by MARK GANDAR

THE NUCLEAR CONNECTION

Civilian and Military Uses of Nuclear Technology

INTRODUCTION

The world's first generation of nuclear reactors was developed simply to produce plutonium for bombs. In the early fifties the novelty of producing energy as a by-product was introduced. It was clear that nuclear power and nuclear weapons could not be separated. Spread of the technology and materials required for nuclear power would also spread nuclear weapons capability.

Since World War Two, international politics has been strongly influenced by the possession of nuclear weapons and weapons capability, the exchange of nuclear technology and the trade in fissionable material. A hotch-potch of strategies to control the horizontal spread (1) of nuclear weapons has been hatched.

There are three significant phases in the history of non-proliferation politics which I shall call

i. the monopolist phase, in which a few countries tried to monopolise nuclear technology and materials and regulate their spread,
ii. the optimist phase of the 'atoms for peace' euphoria and
iii. the pragmatist phase of overt and covert diplomacy.

South Africa is implicated in all three phases, sometimes profoundly. However discussion of South Africa's actions in the nuclear arena is curtailed by sections 68, 69 and 70 of the Nuclear Energy Act, No 92 of 1982.

For nuclear power or nuclear weapons, a supply of fissionable material is required. Before discussing proliferation, I will give a brief outline of the nature and origin of such materials.

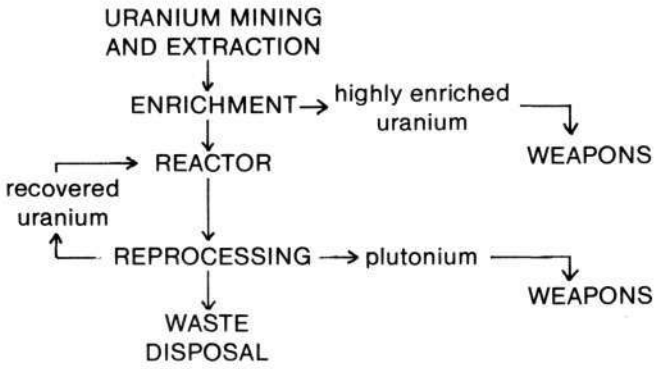
SOME TECHNICAL BACKGROUND

Fissionable material and the nuclear fuel chain

The nuclei of fissionable material are capable of rupturing into two more or less equal halves, at the same time releasing energy and a number of neutrons. These neutrons may cause other nuclei to split likewise, thus setting up a chain reaction. The reaction may be controlled for the steady release of energy or made to accelerate explosively with devastating effect.

The fissionable materials which concern us here are uranium-235 and plutonium-239. Only 0,7% of natural uranium is uranium-235. There are some technologically sophisticated processes by which the concentration can be increased. The procedure is known as enrichment. Uranium can be used as fuel or explosive depending on the degree of enrichment.

The installation in which controlled nuclear fission takes place is called a reactor. After use, the spent fuel contains a mixture of radioactive substances containing, inter alia, some unused uranium and plutonium, which occurs only as a byproduct of nuclear reactions and does not occur in nature. Reprocessing is the name given to the process by which uranium and plutonium are recovered from spent fuel. A simplified diagram of the nuclear fuel chain is shown below.



Only a minority of the world's reactors generate electrical energy. The remainder are military reactors to produce plutonium or so-called research reactors, ostensibly for research, training and the acquisition of nuclear expertise.

Sensitive technologies

The stages of the fuel chain at which material may be diverted to a weapons programme are enrichment (for uranium) and reprocessing (for plutonium), so these technologies are regarded as being highly sensitive. Concerns about proliferation tend to focus on these.

Uranium and plutonium are equally effective explosives: the Hiroshima bomb used uranium and the Nagasaki bomb plutonium. However, for certain technical reasons, plutonium tends to be favoured for most types of nuclear weapons, particularly small tactical devices. Also, reprocessing is technically and economically more accessible than enrichment, so would normally be the more attractive route for most neo-nuclear states. But in the case of South Africa with its large uranium resources, its early acquisition of enrichment facilities was particularly sensitive.

