

South Africa Nuclear Chronology

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Last update: May 2007

**As of May 2009, this chronology is no longer being updated.
For current developments, please see the South Africa Nuclear Overview.**

This annotated chronology is based on the data sources that follow each entry. Public sources often provide conflicting information on classified military programs. In some cases we are unable to resolve these discrepancies, in others we have deliberately refrained from doing so to highlight the potential influence of false or misleading information as it appeared over time. In many cases, we are unable to independently verify claims. Hence in reviewing this chronology, readers should take into account the credibility of the sources employed here.

Inclusion in this chronology does not necessarily indicate that a particular development is of direct or indirect proliferation significance. Some entries provide international or domestic context for technological development and national policymaking. Moreover, some entries may refer to developments with positive consequences for nonproliferation.

2006-2005

December 2006

South Africa plans to use fuel created from former Russian nuclear warheads to fuel a new line of small nuclear power plants. Since 1999, South Africa has been developing *Pebble Bed Modular Reactors*, relatively low-power units, and plans to build 24 of them by 2028. However, the decision to use foreign fuel might change as the nation's demand for fuel increases with the increase in power plants. South Africa has stated that "We are re-evaluating our nuclear program."

— "South African Reactors to Use Uranium from Former Russian Nuclear Warheads," Global Security Newswire, 7 December 2006; www.nti.org.

25 May 2005

On 25 May 2005, the chief director of nuclear matters at South Africa's minerals and energy department, Tseliso Maqubela, briefs parliamentarians on options for dealing with the country's high-level nuclear waste. The government's draft policy on nuclear waste management lists three options for the management of high-level nuclear waste: above-ground interim storage; deep geological disposal; and "reprocessing, conditioning and recycling". According to Maqubela, South Africa is likely to pursue a dual approach to its high-level waste, storing some locally as well as sending some overseas (to the United Kingdom, Japan, or France) for reprocessing. He rules out the possibility of building a nuclear waste reprocessing facility in South Africa, saying this is often construed as "a recipe for other things". Currently, about 95 percent of South Africa's high-level nuclear waste comes from the Koeberg nuclear power station where it is stored on-site at the facility. The draft policy on nuclear waste, currently being revised, is set to go to the Cabinet in August 2005.

Related content is available on the website for the Nuclear Threat Initiative, www.nti.org.



— "Department Sketches Sa's Nuclear Waste Options," *Liquid Africa*, 25 May 2005; in Lexis-Nexis Academic Universe, www.lexis-nexis.com.

July 2005

South Africa plans to convert its SAFARI-1 research reactor to use low-enriched uranium fuel instead of the highly enriched fuel currently used. "The switch marks a further milestone in the government's programme to ensure that the safety of nuclear materials is enhanced globally," according to the country's Department of Minerals and Energy Affairs. In a statement, the minerals and energy affairs department said the remaining HEU at Pelindaba "will generally be applied to the manufacturing of medical isotopes... used in nuclear medicine diagnostics." The conversion will take about three years to complete.

— "South Africa to Convert Nuclear Research Reactor," *Agence France Presse*, 18 July 2005; in Lexis-Nexis Academic Universe, www.lexis-nexis.com.

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2004

2 January 2004

Former Israeli Army officer and assistant rabbi, Asher Karni, is arrested at Denver International Airport in the United States and charged with attempting to smuggle 66 triggered spark gaps to Pakistan through his South African company, Top-Cape Technology. The spark gaps, used for medical purposes in small quantities, can be used in large quantities to detonate nuclear weapons. Karni allegedly exported spark gaps from New Jersey through South Africa to Pakistani businessman Humayun Khan without licenses. Karni is charged with violating two laws: the Export Administration Act and the International Emergency Economic Powers Act. Court papers say Karni admitted sending the spark gaps, yet denied knowingly breaking any US laws or having ties to Abdul Qadeer Khan. His arrest was the result of a tip-off by a South African associate and a sting operation set up by the US Federal Bureau of Investigation. Karni may serve 10 years in prison if convicted.

— "US investigators in South Africa probe nuclear technology ring," *Agence France Presse*, 12 February 2004, in Lexis-Nexis Academic Universe, www.lexis-nexis.com; *NIS Export Control Observer*, February 2004, cns.miis.edu.

February 2004

US investigators arrive in South Africa to probe a local link in an international black market in nuclear technology.

— "US investigators in South Africa probe nuclear technology ring," *Agence France Presse*, 12 February 2004; in Lexis-Nexis Academic Universe, www.lexis-nexis.com.

