Director of Central Intelligence

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Trends in South Africa's Nuclear Security Policies and Programs

National Intelligence Estimate

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5 October 1984

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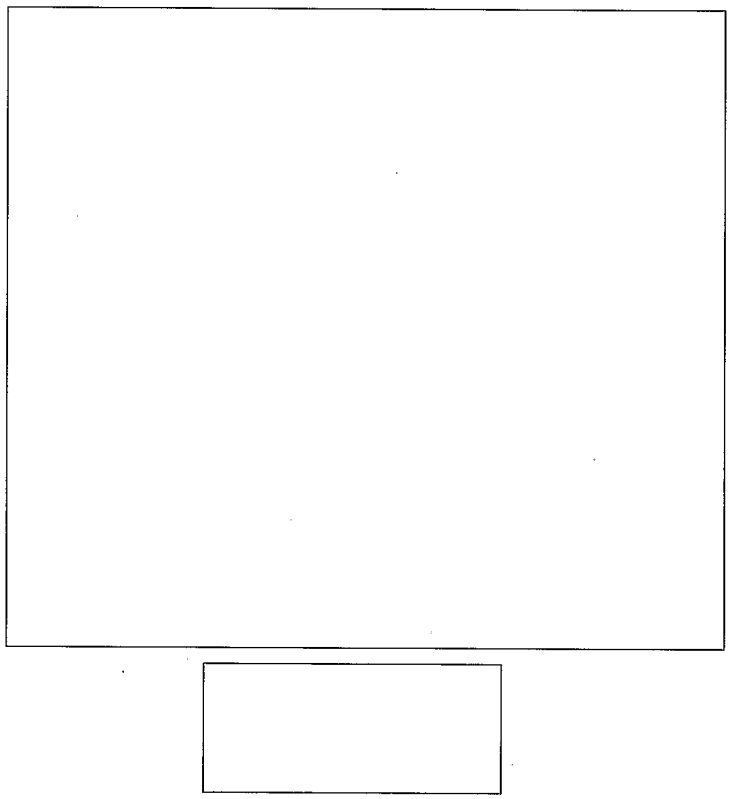

NIE 73/5-84/CX

TRENDS IN SOUTH AFRICA'S NUCLEAR SECURITY POLICIES AND PROGRAMS

Information available as of 25 September 1984 was used in the preparation of this Estimate, which was approved by the National Foreign Intelligence Board on 2 October 1984.

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[redacted]

THIS ESTIMATE IS ISSUED BY THE DIRECTOR OF CENTRAL INTELLIGENCE.

THE NATIONAL FOREIGN INTELLIGENCE BOARD CONCURS.

The following intelligence organizations participated in the preparation of the Estimate:

The Central Intelligence Agency, the Defense Intelligence Agency, the National Security Agency, and the intelligence organizations of the Departments of State and Energy.

Also Participating:

The Assistant Chief of Staff for Intelligence, Department of the Army

The Director of Naval Intelligence, Department of the Navy

The Assistant Chief of Staff, Intelligence, Department of the Air Force

The Director of Intelligence, Headquarters, Marine Corps

[redacted]

CONTENTS

KEY JUDGMENTS

We believe that South Africa has the capability to produce nuclear weapons on short notice. We believe—although we cannot confirm—that South Africa has already stockpiled the components for several test devices or first-generation nuclear weapons that use enriched uranium.

We believe that South Africa has developed a nuclear implosion design and a gun-assembly design as well. Given the size of its nuclear program, South Africa could stockpile annually enough highly enriched uranium for two to four nuclear explosives, depending on the design. ~~(S NF NC OC)~~

Since the furor that accompanied the discovery of the Kalahari test site in 1977, South Africa has followed a policy of calculated ambiguity with respect to its nuclear options by intimating that it has the capability to produce nuclear weapons while disavowing any interest in doing so. Such a policy allows it to avoid the intensified pressures for safeguards and the sanctions that would inevitably follow any revelation of a weapons capability. At the present time, Pretoria appears satisfied with that policy and is likely to adhere to it through the five-year time frame of this Estimate.

There is no hard evidence about the degree to which South Africa has incorporated nuclear strategy into its military planning. The South African defense force's clear-cut conventional military superiority in the region makes a nuclear strike capability unnecessary. Nuclear weaponry would have little effect against the principal military threats—guerrillas operating from domestic or border-state rural bases and insurrection in black urban areas. Moreover, the sense of urgency that prevailed in the 1970s, largely because of the perceived Soviet threat, appears to have diminished.

Much of the South African capability is based on work carried out in the mid-1970s prior to then Prime Minister Vorster's reported direction to halt the program. However, it is reasonable to assume that research and development has continued, with the possibility that emphasis may have shifted more toward fabrication and delivery systems rather than continued stockpiling of uranium and components. Although South Africa already has several types of aircraft capable of delivering nuclear explosives, those aircraft are aging and are becoming

increasingly vulnerable to the air defense systems being provided its adversaries by the Soviet Union. ~~(S NF NC OC)~~

We have no direct evidence of cooperation in nuclear weapons development between South Africa and Israel. The two countries maintain a dialogue on nuclear matters, however, and past or future exchanges of nuclear-weapons-related research, technology, or materials cannot be ruled out. There is evidence that Israel and South Africa have collaborated on weapon systems that have the potential to serve as delivery platforms for nuclear weapons.

We believe that South Africa is not likely to test a nuclear explosive device during the next five years. The increase in tensions on the continent and with the West that would accrue from a test of a nuclear device would be greater than the political/military gains to be derived. However, growing tensions between the United States and the Soviet Union, if accompanied by perceptions that the United States was losing ground to Moscow in Africa, or was losing interest in Africa, might provide incentive to test as a caution to the Soviets. Any attempted intimidation by Moscow on behalf of its African clients might provoke the South Africans to conduct a test as a warning that Pretoria will not be bullied. ~~(C)~~

There is still considerable disagreement within the Intelligence Community as to whether the flash in the South Atlantic detected by a US Vela satellite in September 1979 was a nuclear test, and if so, by South Africa. If the latter, the need for South Africa to test a device during the time frame of this Estimate is significantly diminished. ~~(S NF)~~

Revelation that South Africa possessed nuclear weaponry would immediately exacerbate the tensions that exist in southern Africa. Black African states, supported by the Soviet Union, would seek stricter sanctions against Pretoria and raise the specter of South African nuclear blackmail to achieve regional domination. They might seek some form of protective guarantee from their patron. Although Moscow would almost certainly not offer any explicit nuclear commitment, it might provide more sophisticated air defense systems and step up arms and advisory assistance. ~~(C)~~

Revelation would put the United States in an awkward position. Black African states would hold the United States at least partially responsible for Pretoria's nuclear status and the United States would be criticized for not restraining South Africa's nuclear progress. Conversely, strong US denunciations of South Africa's nuclear weapons capability would be perceived as evidence to Pretoria that the United States has taken an anti–South African position. We do not believe that a harsh US reaction would provoke Pretoria to cut off important minerals exports to the United States, as some observers have contended. ~~(C)~~

South African testing of a nuclear device would weaken the international nonproliferation regime and encourage the acquisition of nuclear weapons by other countries by demonstrating that indigenous development of nuclear weapons can be accomplished. Several states of proliferation concern might feel fewer inhibitions about developing nuclear weapons or openly publicizing their nuclear capabilities if South Africa suffered no serious international repercussions. ~~(c)~~

South Africa's resumption of discussions with the IAEA concerning safeguards for the semicommercial enrichment facility at Valindaba and its commitment to request safeguards for its own nuclear exports may be designed to mitigate future attacks on its IAEA membership. South Africa will not have to make major concessions to the IAEA in order to continue access to nuclear technology. While foreign assistance was crucial to South Africa's nuclear explosives development in the 1970s, Pretoria's current need for such assistance is not great. ~~(S NF NC OC)~~

DISCUSSION

Introduction

The Search for Security

1. The rapid—and largely unforeseen—escalation of conflict in southern Africa following Portugal's withdrawal in the mid-1970s had a traumatic impact on South Africa. Until that time, the Portuguese colonies of Angola and Mozambique were the furthest extensions of the so-called "white redoubt" and, along with the white minority regime in Rhodesia, constituted a buffer against those liberation groups seeking black majority rule in South Africa and Namibia. By and large, South Africans felt secure within their borders and confident of their ability to contain black dissidence. ~~(c)~~

2. South Africa's intervention in the Angolan civil war of 1975-76 failed, however, to turn the tide in favor of pro-Western liberation groups, and this sparked a major reassessment of the country's military capabilities and policies. The intervention showed that South Africa lacked the resources to wage a protracted military campaign. In addition to having been overwhelmed by the magnitude of the Soviet and Cuban involvement in Angola, military officials also identified serious deficiencies in materiel, communications, and logistics. ~~(c)~~

3. Those deficiencies, set against the emergence in Angola and Mozambique of Marxist-oriented, anti-apartheid regimes heavily dependent on Soviet and Cuban support, generated fears in Pretoria that those former colonies would become staging areas for a direct Soviet-backed invasion, perhaps involving Cuban as well as black African forces. A subsequent rise in guerrilla activity in both South Africa and Namibia by guerrillas operating out of Angola and Mozambique and an upsurge in racial demonstrations in South Africa added to a sense of beleaguerment. ~~(c)~~

4. Thus, by the late 1970s, South Africa saw itself as standing virtually alone against a "total onslaught" being waged against it by black insurgents and radical black African states supported by the Soviet Union and its allies. In response, South African leaders adopted a "total national strategy" aimed at creating a self-sufficient, flexible defense force capable of deterring conventional as well as guerrilla threats. In a crash effort to redress the military imbalance, top priority was given to building up the conventional capabilities of the armed forces and to developing an indigenous arms industry capable of reducing—and eventually eliminating—dependence on foreign sources of supply (see inset on page 6). ~~(c)~~

