the manufacture and operation of ultracentrifuges require a high degree of sophistication. The US has never constructed a production-size ultracentrifuge facility, but research has shown the process to be feasible. The cost of constructing and operating a plant for a small weapons program would be less than a gaseous diffusion or electromagnetic plant but more than a small plutonium production program for any country which already had a suitable reactor. Authoritative information on recent foreign developments in ultracentrifuge technology is not available. Only West Germany, the Netherlands, and Japan among the non-nuclear countries have done much research to date on ultracentrifuges. If advanced ultracentrifuge technology becomes more readily available, however, the chances that a nation could develop nuclear weapons clandestinely, right up to the time of the first test, will be somewhat greater than they are now. An ultracentrifuge facility would not require a large building; it would have no distinguishing external features and would not require great amounts of power; and it might be built and operated without attracting attention.

6. A nuclear device could also be produced using uranium-233 which is derived from thorium. Natural thorium itself cannot be used to fuel reactors but, when irradiated in a reactor, thorium becomes in part converted into U-233, which is a fissionable material. Such U-233 can be used to fuel one of the types of "breeder" reactors now under development, which is able to "breed" more U-233 from additional thorium. India has large reserves of

thorium and is interested in reactors of this type. There are great difficulties in using U-233 in a weapons program, but they are not insurmountable.

7. The 1963 partial nuclear test ban treaty, which permits only underground tests, is not a significant technical barrier to undertaking a small scale weapons program. Although underground testing increases somewhat the costs and difficulties of developing nuclear weapons, the differences, as compared with atmospheric testing, are not great. Instrumentation of underground tests to obtain the essential data needed to produce relatively simple weapons would not be too difficult. A fairly large volume of unclassified information is available on US underground tests which would probably enable a nation to determine the depth and size of hole necessary for devices of various sizes, and for soil or rock of various types. Further, it is possible that a nation might produce and stockpile a few weapons without having conducted any test.

B. Cost Considerations

8. The cost of a modest program for producing nuclear weapons would not be prohibitive for most countries with an adequate technological base. A program to produce one or two low-yield (about 20 KT) plutonium fission weapons per year would cost $140 million to $180 million through the first detonation, and $20 million to $30 million a year thereafter. However, the cost increases markedly for more than a minimum program. For example, a program to produce about 20 plutonium fission weapons per year would probably cost about $500 million to $600 million through the first test, with subsequent annual operating expenses of about $75-$100 million. [redacted]

9. A number of the countries discussed in this estimate have already spent on their nuclear programs amounts as great or greater than the cost of acquiring a capability to produce one or two weapons per year (see Table II).

TABLE II

E.O. 13526, section 3.3(b)(1)

COUNTRY	ESTIMATED TOTAL EXPENDITURES TO END 1965 (million $US)	YEAR PROGRAM STARTED	ESTIMATED PRESENT ANNUAL OUTLAYS: MILLION $US	ESTIMATED PRESENT ANNUAL OUTLAYS: PERCENT OF 1965 GNP (current prices)
India	[redacted]			
Israel				
Sweden				
Japan				
West Germany				

10. In these countries, however, funds have been spent for research and for development of facilities not directly related to weapons production, and, in all except India, elements which would be essential for a nuclear weapons program are lacking.

11. The additional amount which each of these countries would have to spend if it wished to produce weapons would depend on the size of the weapons program desired. TABLE III compares our estimates of the additional expenditures needed with the expenditures which these nations will probably make in any case on their non-military nuclear programs over the next five years. With the exception of weapons fabrication and test facilities, all facilities essential to weapons production can be justified as necessary for a peaceful nuclear research and power program. By deferring a decision to manufacture weapons until after completion of all facilities required for production of fissionable materials, a country can limit the incremental cost of undertaking weapons production to the expense incurred for research, development, fabrication, and testing of actual weapons—thereby avoiding much domestic and foreign opposition. [redacted]

E.O. 13526, section 3.3(b)(1)

TABLE III

COUNTRY	ASSUMED SIZE OF WEAPONS PROGRAM (Number of 20 KT weapons produced per year)	EXPENDITURES REQUIRED FOR WEAPONS TO TIME OF FIRST TEST (million $US)*	ESTIMATED EXPENDITURES ON NON-MILITARY NUCLEAR PROGRAM IN NEXT FIVE YEARS (million $US)
India	[redacted]		
Israel			
Sweden			
Japan			
West Germany			

[redacted]

E.O. 13526, section 3.3(b)(1)

12. In the other countries discussed in this estimate, minimum weapons programs would require large and burdensome increases in present annual expenditures for nuclear purposes (see TABLE IV). Most of these countries would require substantial foreign assistance for even a token weapons program.