No country could realistically pursue enrichment or reprocessing technology without first acquiring a reactor. It may or may not have military intentions in acquiring its first reactor, but it at least takes a large step towards weapons capability and opens options for the future.

When Prime Minister Verwoerd opened South Africa's first reactor, SAFARI 1, in 1965 he said, revealingly, to an international audience "It is the duty of South Africa not only to consider the military aspects of the material but to do all in its power to direct its uses for peaceful purposes" (2). South Africa's nuclear capability is discussed in Section 4.

NUCLEAR NON-PROLIFERATION POLICIES

The Monopolist Phase: 1945 to 1953

The first attempt to regulate the spread of nuclear weapons was crude and simple (3). A cartel called the Combined Development Agency representing the USA, UK, and Canada was established to buy up all the uranium in the non-communist world and to share it out between the USA and UK according to their military requirements.

The Baruch Plan, presented to the United Nations in 1946, showed more imagination. It proposed the transfer of all nuclear facilities, including uranium mines, to an international body. It identified the entire nuclear fuel chain as a proliferation risk. The plan was rejected due mainly to Soviet objections.

Know-how was also monopolised by the nuclear "haves", but they operated independently of one another to protect nuclear secrets. The US Atomic Energy Act, known as the McMahon Act, effectively killed cooperation. It cast a blanket of secrecy over US technical information, and established a habit of covert nuclear development and dealings which was adopted by other countries and became a characteristic of the nuclear establishment.

The Optimist Phase: 1953 to mid 1970's

An era of nuclear euphoria dawned with President Eisenhower's famous "Atoms for Peace" speech to the UN General Assembly in 1953. The policy he outlined was a "swords to ploughshares" idea. The central theme was that the peaceful atom was distinguishable from the warlike atom. Peaceful nuclear technology would be promoted vigorously in exchange for a paper declaration that the recipient country would not take military advantage of it. Instead of restricting weapons material, the new deal would actively promote its dispersal.

This was coupled to wild optimism about the benefits of the atom. Amid extravagant and unfounded claims for nuclear generated electricity came other peaceful nuclear triumphs: irradiated food and nuclear powered ships. Now only warships (submarines and aircraft carriers) are built with nuclear reactors. That billions of dollars could be wasted trying to build wildly unrealistic nuclear powered aircraft (bombers, of course) was indicative of the madness of the era. The apex of self-delusion was the concept of a peaceful bomb which would move mountains and build dams and harbours. Both the Soviet Union and the USA, with its quaintly named Ploughshares Project of 1957, began 'experiments' with peaceful nuclear explosives, but the genuine use of such devices has never been a serious possibility. But importantly, the idea opened new avenues for nuclear proliferation as we shall see.

The monolithic structures of the Monopolist Phase began to adjust to new circumstances. The 1954 US Atomic Energy Act, unlike its 1946 predecessor, provided for the export of nuclear technology, instead of blanket secrecy. As uranium reserves proved to be more widely distributed than originally thought, the Combined Development Agency could no longer maintain its policy of uranium denial. It was replaced by the enlarged, but equally secret, Western Suppliers Group of which South Africa

was a member. While the Group had a non-proliferation policy, it was also an economic cartel which controlled the world price of uranium.

In 1957, the International Atomic Energy Agency (IAEA) formally came into existence as a UN agency. The twelve founder nations, including South Africa, enjoyed a priveleged status with seats on the Board of Governors. The aims of the IAEA were later embodied in the Non-Proliferation Treaty (NPT) first signed in 1968. There are now 135 signatories, South Africa being a notable exception.

The NPT affirms that non-nuclear weapon states should not acquire nuclear weapons and that nuclear weapon states should move towards an early and complete disarmament. It affirms support for (and actively encourages) the dissemination of nuclear technology for peaceful purposes, specifically including 'peaceful' nuclear explosions.

