From Defence to Development
Redirecting Military Resources in South Africa
Edited by Jeddyn Coox and Penny McKenzie
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FROM DEFENCE TO DEVELOPMENT

Redirecting Military Resources in South Africa

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for The Group for Environmental Monitoring

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South Africa’s political transition to an apartheid state in the late 1940s was accompanied by another transition that of becoming a nuclear state. At first, it was integrated into the global nuclear conflict as a collaborator: its role was to supply uranium secretly to the Cold War bomb programmes of the United States and Britain. From the mid-1960s, South Africa consolidated its nuclear research programme, and by the late 1970s embarked on a commercial nuclear energy programme and a clandestine programme to build nuclear weapons. The bomb programme was dismantled on the eve of the demise of apartheid. It is clear that the proliferation project was wholly associated with the apartheid state.

This chapter aims to show that the South African state, in defence of the apartheid system, devoted substantial public resources to the development of a nuclear weapons capability. Such a capability was contingent on the prior development of a broader nuclear industry, covering most aspects of the nuclear fuel chain. In the climate of sanctions and state authoritarianism, South Africa’s nuclear weapons capability was widely suspected, but evidence was not decisive until President F.W. de Klerk admitted its former existence for the first time in March 1993.

During the years of proliferation, the country sacrificed considerable resources to developing its nuclear capability. In a country still struggling to meet its people’s basic needs, such resources could have been devoted to more socially useful purposes. Though the weapons programme was terminated before 1994, its costs are still being borne by the post-apartheid state.

It is difficult to accept the logic behind a programme that would deliver nuclear weapons, with their capacity for such extensive physical and cultural destruction. Although it was reassuringly admitted after the dismantling of the weapons that they were regarded as mere deterrents against any severe assault by the enemies of apartheid, it is now clear that they were not the only weapons of mass destruction.
being developed during that period. South Africa was also developing effective chemical and biological warfare capabilities. It is unlikely that all of these weapons of mass destruction were produced as deterrents. The defiant public hints made by Prime Minister Vorster and Finance Minister Horwood about the right of the apartheid state to possess a nuclear weapons capability were reminiscent of the aspirations of Dr Strangelove, Hollywood’s crazed nuclear scientist, in the classic film of the 1960s.

The official admission was that the bomb programme (seen narrowly as the manufacturing process) cost between R200 and R400 million. Critics maintained that the real costs amounted to ten times this amount. With the destruction of all the relevant documentation, as ordered by De Klerk, it is impossible to prove. It is unlikely that these estimates would have taken into account the upstream costs of developing a weapons capability. If one had to include such costs, these would encompass many elements of the budget of the Atomic Energy Corporation (AEC) and its predecessor, the Atomic Energy Board. The production costs of uranium hexafluoride and enriched uranium would have to be added. So too would the training and development costs for the relevant AEC and Armscor personnel. The total estimate for these costs would probably be at least R5 billion at 1993 prices.

To illustrate the extent of the programme, it is necessary to link it to the entire nuclear project in South Africa. Each piece of the project added extra impetus to the development of a weapons programme. The approach of this chapter will therefore be to set out the history of the weapons programme, followed by an explanation of its technological aspects, and finally to offer some background to the nuclear disarmament process.

Historical background

The geopolitical context

In April 1974, disgruntled Portuguese army officers unseated the government in Lisbon, and new revolutionary governments took power in the former colonies. By June 1975, Frelimo was ruling Mozambique, and by independence on 11 November Luanda fell under the control of the MPLA (Mailer, 1977).

South Africa tried to stop the MPLA from ruling the country. It launched an invasion of Angola, which it anticipated would attract United States support, but the loss of the war in Vietnam had been a salutary lesson and, ultimately, Washington could not commit itself decisively. South Africa was forced to withdraw in the face of growing Cuban support for the MPLA (Stockwell, 1978). Guerrilla movements in Rhodesia had also intensified their struggles since late-1972, and in the mid-1970s the Smith government appeared to be facing a

These events traumatised the apartheid regime in Pretoria. On the one hand, they precipitated a renewed rise of social struggle, typified by the events of June 1976 in Soweto, the emergence of the black consciousness movement and a stronger ANC underground. On the other hand, the state responded with intensified domestic repression and external aggression (Hirshon, 1979). Not only had the front-line moved closer, it had taken shape in the dusty streets of South Africa’s townships.

The decision to build nuclear weapons arose in this atmosphere, during the paranoia about external attack and internal subversion, and as part of a growing move to create a total strategy against the total onslaught of apartheid’s enemies.

**Uranium extraction for the United States and Britain**

South Africa would scarcely have been in a position to build bombs had it not been a key uranium producer. In 1945, the Manhattan Project resulted in the production of bombs used on Hiroshima and Nagasaki (Rhodes, 1986, 1995). In its aftermath, the United States and Britain sought stable uranium supplies for their intended nuclear weapons programmes, which aimed to assert Western military superiority in the post-war world. In a global scan for uranium, it appeared that the Witwatersrand gold-mining complex around Johannesburg produced important quantities of uranium as a by-product. South Africa’s then prime minister, Jan Smuts, was secretly approached to facilitate the uranium transfers. South Africa’s mining conglomerates were given the finances to organise the separation of the uranium and a cost-plus deal to supply the entire output to the United States and Britain for at least a decade. In fact, their bomb programmes relied almost entirely on South African uranium between 1950 and 1964 (Fig, 1993). During this period, Cold War tensions meant that, in the minds of the purchasing countries, nuclear sanctions against South Africa were unthinkable.