TABLE IV

COUNTRY	ASSUMED SIZE OF WEAPONS PROGRAM (Number of 20 KT weapons per year)	EXPENDITURES REQUIRED FOR WEAPONS TO TIME OF FIRST TEST (million $US)	ESTIMATED PRESENT ANNUAL OUTLAYS FOR NON-MILITARY NUCLEAR PROGRAMS (million $US)
Switzerland	[redacted]		
Australia			
South Africa			
Nationalist China			
The UAR			
Pakistan			
Indonesia			

C. List of Foreign Nuclear Reactors

E.O. 13526, section 3.3(b)(1)

13. TABLE V, following, lists all known foreign reactors in operation which are outside the present nuclear powers and capable of producing plutonium in amounts significant for a weapons program. TABLE VI lists reactors in the same categories now under construction. As a rough guide, about six kilograms of plutonium is enough for one nominal-yield fission weapon. [redacted] The principal types of reactors which we have omitted from the tables that follow are (1) reactors with a power rating of less than 10 megawatts-thermal, and (2) reactors using as fuel uranium enriched with more than 20 percent U-235.

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TABLE V

REACTORS NOW IN OPERATION LOCATED OUTSIDE THE PRESENT NUCLEAR POWERS AND CAPABLE OF PRODUCING PLUTONIUM IN AMOUNTS SIGNIFICANT FOR A WEAPONS PROGRAM [a]

COUNTRY, NAME, AND LOCATION OF REACTOR	TYPE OF REACTOR	SIZE OF REACTOR (POWER RATING) [b]	DATE REACTOR WENT CRITICAL	SAFEGUARDS	PLUTONIUM PRODUCTION CAPABILITY (Kg. per year) [c]
BELGIUM					[redacted]
BR-3 reactor, Mol	Prototype power reactor. Fueled with 3.7 percent enriched U-235.	41 MWT	Aug 1962	US/EURATOM on both fuel and reactor.	
	Core later changed on above reactor for Vulcain project, to make it a prototype ship propulsion reactor. Fueled with 6-7 percent enriched U-235.	40 MWT		UK on both fuel and reactor.	
CANADA					
NRX reactor, Chalk River	Research. Fueled with natural uranium, moderated with heavy water.	40 MWT	Jul 1947	None	
NRU reactor, Chalk River	Research and test reactor. Fueled with natural uranium.	200 MWT	Nov 1957	None	
NPD reactor, Rolphton	Power reactor. Fueled with natural uranium, moderated with heavy water.	83 MWT	Apr 1962	None	
WR-1 reactor, Whiteshell Res. Center	Research reactor. Moderated with heavy water. Fueled with slightly enriched U-235.	40 MWT	Nov 1965	Joint US-Canadian project.	
WEST GERMANY					
VAK reactor, Kahl	Prototype power reactor, fueled with 2.5 percent enriched U-235.	60 MWT	Nov 1960	EURATOM on both fuel and reactor.	
FR-2 reactor, Karlsruhe	Research reactor, cooled and moderated with heavy water. Fueled partly with natural uranium, partly with 20 percent enriched U-235.	12 MWT	Mar 1961	EURATOM on both fuel and reactor; US on heavy water and enriched fuel.	
MZFR "multi-purpose" research reactor, Karlsruhe	Power and test reactor. Fueled with natural uranium and cooled with heavy water.	200 MWT	Oct 1965	EURATOM on both fuel and reactor; US on heavy water.	
INDIA					
CIR reactor, Trombay	Research reactor. Fueled with natural uranium, moderated with heavy water.	40 MWT	Jul 1960	Agreements with Canada and US to use for peaceful purposes. No right of inspection.	
ISRAEL					
Dimona reactor, Dimona	Research reactor. Fueled with natural uranium, moderated with heavy water.	26 MWT	Dec 1963	Irradiated French fuel elements to be returned to France. No safeguards on future fuel loadings if provided by Israel itself.	