5. The transfer of power to a black majority regime in Rhodesia in 1980 came as another blow to South Africa's sense of security. By then, however, the South African military had adopted a "forward defense" strategy based on increasingly aggressive conventional and covert military operations against guerrilla bases and local defense positions in neighboring states, particularly Angola and Mozambique. As a result, South Africa has reasserted itself as the dominant military power in southern Africa. It has forced Mozambique to accept a mutual nonaggression pact and is exerting pressure on Angola to send home the more than 30,000 Cuban troops stationed there. In addition, it has convinced those governments to place restrictions on guerrillas operating from their territories. ~~(c)~~

The Nuclear Option

6. The ominous military situation that prevailed in the mid-1970s also induced South Africa to accelerate a nuclear explosives research and development program that had been formally launched in 1973. That program, like the conventional military buildup, has shown major accomplishments. By 1977, South Africa had constructed a nuclear test site in the Kalahari Desert and appeared well on its way toward testing a nuclear explosive device. ~~(S NF NC OC)~~

7. The international outcry that followed the discovery of the Kalahari site persuaded Pretoria to abandon any plans it may have had for a test and to impose tighter security over its nuclear explosives programs. A mysterious flash in the South Atlantic Ocean in 1979 raised fears in the international community that Pretoria finally had tested an explosive device, although there is still strong disagreement within the Intelligence Community as to whether a test actually took place (see annex B). ~~(c)~~

The Regional Military Balance

In relation to its neighbors South Africa is a superpower, although it falls far short of that status by Western or Soviet standards. The South African defense force is made up of 76,500 active-duty personnel including 28,000 regular forces. In all, South Africa probably could muster a force of approximately 400,000 soldiers when ready reserves, home guard units, and older males liable for service in case of national emergency are added in. (c)

The government-controlled Armaments Corporation of South Africa, with assets now estimated at $1.2 billion, currently meets the bulk of the military's requirements for ground force equipment. It produces small arms and ammunition, artillery and rockets, armored vehicles, tactical communications equipment, and landmines. It also modifies and upgrades aging equipment such as the British-supplied Centurion tank of World War II vintage. Pretoria still faces serious problems, however, replacing its aging fleet of fighters, bombers, and reconnaissance aircraft. (c)

In contrast, the black armies in the region are ill-trained, inadequately supported, and poorly led. Making the transition from bush fighter to conventional soldier has been extremely difficult. Angola has some 30,000 to 35,000 men under arms, and Mozambique has close to 22,000. The majority in both countries, however, are engaged in counterinsurgency operations, for which they are inadequately prepared, or in local law enforcement. (c)

Zimbabwe's armed forces, once second in ability only to those of South Africa, now number about 45,000 but have been weakened since independence in 1980 by the loss of white professionals, desertions, political interference, and the inevitable frictions arising from tribalism and the largely failed integration of rival guerrilla elements. (c)

While South Africa has an indigenous arms industry, Angola and Mozambique must depend on Soviet-supplied weaponry. Both countries have more battle tanks than South Africa and together have more (and more advanced) jet fighter aircraft. However, neither country has the personnel trained to operate or maintain the equipment, and the flow of spare parts is unreliable. (c)

The only weaponry in the Angolan inventory that limits South African operations within Angola are the sophisticated SA-8 and SA-9 surface-to-air missiles provided by the Soviet Union in mid-1983. This modern air defense system is manned by Soviet and/or Cuban personnel at bases 150 to 200 miles north of the Angola-Namibia border. (c)

8. The Soviet Union's projection of power into southern Africa in the mid-1970s may well have been the key factor in Pretoria's decision to step up its nuclear explosives research and development. South Africa's leaders long have identified the Soviet Union as their country's major adversary. With Moscow having once again (as it did elsewhere in Africa in the 1960s) brought the great-power rivalry to the continent—and with it the perceived threat of an invasion of South Africa—the added protection of a credible nuclear deterrent took on a new urgency.[1] (S NF NC OC)

9. South Africa's readiness to move ahead with both conventional military buildup and nuclear explosives development has also been motivated by the belief that it cannot depend on the West. That belief—along with the Soviet threat—will dominate South African defense thinking through the 1980s and probably beyond. (S NF NC OC)

10. Prior to the 1970s, South Africa's leaders extolled the idea that their country was of strategic importance to the West given its location and mineral resources. Because of that importance, they argued, it was a major Soviet target. Thus, South Africa could count on Western assistance in the event of Soviet-inspired aggression, Western criticism of apartheid notwithstanding. In 1976, however, following the ill-fated intervention in Angola, Defense Minister (now Prime Minister) Botha, warned that realities had changed and that South Africa no longer could count on such assistance. That warning was based to a large degree on the widespread belief among South African military planners that their intervention in Angola could have succeeded if the West had been willing to support it. (c)

11. Uneasiness over the West's reliability was reinforced by its outcry over the Kalahari test site and the mandatory arms embargo against South Africa passed by the United Nations. In addition to calling for an embargo against conventional military assistance, the embargo also called for a ban against UN member states cooperating with South Africa in developing nuclear weapons. The West's refusal to veto the embargo deepened South African suspicions. (c)

[1] The present director of the National Intelligence Service, Dr. Barnard, wrote extensively on the strategy of nuclear deterrence while a university professor in the 1970s. He urged that South Africa develop a nuclear weapons capability and demonstrate it to the world. He justified his position by observing that Moscow would have few reservations about using nuclear weapons against South Africa. (c)

12. Since then, South Africa's defense policy—including nuclear policy—has been driven by a strong desire for self-sufficiency and a fear of Western interference. At the same time, it follows a policy of calculated ambiguity by which it intimates that it has a nuclear weapons capability while disavowing any interest in testing a nuclear device. ~~(c)~~

South Africa and Nonproliferation

13. South Africa, which has been a charter member of the International Atomic Energy Agency (IAEA) since 1957, has been reluctant to make major international legal commitments that would restrict its freedom to develop nuclear technology. It is probable that its refusal to adhere to the Non-Proliferation Treaty (NPT) is in large part due to the fact that the treaty requires signatories to place all fissile material under IAEA safeguards. ~~(c)~~

14. Pretoria's unwillingness to bend to outside pressure from Western supplier states concerning safeguards requirements was perhaps best illustrated in the early 1980s when the South Africans had to secure nuclear fuel for the first of the two Koeberg power reactors. Faced with a joint US-French strategy designed to force them to accept comprehensive safeguards in return for guaranteed fuel supply, the South Africans canvassed the uranium market and succeeded in obtaining a sufficient supply of low enriched uranium from a number of alternative sources, including China. ~~(S-G)~~

15. Pretoria's position concerning IAEA safeguards on specific South African nuclear facilities has been more flexible. It has acceded to requests from supplier states for such controls involving imported nuclear materials, equipment, and technology. For example, the country's only research reactor at the Pelindaba nuclear research center has been under IAEA safeguards since 1965 because it utilizes US-origin enriched uranium. (US supplies were discontinued in the mid-1970s.) Likewise, the two French-built Koeberg power reactors are open to IAEA inspection. ~~(c)~~

16. In January 1984 South Africa announced that it would be willing to resume discussions with the IAEA concerning safeguards for the indigenous semicommercial uranium enrichment facility at Valindaba. The motives behind this announcement are not clear. This gesture was not the first time Pretoria has shown a cooperative attitude. On a number of occasions between 1973 and 1977, the South Africans demonstrated an interest in sharing knowledge about their unique aerodynamic enrichment process with other countries and a willingness to place the projected commercial facility under IAEA safeguards.[2] However, persistent and successful efforts by the black African states and India after 1977 to restrict South Africa's ability to participate in IAEA activities reinforced a South African proclivity toward a siege mentality. As a result, Pretoria saw no incentive to cooperate on safeguards issues with an international organization that appeared to have become captive of South Africa's enemies. ~~(c)~~

17. The controversy with regard to South Africa's status within the IAEA has become less intense in recent years but the problem still remains. It is possible that Pretoria's strategy is to head off future attacks on its IAEA membership. There have been several UN resolutions introduced during the past year calling on the IAEA to terminate all contact with South Africa until it accepts comprehensive safeguards. Several Western nations, including the United States, have urged that no action be taken in view of the resumption in early August of South African–IAEA discussions concerning the possible application of IAEA safeguards to the semicommercial enrichment facility at Valindaba. ~~(c)~~

18. Pretoria's public commitment in the January 1984 announcement to request IAEA safeguards for all of its own nuclear exports can be viewed as another positive development justifying a more restrained approach in dealing with the South African problem.[3] ~~(c)~~

19. The actual technical difficulties in reaching a safeguards arrangement for the enrichment facility are considerable and will ensure that discussions will

[2] The South African aerodynamic enrichment process is similar to the West German Becker nozzle method. But South Africa asserts that its secret process, though similar in concept, is unique. (c)

[3] In that announcement, Dr. J. W. L. DeVilliers stated that, "South Africa will conduct and administer its nuclear affairs in a manner which is in line with the spirit, principles, and goals of the Non-Proliferation Treaty (NPT) and the Nuclear Suppliers Group Guidelines. . . . This would specifically include: I. South Africa will not sell uranium to nonnuclear weapons countries without International Atomic Energy Agency or Euratom safeguards; II. South Africa will not make available sensitive technology to any other country without Agency or Euratom safeguards; III. South Africa will not sell enriched uranium or nuclear equipment without Agency or Euratom safeguards." Dr. DeVilliers concluded by stating that any sales of such material or equipment must have guarantees that it will only be used for peaceful purposes. ~~(c)~~

be protracted.[4] The enrichment process utilized by the South Africans has unique features that Pretoria will wish to protect as a commercial secret. (c)