18 February 2004

A South African government delegation, consisting of state power utility representatives and officials from the Departments of Trade, Industry, and Minerals and Energy, holds talks with a French company in Paris to induce its participation in the construction of the controversial Pebble Bed Modular Reactor (PBMR) project. Experts project the PBMR nuclear reactor will provide enormous future revenue as well as address South Africa's rapidly expanding energy requirements.

— "South African team said in Paris for talks aimed at reviving nuclear project," *Business Day*, Johannesburg, 18 February 2004, reported by BBC Monitoring Africa, 19 February 2004; in Lexis-Nexis Academic Universe, www.lexis-nexis.com.

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28 May 2004

An IAEA report documents far reaching international involvement in Libya's nuclear weapons program, spanning three continents. Although the report did not name the countries involved in supplying Libya, diplomats close to the agency said the report indicates that the former Soviet Union, South Africa, Pakistan, the United Arab Emirates, and Malaysia supported or served as bases for individuals selling nuclear components or expertise to Libya.

— "U.N.: Libya Nuke Suppliers Spanned Globe," Associated Press, 29 May 2004, www.newsmax.com.

22 June 2004

Minerals and Energy Minister Phumzile Mlambo-Ngcuka states that South Africa's Cabinet has endorsed a five-to-ten year plan to develop the Pebble Bed Modular Reactor (PBMR) in order to grow a "critical research and skills base to support the PBMR program and a sustainable nuclear industry in South Africa."

— "SA Cannot Avoid use of Nuclear Energy," Comtex News Network, Inc., 22 June 2004; in Lexis-Nexis Academic Universe, www.lexis-nexis.com.

23 June 2004

David Albright, president and founder of the Institute for Science and International Security, testifies before the Senate on the subject of smuggling of weapons of mass destruction. He describes the so-called "Khan" network, an international, relatively non-hierarchical, and clandestine nuclear network whose key technology holders and leaders were in Pakistan, including the father of Pakistan's gas centrifuge program, Abdul Qadeer Khan. Albright further testifies that many other network members were spread throughout the world, located in Europe, the United Arab Emirates, Turkey, South Africa, and Malaysia. They relied on unwitting manufacturing companies and international suppliers for the dissemination of nuclear materials and devices.

— Federal Document Clearing House Congressional Testimony, FDCHeMedia, Inc., 23 June 2004.

24 August 2004

Gerhard Wisser, chief of the South African-based engineering company Krisch Engineering, is arrested in Germany and accused of acting as a middleman in procuring pipes his company manufactures for a uranium enrichment facility in Libya. He is released on bail but rearrested in South Africa a month later.

— "South African Council for the Non-Proliferation of Weapons of Mass Destruction, Press Release," 7 September 2004, Department of Foreign Affairs Republic of South Africa website, www.dfa.gov.za; "South Africa makes nuclear arrest in Libyan Proliferation," *Financial Times Limited*, 4 September 2004.

2 September 2004

Johan Andries Muller Meyer, engineer and head of the South African engineering company Tradefin (located in Vanderbijlpark, about 50 miles southeast of Johannesburg), is arrested for violating the Non-Proliferation of Weapons of Mass Destruction Act and the Nuclear Energy Act. South Africa's National Prosecuting Authority arrests Meyer for his alleged activities with an international nuclear weapons-smuggling organization; he is accused of helping to supply equipment to Libya's now abandoned nuclear weapons program. Meyer, 53, was arrested at his Tradefin Engineering company in Vanderbijlpark and charged with violating South Africa's Non-Proliferation of Weapons of Mass Destruction Act and Nuclear Energy Act. Charges against him provide a detailed list of key nuclear weapons components that Meyer's Tradefin was alleged to be trafficking, including: gas centrifuges that enrich uranium for bombs; feed and piping systems that deliver the uranium inside the centrifuges; and a Spanish-made flow-forming lathe that produces the main centrifuge component — high-precision steel rotor tubes where the enriching takes place. Police also seize 11 shipping containers holding components of a centrifuge uranium enrichment plant and related documentation during the raid at his company.

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— "South African Council for the Non-Proliferation of Weapons of Mass Destruction, Press Release," 7 September 2004, Department of Foreign Affairs Republic of South Africa, www.dfa.gov.za; Dafna Linzer and Craig Timberg, "S. African's Arrest Seen as Key to Nuclear Black Market," *The Washington Post*, 4 September 2004; in Lexis-Nexis Academic Universe, www.lexis-nexis.com.