The secret income flows were a windfall for the South African mining industry. They helped to resolve the infrastructural bottlenecks in transport and steel production which plagued the country after the war, and the resulting boom served to stabilise and consolidate the apartheid government.

**Nuclear governance and research**

Smuts established a Uranium Research Committee answerable to himself and charged with the control of fissile material. Instead of vesting it within the Council for Scientific and Industrial Research (CSIR), Smuts followed the model of the United States and Britain in creating an autonomous Atomic Energy Board (AEB) as a parastatal
The entire history of the AEB thus coincides with the establishment of apartheid. Throughout its history, the AEB was to employ only whites in most of its strategic tasks.

The AEB acted to regulate uranium exports, but also began to establish its own research programme by June 1958, led by its president, Dr A.J.A. Ampie Roux. The programme included research on a power reactor concept appropriate to South Africa (Newby-Fraser, 1979:40). Cabinet approval of this policy was formally announced by Senator De Klerk, then Minister of Mines, chair of the AEB, and father of the future president, on 5 September 1959.

The programme had three prongs: research on uranium and other fissile materials, research on radio-isotopes and radiation, and research on the establishment of a power reactor. To house its research, the AEB moved from its suite in a Pretoria office block to secretly purchased farmland west of Pretoria. This site became known as Pelindaba (The talking is over), and became the new home of the South African National Nuclear Research Centre. Construction began and the first buildings were occupied in 1963.

One of the buildings was designed to house a research reactor. Under the Atoms for Peace programme (Ambrose, 1984:147-51), the United States agreed to make available a reactor with a capacity of 20 megawatts (MW), running on highly enriched weapons-grade uranium. The United States was also willing to supply the enriched uranium on condition that South Africa signed a safeguards agreement allowing international inspection of the facility. This condition was accepted by South Africa. Named SAFARI-I, the South African Fundamental Atomic Research Reactor was first commissioned on 18 March 1965.¹

Scientific training

The Atoms for Peace initiative included the forging of a secret treaty: the US-South African Agreement for Co-operation Concerning Civil Uses of Atomic Energy.² This co-operation enabled a cadre of South African scientists to be trained in reactor physics in the United States. Training occurred at the Argonne National Laboratories outside Chicago, at the Oak Ridge National Laboratory in Tennessee, and other venues. On their return to South Africa, this group was to form the active nucleus of an increasingly powerful nuclear bureaucracy.

The early seeding by the United States of South Africa s nuclear research facilities was crucial. By the mid-1960s, South African universities were running their own nuclear research departments. The AEB was able to recruit 75 scientists to staff Pelindaba. With the inauguration of SAFARI-I, thanks to United States collaboration,

¹ The reactor vessel slipped from its rigging as it was being moved after construction. The damage took a further year to be repaired before it could be shipped to Pelindaba. Within eight hours of operation, the reactor began to release abnormal levels of radioactivity. The alarm bells sounded and the reactor team had to shut down SAFARI-I. South Africa s first nuclear accident had occurred during the country s first self-sustaining nuclear chain reaction.

² Severed under President Jimmy Carter in 1976, the agreement was resumed on 25 August 1995 when President Bill Clinton s Secretary for Energy, Hazel O Leary, visited Pretoria.
South Africa’s nuclear research effort had reached its critical mass.

From the late 1940s onward, South African scientists were also given access to British facilities. However, by the late 1960s, it had become more difficult to sustain open nuclear collaboration. As the AEB turned its attention towards developing enrichment technologies, the relationship with its West German counterpart began to flourish. South Africa was keen to understand the jet-nozzle enrichment process pioneered by West German Professor Erwin Becker. Brokered by Franz-Josef Strauss, right-wing Bavarian politician, friend of apartheid, and minister in the West German coalition cabinet, South African scientists became interns at the Karlsruhe headquarters of the GfK, the federal Nuclear Research Centre. One of these scientists was Dr Waldo Stumpf, currently chief executive of South Africa’s Atomic Energy Corporation (successor to the AEB).

The similarities between the Becker method and the final enrichment technique adopted by South Africa led to speculation about the close levels of collaboration (Cervenka & Rogers, 1978:43, 73-8).

**Enrichment**

The United States, British and West German experience culminated in the AEB’s secret setting-up of a pilot enrichment plant at a site called Valindaba (The talking has ceased) adjacent to Pelindaba. As the construction began to take shape, it became clear that the intense secrecy around the enrichment programme could not be maintained. It was decided that an official statement would be preferable to accidental discovery of Valindaba’s purpose.