20. The South Africans are acutely aware of the time it will take to resolve the safeguards issue and may well have calculated that their gesture was a relatively costless way to buy time and more protection against further attacks on their IAEA membership status. If the black African states and others continue their effort to expel Pretoria from the IAEA, the South Africans will have a legitimate rationale for breaking off negotiations at any time. We doubt that there is some other vested interest that would persuade Pretoria to remain at the negotiating table under such circumstances. The current South African need to import nuclear fuel or technology from the United States, or other supplier states with rigorous nonproliferation policies, is not great. If necessary, Pretoria can probably fulfill its requirements through a number of channels without having to make major concessions to the IAEA on safeguards issues. (c)

South Africa's Nuclear Explosives Capability

21. Evidence that South Africa has developed a significant nuclear explosives capability is substantial and compelling. There are reliable reports of nuclear explosives research and development, and there are several facilities in South Africa, such as the Valindaba uranium enrichment pilot plant, which have a direct relevance to the development of nuclear explosives (see figure 1). (S NF NC OC)

22. We are reasonably confident of the existence of an active nuclear explosives program dating back to the early 1970s. The program envisioned testing, and efforts proceeded in that direction until the Kalahari test site was discovered by the Soviet Union in 1977. There are reports that South Africa in fact intended to test a nuclear explosives device before 1977 but was delayed by a lack of fissile material. (S NF NC OC)

23. [redacted] 1978, [redacted] we believe that South Africa has developed two nuclear explosives designs—for an implosion device [redacted] and for a gun-assembled device. This

[redacted]

(S NF NC OC)

Genesis and Development

24. According to open literature, South Africa could have begun research on nuclear explosives devices as early as 1968-69, when the Valindaba plant was being designed and at least one South African scientist was in the United States studying the application of peaceful nuclear explosives. [redacted] (S NF NC OC)

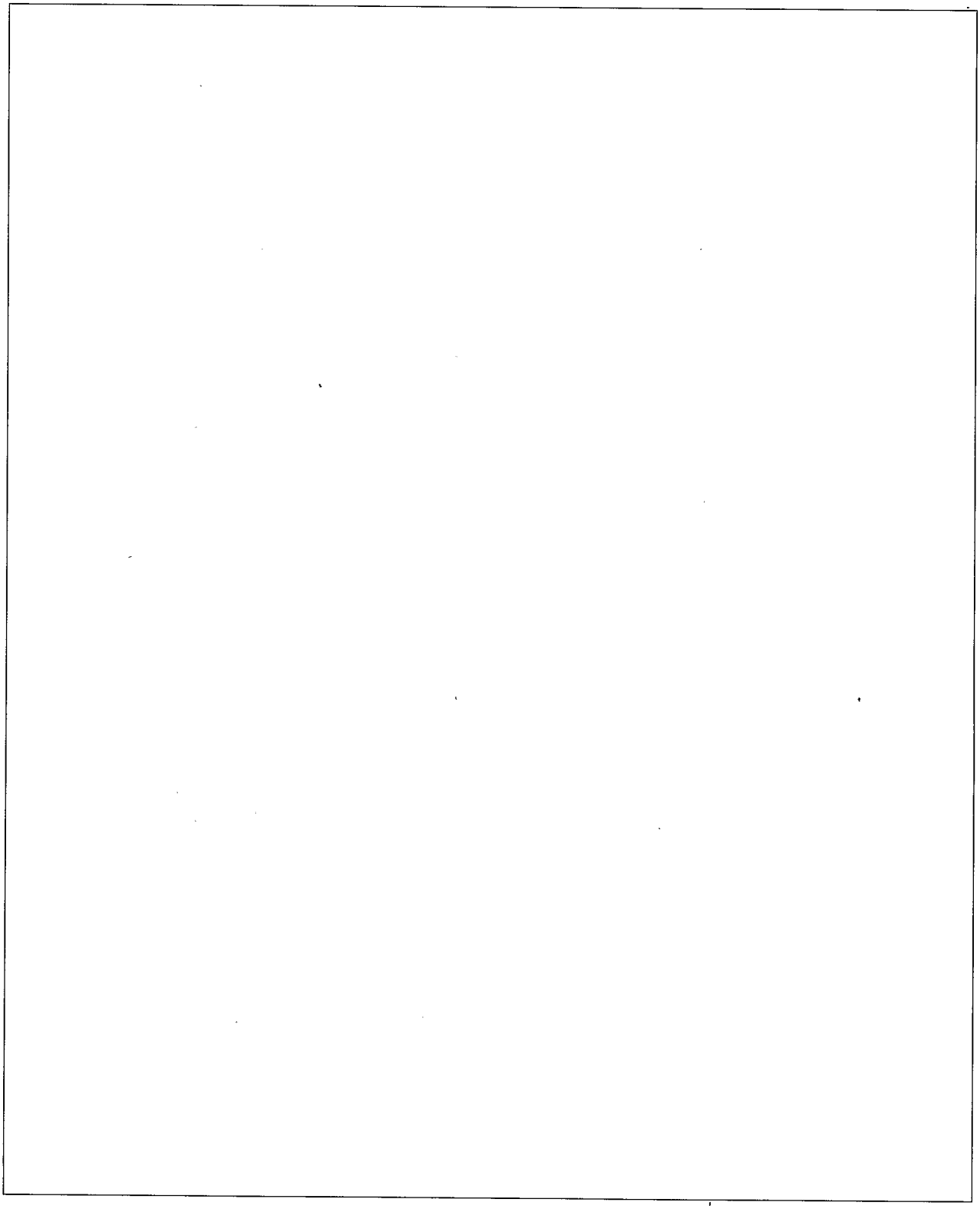
25. [redacted] (S NF NC OC)

26. [redacted] (S NF NC OC)

27. A group at Somerset West, near Cape Town, the National Institute for Defense Research (now called Kentron), can also be linked to the nuclear explosives program. The institute basically is responsible for research, development, and production of propellants and high explosives and probably is focused primarily

[4] A serious proliferation concern is whether IAEA safeguards coverage can be extended in some manner to the pilot enrichment facility at Valindaba. The objective would be to prevent low enriched uranium from the commercial plant from being used as "feed" for the production of highly enriched uranium outside safeguards in the pilot facility. (c)

[redacted]



on developing the conventional explosives system for a gun-assembled and/or implosion device. ~~(S NF NC OC)~~

[redacted] ~~(S NF NC OC)~~

29. The Intelligence Community has not identified full-scale nuclear-related high explosives testing anywhere in South Africa. There could have been a series of such tests at unidentified, perhaps remote, locations in South Africa that was not detected. Such testing is necessary in developing implosion devices, but not for gun-type devices, and involves the detonation of nuclear device mockups that employ a surrogate—usually natural uranium or depleted uranium—for the fissile material in an actual nuclear explosives device. These tests can provide assurance that the compression needed for device detonation and desired yield is attained. (See annex B.) ~~(S NF NC OC)~~

Availability of Fissile Material

30. The Valindaba pilot scale uranium enrichment plant was crucial to South Africa's development of a nuclear explosive device. The plant uses a unique aerodynamic enrichment process developed from research that began in 1961. Pretoria asserts that it is a proprietary process and has refused to subject it to international nuclear safeguards inspection for fear that the design and operating data for it will be stolen. ~~(S NF NC OC)~~

31. Contrary to South African claims of its peaceful use, we have reliable reports that Valindaba is designed for weapons-grade uranium production, and in significantly larger quantities than needed for fueling its existing research reactors. These reports also indicate that technical problems initially hindered Valindaba from operating at its peak design capacity, which is about 100 kilograms per year of 95-percent enriched uranium. ~~(S NF NC OC WN)~~

[redacted]

[redacted] ~~(S NF NC OC WN)~~

33. [redacted] Valindaba plant has continued to operate since 1977, notwithstanding then Prime Minister Vorster's reported decision that year to curtail nuclear explosives development. Thus, it seems plausible that stockpiling of fissile material has continued since 1978. South Africa's SAFARI-1 research reactor is the only known civil consumer of highly enriched uranium, but its design requirement for HEU is less than one quarter of Valindaba's designed annual production capacity. It is difficult to assess to what extent HEU has been stockpiled at Valindaba, but, given the size of the facility and the excess production capacity, South Africa could stockpile annually enough HEU for two to four nuclear explosives, depending on the device design. We cannot determine, however, how much HEU has actually been produced to date. Technical problems have limited production levels in the past and may have continued to do so. ~~(S NF NC OC)~~

34. South Africa currently is building a semi-commercial-scale enrichment plant for producing low enriched uranium for the two Koeberg power reactors. The plant is theoretically capable of producing HEU, but it could better enhance Valindaba's HEU production capacity by providing low enriched uranium feed to the pilot plant. The capacity of the semi-commercial-scale plant will be about 30 percent higher than the needs of the Koeberg reactors. This excess could be used for export or making up for unscheduled plant shutdowns. ~~(S NF WN)~~

35. Although enriched uranium is the only known source of fissile material in South Africa, a plutonium capability could be added if South Africa developed indigenous reprocessing and/or reactor technology (see inset on page 12). The presence of such facilities would not in itself constitute a clear indication of intent to use plutonium for nuclear explosives, but it would represent access to technology necessary for such development. ~~(S NF WN)~~