In return, non-nuclear weapon states agree to open all their nuclear facilities to inspection by the IAEA so that an audit of all fissionable material can be compiled. The idea is that the audit will detect any clandestine diversion of material to a weapons programme. However Article 10 provides that any Party may withdraw from the Treaty with three months notice "if it decides that extraordinary events, related to the subject matter of this Treaty, have jeopardised the supreme interests of its country".

In the words of Lovins and Lovins (4) the NPT "legitimates or even mandates the supply to all NPT adherents of plants that yield pure bomb materials, or of those materials themselves so long as they have some civilian use: in short a treaty against proliferation encourages or requires that non-weapon states be placed days or hours away from having bombs provided they promise (quite revocably and unenforceably) not to make them". The NPT is a contradictory document in that it pretends that peaceful and military uses of nuclear technology can be separated, but simultaneously implies that they cannot.

The first major blow to these proliferation policies came in 1974 when India exploded a nuclear device. Its claim that the explosion was 'peaceful' was not taken seriously, least of all by Pakistan. The plutonium had come from a reactor purchased from Canada before IASEA safeguards. In recording the politics behind the Indian bomb, Moss (5) comments that nuclear installations last longer than many governments. Facilities may be peaceful today but warlike tomorrow under a new regime. Nehru opposed nuclear explosives but Mrs Gandhi sanctioned the detonation.

Pakistan responded by stealing uranium enrichment know-how from Holland and building an enrichment plant with components bought on the open market. It obtained uranium from Libya which had allegedly hijacked (6) it on its way from mines in Niger, though other reports say it was purchased. Just to make sure, Pakistan also built an unsafeguarded reprocessing plant with components obtained from a French company.

When Iraq used its influence as an oil exporter to obtain a research reactor (for which it insisted on weapons grade uranium) from Italy, Israel implemented its own brand of anti-proliferation policy and, in 1981, bombed the Iraqi reactor to pieces. Israel, of course, understood well what Iraq was probably up to since it had its own French built reactor at Dimona and was quietly and secretly building up a nuclear arsenal (as was later confirmed by informer Mordechai Vanunu now serving an 18 year sentence in an Israeli jail). Iraq learned from the experience and, in 1987, bombed an Iranian reactor out of existence.

The Israeli secret service, Mossad, had earlier deviously obtained uranium through phantom companies with laundered money. Iraq, now sans reactor, also indulged in such operations and in 1984 an investigation revealed that it had attempted to obtain 34kg of plutonium (enough for six bombs) from illegal arms dealers in Italy (7).

Last year the West German press exposed a similar covert transfer of fissile material between west and east Europe. The movement of weapons material is now clearly getting out of control. The situation is reminiscent of the shady dealings which characterise the oil trade, only doubly sinister.

The Pragmatist Phase: mid 1970's to present

With IAEA non-proliferation policy seriously dented, the emphasis shifted to diplomacy. The USA took the lead in this, first under the Carter administration and later under President Reagan. The rationale was that if it was not possible to plug all the loopholes, then it is better to alleviate the fears that cause nations to want nuclear weapons.

The USA had tightened its own non-profileration policy (US Nuclear Non-Proliferation Act of 1978) and as a result had lost out on a number of nuclear contracts to European suppliers who attached less stringent conditions. This reduced the USA's leverage in the international arena of nuclear technology. Instead non-proliferation was drawn even more intimately into foreign policy. One result was that countries with (or close to) nuclear weapons capability, or countries with the potential to sell uranium indiscriminately, could wield significant bargaining or blackmailing power in international relations, particularly with the USA.

It is not clear exactly how this influenced US policy towards South Africa, but it surely encouraged the policy of constructive engagement. Also the Reagan administration gave as much support to South Africa's nuclear development as was allowable by the US Nuclear Non-Proliferation Act, until congressional pressure forced it to backtrack (8).

In 1987 attempts by non-aligned countries to have South Africa suspended from the IAEA were blocked. It is interesting to note that this anti-South African move failed to gain the support of the Soviet Union as well as major Western powers.