On 20 July 1970, the then prime minister, B.J. Vorster, stood up in the Houses of Parliament in Cape Town and, for the first time, revealed information about South Africa’s enrichment plans. He announced that the main motive was based on the fact that South Africa, as a major uranium exporter, could derive more foreign exchange exporting uranium in its enriched form. A further motive was the immense cost of importing enriched uranium to fuel South Africa’s nuclear power programme, envisaged as having a capacity of 20 000 MW by the year 2000 (more than 20 Koeberg-sized reactors). At no stage was there mention of a military application of uranium enrichment. Vorster emphasised the peaceful intention of the programme three times during his speech, and offered to collaborate with any non-communist countries in the exploitation of the process. Vorster also set in train the creation of a separate parastatal entity charged with uranium enrichment. Within a month of his speech, legislation had been signed creating the Uranium Enrichment Corporation of South Africa (UCOR).

UCOR attempted to draw on the West German connection to create an international partnership in which its activities would be adequately financed and its product marketed globally. The calculation
still held that such a partnership was a vital component of any commercial enrichment plant. For six years it entertained potential West German partners, embarking on discussions and negotiations with a view to securing a joint venture. The German company STEAG, which the GfK had entrusted with licensing the jet-nozzle process, signed a memorandum of understanding with UCOR in August 1973. STEAG aimed to sub-license UCOR.

However, there was no unanimity in the West German cabinet, which had to approve the deal, and STEAG withdrew its formal application for federal government approval. Although the official deal fell through, a joint feasibility study was conducted comparing the South African and German enrichment processes. Many saw this study as a smokescreen for continued collaboration.

It took until 1974 before the pilot enrichment plant began production and only in January 1978 did it begin to produce highly enriched uranium (HEU). Located in the Y-Plant at Valindaba, the pilot plant had to overcome a number of serious mechanical and chemical problems. This included a period, from August 1979 to July 1981, during which there was a complete halt in production. The plant was reopened in 1981. Since South Africa was not party to non-proliferation treaties, there was never any international inspection of the plant, which remained unsafeguarded.

Vorster had provided parliament with the rationale that the process would add value to South African uranium oxide, and that the power programme would not have to depend on foreign enrichment processes. But this was patently false with respect to the pilot plant. It was never in its lifetime in a position to manufacture the enriched uranium required to meet the anticipated needs of South Africa’s nuclear energy programme. Ostensibly it was meant to be producing some of the HEU required by SAFARI-1, because of a United States embargo on supplying further HEU to South Africa. But this was by no means the entire story.

Almost from the beginning of its existence, the Y-Plant was dedicated to enriching uranium for a weapons programme. It provided HEU for the six nuclear weapons which President De Klerk later admitted were manufactured between 1978 and 1990. It is no surprise that the Y-Plant was also decommissioned in 1990, particularly in view of South Africa’s prospective adherence to the Treaty on the Non-Proliferation of Nuclear Weapons (the NPT).

**Nuclear energy programme**

In the late 1950s, it was predicted in South Africa that supplies of uranium to the Anglo-American weapons programme would fall off at the end of the secret contract in 1964. The mining industry and the nuclear research establishment started to press for a local power industry to create a captive domestic outlet for some of the spare ura-

3. Waldo Stumpf, chief executive officer of the AEC, describes this as being due to a massive catalytic in process gas reaction between the UF6, and the hydrogen carrier gas, a mixture that is thermodynamically unstable and, when contaminated by certain impurities, can react to form uranium tetrafluoride (UF4) plus hydrofluoric acid. . . . the 1979 incident . . . resulted in a massive gas loss (Stumpf, 1995/6: 3-8).
A commission of enquiry had been established to look into the matter, but in its report of April 1961 it concluded that no economic advantage would result from the introduction of nuclear power in the Western Cape or elsewhere in South Africa. Nevertheless, the AEB’s nuclear research programme under Dr Roux kept the plan alive. The cadre of scientists who had been trained at Argonne returned with the idea that South Africa needed nuclear power stations.

By May 1971, the Electricity Supply Commission had put aside its long-held misgivings about going nuclear, and purchased the farm Duynefontein, 28 km north of Cape Town, a sign that it had plans for building a power station on this site. But it was not until the oil crisis broke that Eskom could justify the costs of such a plan. The Arab oil boycott of South Africa had been instituted in October 1973. Eskom argued that its coal reserves were needed to feed the existing and planned SASOL oil-from-coal complexes, as well as the local power and export markets. The escalation of energy prices made nuclear power relatively more competitive.

Tenders were invited for two identical pressurised water reactors to be located on the Duynefontein site, renamed Koeberg (Dutch for cow mountain) after a nearby landmark. Ultimately Eskom awarded the contract to a French-led consortium. The anti-apartheid movement was much weaker in France than in the United States and the Netherlands, where local politicians had questioned the rival bids.

The Koeberg contract was signed in Johannesburg and Paris in August 1976, followed by a bilateral agreement between France and South Africa in October, and a trilateral agreement with the International Atomic Energy Agency (IAEA) on safeguards for the reactors, which entered into force on 5 January 1977. South Africa felt extremely comfortable with the French deal. France offered good credit and training facilities for over a hundred reactor staff, and was sympathetic to the South African regime’s defence needs, providing submarines, Crotale missiles and Mirage jets, despite United Nations boycotts.