[redacted] ~~(S NF NC OC)~~

Heavy Water Technology and Plutonium Production

[redacted] ~~(S NF NC OC)~~

South Africa once had plans to develop natural uranium power reactors. Those plans were abandoned in the 1960s in favor of light water reactors, purportedly because of economics. Thus, South Africa's recent interest in heavy water technologies could reflect changed economic conditions that favor natural uranium reactors because of the relatively high cost of indigenously produced enriched uranium, and concerns about energy self-sufficiency. ~~(S NF NC OC)~~

In comparison to the enrichment issue, we believe that South Africa would have a less credible argument for rejecting nuclear safeguards either on the heavy water plant or on an indigenous plutonium production reactor. These technologies do not have as much proprietary sensitivity and uniqueness as does the South African enrichment process. ~~(S NF NC OC)~~

Interest in heavy-water may portend yet another technology—spent fuel reprocessing. The South Africans have shown interest in this technology for several years, and every country of proliferation concern that has added heavy-water-based natural uranium reactor technology to its program also has shown strong interest in reprocessing. ~~(S NF NC OC)~~

[redacted]

[redacted] ~~(S NF NC OC)~~

38. Thus, we believe that South Africa has the capability to produce nuclear weapons on short notice. We believe—although we cannot confirm—that South Africa has already stockpiled the components for several test devices or first-generation nuclear weapons [redacted] ~~(S NF NC OC)~~

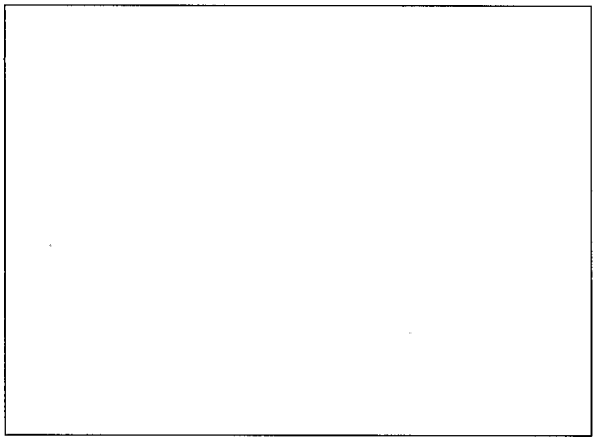
Foreign Suppliers

39. Foreign suppliers, predominantly West European, have been important to South Africa's nuclear program from its inception. The development of South Africa's nuclear explosives program would not have been possible without foreign technical assistance during the 1970s. ~~(S NF)~~

40. Despite embargoes and periods of political controversy, foreign firms have exported equipment and technology used in both the nuclear weapons development program and the associated uranium enrichment pilot plant. [redacted] These imports, consisting mostly of specialized laboratory or industrial equipment and nuclear-quality materials, serve the interests of foreign suppliers searching for markets and South African nuclear program managers facing limitations on domestic capabilities. ~~(S NF NC OC)~~

41. [redacted] ~~(S NF NC OC)~~

[redacted]

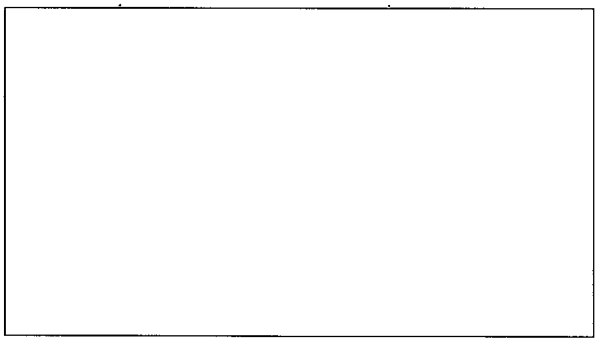


45. The South Africans have had little difficulty acquiring materials and technology essential to their nuclear weapons development program. There are a number of reasons for this. First, the program was very secret for most of its history, and nonproliferation concerns were lower during the 1960s and early 1970s when many important acquisitions took place. For example, during that period the South Africans acquired an IBM 370 computer for Pelindaba from the United States. This computer could have been quite important to nuclear weapons design calculations. The export of an equally state-of-the-art computer today would meet with stiff resistance.

46. Second, South Africa has a large scientific and industrial infrastructure that makes a large number of nonmilitary purchases every year. Thus, some nuclear-related purchases do not attract the attention they would if made by other countries. Moreover, the South Africans can easily purchase equipment through front organizations.

Taiwan and Israel

47. We have no direct evidence of cooperation in nuclear weapons development between South Africa and Taiwan. The two countries, however, do have a cooperation agreement on civil nuclear technology such as uranium ore processing and nuclear medicine. ~~(S NF NO OC)~~

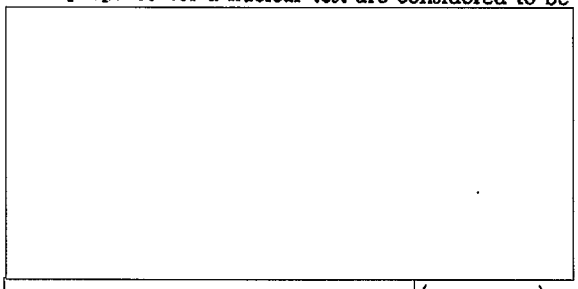


There is evidence that Israel and South Africa have collaborated on weapon systems that have the potential to serve as delivery systems for nuclear weapons. ~~(S NF NO OC)~~

Prospects for South Africa's Nuclear Weapons Development

Size and Nature Over the Next Five Years

49. There is little evidence to indicate the intentions of the present South African Government with respect to nuclear testing and weapons production over the next five years. Pretoria's apparent standdown regarding testing in recent years suggests that nuclear development has met the country's military requirements, at least to the extent warranted by current perceptions of the strategic threat and of the risks involved in overt actions such as testing. It also suggests that the diplomatic and political benefits of being seen as having once prepared for a nuclear test are considered to be



~~(S NF NO OC)~~

51. South Africa will not be constrained by economic considerations. During the 1970s, it made significant progress in nuclear weapons technology

Given the availability of weapons-grade uranium, we believe the additional costs for research and development on weapons fabrication would be relatively modest and easily absorbed in Pretoria's $16 billion annual budget. ~~(S NF WN)~~

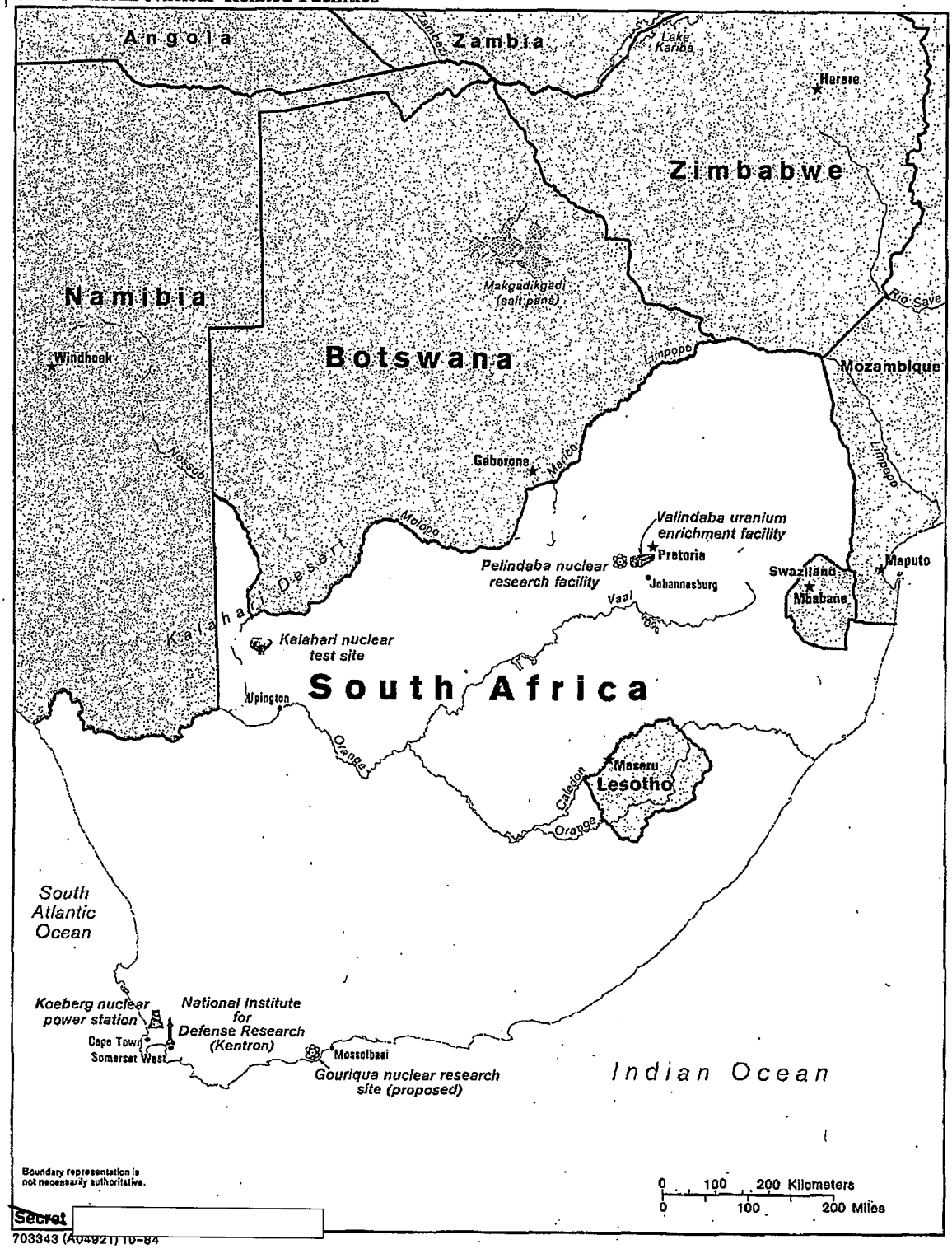
Considerations Regarding Nuclear Testing