South Korea demonstrated what is possible. When South Korea appeared intent on pursuing the nuclear weapons option under the guise of nuclear power, President Carter reversed his decision to withdraw US troops from that country. The strengthening of US military links with Pakistan and Israel was also justified on the grounds of nuclear non-proliferation expediency.

Not only has diplomatic attention been turned to nuclear customers. The European suppliers have felt US pressure. For example, proposed sales of enrichment and reprocessing facilities to Pakistan, Brazil and South Korea by European suppliers incurred weighty and partly ineffective US diplomatic action to prevent the sales. These sensitive technologies were probably thrown in as sweeteners for contracts for nuclear power stations. In the case of reprocessing, there is no plausible peaceful use now or in the near future (9).

SOUTH AFRICA'S NUCLEAR PROGRAMME

Early doubts

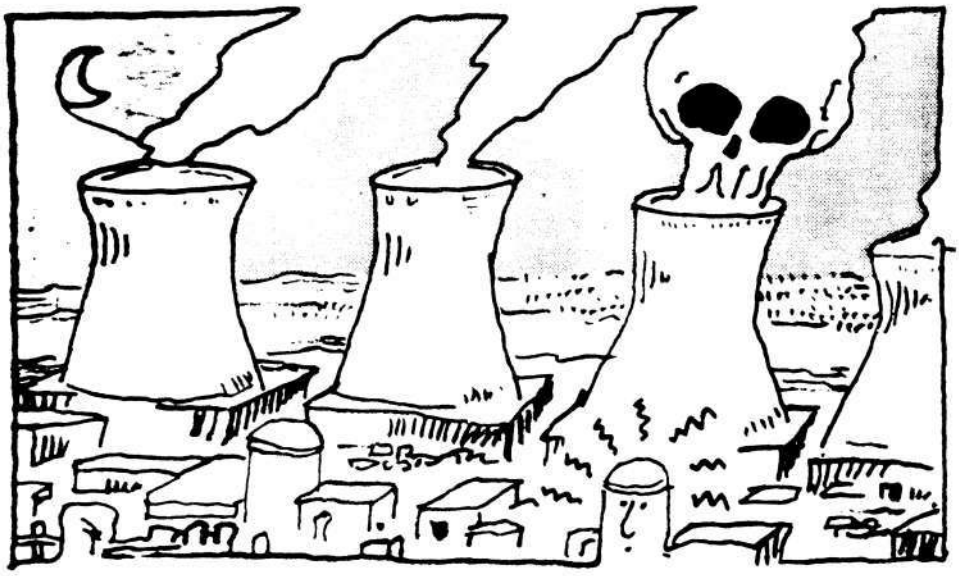
South Africa was originally an active, respected and obedient member of the nuclear club. It had uranium contracts with the Combined Development Agency during the Monopolist Phase, and was then inducted into the Western Suppliers Group when this superceded the CDA. As we have seen, South Africa was a founder member of the IAEA and on its Board of Governors. With the dawning of the Optimist Phase, South Africa was high on the list of worthy recipients of nuclear technology, and was duly rewarded with a research reactor, SAFARI 1 at Pelindaba, opened in 1965. Prime Minister Verwoerd's opening words (Section 2.2) went almost unnoticed. When General Martin let slip in 1968 that South Africa's missile tests should be seen in the context of the possible delivery of nuclear warheads, this was repudiated by the Government (10).

Doubts about South Africa's intention grew with its refusal to sign the NPT. South Africa explained the refusal in terms of guarding industrial secrets: in 1970 Prime Minister Vorster announced with great fanfare that South Africa had developed an entirely new and unique enrichment technique. The NPT would have required South Africa to open enrichment facilities to international inspection. It is widely believed by experts that the technique is not entirely original, and is only an adaptation of a West German Process (11), so the excuse for not signing the NPT is thin. A pilot enrichment plant began operation at Valindaba near Pretoria in 1975.

Evidence of testing of nuclear explosives

Two events fuelled speculation that South Africa had embarked on a programme of nuclear weapons develolpment. In August 1977 a Soviet satellite detected what appeared to be preparations for a nuclear explosion in the Kalahari. The images were confirmed by a US satellite and interpreted to be a nuclear test site.