8 September 2004

German engineer Gerhard Wisser and Swiss engineer Daniel Geiges, living permanently in South Africa, are arrested for participating in a nuclear technology smuggling ring. Wisser is the owner, and Geiges a colleague and employee, of Krisch Engineering in Randpark, a Johannesburg suburb. Both are charged with contravening the Nuclear Energy Act and Non-Proliferation of Weapons of Mass Destruction Act by making and trafficking components for nuclear weapons without necessary authorization. Specifically, authorities charge Geiges and Wisser with illegally acquiring and exporting a flow-forming lathe manufactured by the Spanish-based company Denn and unlawfully acquiring and exporting a gas centrifuge and related equipment used in the enrichment of uranium.

— Tiziana Cauli, "Two More Arrested in South Africa in Investigation into Nuclear Arms Equipment Trafficking," Associated Press, 9 September 2004; in Lexis-Nexis Academic Universe, www.lexis-nexis.com; Stephen Fidler and John Reed, "South Africa Makes Nuclear Arrest Libyan Proliferation," *Financial Times*, 4 September 2004; in Lexis-Nexis Academic Universe, www.lexis-nexis.com; 'Nuclear' case opens in S Africa, BBC News, 16 September 2004, www.bbc.net.uk.

8 September 2004

Unexpectedly, authorities drop charges against Johan Meyer; he had been charged with violating the Non-Proliferation of Weapons of Mass Destruction Act and the Nuclear Energy Act. He is released but there is speculation that he has cooperated with South African authorities, who are investigating a nuclear weapon components smuggling ring.

— Tiziana Cauli, "Charges Dropped Against South African Accused of Trafficking in Nuclear Equipment," 8 September 2004, Associated Press; in Lexis-Nexis Academic Universe, www.lexis-nexis.com.

8 September 2004

The Washington, DC-based think tank Institute for Science and International Security (ISIS) releases a report suggesting that nuclear smugglers used South Africa as a transit point for illicit trade in nuclear components due to perceptions that the country's export control system is weak. Abdul Minty, chairman of the South African Council for the Non-Proliferation of Weapons of Mass Destruction, states that South Africa's export regulations comply with international standards of nonproliferation as specified by the IAEA. Many experts express surprise at South Africa's involvement. "This has exposed an incredibly important node of the Khan network, and it is surprising that it has happened in a country like South Africa, which is generally considered a white knight on nonproliferation," said David Albright, a former nuclear inspector and president of the Institute for Science and International Security.

— Jacob Blackford, "Asher Karni Case Shows Weakness in Nuclear Export Controls," 8 September 2004, ISIS website, www.isis-online.org; Stephen Fidler and John Reed, "Nuclear Trade Smugglers Home in on Loopholes in South Africa," *Financial Times*, 14 September 2004; in Lexis-Nexis Academic Universe, www.lexis-nexis.com; Dafna Linzer and Craig Timberg, "S. African's Arrest Seen as Key to Nuclear Black Market," *Washington Post*, 4 September 2004.

15 September 2004

South Africa continues to work closely with the UN atomic agency to help it uncover international smuggling of nuclear weapons-related materials. Abdul Samad Minty, chairman of the South African Council for the Non-

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Proliferation of Weapons of Mass Destruction, affirms his commitment to cooperate with the IAEA "in every way." IAEA chief Mohamed ElBaradei states that investigations into cases of South African businessmen illegally trading in nuclear materials are helping shed light on nuclear programs in Iran and Libya.

— "South Africa Works with IAEA to Crack Down on Smuggling of Nuclear Materials," AFX News, 15 September 2004; in Lexis-Nexis Academic Universe, www.lexis-nexis.com.

27 September 2004

A meeting between President Thabo Mbeki and Hassan Rouhani, Iran's secretary of national security, results in South Africa's pronouncement that it will help Iran resolve questions about its nuclear program that have caused concern within the International Atomic Energy Agency. South Africa, as a member of the Board of Governors of the IAEA, will interact intensively with Iran to help reach a solution.

— South African Council for the Non-Proliferation of Weapons of Mass Destruction, Press Release, 30 September 2004, Department of Foreign Affairs Republic of South Africa, www.dfa.gov.za.

13 November 2004

Swiss authorities arrest German engineer Gotthard Lerch, a senior employee of German vacuum technology maker Leybold Heraeus. Allegedly, Lerch helped procure uranium-enrichment technology for the Khan network in collaboration with Johan Meyer's South African firm, Tradefin. Lerch has surfaced in a number of nuclear proliferation investigations in Europe since the 1980s, but has yet to be charged. Earlier this year, Iran and Malaysia identified him as a middleman in helping develop gas centrifuges for uranium enrichment in both Libya's and Iran's atomic weapons programs. Diplomats have long considered Lerch a "significant" player in the illicit nuclear trafficking network.