Nuclear Test Plans

52. There are strong indications that South Africa was proceeding toward a nuclear explosives test in the 1970s, while the military conflict in southern Africa was escalating. Along with its efforts to develop at least two nuclear device designs, South Africa constructed an underground nuclear test site (see figure 3) in the

[6] Prime Minister Botha stated in 1981 that he could not set the minds of his enemies at rest by signing the Nuclear Non-Proliferation Treaty. (S)

Figure 3
South African Nuclear-Related Facilities



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Kalahari Desert, 80 kilometers north of Upington. Development of the site, [redacted] began as early as 1974. By the end of 1975, the geology of the site was sufficiently understood to make sure that no radioactivity would seep out. Logistics structures were constructed in 1975-76. ~~(S NF NC OC)~~

[redacted] ~~(S NF NC OC)~~

[redacted] ~~(S NF NC OC)~~

55. In August 1977, while the South Africans were still awaiting an adequate supply of fissile material, the site was identified on satellite imagery by the Soviets, who publicized its existence. The features of the site (emplacement area, instrumentation area, housing, and support area), the security imposed by the South African military, [redacted] provide a strong case that the site was being prepared for a nuclear test. ~~(S NF NC OC WN)~~

Political Considerations

56. Since 1977 South Africa has followed a policy of calculated ambiguity with respect to the nuclear option by intimating that it has the capability to produce nuclear weapons while disavowing any interest in doing so. ~~(C)~~

57. Such a policy holds a number of benefits, particularly for a pariah state such as South Africa. It forces Pretoria's adversaries to assume that South Africa has a weapons capability and to factor that assumption into their policy formulation. For example, even though Moscow need have no fear of South Africa's ability to launch a nuclear strike against the Soviet Union, it must take into consideration the damage South Africa could inflict on the Soviet Union's African clients, as well as on Soviet and Cuban garrisons in Africa. ~~(S NF NC OC)~~

58. Calculated ambiguity also allows South Africa to avoid the intensified pressures for nuclear safeguards and sanctions that would inevitably follow any open display of a weapons capability. Under present policy it can proceed with research and development fairly confident that the court of world opinion lacks the evidence to bring a case against it. ~~(S NF)~~

59. The assumption on the part of its adversaries that South Africa has a nuclear weapons capability also gives Pretoria a deterrent credibility while allowing it to avoid the stigma of being the first to introduce nuclear weapons on the African continent. That introduction also might prompt neighboring black African states to seek protection under the Soviet nuclear umbrella or—though less likely—to allow deployment on their territory of tactical nuclear weapons superior, no doubt, to any South Africa might have. ~~(S NF)~~

60. There is no hard evidence about the degree to which South Africa has incorporated nuclear strategy into its military planning. The absence of such evidence should not be taken to mean that South Africa's military research and development is lagging, however. It may only mean that the military is more concerned with its immediate conventional needs. ~~(S NF)~~

61. The South African defense force's clear-cut superiority in southern Africa and the success of its operations against its adversaries make a nuclear strike capability irrelevant at the present time. In addition, the cost and effort involved in maintaining and upgrading the conventional capabilities of the military and of acquiring, if possible, new and advanced weaponry, particularly aircraft and tanks, strongly suggest that a nuclear weapon is far down on the military's shopping list. ~~(S NF)~~

62. We believe that South Africa is not likely to test a nuclear explosive device during the time frame of this Estimate. At the present time, the sense of urgency associated with nuclear development in the 1970s appears to have diminished. Moreover, the increase in tensions on the continent and with the West that would accrue from a test would be greater than the political/military gains to be derived, particularly in view of South Africa's military superiority in the region and the conventional deterrent capability it now enjoys. ~~(S NF NC OC)~~

63. There are circumstances which could induce the South Africans to change their policy and test a nuclear device. International considerations could lead to a nuclear test far sooner than regional ones, at least within the period of this Estimate. Growing tension between the United States and the Soviet Union, if accompanied by perceptions that the United States

was losing ground to Moscow in Africa, or was losing interest in Africa, might give added weight to advocates of nuclear deterrence and trigger a test. (S NF)

64. Stronger Soviet efforts to defend its African allies either with conventional weapons or intimations of stronger retaliation could force South Africa to counter with a test and with proclamations that it will not be bullied. A private Soviet message last November condemning South Africa's military policy toward Angola, while not accompanied by threats of retaliation, nonetheless was regarded by Pretoria as an attempt at intimidation. (S NF)

Technical Considerations

65. Although we believe that the political considerations governing whether South Africa conducts a nuclear test are preeminent, there are, nevertheless, significant technical considerations as well. These relate principally to reliability and performance of nuclear explosives devices. (S NF)

66. [redacted] South Africa undertook development of both gun-assembly and implosion designs. Even though gun-assembly devices can be deployed to weapon systems without a strong requirement that the nuclear explosive be tested, there would still be some uncertainty about the yield.[7] If South Africa wishes to have confidence in an implosion design, its need to test increases substantially. It would be possible to deploy an implosion device without testing, but they probably would have little confidence in its performance unless they received outside assistance. We note that an implosion design is much more efficient in use of fissile material than is a gun-assembly design. (S NF NC OC)

67. The relatively strong technical requirement for testing of an implosion design provides additional significance to the effort to resolve whether the 22 September 1979 event was, in fact, a nuclear test. If it was, the South Africans may already have resolved many of their basic uncertainties, and their technical requirement for nuclear testing during the next five years would be significantly diminished. Development of more advanced weapons concepts such as boosting and thermonuclear designs would require at least one and probably more tests. For a boosted design, the South Africans would have to test an unboosted version to establish the necessary physics calibration points to determine how it could be boosted. For a thermonuclear design, tests would be required to characterize the implosion device performance and to develop thermonuclear design concepts. (S NF NC OC)

Alternative Scenarios

68. Despite former Prime Minister Vorster's decision in 1977 to halt South Africa's nuclear explosives program, it is possible that South Africa has leapfrogged the testing phase and is concentrating on the weaponizing and delivery of its nuclear explosives device. Afrikaners are a contingency-minded people and as such probably would prefer to have a deliverable nuclear weapon rather than be forced to develop one hastily in the face of a worsening security situation. (S NF NC OC)

69. The head of South Africa's National Intelligence Service, Dr. Bernard, voiced that point of view in 1979 when he publicly stated that "by the time a nuclear crisis really faces us, it will probably be too late to make ourselves really prepared and to be able to defend ourselves at that level." (S)

70. Another alternative scenario is that South Africa is working on advanced design concepts such as boosting or the thermonuclear device that was originally tasked in 1973. It is difficult to assess the likelihood of this scenario because we do not know enough about the reasoning behind South Africa's initial decision in 1973 to develop such advanced concepts. (S NF NC OC WN)

71. [redacted] (S NF NC OC WN)

Delivery System: Present Status and Future Prospects

It is unquestionable that the Republic of South Africa has the technological capacity to manufacture nuclear arms as well as sophisticated systems of delivery with the desired accuracy and penetration.

—(Commodore H. F. Nel, speech to the South African Institute of Strategic Studies, 1980.) (S)

[7] Even so, we note that the United States deployed its first gun-assembly weapon in World War II without first testing the nuclear explosive. (S)

72. Virtually all of South Africa's combat aircraft can carry a nuclear payload. These include the Mirage F1AZ, the Mirage III EZ, the Buccaneer S Mk 50, the Impala, and the Canberra B(I)Mk 12. We do not believe the Impala is a sound tactical choice, however, because of its small size and inferior performance. This issue is discussed in detail in annex C. ~~(S NF)~~

73. In 1976, the South African Air Force (SAAF) publicly announced that Buccaneer bombers had been used for practicing nuclear delivery techniques. Using conventional bombs, five Buccaneer bombers destroyed a decommissioned 797-ton World War II salvage ship off Cape Town. The bombers released their bombs 3 to 5 miles away from the ship, then pulled up sharply and veered away. The SAAF further characterized the exercise as employing a "computerized technique to deliver nuclear bombs and escape the effect of the resulting explosions." ~~(C)~~

74. The prospects for delivery systems other than aircraft—that is, ballistic missiles or artillery systems—are less likely during the period of this Estimate. The extremely difficult physics problems associated with artillery-delivered nuclear weapons militate against successful development (see annex C). ~~(S NF)~~

75. However, there have been recent indications [redacted] that South Africa may be undertaking ballistic missile development at Somerset West. If this is so, it would probably take about five years to develop an effective system. This assumes that there is no assistance from other countries, such as France or Israel. A missile delivery system would have a significant advantage over aircraft in penetrating air defenses. It also could serve to fill a future gap if South Africa continues to have difficulty replacing its aging aircraft. ~~(S NF NC OC WN)~~

Implications of South African Nuclear Weapons Development

76. For the past few years at least, South Africa's nuclear program has not been a major source of contention in Africa nor has it had adverse implications for the United States except in relation to the international nonproliferation regime. With the exception of the discovery of the Kalahari test site in 1977 and the mysterious flash in the South Atlantic in 1979, South Africa's nuclear program has provoked little condemnation. This is partly because of its low visibility and partly because Africans—who would be the first to condemn—have been preoccupied with other matters. The low level of open contention regarding Pretoria's nuclear development has provided the United States with room to maneuver in international forums [redacted] to attempt to bring South African facilities under international nuclear safeguards. ~~(S NF NC OC)~~