President Carter announced that he had assurances from Prime Minister Vorster that South Africa did not have and did not intend to develop nuclear explosive devices for any purpose (12). Vorster, in turn, denied giving such assurances, although he did say that



South Africa's only interest in nuclear technology was peaceful (13). There is evidence that South African scientists had shown interest in peaceful nuclear explosives (14). Also in the aftermath of the incident the French Foreign Minister said on radio "we did indeed receive information that South Africa was preparing for an atomic explosion, which according to the South African authorities was for peaceful purposes" (15).

Then in 1979, a US Vela satellite detected a double flash (the fingerprint of an atmospheric nuclear detonation) over the south Atlantic. The Vela satellite was specifically designed to detect atmospheric tests and all previous double flashes had been traceable to tests conducted by either France or China, the only countries conducting atmospheric tests at the time. This one however could not be linked to those countries.

A South African bomb (an atmospheric test cannot be 'peaceful') would have caused such international ructions that every effort was made by the US to offer alternative explanations for the double flash, such as lightning, meteors etcetera. However it is more than likely that some unidentified nation did explode a bomb.

There has been wide speculation that these events were the product of South African-Israeli cooperation on nuclear weapons development or that the 1979 flash was an Israeli bomb tested with South Africa's help (16).

Enrichment and uranium

South Africa is in the ambiguous position of being a non-signatory of the NPT and a member of the IAEA. As a result, international safeguards apply on all South Africa's reactors but not on enrichment facilities. It is improbable that South Africa could have diverted significant amounts of plutonium to a weapons programme. Any such programme would have to use enriched uranium or clandestinely imported plutonium, for example from Israel.

Uranium and enrichment have been the main concerns with regard to South Africa and proliferation. The reason is not only because of the weapons capability it confers, but also because South Africa is a uranium producer.

Being a non-signatory of the NPT South Africa is theoretically at liberty to sell unsafeguarded uranium to anyone it chooses, although South Africa has said it will abide by the IAEA principles with regard to uranium sales. While the indiscriminate export of natural uranium is concern enough, that of enriched uranium is greater. Such action could bring nuclear weapons within other nations reach, or at least undermine other non-proliferation initiatives.

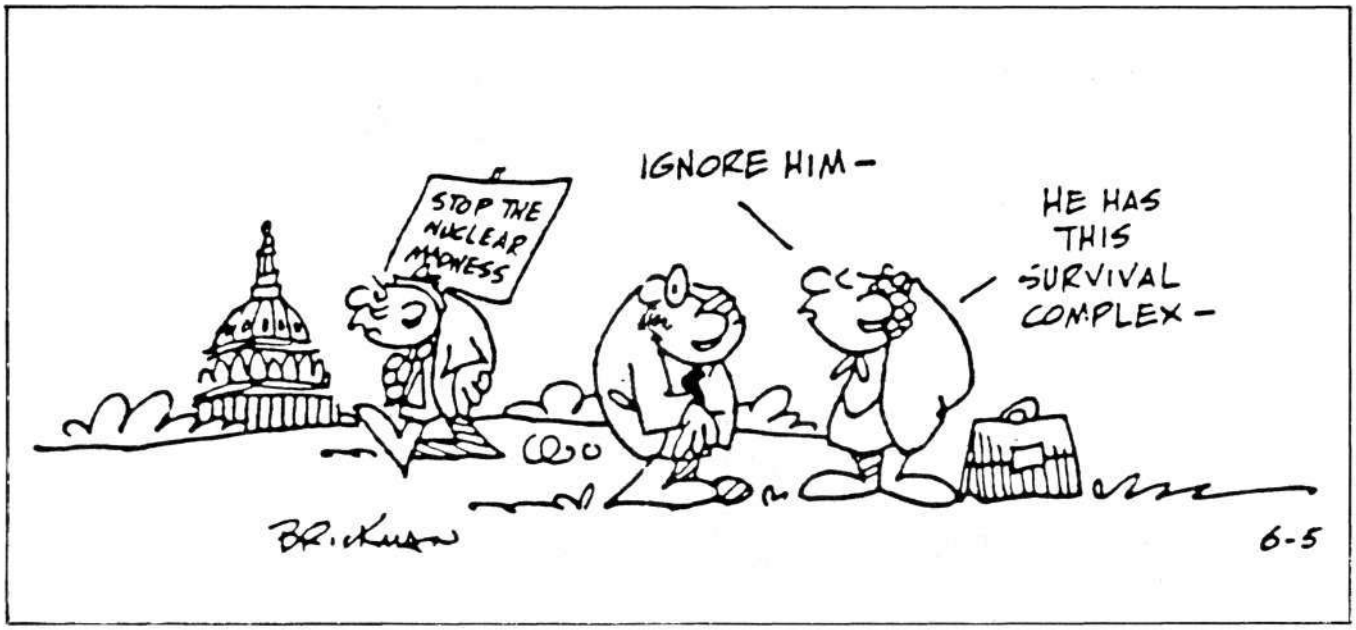
South Africa's plans to build a large commercial enrichment plant were revised as a result of economic and political forces. These were scaled down and instead a so-called semi-commercial plant has just been completed in addition to the original pilot plant.