E.O. 13526, section 3.3(b)(1)

SECRET

REACTORS NOW IN OPERATION LOCATED OUTSIDE THE PRESENT NUCLEAR POWERS AND CAPABLE OF PRODUCING PLUTONIUM IN AMOUNTS SIGNIFICANT FOR A WEAPONS PROGRAM [a] *(Continued)*

COUNTRY, NAME, AND LOCATION OF REACTOR	TYPE OF REACTOR	SIZE OF REACTOR (POWER RATING) [b]	DATE REACTOR WENT CRITICAL	SAFEGUARDS	PLUTONIUM PRODUCTION CAPABILITY (Kg. per year) [c]
ITALY					[redacted]
SIMEA reactor, Latina	Power reactor (Calder Hall type). Fueled with natural uranium.	705 MWT	Dec 1962	UK/EURATOM on both fuel and reactor.	
SENN Garigliano reactor, Punta Fiume	Power reactor. Fueled with 2 percent enriched U-235.	508 MWT	Jun 1963	EURATOM safeguards on both fuel and reactor.	
SELNI reactor, Trino Vercellese	Power reactor. Fueled with 2.6 percent enriched U-235.	272 MWE (No thermal power rating available)	Jun 1964	EURATOM on both fuel and reactor.	
JAPAN					
JRR-3 reactor, Tokai Mura	Research reactor. Fueled with natural uranium.	10 MWT	Sep 1962	US on heavy water; Canada on fuel.	
JPDR reactor, Tokai Mura	Power demonstration reactor. Fueled with slightly enriched U-235.	45 MWT	Aug 1963	US/IAEA on both fuel and reactor.	
JAPCO-1 reactor, Tokai Mura	Power reactor (Calder Hall type). Fueled with natural uranium.	585 MWT	May 1965	UK/IAEA on both fuel and reactor.	
NORWAY					
HBWR reactor, Halden	Research reactor. Fueled with natural uranium or slightly enriched U-235.	10-20 MWT	Jun 1959	UK/US/IAEA on both fuel and reactor.	
SWEDEN					
Agesta reactor, Agesta	Power reactor. Moderated and cooled with heavy water. Fueled with natural uranium.	65 MWT	Jul 1963	None	
SWITZERLAND					
DIORIT reactor, Wurenlingen	Research reactor. Moderated and cooled with heavy water. Fueled with natural uranium.	20 MWT	Jul 1960	US, on the heavy water only.	

E.O. 13526, section 3.3(b)(1)

[a] See paragraph 12 of ANNEX, above, for criteria used in determining the reactors to be included in TABLES V and VI.

[b] For most of the reactors in TABLES V and VI, the power ratings are given in terms of Megawatts-thermal (MWT). For a few of the reactors, the only power ratings available are in Megawatts-electric (MWE). The thermal output of any reactor is always several times greater than its output of electricity. Thus a reactor rated at 100 MWE could have an MWT rating ranging from 300 to considerably higher.

[c] All figures are very rough approximations. It is assumed that reactors will be operated to obtain maximum production of plutonium suitable for weapons at the possible expense of research or power production, but with only minor modifications of the reactor.

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TABLE VI

REACTORS UNDER CONSTRUCTION LOCATED OUTSIDE THE PRESENT NUCLEAR POWERS AND CAPABLE OF PRODUCING PLUTONIUM IN AMOUNTS SIGNIFICANT FOR A WEAPONS PROGRAM [a]