— David Rising, "German suspected of helping Libyan nuclear program arrested in Switzerland," Associated Press, 16 November 2004, in Lexis-Nexis Academic Universe, www.lexis-nexis.com; Dafna Linzer and Craig Timberg, "S. African's Arrest Seen as Key to Nuclear Black Market," *Washington Post*, 4 September 2004; "Scale of Pak Nuke Proliferation Still Unknown," Agence France Presse, Reuters, Arab News, 13 February 2004, www.aljazeera.info.

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2003

February 2003

At the World Economic Forum in Davos, Switzerland, Ruel Khoza, chairman of the state-owned South African utility company Eskom, states that South Africa is seriously considering building several nuclear power stations. According to Khoza, Electricite de France and British Nuclear Fuel are advising Eskom in this regard.

— "Eskom and Nuclear Power," *Africa Energy Intelligence*, 5 February 2003, www.lexis-nexis.com/universe.

February 2003

A team of South African disarmament experts arrives in Iraq to begin talks with senior Iraqi officials on how Iraq can dispose of its weapons of mass destruction. The team, led by the South African Deputy Foreign Minister, consists of seven nonproliferation experts, most of whom helped disarm South Africa of weapons of mass destruction after the end of apartheid in 1994. According to Deon Smit, a South African scientist who assisted in his country's nuclear disarmament effort, the team will help Iraq prove it has disarmed itself by aiding Iraqi officials in documentation.

— "South African Disarmament Experts Arrive in Iraq," Global Security Newswire, 24 February 2003, www.nti.org.

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March 2003

China and South Africa sign a technical and scientific cooperation protocol agreement in 10 major projects, for which researchers and scientists carry out research, development, and information exchange towards mutual economic enhancement. China and South Africa will cooperate in such fields as peaceful use of nuclear energy, mini-satellite, remote sensing, mining, space, medicine, and health care, among others.

— "China, South Africa Sign Protocol on Scientific Cooperation," Global News Wire - Asia Africa Intelligence Wire, 13 March 2003, www.lexis-nexis.com/universe.

April 2003

The City of Cape Town tells Eskom that it will not accept the toxic, high-level nuclear waste that would be produced by the pebble bed modular reactor (PBMR). Cape Town informed Eskom that it does not support the findings of the final environmental impact report for the modular reactor project and that Eskom must still formally apply for planning permission before any nuclear plant can be built. Cape Town has criticized the PBMR environmental impact assessment several times in the past; however, Eskom did not address the issues it raised.

— "Cape Town Rejects Nuclear Waste," Xinhua News Agency, 9 April 2003, www.lexis-nexis.com/universe.

May 2003

The U.S. Congress is close to approving a \$200 million package to build a test pebble bed modular reactor in Idaho, which offers great opportunity for South Africa and its electricity company Eskom. The proposed Energy Policy Act indicates that the United States wants hydrogen to replace oil as a future energy source. The PBMR has the potential to produce hydrogen in commercial amounts; however, several hurdles must be overcome before the U.S. demonstration project can proceed.

— "Plans to Build 'Revolutionary Mini-Nuclear Reactor' Receive U.S. Boost," Financial Times Information, *BBC Monitoring*, 16 May 2003, www.lexis-nexis.com/universe.

June 2003

Following a three-year investigation into Eskom's application to construct a demonstration pebble bed modular reactor at Koeberg, the Environmental Affairs Department announces that it has approved the environmental impact assessment. The conditional approval includes the manufacture and transport of nuclear fuel between Pelindaba (west of Pretoria) and Koeberg. The approval does not mean that construction of the reactor can proceed. A separate licensing procedure dealing with nuclear safety issues is in process. Also, policy issues remain regarding the use of nuclear power and the storage of nuclear waste. Earthlife Africa, an environmental NGO, expresses shock and outrage at the decision and plans to continue its legal action against the PBMR construction at Koeberg.

— "Nuclear Reactor Environmentally Safe: DG," *Financial Times Information*, South African Press Association (SAPA), 26 June 2003, www.lexis-nexis.com/universe; "Earthlife Africa Shocked about Reactor Approval," *Financial Times Information*, South African Press Association (SAPA), 27 June 2003, www.lexis-nexis.com/universe.

July 2003

Ten South African engineers return to South Africa from France, where they attended a nuclear safety training course as part of an agreement between the South African government and Areva Group, a French high-tech industrial group and leader in the nuclear energy and connectors industry. The first training session marks the beginning of a project to train and educate South Africans in nuclear technology and mining and related high-technology industries. Two more groups, each of 10 South African engineers, will participate in additional training sessions later this year.