Pressure to persuade South Africa to accept safeguards on both plants continues. A new set of procedures was drawn up in 1983 to enable IAEA safeguarding of enrichment facilities without risk to technological secrets. The arrangement was developed specifically with South African interests in mind. Despite this South Africa maintains objections to safeguards.

The politics of uncertainty

The uncertainty surrounding South Africa's nuclear weapons was played up by the Nationalist Government. Denials of a nuclear arsenal were interspersed with reminders about the country's capability to make weapons and hints about its preparedness to do so. The statement by Owen Horwood, then Minister of Finance, was typical of these: "If we wish to do things with our nuclear potential we will jolly well do so" (17).

South Africa's cultivated image as a near nuclear state had political advantages. Western governments could be pressured to continue support for the white regime if they were led to believe that abandoning support might drive the Nationalist Government to make (or even worse, to use) nuclear weapons. The



guessing game would also cause edginess on the part of other countries on the subcontinent which would be useful to a policy of destabilisation and regional hegemony. On the other hand open revelations of nuclear weapons could severely damage South Africa's relations with Western states, particularly in regard to nuclear cooperation. Thus South Africa has de facto nuclear deterrence without having to face the political consequences of crossing the nuclear threshold.

In order for the Nationalist Government to exploit the politics of uncertainty, South Africa has to have a programme of development of nuclear energy. The reason is that the politics of uncertainty, whether related to weapons production or to the indiscriminate sale of enriched uranium, is a ploy which needs enrichment capability (preferably unsafeguarded) to give it credibility. Enrichment, in turn, needs the impression of a domestic power programme to give it respectability.

Recently the nuclear power programme has acquired its own brand of uncertainty politics. An Eskom statement claimed that nuclear power development had been frozen until the end of the century, but added that the search for nuclear power station sites was continuing (18). After the launch of a costly investigation for possible nuclear power sites on the Natal north coast this year, the Minister of Mineral Affairs and Technology, Mr Steyn, said he considered this to be a bad area for a nuclear power station (19). There may be several reasons for the decision to keep a nuclear power programme alive and visible, but it would certainly be strategically damaging to the Government were it to fade into obscurity.

What use is a bomb?

It has been argued that nuclear weaponry would be useless to the South African regime since it is in conflict with its own population. This is only partly true. The possible deployment of nuclear weapons should be seen in the context of the laager mentality exemplified by Connie Mulder (then a Cabinet Minister) when, in the aftermath of the test-site incident of 1977, he said "if we are attacked no rules apply at all if it comes to a question of our existence. We will use all means at our disposal whatever they may be".

South Africa is unique amongst the nuclear and near nuclear states. In all other cases nuclear capability was acquired in response to a threat (real or perceived) of a similar capability on the part of an adversary. This does not apply to South Africa. There is no liklihood of any other sub-Saharan country acquiring nuclear weapons in the foreseeable future.