The two Koeberg reactors were eventually commissioned in 1984 and 1985. Their joint installed capacity is 1930 MW, but they have seldom reached the total sent-out rating of 1840 MW and were subject to severe teething troubles. Nuclear electricity output has amounted to under 6 per cent of South Africa’s total electricity output. The electricity industry has excess capacity, causing it to mothball a number of conventional plants. Nuclear electricity, which, at conservative official estimates, costs more than twice as much as coal-fired power to produce, has never been economically viable (Thomas, 1996:1-10). This has led to questions about its strategic role. The reactors provided South Africa with new nuclear know-

4. The commission’s reasoning was that existing power sources in the Cape would suffice until the end of the 1960s. It was too early to be able to estimate capital and operating costs of a South African nuclear power station, but they were thought to be at least double the cost of a new conventional station. (South Africa, 1961)

5. 5.2 cents as opposed to 1.89 cents per kilowatt-hour (Hansard, 26 March 1986). Eskom now argues that the primary energy costs of coal and nuclear are very competitive in terms of rands per megawatt hour sent out (Murray, 1995: 111).
how, justification for the extension of the enrichment enterprise, and the establishment of BEVA, a unit at Pelindaba charged with the manufacture of nuclear fuel pellets destined for the fuel rods at Koeberg.

The dilemma faced by the Western countries was their desire on the one hand to curb proliferation, but on the other hand to stimulate sales of nuclear equipment. Compromises, like guarantees of adherence to safeguards, helped ease the dilemma, and took the pressure off having to institute strong sanctions against the building of nuclear reactors. While the United States vacillated during the 1970s and 1980s about how much to engage with the South African nuclear programme, in the end its sanctions led South Africa to turn to Western Europe and China for supplies of start-up low-enriched uranium for the reactors.

**The nuclear weapons programme**

The decision to build nuclear weapons was taken by Prime Minister Vorster in 1974. This was the year of the fall of the Portuguese dictatorship in Lisbon. Military solutions replaced Vorster’s earlier foreign policy of dialogue and détente. At home, the creeping militarisation of the apartheid regime reflected its growing desperation. Armscor, the parastatal arms production, procurement and export corporation, began a period of consolidation. The war on the Namibian-Angolan border was intensified. In such a political climate the bomb construction programme developed according to its own bizarre logic. South African strategists argued that bombs were not for launching but for gaining political leverage. In a doomsday situation, the apartheid regime could gain time if ultimately challenged by its neighbours, the Soviet Union or even the NATO countries.

By the late 1970s, South Africa had in place the makings of a nuclear weapons industry. It had developed a cadre of locally born white nuclear scientists who were amenable to, and dependent on, the apartheid regime’s politicians. The scientists, in turn, had delivered a capability in the sphere of conversion and enrichment of uranium, including weapons-grade enrichment. The plans in place for a nuclear energy industry were a useful mask for these enrichment activities, which fell outside any regime of IAEA safeguards.

**The nature of the weapons**

Armscor and the Atomic Energy Board have claimed that the South African devices were of the so-called cannon type, a very old technological concept, and have refrained from any claim that the design was local, although they vigorously rejected suggestions that any technology or support was received from abroad (AEC & Armscor, 1993: para B1). The cannon- or gun-type device dates back to the earliest weapon produced by the Manhattan Project. Consisting of

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6. Peter Hounam and Steve Mcquillan claim, on the basis of many interviews, that full information about the South African programme was not disclosed by De Klerk. They assert that production at the Advena plant was totally devoted to producing tactical and strategic warheads (Hounam & Mcquillan, 1995:148).
two sections, each containing a sub-critical mass of nuclear material, the design required the one section to be propelled to impact on the other, triggering a nuclear explosion.

It is likely that intensified sanctions after 1977 limited the programme to the manufacture of a small number of rather crude devices. It is unclear whether plans to develop implosion-type devices were very advanced. Armscor has claimed that no implosion tests were done up to the time that the programme was terminated and no prototypes were constructed (Albright, 1994a: 15). Whether this was due to financial, technological or skill-related constraints is difficult to ascertain.

AEC and Armscor officials have maintained that the weapons programme was completely indigenous. Only South African-born nationals were employed. However, in their efforts to develop a new generation of more sophisticated thermonuclear weapons, it subsequently came to light that they had managed to import small amounts of tritium from Israel. Although the AEC claimed that it never utilised the tritium, and allowed its shelf-life to expire, it remains an indication that at least one other nation had given deliberate assistance to South Africa’s nuclear weapons research and development efforts. The destruction of the documentation relating to the programme raises questions of other types of support, including provision of dual-use equipment.

The nuclear scientists justified their work in terms of sanctions-busting and chauvinist ideology. The camaraderie was amazing, a former technician was later to admit, We were proud that our efforts were beating the sanctions. We did something here that has amazed the world. It made us one of the top seven nations (Sunday Star, 28 March 1993).