77. Revelation that South Africa possessed nuclear weaponry would immediately exacerbate the tensions in southern Africa. Black African states, supported by the Soviet Union, would renew their calls for UN and other sanctions against Pretoria. Those calls would be more intense than previous ones in view of South Africa's recent military operations in the region and fears of South African nuclear blackmail to achieve regional domination. Moscow's clients in southern Africa might seek some form of protective guarantee from their patron. While the Soviet Union almost certainly would not offer any explicit nuclear commitment, it might provide more sophisticated air defense systems and step up arms and advisory assistance. In addition, Moscow could be counted on to issue generalized but ominous threats against South Africa and those who were suspected of contributing to its nuclear development. ~~(S NF)~~

78. Black African states would hold the United States at least partly responsible for Pretoria's nuclear status, particularly if the United States did not join in the denunciations. In African eyes, the United States has done little to restrain South Africa's military operations in the region and the United States as a nuclear superpower would be criticized for not restraining its nuclear progress as well. ~~(S NF)~~

79. Revelation would put the United States in an awkward position. The revived need to bring South Africa under international nuclear safeguards and to exert some control over its nuclear programs would be a strong argument in favor of US–South African nuclear cooperation. However, any such cooperation would be viewed in Africa and much of the Third World as contributing to South Africa's nuclear military strength. Even the current minor level of US assistance is rejected by many pro-Western African states. Revelation would fire the drive for sanctions and US disinvestment in South Africa. ~~(S NF)~~

80. On the other hand, strong US denunciations would be additional evidence to Pretoria that the West is undependable or, at the very least, that the United States expected South Africa to meet the threats against it with one hand tied behind its back. Many South African officials long have believed that accepting the safeguards demanded by the West puts smaller nuclear countries at a distinct disadvantage. We doubt that a harsh US reaction would provoke Pretoria to cut

off important minerals exports to the United States, as some observers have contended, since economic reality probably would prevail over South African pique. A cutoff could become more possible, however, should the United States actively seek to interrupt the flow of nuclear-related equipment and technology to South Africa. ~~(S NF)~~

81. South African testing of a nuclear device would weaken the international nonproliferation regime and encourage the acquisition of nuclear weapons by other countries by demonstrating that indigenous development of a nuclear weapons capability can be successfully accomplished. Several states (such as Pakistan, Argentina, Brazil, and Israel) might feel fewer inhibitions about developing nuclear weapons or openly publicizing their nuclear weapons capabilities if South Africa suffered no serious international repercussions or technological setbacks. ~~(S NF)~~

ANNEX A

THE CIVIL NUCLEAR PROGRAM

1. Although South Africa has vast coal reserves and exports significant amounts of coal, it saw a need for nuclear power as early as the 1960s. This need arises because South Africa has built its electrical power plants where its coal is located. A number of the developed regions in South Africa, most notably the western Cape, are not near coal deposits, however, and transporting coal by rail or transmitting power over electrical lines, at distances sometimes up to 1,500 kilometers, is inefficient and prohibitively expensive. ~~(c)~~

2. Pretoria chose therefore to construct nuclear power plants on the coast to ensure adequate cooling water from the ocean. In fact, the recent drought in South Africa has heightened South African interest in additional nuclear plants since some conventional power plants located inland have been forced to shut down because of inadequate cooling water supply. ~~(c)~~

3. South Africa's entry into the realm of civil nuclear power began in 1976 when it signed an agreement with a French-led consortium to supply two 922-megawatt (electrical) light water reactor power plants for the Koeberg nuclear station near Cape Town. The first of these reactors started up for initial testing on 19 March 1984. When both reactors are operating, they will contribute about 8 to 10 percent of the country's electrical power needs. ~~(c)~~

4. The problems encountered in obtaining foreign enriched uranium fuel have pushed Pretoria into a program for self-sufficiency in nuclear fuel supply. It is developing and/or constructing commercial-scale facilities for uranium processing, enrichment, and reactor fuel fabrication. These facilities, shown in figure 4, should be available by the time current foreign supply contracts are completed. ~~(S NF NC OC)~~

5. We believe that, during the period of this Estimate, South Africa will develop heavy water technology and spent fuel reprocessing, and that it will begin an indigenous nuclear reactor program. ~~(S NF NC OC)~~

Heavy Water Technology and Its Implications

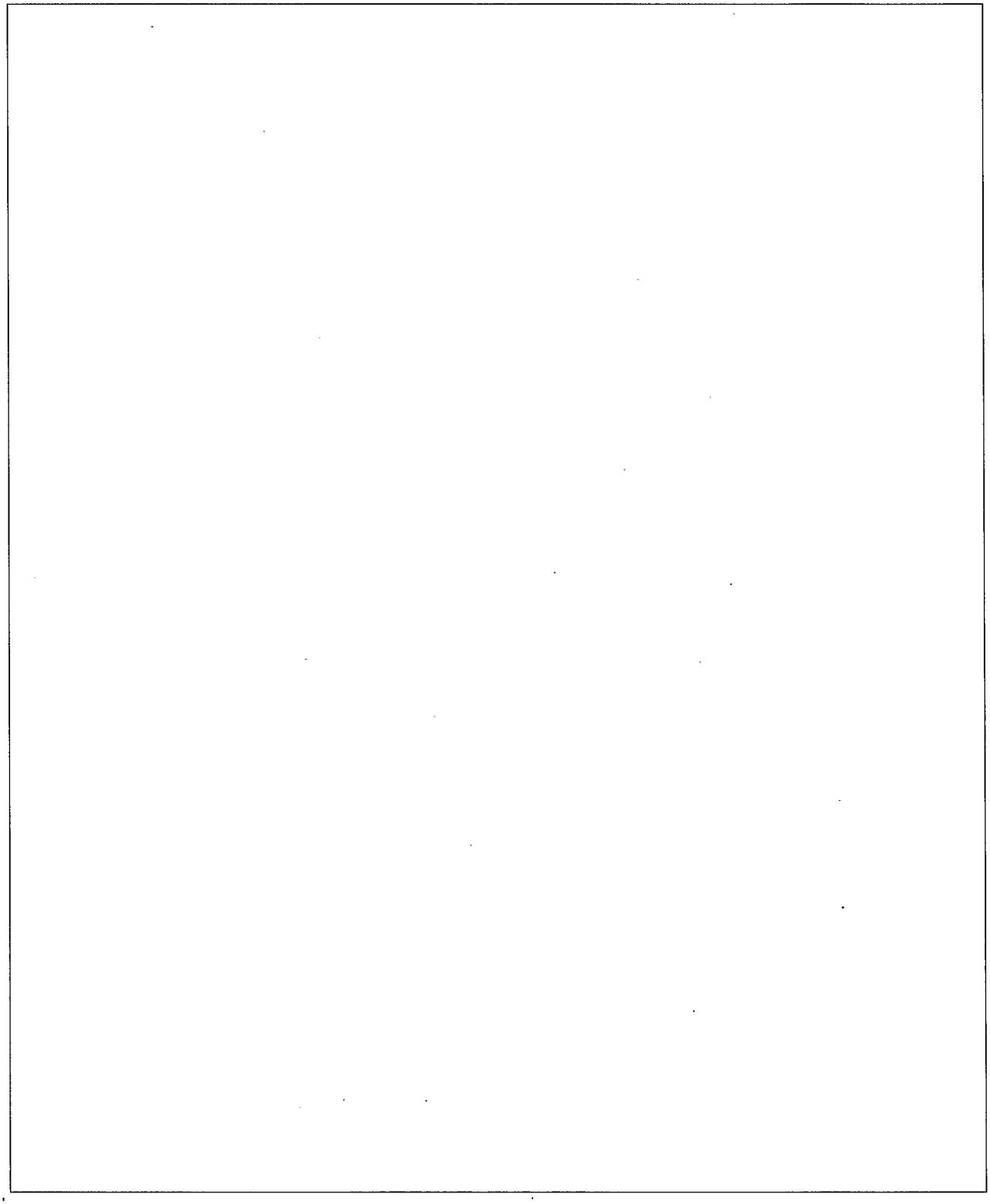
6. [redacted] South Africa is negotiating for the purchase of a large (approximately 250- to 500-ton-per-year) plant, scheduled for completion in 1987-88. Such heavy water technology presages development of natural uranium-fueled reactors, which can be excellent producers of plutonium. ~~(S NF NC OC)~~

7. In the 1960s a South African effort to develop a heavy-water-based power reactor was abandoned. A competing effort on a process for uranium enrichment, which would support a light-water-based nuclear fuel cycle succeeded, however, and development of the process began. ~~(S NF)~~

8. South Africa's renewed interest in heavy water technology could grow out of either civil or military interests. A civil interest could derive from economics and the drive for self-sufficiency. Military interests could stem from a desire for smaller nuclear explosives than comparable-yield uranium-based devices. ~~(S NF NC OC)~~

9. South Africa may have determined that its enrichment process is not economical enough to support a domestic power program. Even though its pilot-scale uranium enrichment plant has proved its unique aerodynamic process on a technological level, it has not done so on an economic (or commercial) scale. Previous South African statements on the process have indicated that a break-even point exists with respect to plant size. In early 1982, a senior South African official stated that a plant size of 3 million separative work units (SWU) per year was needed to be competitive in the world market. ~~(S NF NC OC)~~

10. At the present time, however, there is a large worldwide oversupply of enriched uranium, and an export market does not exist. Presumably for this reason, South Africa scaled down the size of its plant to 300,000 SWU per year, or only enough to provide refueling for the Koeberg reactors and to provide some excess capacity. Given the lack of a world market to support construction of a competitive enrichment plant, we believe that the economics of self-sufficiency for the light water fuel cycle have become less attractive than for the heavy water cycle. ~~(S NF NC OC)~~