In conflict with a non-nuclear adversary there would be little use for medium or large strategic nuclear weapons. Only small tactical weapons could have any application. The manufacture of a small nuclear bomb is technologically more demanding than a large one. The 1979 flash over the south Atlantic indicated a small 2 to 4 kiloton detonation: either a large dud or a small sophisticated device. It is, in fact possible to make a small nuclear landmine which can be carried in a backpack.

Suppose a desperate regime felt that its existence was threatened, that it had little more to lose diplomatically, that it had conducted audacious conventional raids on neighbouring capitals with impunity. and that it possessed small tactical nuclear weapons. Would it use one? It may reason that the shock waves would bring more benefit in terms of its survival than costs in terms of retaliation. It may reason that the major powers would be more concerned about avoiding a nuclear conflagration over southern Africa than about appropriate retribution, whatever that may be.

If the nuclear device were to be used within South Africa's boundaries, the regime may feel even less inhibition about the threat or reprisal. A scenario for such deployment might arise if liberation forces were to gain control over sizeable parts of the country, as happened in Mozambique.

Although deployment is hopefully improbable, a South African nuclear bomb should not be dismissed as an expensive folly which could never be used. □

NOTES AND REFERENCES

1. This paper is concerned primarily with horizontal proliferation (the spread of nuclear weapon capability to additional countries) rather than vertical proliferation (the acquisition of greater destructive capabilities by existing weapon states). In the former, non-proliferation policies focus on access to technology and fissionable material. In the latter, arms control negotiations have been concerned with control of weapons testing and delivery systems.
2. Quoted in Panorama.
3. Readable accounts of non-proliferation politics and of the spread of nuclear capabilities can be found in:- N. Moss 1981. The politics of uranium. Andre Deutsch. P. Pringle & J. Spigelman 1982. The nuclear barons. Michael Joseph.
   J.D.L. Moor 1987. South Africa and nuclear proliferation. MacMillan.
   R. Edwards 1987. The deadly connection: nuclear power, nuclear weapons. CND Publications.
4. A.B. Lovins & L.H. Lovins 1982. Energy/War: breaking the nuclear link. Harper & Row. Page 128.
5. Moss, op cit. Chapter 6.
6. Moss, op cit. Pages 190, 191.
7. L.S. Spector 1984. Nuclear proliferation today: the spread of nuclear weapons 1984. Ballinger. Page 187.
8. Spector, op cit. Page 297.
9. The production of plutonium for breeder reactors is sometimes given as justification for obtaining reprocessing facilities. Breeder reactors, which use plutonium fuel, are supposed to convert non-fissionable uranium-238 into plutonium at a faster rate than they use the plutonium fuel, hence the name 'breeder'. Breeder reactors have proven to be temperamental, and only a handful of countries are continuing to try to develop them. Even the USA has discontinued its breeder development programme. Should breeders ever become commonly used, the consequences for weapons control will be very serious.
10. Spector, op cit. Page 283.
11. Moore, op cit. Page 88.
12. Department of State Bulletin, 19 September 1977.
13. Washington Post, 25 October 1977.
14. Moore, op cit. Page 114.
15. UN Centre for Disarmament, Department of Political and Security Council Affairs, 1981. South Africa's plan and capability in the nuclear field. Report of the Secretary General A/35/402. Appendix 2.
16. There are several somewhat speculative reports, for example: UN Special Committee Against Apartheid, 1983. South Africa's nuclear capability. Report A/AC 115/L 602.
    'A most unholy alliance', an article by J. Hunter, editor of Israeli Foreign Affairs, published in Sanity, March 1987. The Guardian (14 June 1988) reported that a book by Benjamin Biet-Hallahmi soon to be published, claims that the flash was almost certainly the test of a 155mm nuclear shell produced secretly by South Africa and Israel.
17. Washington Post, 16 February 1977.
18. Natal Mercury, 4 February 1988.
19. Natal Witness, 19 May 1988.
20. Washington Post, 16 February 1977.

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