Control over production shifts to Armscor

Once the design for the gun-type device was acquired, it was initially evaluated by AEC scientists and engineers at Pelindaba. The AEC was not only involved in testing the design of the bombs, but was also involved in the development of their fuel. From 1974, the budget of the AEC reflected a sudden massive increase. This coincided with the drive to deliver weapons-grade enriched uranium for the bombs.

The first production of highly enriched weapons-grade uranium by the pilot Y-plant took place in January 1978. The AEC’s chief executive officer at the time, Dr Wynand de Villiers, later admitted that the pilot enrichment plant had been dedicated to the production of weapons-grade uranium (AEC & Armscor, 1993: para A). Once the problems of the Y-plant had been sorted out, the weapons programme could rely on the local supply of the nuclear material required.

During 1977, the first gun-type device was completed by the AEC, and later tested in Building 5000 at Pelindaba. It did not contain the fissile component, since the Y-plant was not fully on stream to provide sufficient HEU. A second device, also not loaded with fissile material, and nicknamed Melba, was built by the AEC in 1978, and kept for the duration of the programme as a demonstration model. Thereafter, between 1982 and 1989, Armscor took over the manufacture and assembly of the devices. The AEC was expected to provide the weapons-grade uranium and to conduct research on development of more advanced weapons (Albright, 1994a: 6-9).

This shift was related to a change in strategy, which can be dated to around 1978. Until then, the devices were experimental and not linked to any delivery system. With the changing security situation, it was felt that the ability of the South African military to deliver the weapon would raise its credibility as a deterrent in the event of a severe external threat.

Over the following eight years, a further four bombs were manufactured in the small Circle factory at Advena, to the west of Pretoria (and only 4 km from the black township of Atteridgeville). By 1989, the pilot enrichment plant at Valindaba had manufactured sufficient HEU for a seventh bomb (Buys, 1993).

From the mid-1980s, Armscor embarked on a programme to build newer facilities to develop more sophisticated weapons. Located close to the Circle factory, the Advena Central Laboratories were constructed with a capability of producing implosion-type devices. According to David Albright, the design of Advena’s integration building implies that South Africa was thinking of an enhanced weapons system in the long run. The building had enough space to load a warhead onto a ballistic missile and the new storage vaults contained space suitable for one small re-entry body (Albright,
Known informally as Ararat, the final resting place of Noah’s ark after the great flood, the buildings were completed but never ultimately utilised in the weapons programme.

**Testing**

A nuclear test site was prepared at Vastrap base in the Kalahari, on orders issued by Prime Minister Vorster as early as 1974. The site consisted of three deep shafts evidently drilled with mining equipment. Of the three, one shaft had to be abandoned after groundwater seepage, a second was 385 metres deep and completed in 1976, while the third was 216 metres deep and built in 1977. At this time, there was insufficient production of HEU to power a weapon. One possibility might have been the intention to conduct a test without HEU—a cold test.

Despite camouflage, the site was picked up by a Soviet surveillance satellite, Cosmos 922, in orbit above the Kalahari. The Soviet President Leonid Brezhnev alerted President Jimmy Carter, who responded by pressurising Pretoria to dismantle the site. The United States may already have identified the real use for Vastrap through information received from its 56A Big Bird satellite, which was known to have overflown the site at least a month earlier.

The French government also insisted on the South Africans abandoning Vastrap, and South Africa reluctantly obliged, fearing that the Koeberg contract might otherwise be jeopardised. With the tide of international allies turning against any South African nuclear testing, the Finance Minister responded in bellicose terms at an election meeting of the ruling National Party on 30 August 1977. We’ll have the A-bomb if we want, boasted the press headline, going on to quote: If we wish to do things with our nuclear potential, we will jolly well do so according to our own decisions and our own judgement (The Star, 1 September 1977).

In an incident on 22 September 1979, the double flash characteristic of a nuclear explosion was detected by a United States Vela satellite in the Southern Ocean, off-shore of the Prince Edward Islands, a South African possession. The United States, perturbed by the implications for proliferation of weapons, responded by establishing a scientific inquiry. Chaired by Professor Jack Ruina of the Massachusetts Institute of Technology, the committee first claimed that the evidence pointed to a nuclear explosion, but later claimed that the double flash could have been caused by satellite malfunction or an accident resulting from a meteorite impact. In turn, the revised verdict was contradicted by further evidence gleaned from a number of sources, including radio telescopes in Puerto Rico, other satellite readings picked up at Los Alamos, and studies in Australia and New Zealand. The Vela’s detectors had previously been regarded as extremely reliable in perceiving nuclear testing. Other studies by official United States agen-
cies, including the Naval Research Laboratory and the Defense Intelligence Agency, contradicted the revised views of the Ruina committee.

The unofficial view is that South Africa, perhaps with Taiwanese support, provided the vessel to support testing of an Israeli tactical nuclear weapon. The test was conducted in an area subject to the Cape Town Anomaly, in which the ionosphere approaches the earth’s surface, normally making it difficult to detect an explosion. Weather patterns on the day of the test might have negated the effect of the anomaly. This scenario is expected to be confirmed in the memoirs of Commodore Dieter Gerhardt, former head of the Simon’s Town naval base, who was exposed as spying for the Soviet Union in 1982 and now lives in Switzerland.