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— "First SA Nuclear Safety Trainees Return from France," Financial Times Information, South African Press Association (SAPA), 6 July 2003, www.lexis-nexis.com/universe.

July 2003

In response to safety and health issues brought to light by environmental NGO Earthlife Africa, South African nuclear engineers express their support for development of the Koeberg-based pebble bed nuclear reactor (PBMR) by saying it is "walk-away safe." A statement by the South African Institution of Nuclear Engineers indicates that accidents like those that occurred at Three Mile Island or Chernobyl are impossible with the PBMR. The statement emphasized the cost effectiveness of PBMR technology, disputed the dangers related to the transport of nuclear materials, and admitted that plans for the nuclear waste were still in development, but that it would not endanger future generations.

— "Engineers Support PBMR Nuclear Development," Financial Times Information, South African Press Association (SAPA), 25 July 2003, www.lexis-nexis.com/universe.

August 2003

A U.S. cargo ship carrying 1,037 containers, including 50 tons of uranium ore, runs aground off the coast of Cape Town. The uranium ore is en route from South Africa to the United States for processing. Nuclear Fuel Corporation (Nufco) states that the uranium ore is packed in high integrity drums that would require a "fairly catastrophic" event to cause a spill.

— "Stranded Ship Aground Off Stormy Cape Coast with Uranium Onboard," Deutsche Presse-Agentur, 21 August 2003, www.lexis-nexis.com/universe.

August 2003

The city of Cape Town backs objections to the proposed construction of the pebble bed modular reactor. It lodged an appeal of the Department of Environmental Affairs' acceptance of an environmental impact report. Among other issues, the objection arises from concerns about the handling of waste and the adequacy of disaster management plans.

— "Cape Town Objects to Nuclear Reactor Plan," Financial Times Information, South African Press Association (SAPA), 24 August 2003, www.lexis-nexis.com/universe.

September 2003

Deputy Minerals and Energy Minister Susan Shabangu releases a draft radioactive waste management policy, which states that entities producing nuclear waste will have to bear the cost for the management thereof. It also states that waste management activities should be conducted in an open and transparent manner and shifts focus from disposal or reprocessing of the waste to safe management. The policy recommends the creation of a national executive committee on radioactive waste management, a radioactive waste management agency, a radioactive waste database, and a radioactive waste management fund, with contributions coming from the generators of nuclear waste.

— "Draft Nuclear Waste Policy: You Produce, You Pay," Financial Times Information, South African Press Association (SAPA), 3 September 2003, www.lexis-nexis.com/universe.

September 2003

According to Minerals and Energy Minister Phumzile Mlambo-Ngcuka, the Nuclear Energy Corporation of South Africa (NECSA) sold 131 million rand worth of isotopes in 2002/2003 and exported 86 percent of these sales to 40 different countries.

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— "Nuclear Energy Corp Sells Isotopes Worth R131-M," Financial Times Information, South African Press Association (SAPA), 10 September 2003, www.lexis-nexis.com/universe.

September 2003

Earthlife Africa, an environmental NGO, lodges an application with the High Court in Cape Town, requesting it to review and set aside the environmental impact assessment (EIA) authorization granted to Eskom to build a demonstration pebble bed modular reactor at Koeberg. Earthlife Africa says that its participation in the EIA was limited because it was refused access to information on the economic and technical feasibility of the project. Due to this limitation, Earthlife Africa claims its constitutional right to be heard was violated when the approval for the reactor was granted in June. Whether the court case succeeds or not, it further delays the project.

— "Earthlife Africa Tackles South African Nuclear Giant," Financial Times Information, Panafrican News Agency (PANA), 16 September 2003, www.lexis-nexis.com/universe; "Court Block to SA Nuclear Project," Financial Times Information, Global News Wire, 19 September 2003, www.lexis-nexis.com/universe.

October 2003

Minerals and Energy Minister Phumzile Mlambo-Ngcuka signs a long-term exchange agreement with French nuclear company Areva. The agreement will provide training for South African nuclear scientists and engineers in exchange for credits in terms of the industrial participation program. South Africa seeks to ensure a succession plan for its "very mature and experienced scientists."

— "Mlambo-Ngcuka Signs Training Exchange Agreement," AllAfrica, Inc., Africa News, 2 October 2003, www.lexis-nexis.com/universe.