Spent Fuel Reprocessing

11. [redacted] South Africa planned to undertake spent fuel reprocessing in the late 1970s. At that time, scientists had studied various reprocessing methods and had made plans for a plant at Pelindaba for reprocessing Koeberg power reactor fuel. ~~(S NF NC OC)~~

12. [redacted] planning proceeded to the point where a site for the facility had been selected and draftsmen were studying plant specifications. In 1981 [redacted] major new construction at Pelindaba would include hot cells for Koeberg fuel reprocessing. Construction of a building with the characteristics of a hot cell complex is confirmed by satellite imagery. South African scientists also have shown interest in computer programs that model reprocessing plant component performance. ~~(S NF NC OC WN)~~

13. There are other factors, however, that complicate judgments on South African intentions regarding reprocessing. Under the terms of the French–South African agreement concerning the Koeberg power reactors, all Koeberg fuel reprocessing must be done outside of South Africa. The French reaffirmed that provision in 1983. In addition, the South Africans have announced the construction of a hot cell complex, not for reprocessing but for the examination of nuclear fuel associated with fabrication development. [redacted] however, and South African intentions cannot be determined at this time. ~~(S NF WN)~~

14. If the South Africans decide to develop large-scale reprocessing, we believe they are more likely to do so at the new nuclear research center at the Gouriqua site (near Mosselbaai) or elsewhere. The Pelindaba site does not have the necessary space and probably cannot be expanded. ~~(S NF NC OC)~~

Indigenous Reactors

15. South Africa has been interested in indigenous reactor development since the 1960s. [redacted] South Africa is again undertaking, or at least considering, such development. These include solicitations for expertise on development of nuclear reactor components and [redacted] the existence in 1981 of a military experimental uses reactor at Pelindaba. In 1983, 11 South African scientists attended a US conference on reactor technology (design). And more recently, a South African official suggested the possibility of a research reactor at the Gouriqua site. ~~(S NF NC OC)~~

ANNEX B

NUCLEAR TEST CAPABILITIES

[redacted]

~~(S NF)~~

The Kalahari Nuclear Test Site

Background

9. The Kalahari nuclear test site is located about 80 kilometers north of Upington in the Kalahari Desert. The site's existence was discovered and publicly made known by the Soviets in August 1977. At the time of its discovery, early preparations appeared to be under way for an underground nuclear test. Subsequent to the international uproar created by the Soviets' announcement, the site was mothballed, although not decommissioned. A low level of activity has been observed by satellite imagery since that time. ~~(S NF NC OC WN)~~

Site Description

10. The general area around the Kalahari facility is well-suited to underground nuclear testing. The isolation from important centers of activity, the relatively low intrinsic value of the land, and the hard-rock geology are all typical features sought in selecting a nuclear test site. ~~(S NF WN)~~

11. The site itself is large, comprising a perimeter of 20 by 23 kilometers (or an area of about 450 square kilometers). The facility consists of an operational area and a support base. The support base generally is upwind of the operational (test) areas as one would expect at a test site. ~~(S NF WN)~~

12. The operational area of the site in 1977 contained two large-diameter holes (which since have been capped) and what we believe was an instrumentation area. A tower had been erected around one emplacement hole.

of the hole suggest the hole had a diameter of 1 meter. The tower site was connected to the instrumentation area by a straight trace. A large inflatable building was erected at the instrumentation site.

The 22 September 1979 Event

The Context

16. While faced with the possibility that South Africa conducted a nuclear test in 1979, we should consider the following context.[9] In 1963, South Africa acceded to the Limited Test Ban Treaty, which prohibits atmospheric nuclear testing.

[9] South Africa would be the principal though not the only candidate for such a test. ~~(c)~~

we estimate that by 1979 Pretoria could have produced enough of that fissile material for a first nuclear device. ~~(S NF NC OC WN)~~

The Event

17. Early in the morning of 22 September 1979, a US Vela nuclear test detection satellite over the South Atlantic recorded an optical time history characteristic of a near-surface atmospheric nuclear detonation (see figure 6). This Vela satellite also had a directional sensor on board to pinpoint event location; that sensor did not trigger on this event. The initial Vela indication suggested a nuclear test of less than 3.5 kilotons; this was later revised to be 0.75 to 2.75 kilotons. Between 1972 and the 1979 event, this particular satellite had recorded 17 known nuclear events, including some in the equivalent yield range of this event. In all, Vela satellites had recorded 41 confirmed nuclear events. ~~(S)~~

The Search for Other Technical Evidence

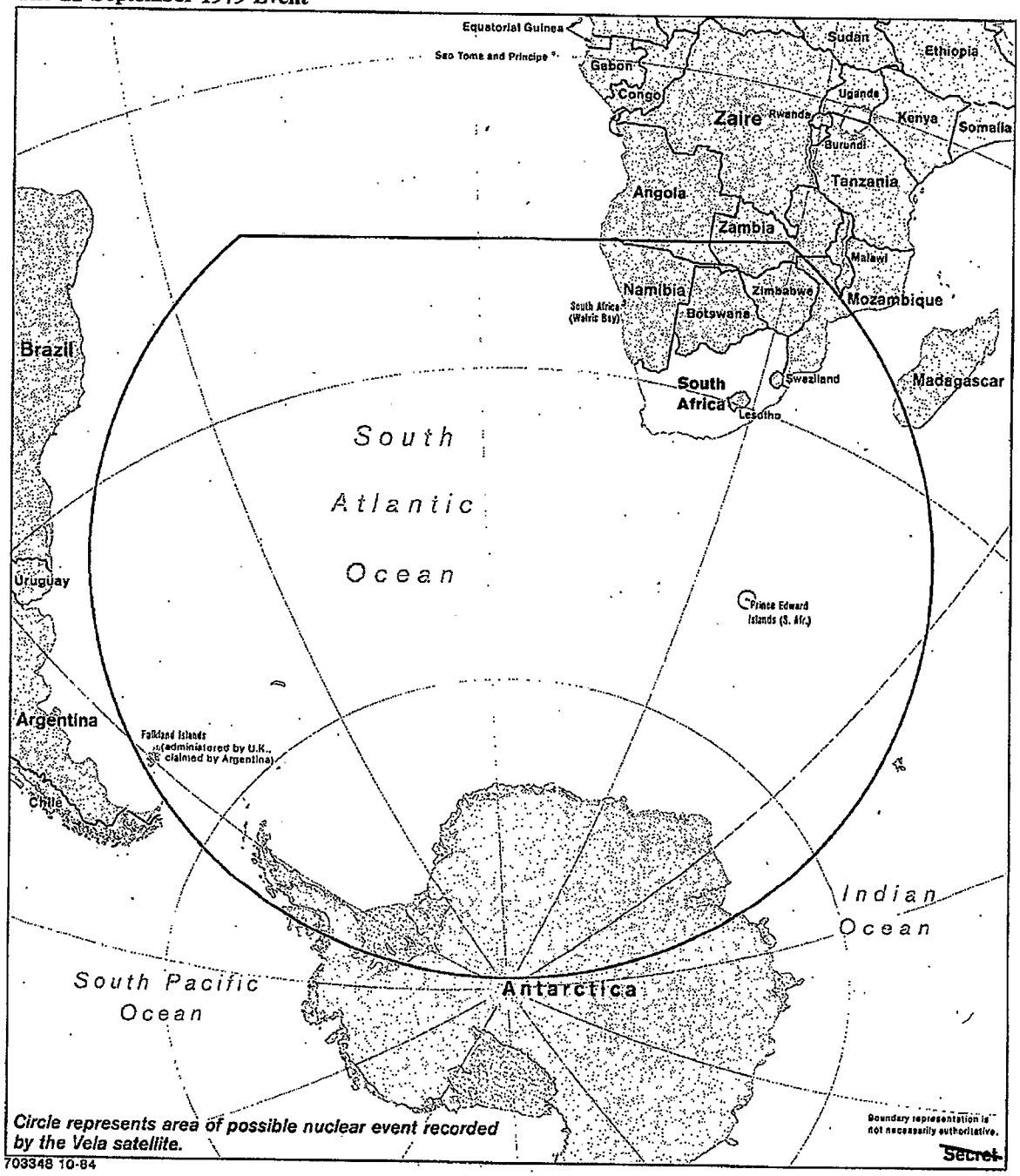
18. A massive Intelligence Community effort was launched to corroborate the occurrence of a nuclear detonation through means other than satellite observations.

~~(S)~~

~~(S)~~

20.

Figure 6
The 22 September 1979 Event



22. Given these factors, it is not surprising that environmental sampling in Africa, Antarctica, and Australia also did not yield significant results. One laboratory report that analysis of radioactivity in sheep thyroids from Australia indicated a nuclear event was investigated and found to be faulty on the basis of incorrect instrumentation and measurement techniques. Moreover, the same year (1979), that same laboratory had published similar anomalous findings (not correlated to any nuclear event) which the author attributed to an unknown source of contamination. Finally, the radioactive isotope purportedly detected had been used in the same building that housed the laboratory that analyzed the sheep thyroids.

Subsurface Signals

23. Analysis of data from AEDS seismic detection stations did not reveal any signals associated with the event. All seismic stations in the Southern Hemisphere that had the capability to detect signals were queried with no positive results. No evidence was found to either prove or disprove association between hydroacoustic signals and the event.

Resolution of Technical Data

27. Extensive disagreement and controversy continue to exist within the Intelligence Community about the origin of the signals recorded by the Vela nuclear test detection satellite on 22 September 1979. Two outside panels have reviewed relevant data and reached opposite conclusions. The Office of Science and Technology Policy (OSTP) panel concluded that the signals "probably were not from a nuclear explosion" since they appear to be internally inconsistent and could have an alternate explanation. The Nuclear Intelligence Panel (NIP) stressed the peculiarity of the two signals in comparison to those known from nuclear explosions and believes that they "probably, but not certainly" were from a nuclear explosion.