The views of the Ruina committee were never revisited, and the United States refrained from challenging what must have been at least strong circumstantial evidence of South Africa’s access to and support of a third country’s nuclear weapons system. This evidence, along with that of potential testing in the Kalahari, was never mobilised to stop South Africa producing weapons.

The nuclear disarmament process

Reasons for nuclear disarmament

During 1989, the Berlin wall fell, the Soviet bloc crumbled, and years of Cold War came to an end. In September of the same year, F.W. de Klerk became President of the Republic of South Africa. Two months later, Wynand de Villiers, due for retirement as chief executive officer of the AEC, underwent a crisis of conscience about the nuclear bombs. As the world situation changed in 1989, De Villiers later revealed, I became convinced that South Africa did not need such a terrible weapon. If we had ever used it in anger, it would have been the end for this country. I knew we would never use it and many others were agreeing with me. Wynand de Villiers’s next move on 13 November 1989 was to approach the newly appointed Minister of Mineral and Energy Affairs, Dr Dawie de Villiers. Minister De Villiers was charged with conveying the AEC’s views to the President.

It is not known whether the decisive argument that was used to convince De Klerk to dismantle South Africa’s nuclear bombs was the alluring prospect of South Africa normalising its international nuclear standing, or whether the nuclear bureaucracy feared a future in which an ANC government might have access to nuclear weapons. Whichever the case, De Klerk recognised that the new political climate demanded the full dismantling of the nuclear weapons, and issued orders to have the weapons destroyed.

The first move was to close down the R210 million pilot enrichment plant the Y-plant in February 1990. Although nuclear mate-
rial for the seventh bomb had been produced, it was never built. Throughout the Gulf War, dozens of nuclear scientists and engineers worked at Armscor's Advena warehouse to dismantle the nuclear weapons and decontaminate the buildings. Afterwards, De Klerk attended a celebration party at Advena. He was grateful, commented one scientist.

In our hearts we all knew it was the right decision. These bombs are not things that can be used (Sunday Star, 28 March 1993).

In July 1991, South Africa became a signatory to the NPT. Under the treaty, there is no obligation for any nation-state to reveal details of its past proliferation. By the time the safeguards agreement came into force in September, the remaining HEU had been returned from Advena to Pelindaba. In November, IAEA inspectors were shown around Pelindaba and Valindaba, and expressed some of their suspicions about what might have occurred in Building 5000. It was only after De Klerk's announcement in March 1993 that the IAEA insisted on inspecting the Circle and other buildings in the Advena complex.

The dismantling of the bombs and South Africa's adherence to the NPT laid the foundation for the country's re-entry into international nuclear politics. South Africa played a brokering role in the Review and Extension Conference of the NPT in New York in April-May 1995. It has also been a significant supporter of the African nuclear weapons-free zone, formalised as the Treaty of Pelindaba, signed in Cairo in April 1996. It is slowly beginning to resume its activities in the IAEA. The United States has renewed its treaty allowing for trade in nuclear materials and for extending nuclear co-operation. Nuclear sanctions have come to an end.

The documentation of the weapon-making process (amounting to 12 000 documents) was destroyed, according to Professor Wynand Mouton, whom De Klerk put in charge of this process. If we kept the plans people would say that although we had destroyed the bombs, we could make them again quickly... I did have a bit of a doubt whether it was really necessary to destroy them. The IAEA would have been happier if we had not (Hounam & Mcquillan, 1995: 48-9).

The pressure to adhere to the NPT, and the desire to keep the programme's information out of the hands of an incoming ANC government, formed the reasons for the end of the weapons programme. Because of the destruction of the documentation, it is not possible to know the exact extent of foreign involvement in the acquisition, manufacture and final dismantling of the weapons programme.

Storage and disposal of fissile material

The fissile material from the gun-type devices (amounting to some 55 kg of HEU per device) was returned to Pelindaba for storage after
the weapons programme was dismantled. The transport was supposed to occur at night, and Citizen Force members of the military were called up to guard the route between the Circle building and Pelindaba. However, it was felt that even their knowledge of the transfer would be a security risk. Ultimately the fissile material was conveyed in the rear trunk of a civilian vehicle, in the interests of being less conspicuous. The fissile material has been stored in a high-security site at Pelindaba, subject to IAEA inspection. The amount of HEU has never been revealed publicly, on the grounds that this might constitute a security risk. However, informed speculation places the amount at around 300 kg.

The fate of the production facilities

The Circle factory is still intact, although now decontaminated. Set within the grounds of a military vehicle test track, it nestles against the ridge of a hill. The eerie vaults, which once contained the separate parts of the gun-type nuclear weapons, and which four senior officials needed codes to open, can still be seen. So are the ground-floor areas where the weapons were manufactured and assembled, and where triggering devices were tested. Upstairs, in the claustrophobic board room, a portrait of a Mirage overflying the Voortrekker Monument still hangs, redolent of the kind of misplaced patriotism from which the programme was born. The building has the makings of a good museum on nuclear non-proliferation.