COUNTRY, NAME, AND LOCATION OF REACTOR	TYPE OF REACTOR	SIZE OF REACTOR (POWER RATING) [b]	DATE REACTOR TO GO CRITICAL	SAFEGUARDS	PLUTONIUM PRODUCTION CAPABILITY (Kg. per year) [c]
CANADA					[redacted]
CANDU reactor, Douglass Point	Power reactor. Moderated with heavy water. Fueled with natural uranium.	693 MWT	1966	None	
Pickering Generating Plant, Fairport, Ontario	Power reactor. Fueled with natural uranium, moderated with heavy water.	1,000 MWE (two reactors of 500 MWE each. Thermal output not available.)	1970–1972	None	
CZECHOSLOVAKIA					
A-1 reactor, Bohunice	Power reactor. Moderated with heavy water. Fueled with natural uranium.	590 MWT	1968–1969	Supplied by USSR. Safeguards unknown.	
EAST GERMANY					
Rheinsberg reactor, Rheinsberg	Power reactor. Fueled with slightly enriched U-235.	260 MWT	Probably early 1966	Supplied by USSR. Safeguards unknown.	
WEST GERMANY					
KRB reactor, Gundremmingen	Power demonstration reactor. Fueled with 2.6 percent enriched U-235.	801 MWT	1966	EURATOM on both fuel and reactor.	
FDR "Otto Hahn" reactor, Kiel	Ship propulsion reactor. Fueled with low enrichment U-235.	38 MWT	1966	EURATOM on both fuel and reactor.	
KWO reactor, Obrigheim	Power demonstration reactor. Fueled with 3 percent enriched U-235.	908 MWT	1968	EURATOM on both fuel and reactor.	
KWL reactor, Lingen	Power demonstration reactor. Fueled with slightly enriched U-235.	520 MWT	1968	EURATOM on both fuel and reactor.	
HDR reactor, Grosswelzheim b. Kahl	Prototype power reactor involving nuclear superheating. Fueled with slightly enriched U-235.	100 MWT	1968	EURATOM on both fuel and reactor.	
INDIA					
Tarapur Power Station, Tarapur	Power reactors. Fueled with slightly enriched U-235.	380 MWE (two reactors, each 190 MWE. Thermal output not avail.)	1967–1968	US on both fuel and reactors.	
Rajasthan Power Station, Rana Pratap Sagar	Power reactors. Fueled with natural uranium. Moderated with heavy water.	400 MWE (two reactors of 200 MWE each. Thermal output not avail.)	1968–1969 (date for first reactor. Second reactor indefinite.)	Canada on both fuel and reactor.	

E.O. 13526, section 3.3(b)(1)

SECRET

REACTORS UNDER CONSTRUCTION LOCATED OUTSIDE THE PRESENT NUCLEAR POWERS AND CAPABLE OF PRODUCING PLUTONIUM IN AMOUNTS SIGNIFICANT FOR A WEAPONS PROGRAM [a] (*Continued*)

COUNTRY, NAME, AND LOCATION OF REACTOR	TYPE OF REACTOR	SIZE OF REACTOR (POWER RATING) [b]	DATE REACTOR TO GO CRITICAL	SAFEGUARDS	PLUTONIUM PRODUCTION CAPABILITY (Kg. per year) [c]
ITALY					[redacted]
ESSOR reactor, Ispra	Research reactor. Fueled with natural uranium.	38 MWT	1967	EURATOM on both fuel and reactor.	
JAPAN					
JMTR reactor, Tokai Mura	Research reactor. Fueled with enriched U-235.	50 MWT	1968-1969	Probably US/IAEA or UK/IAEA on fuel.	
NETHERLANDS					
GKN reactor, Doodewaard	Power reactor. Fueled with slightly enriched U-235.	50 MWE (Thermal output not avail.)	1968	US/EURATOM on both fuel and reactor.	
SPAIN					
UEM reactor, Zorita de Canes	Power reactor. Fueled with slightly enriched U-235.	153 MWE (Thermal output not avail.)	1967	US on both fuel and reactor.	
SWEDEN					
Marviken reactor, Marviken	Power reactor. Fueled with either slightly enriched U-235 or with natural uranium.	100-200 MWE (Thermal output not avail.)	1968	UK safeguards only if enriched fuel is used.	
SWITZERLAND					
ENUSA reactor, Lucens	Power reactor. Fueled with combination of 3 percent enriched U-235 and natural uranium.	30 MWT	1966	US safeguards on fuel only.	
NOK reactor, Beznau	Power reactor. Fueled with slightly enriched U-235.	1,130 MWT	1969-1970	US safeguards on both fuel and reactor.	

E.O. 13526, section 3.3(b)(1)

[a] See paragraph 12 of ANNEX, above, for criteria used in determining the reactors to be included in TABLES V and VI.
[b] For most of the reactors in TABLES V and VI, the power ratings are given in terms of Megawatts-thermal (MWT). For a few of the reactors, the only power ratings available are in Megawatts-electric (MWE). The thermal output of any reactor is always several times greater than its output of electricity. Thus a reactor rated at 100 MWE could have an MWT rating ranging from 300 to considerably higher.
[c] All figures are very rough approximations. It is assumed that reactors will be operated to obtain maximum production of plutonium suitable for weapons at the possible expense of research or power production, but with only minor modifications of the reactor.

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