October 2003

Documents on apartheid nuclear weapons are declassified. Although initially told that all weapons-program records were destroyed, the South African History Archives Project at Wits University applied for the release of information under the Promotion of Access to Information Act. The top secret memo released is from March 1975 and titled "The Jericho Weapon System." The memo indicates that South Africa was considering buying Israeli ballistic missiles tipped with nuclear warheads that could strike Lusaka, Lilongwe, Maputo, and other African capitals. Ultimately, South Africa never purchased the Jericho system.

— Michael Schmidt, "SA's Nuclear Truth Leaks Out," Times Media Limited, 12 October 2003, www.lexis-nexis.com/universe.

October 2003

According to Westinghouse, a U.S.-based business unit of U.K.-based nuclear group British Nuclear Fuels (BNFL), South Africa's pebble bed modular reactor (PBMR) is set to become the first plant in the world to produce both electricity and commercial quantities of hydrogen. If the reactor is proven safe, Eskom, the main driver behind the PBMR project, is likely to enter the hydrogen-based U.S. energy market. Regis Matzie, Senior Vice President and Chief Technology Officer of Westinghouse, and two former executives of U.S. utility Exelon, visited South Africa earlier this month to solicit support for the project from the South African government and the PBMR investors. According to Matzie, U.S. President George Bush has pledged one billion dollars for research and development of the nuclear hydrogen program.

— "U.S. Company to Assist S Africa in 'Commercialization' of Nuclear Plant," Financial Times Information, BBC Monitoring, 27 October 2003, www.lexis-nexis.com/universe.

November 2003

South Africa and Russia complete the third session of the South African/Russian Joint Inter-Governmental

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Committee on Trade and Economic Cooperation (ITEC). South African Foreign Minister Nkosazana Dlamini Zuma and Russian Deputy Prime Minister Vladimir Yakovlev conclude that there is "significant room for improvement" in bilateral trade between their two countries. The session resulted in a proposal to involve the private sector in leveraging trade and economic issues. In addition, the Joint Commission on Science and Technology agrees to assist their respective Space Councils in finalizing the agreement on cooperation in research and peaceful use of outer space and will develop plans to use Russian scientists in the National System of Innovation to develop capacity in areas where South Africa needs expertise, such as astronomy and mathematics. The Joint Sub-Committee on Minerals and Energy agrees to sign the agreement on the Peaceful Use of Nuclear Energy at the earliest convenient date and to facilitate the training and education in the Russian Federation of South African nuclear specialists.

— "South Africa, Russia to Enhance Trade, Investment," Financial Times Information, Panafrican News Agency (PANA), 13 November 2003, www.lexis-nexis.com/universe.

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2002

January 2002

A U.S. engineering firm and two South African companies have agreed to build South Africa's second nuclear plant, a trial plant utilizing the pebble bed modular reactor (PBMR) technology. Shaw Group, Inc. and South African nuclear technology company PBMR Pty. Ltd. and engineering firm Murray and Roberts are still doing feasibility studies, but specified that Koeberg (near Cape Town) would be their "preferred site." Anti-nuclear activists protest the technology development in South Africa and question whether the location is due to the unproven technology which does not meet required standards in the United States.

— "S. African, U.S. Firms in Deal on Nuclear Power Plant," Agence France Presse, 15 January 2002, www.lexis-nexis.com/universe.

March 2002

The City of Cape Town considers legally challenging the environmental impact assessment (EIA) currently being carried out on the pebble bed nuclear reactor (PBMR) proposed for Koeberg, located just north of Cape Town. Cape Town says the EIA has failed to assure the city that concerns will be addressed, has not allowed for adequate time to fully review key documents, and has not provided technical, feasibility, and energy planning studies to the city. The project appears to be proceeding without delay, although EIA authorization and a nuclear license have not yet been granted.

— "Council Concern over Nuclear Reactor," Financial Times Information, South African Press Association (SAPA), 14 March 2002, www.lexis-nexis.com/universe.

April 2002

U.S. electricity company Exelon Corporation, parent company of Peco Energy Company, announces that it will end its cooperation with Eskom, South Africa's state-owned utility company, to develop the next generation of nuclear reactors. Although Exelon does not rule out using the technology in the future, its withdrawal casts doubt on the technology's future. The remaining partners, Eskom, British Nuclear Fuels, Ltd. and South Africa's Industrial Development Corporation, state that the project will continue despite Exelon's departure.

— "Nuclear Operator Exelon Won't Work on New Type of Reactors," Knight Ridder / Tribune News Service, 17 April 2002, www.lexis-nexis.com/universe.