The Advena Central Laboratories no longer function. For a time, after the programme ceased, Armscor tried to market the skills which the bomb makers collectively embodied for purposes other than the manufacture of weapons. However, the scheme failed to bear fruit, and Armscor was unable to commercialise the operation. Visitors are cautioned about the dangerous snakes lurking in some of the vacant facilities.

As for Building 5000, it too is no longer in use, other than for storage of old equipment and waste drums. After South Africa adhered to the NPT, there was no obligation for the AEC to reveal the building or its contents to the IAEA inspectors. However, the IAEA had been alerted to the history of the building and, on request, was given full access.

The fate of the weapons scientists and engineers

Of the thousand people who knew about the programme through the entirety of its course, it is estimated that Armscor employed about 300 staff at the Circle factory, less than half of whom worked directly on the weapons. In addition, a number of AEC employees knew of or had contributed to the weapons programme.

By the end of the programme, less than a third of the Armscor employees remained, and all have been redeployed. Similarly, overall
employment at the AEC has dropped drastically, particularly with the end of the conventional enrichment and other programmes. The commercial failure of Advena Central has also made redundant many of those knowledgeable about the weapons programme. Some scientists have found work in an explosives plant in Namibia.

The risk of maverick nuclear scientists selling their services in the interests of further proliferation is not insignificant. In March 1994, 16 former employees of the weapons programme announced that, unless they were paid substantial retrenchment packages (amounting to over US$1 million), they would reveal information about the programme to the highest bidder. In turn, Armscor took legal action to silence the group, on the grounds that they would be jailed for treason under secrecy laws to which they had all been bound by oath. Subsequently, little was heard from the group.

**Costs and benefits of ending the weapons programme**

The advantages of ending the weapons programme have been overwhelming. First, it underscored a sincere commitment to regional peacemaking in southern Africa, which had become an imperative since the start of the political transition in 1989. It indicated that an era of paranoid Cold War politics was almost over.

Second, dismantling the weapons was the key to South Africa’s adherence to the NPT. Accession to the Treaty (which occurred on 10 July 1991) required detailed opening of facilities to the IAEA for routine verification and other inspections, and for ensuring that plants were fully safeguarded against potential proliferation (Schriefer, 1995). In turn, the signing of the NPT allowed for South Africa’s readmission to the IAEA after a long period of exclusion. South Africa has replaced Egypt on the IAEA Board of Governors and the Zangger Committee, being the African continent’s most advanced nuclear state. South Africa not only plays a role in international nuclear governance, but has been readmitted to the Nuclear Suppliers Group, a cartel of nuclear states controlling the trade in nuclear technology. Another spin-off from South Africa’s adherence to the NPT was the new possibility for declaring the whole of Africa a nuclear weapons-free zone. This came to fruition with the formal negotiation and signing of the Treaty of Pelindaba (site of one of the last negotiation sessions) in Cairo in April 1996. A third bonus was the ability, which the ratification of the NPT provided for South Africa, to participate in the Review and Extension Conference of the Treaty after 25 years of implementation.

At the conference, South African diplomats chose not to galvanise the opposition to indefinite extension of the treaty, but to help deliver the whole conference to a commitment to indefinite extension. The carrot offered to disgruntled non-aligned countries was an informal declaration of principles to which the official nuclear powers agreed.

8. The Zangger Committee, named after its first chairperson, Swiss Professor Claude Zangger, consists of representatives of countries who regard themselves as exporters of nuclear equipment or material which might lead to proliferation of nuclear weapons. The aim of the committee is to place export controls on such equipment or material (United Nations, 1995:17).
to adhere. In these principles, the nuclear powers undertook to end weapons testing and to make progress towards nuclear disarmament. This declaration was brokered by South Africa, which received extensive media praise, except at home, where some questioned the role the diplomats had played in the process (Fig, 1995:8ff; Masiza & Landsberg, 1996). Within two weeks of the conference, both France and China announced their intention to carry out further nuclear tests, flouting their commitment to the South African principles. These tests have now come to an end with both countries' adherence to the Comprehensive Test Ban Treaty, signed in September 1996.

A third advantage of the end of the weapons programme is that it marks the beginning of the end of the South African state's privileging the nuclear industry with immense amounts of state subsidy. The nuclear item (including running costs and debts incurred by the AEC) continues as an overwhelmingly large part of the budget of the Department of Mineral and Energy Affairs. However, to date, cost overruns have caused the closure of the conventional enrichment plants (both Y and Z) and an end to the manufacture of fuel rods. After being mothballed for three years, the technology for cladding the fuel rods with zirconium has been sold to the People's Republic of China. The AEC is currently promoting non-fuel-cycle products, testing their viability and commercial potential. It has, since 1994, tried to develop a process for molecular laser isotope separation (MUS) of uranium, which it regarded as a commercially viable system of enrichment. For a while MUS attracted investments from the French company COGEMA. However, COGEMA has withdrawn from the project, favouring another technology, and by late 1997 the AEC had to abandon further costly research into MUS. According to the director of the Energy for Development Research Centre at the University of Cape Town, Dr Anton Eberhard, the AEC has been unable to produce a competitive, commercially viable nuclear fuels industry despite massive, almost unrestricted, investments. Considering also the uncertainties of future demand, a prudent decision would be to cut losses now (Eberhard, 1994). Whether the MUS gamble can unseat this verdict is a matter for speculation.