28. Barring an unforeseen breakthrough, it seems unlikely that a definitive resolution of the 22 Septem-

ber event will be possible from existing technical data. The difference in the assessments of these data flow from different approaches to the problem and are unlikely to change. The OSTP panel was composed primarily of experimental physicists, who require a rigorous standard of proof and quantitative consistency to be persuaded of nuclear origin. The NIP was dominated by experienced senior figures in the US nuclear weapons community who are used to dealing qualitatively with signals from nuclear explosions and are very conscious of potential methods for testing clandestinely in ways designed to avoid detection.

29. The Defense Intelligence Agency, stressing the nuclear character of the signal, continues to believe that a nuclear explosion certainly occurred.

Collateral Information

31. Despite continuing efforts since 1979 to collect corroborative information from nontechnical sources, there still is no information that would indicate that the 22 September event was a nuclear test by South Africa.

32. Some reporting can be viewed as circumstantially supporting such a conclusion, but it does not provide unambiguous evidence.

ANNEX C

SOUTH AFRICAN DELIVERY SYSTEM ALTERNATIVES [10]

Aircraft

1. The aircraft in the current South African Air Force (SAAF) inventory most likely to be selected for the nuclear weapons delivery role are fighter-bombers and light bombers. The fighter-bomber and light bomber aircraft in the SAAF are the Mirage F1AZ, the Mirage III EZ, the Buccaneer S Mk 50, the Impala, and the Canberra B(I)Mk 12. We do not believe the Impala is a realistic alternative because of its small size and inferior performance. Thus, our analysis of the SAAF's nuclear-capable aircraft focused on the Mirage F1, Mirage III, Buccaneer, and Canberra. (S NF)

2. Based on all performance aspects, we believe that the best nuclear strike aircraft in the SAAF is the Buccaneer. The Canberra has a greater combat radius but was designed for clear-weather operations. The Buccaneer is capable of unrestricted operations at night and in adverse weather. Furthermore, the low-altitude penetration speed of the Buccaneer is higher, and the Buccaneer's superior avionics should enable it to penetrate at a lower altitude.[11] Although no information was available on the electronic countermeasures (ECM) of either aircraft, the Buccaneer ECM is almost certainly superior to that of the Canberra. All of these factors—the higher speed, lower penetration altitude, and superior ECM—tend to make the Buccaneer more survivable than the Canberra. The Canberra probably would not be selected in preference to the Buccaneer unless:

- The weight and/or size of the nuclear weapon exceeds the Buccaneer bomb bay weight or dimension limits.
- The selection criteria are such that the Canberra's 200-nautical-mile combat radius advantage over the Buccaneer is a critical factor. (S NF)

3. The survivability of the Mirage F1 and Mirage III probably is comparable to that of the Buccaneer. However, the inferior combat radius of the two Mirage aircraft limits their employment to targets at relatively short range. Even against short-range targets, the superior range of the Buccaneer would allow it to follow a more circuitous route to the target. Such flexibility permits an aircraft to bypass concentrations of air defense weapons, to use terrain-masking to make tracking and interception more difficult, or to approach the target from the most advantageous direction. Thus, we would not expect either Mirage aircraft to be selected over the Buccaneer unless the selection criteria are such that:

- The markedly superior combat radius of the Buccaneer is not a critical factor.
- The SAAF believes that the superior over-target speed of the Mirage aircraft will significantly improve the mission's chances of success. (S NF)

Weapons Delivery

4. All four aircraft are capable of performing the standard nuclear weapons delivery techniques. High-altitude bombing, for example, with a free-fall or parachute-retarded nuclear weapon should present no problems, since all four aircraft have service ceilings in excess of 10,000 meters. However, this delivery profile may not be used in a high-threat environment since low-level delivery makes the attacking aircraft less vulnerable to air defenses. The four aircraft should be capable of low-level bombing techniques—loft bombing (free-fall or parachute-retarded weapon) and level laydown (parachute-retarded weapon)—with no unusual restrictions. (U)

Cruise Missile or Glide Bomb

5. [redacted] South Africa began developing a conventional warhead glide bomb for use by the South African Air Force in the late 1970s. Its scheduled deployment was for the early 1980s. The weight and diameter of this glide bomb are within the capabilities for a first-generation nuclear

[10] For the purpose of this analysis we assume that South Africa can presently produce a nuclear explosive device that uses uranium as its fissile material, is 0.5 meter in diameter, and weighs 450 kilograms. First-generation nuclear weapons are generally considered to weigh several hundred kilograms, most likely on the order of 450 kilograms. Such weapons should have a diameter of 0.5 to 1 meter. (C)

[11] The Buccaneer is equipped with a Doppler radar, a search-and-fire-control radar, and a head-up display radar. Canberra has none of these. (C)

device. The conventional glide bomb weighs 460 kilograms with a diameter of about 1.5 feet (0.5 meter). Its range reportedly is 60 kilometers and is intended for carriage by the Buccaneer and Mirage F1 aircraft. The bomb could not be carried by the Mirage III, reportedly because that aircraft's navigation system was not sufficiently accurate for launching. ~~(S NF NC OC)~~

6. The South Africa Navy has Gabriel cruise missiles on its Reshef patrol boats from Israel. The Gabriel missile conventional warhead weighs 180 kilograms and is about 0.3 meter in diameter. While the environmental considerations for a cruise missile (temperature, acceleration, altitude) are similar to those for aircraft delivery, the Gabriel is much too small to carry the device postulated for South Africa. Modifying the design to accommodate a 60-percent reduction in weight and a 30-percent reduction in diameter would require an order of magnitude advance in both design and fabrication technology over that required to produce the original device. ~~(S NF)~~

7. If the South Africans were to develop indigenously a cruise missile of sufficient size to carry the postulated design, then the weaponization requirements would not be significantly more difficult to master than for an air-delivered free-fall bomb. The same conclusions apply whether the missile is surface launched or air launched, or whether it is a glide bomb. We believe the South Africans would have little trouble in adapting their aircraft delivered design to a cruise missile if no major weight and size reductions are necessary. ~~(S NF)~~

Ballistic Missiles

8. There have been some indications of South African interest in ballistic missiles. South Africa is producing an air-to-air missile similar to the Sidewinder and short-range artillery barrage rockets. Research has been done on antishipping missiles and on a surface-to-surface missile. The nuclear potential of this last project is of most concern, since it conceivably could be under consideration as a nuclear delivery vehicle itself or could lead to a more advanced nuclear-capable missile. It should not be difficult to convert a missile using a conventional warhead to a nuclear warhead if the two warheads are matched in size, weight, center of gravity, and moment of inertia. ~~(S NF NC OC PR WN)~~

Artillery

9. Nuclear artillery projectile design is very different from that of aircraft or missile delivered nuclear weapons. Artillery delivery requires that very high acceleration be imparted directly to the projectile case and presents formidable challenges to weapon designers. Both interior and exterior ballistics considerations must be included in the design. Center of gravity, moment of inertia, size, weight, volume, and safety are critical to provide the reliability and accuracy required for battlefield operations. ~~(C NF)~~

10. The South Africans manufacture their own 155-mm field artillery guns and sophisticated extended-range ammunition for them. This has led to speculation that they may also be working on nuclear rounds for these guns. Given the present known scope of their program, however, we believe they would stand no chance of succeeding in such an effort. ~~(S NF)~~

11. In general, a uranium gun-assembled device will not fit a 155-mm shell. While it might be possible to pack a critical (nuclear) mass of uranium in such a small diameter, there would be no room left for other essential nuclear components and no possibility of a meaningful nuclear yield. It is conceivable that a uranium implosion device could be fit into a 155-mm shell, but the resulting device would be too long to be ballistically stable (5 or 6 calibers). To make it work, some sort of miniature guidance system would be required, adding weight and reducing range. At best, such a device might yield 100 tons or so. ~~(S NF)~~

12. A plutonium implosion device can be built for 155-mm artillery. At present, however, South Africa has no plutonium production capability. Even if it were to acquire plutonium, we believe South Africa probably would not succeed in developing nuclear artillery [redacted] ~~(S NF)~~

13. It is possible the South Africans could design and produce a larger caliber artillery piece and then produce uranium gun-assembled devices for it. This would be a difficult challenge, however, because South Africa lacks some of the requisite artillery technology. It probably does not have the conventional ordnance for such a large caliber gun either, making it more difficult to justify the required development expenses. Foreign embargoes have made access to conventional weapons technology difficult, and it would be very expensive for the South Africans to develop a new, very large field gun by themselves. If they did produce such a weapon, a uranium gun-assembled nu-

clear round would be a fairly straightforward engineering problem for them but, as noted, still a difficult problem; and the resulting device would require very large amounts of uranium for a very small yield. ~~(S NF)~~

Torpedoes

14. The constraints placed on a nuclear explosive device intended for use in a torpedo would be no more severe than those for an aircraft-delivered bomb. South Africa has a number of French-built submarines equipped with torpedo tubes capable of firing 21.7-inch (0.55-meter) torpedoes. We believe they would have minimal difficulty adapting a 0.5-meter, 450-kg device to torpedoes designed for these submarines. The weight of the nuclear device does not exceed the conventional warhead weight for such torpedoes, and there is enough room for the fuzing and firing equipment necessary to operate the weapon. ~~(S NF)~~

15. The South Africans have a stockpile of conventional torpedoes, and would not need to make their own from scratch in order to get a nuclear-armed stockpile. On the other hand, their torpedoes do not have an extended range, and targets such as enemy ports or amphibious task forces, against which a nuclear torpedo might be used, could be more reliably attacked from the air. ~~(S NF)~~

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