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June 2002

At the end of June, South Africa's Department of Minerals and Energy, in partnership with the International Atomic Energy Agency, will host an intergovernmental seminar on the nonproliferation of nuclear weapons. The goal of the seminar is to encourage African countries to honor their commitment to the nonproliferation of nuclear weapons, as embodied in the Pelindaba Treaty, which strives for an African continent free of nuclear weapons. Approximately 80 government representatives from at least 33 African nations are expected at the seminar, which will be held in Benoni.

— "Nuclear Seminar to be Held Near Johannesburg," *Financial Times Information*, South African Press Association, 19 June 2002, www.lexis-nexis.com/universe.

July 2002

Two Japanese companies, Nuclear Fuel Industries, Ltd. and Mitsubishi Heavy Industries, Ltd., will participate in the construction of the pebble bed modular reactor (PBMR) in South Africa. Nuclear Fuel Industries, Ltd. will build a factory for the production of spheres of graphite containing coated uranium, the special fuel for the reactor. Mitsubishi Heavy Industries, Ltd. will develop helium-powered turbine generators.

— "Two Japanese Firms to Join in Building New Reactor in South Africa," Xinhua General News Service, 16 July 2002, www.lexis-nexis.com/universe.

July 2002

During a visit to Russia, South African Foreign Minister Nkosazana Dlamini-Zuma meets with her Russian counterpart Igor Ivanov to discuss nuclear nonproliferation and the fight against international terrorism. Also on the agenda for discussion are exports of South African farm produce to Russia and Russian exports of technologies to South Africa.

— "Russia, S Africa to Boost Cooperation," ITAR-TASS News Agency, 19 July 2002, www.lexis-nexis.com/universe.

August 2002

During a visit to Brazil for the inauguration of the South Africa-Brazil binational commission, South African Foreign Affairs Minister Nkosazana Dlamini-Zuma praises the relationship between South Africa and Brazil, which is to include cooperation in the electricity and nuclear industries.

— "Dlamini-Zuma Lauds Relationship with Brazil," *Financial Times Information*, South African Press Association, 7 August 2002, www.lexis-nexis.com/universe.

August 2002

Western Cape Premier Marthinus van Schalkwyk expresses concern over a security breach at Koeberg nuclear power station. During a recent protest, Greenpeace activists approached the plant on inflatable boats and climbed over the wall of the nuclear plant and onto a roof where they unfurled a green banner reading "Nukes out of Africa" before they were arrested by police. Van Schalkwyk says the security breach should be addressed immediately. Eskom, however, denies that a security breach occurred and states that its security personnel monitored the approach of the protesters and took action when the boats entered the intake basin. Although satisfied with the plant's management, van Schalkwyk expressed serious concerns about the high-level nuclear waste stored at Koeberg over the past 18 years.

— "Koeberg Vulnerable from the Sea: W Cape Premier," *Financial Times Information*, South African Press Association, 30 August 2002, www.lexis-nexis.com/universe; "Eskom Denies Security Breach by Greenpeace," *Financial Times Information*, South African Press Association (SAPA), 24 August 2002, www.lexis-nexis.com/universe.

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September 2002

British Prime Minister Tony Blair, by revealing the contents of a government dossier, implicates Saddam Hussein in trying to buy African uranium to give Iraq's weapons program a nuclear capability. Blair's documents did not identify any country allegedly approached by Iraq, but security analysts said the Congo was the likeliest, followed by South Africa. Jakkie Cilliers, head of the Institute for Security Studies in Pretoria, is doubtful of Baghdad obtaining uranium from South Africa. "As a past nuclear power we are an obvious suspect but it is unlikely because the programme was dismantled under the observation of the International Atomic Energy Agency." According to a BBC investigation, a year before South Africa halted its nuclear weapons program, it traded enriched uranium with Saddam Hussein with U.S. approval. The BBC cited an anonymous South African intelligence official who said about 50kg of uranium was sold to the Iraqis.

— James Astill and Rory Carroll, "Iraq Dossier: African gangs offer route to uranium: Nuclear Suspicion falls on Congo and South Africa," *The Guardian*, 25 September 2002.

September 2002

South Africa and 18 other nations ratify the Comprehensive Nuclear-Test-Ban Treaty (CTBT) at the United Nations General Assembly meeting in New York. The CTBT is to contribute to a systematic and progressive reduction of nuclear weapons and the prevention of nuclear proliferation.

— "Countries Commit to Nuclear Test Ban," *AllAfrica, Inc., Africa News*, 17 September 2002, www.lexis-nexis.com/universe.