The 1995 Energy Summit, a multi-stakeholder consultative conference on South Africa's energy policy, called for an independent review of the future of the AEC with a view to assessing its continued economic viability. A cabinet reshuffle in mid-1996 placed an ANC politician as Minister of Minerals and Energy for the first time. But the new incumbent failed to appoint an independent review panel. Instead, the call for a less extensive review was formally contained in the *White Paper on Science and Technology* published in September 1996 (Republic of South Africa, 1996:35). The Department of Arts, Culture, Science and Technology (DACST) has, as part of a review of all the science councils, established this independent review panel,
which has assessed the role of the AEC and reported to DACST and the AEC Board.

In the 1997/8 budget, the AEC was allocated R473 772 000 (over US$100 million), a rise of over R117 million from the previous year. The largest increase is the contribution to the redemption of strategic loans, set at R178 million (up from R24 million the previous year). The AEC now consumes 58 per cent of the budget of the Department of Minerals and Energy, while the regulatory authority, the Council for Nuclear Safety, consumes R5.4 million (or 1 per cent of the departmental budget). It is not disclosed whether the strategic loans were contracted for the weapons or the enrichment programmes. Public money is nevertheless still being utilised to pay off defunct nuclear projects.

A fourth advantage is the end to the conspiracy of silence on nuclear matters in South Africa. This has given the regulatory body, the Council for Nuclear Safety, increased legitimacy and authority to exercise its capacity to regulate. For example, the mining industry, which previously had escaped the net of strict nuclear regulation, has come more squarely under the scrutiny of the council. The level of public debate and information, while still objectively low, has fewer impediments against open discussion and dissemination of ideas. Environmental, peace and other non-governmental watchdog organisations have had some space to intervene where necessary.

The costs of ending the weapons programme are, by comparison, fewer. Much of the technological capital invested in the careers of the bomb makers could have been converted to other socially productive uses. However, neither Armscor nor the AEC has sought to do this and, as a result, much expertise has leaked away due to the downsizing of these operations. South Africa lost an opportunity to rebuild this expertise to serve basic human development needs.

A further cost could be that no fundamental reform of the nuclear sector has occurred. To date, the state has not acted on the recommendation raised at the Energy Summit to set up an independent inquiry into the future of the nuclear industry. In the policy vacuum, the unreconstructed AEC proceeds with its plans, albeit under a newly constituted but inexperienced board. Those AEC and Armscor (or Denel) personnel involved with the weapons programme have never been called to account for their involvement in the development of weapons of mass destruction. The Truth and Reconciliation Commission, designed to deal with the crimes of apartheid against human rights, is not planning to deal with uncovering the full story of how the state developed nuclear weapons. Many of the AEC and Armscor officials are still in position, without any review having taken place of their roles in proliferation.

The costs of the weapons programme have never been verified. The loss of the documentation, and the secrecy surrounding sanctions

11. I am indebted to Peter van Heusden of the University of the Western Cape for researching these aspects of the 1996/7 budget (personal communications, 26 April 1997).
busting and the programme itself, have all served to obscure this information from the South African public. Even if the true costs of the programme were determined, it is unlikely that the benefits of its demise have been invested directly in the task of meeting basic human needs. It appears too, that the South African taxpayer continues to repay debts incurred by the programme, although neither the previous nor the present government fully acknowledges the real reason for the debt. The ultimate benefit is that the entire African continent can now breathe free of the risk of a nuclear war caused by one of its own nations.

Conclusion

The massive public resources tied up in the entire nuclear project, in terms of weapons development and the broader fuel chain, have never been sanctioned by the people of South Africa. Although democratic institutions have been in place for some time, the state has only recently and tentatively begun to undertake a low-key review of the industry and of the public resources it has consumed.

What is the reason for this irresolute approach? Has there been a forging of common interests between the former nuclear bureaucracy and key elements of the new political elite? Clearly there are those in the new political elite who felt cheated by De Klerk’s decision to dismantle the country’s weapons capability. Among many of those who opposed proliferation, there is nevertheless support for the notion that useful commercial nuclear technologies should be retained and made available to potential consumers in the rest of the continent.

If anything, South Africa ought to allow an open debate on the future of the industry, and not retain it simply for reasons of prestige. Nuclear scientists need to be directed towards socially useful research and product development, and not allowed to continue milking public resources for projects of limited potential. Much of the industry has been downscaled; it is time to examine what is left and create opportunities for successful technological conversion. Only then will the industry be cleansed of its tarnished reputation and be able to make a real contribution to socio-economic development.