September 2002

South Africa signs a protocol with the International Atomic Energy Agency (IAEA) to enhance their joint efforts to achieve global nuclear nonproliferation. The Additional Protocol requires South Africa to provide more information to the IAEA than what is already required by the existing Safeguards Agreement. Minerals and Energy Deputy Minister Susan Shabangu signed the protocol in Vienna, Austria, and it immediately entered into force. Mali and Chile also sign the Additional Protocol with the IAEA this month.

— "South Africa Signs Protocol Agreement with IAEA," *Financial Times Information, Panafrican News Agency (PANA) Daily Newswire*, 13 September 2002, www.lexis-nexis.com/universe; "Pretoria, International Atomic Energy Agency Sign Protocol," *Financial Times Information, Panafrican News Agency (PANA) Daily Newswire*, 14 September 2002, www.lexis-nexis.com/universe; "Strengthened Safeguards, Mali, Chile and South Africa," *International Atomic Energy Agency Staff Report*, 24 September 2002, www.iaea.org.

September 2002

Minerals and Energy Minister Phumzile Mlambo-Ngcuka states that South Africa is seeking to diversify its sources of energy, including using nuclear power, in order to generate a sustainable security of supply. South Africa's main source of energy is coal, which constitutes about 75% of energy generation, followed by oil and gas. Nuclear energy constitutes less than 5% of energy production.

— "South Africa to Diversify Sources of Energy," *BBC Monitoring Africa*, 26 September 2002, www.lexis-nexis.com/universe.

September 2002

The World Nuclear Association considers the results of the feasibility study carried out on the Eskom PBMR in South Africa as positive. It says the study predicts power generation between \$0.026/kWh and \$0.034/kWh, as long as series production could be achieved to reduce installation costs to \$1000/kW. If the project succeeds, the study predicts orders for 258 of the 140 MW units by the year 2027 and 1175 total orders in the long term.

Related content is available on the website for the Nuclear Threat Initiative, www.nti.org.



— "Study Predicts Pebble-Bed Success Story," *Modern Power System*, 30 September 2002, www.lexis-nexis.com/universe.

October 2002

South Africa dismisses British and U.S. media reports alleging South Africa's involvement in helping Iraq develop its nuclear weapons program as "unfounded and unsubstantiated." Britain's *The Spectator* and the U.S. *Insight on the News* both claimed that South Africa was selling Iraq aluminum tubes to help Baghdad develop nuclear weapons. Foreign Affairs spokesman Ronnie Mamoepa said the allegations were not only factually incorrect but could even be libelous. Mamoepa added that South Africa had constantly engaged with the UN to find a peaceful resolution to the current crises in the Middle East and had since 1991 committed itself to a policy of nonproliferation, disarmament, and arms control that covers all weapons of mass destruction and conventional weapons. Abdul Minty, chairperson of the South African Council for the Non-Proliferation of Weapons of Mass Destruction, said it "has not approved any exports of controlled goods, including special aluminum tubes that can be used for uranium enrichment, to Iraq."

— "South Africa Denies Providing Iraq with Nuclear Material," Panafican News Agency (PANA) Daily Newswire, 10 October 2002, www.lexis-nexis.com/universe.

October 2002

Foreign Affairs Deputy Minister Aziz Pahad states that implementation of the Pelindaba Treaty is hindered by lack of capacity and the conflict in the Middle East. Although 50 out of 54 African nations have signed the Pelindaba Treaty, an African initiative to ensure that the continent is free of nuclear weapons, only 17 out of 28 nations required for the treaty's entry into force have ratified it. Many African countries have not ratified the treaty due to their limited expertise in the nuclear field and lack of capacity to pass it through their legislatures. In North Africa, Arab nations have established a link between the Pelindaba Treaty and the creation of a nuclear weapon-free zone in the Middle East and progress in the Middle East peace process.

— "Mid East Conflict Hampers Nuclear-Free Africa," AllAfrica, Inc., Africa News, 23 October 2002, www.lexis-nexis.com/universe.

November 2002

During a session of the Russia-South Africa intergovernmental commission in Pretoria, Russian Vice Premier Valentina Matviyenko and South African Foreign Minister Nkosazana Dlamini-Zuma discuss new possibilities for economic and trade cooperation. The nuclear industry is one of several areas in which joint projects may be possible.

— "Russia, South Africa Intergovernmental Commission Starts Session in Pretoria," RIA Novosti, 18 November 2002, www.lexis-nexis.com/universe.

November 2002

Western Cape Provincial Premier Marthinus van Schalkwyk visits France as part of a week-long trade, tourism, and investment drive. His visit includes meetings with top management of Electricite de France (EDF) to learn about France's experience in producing safe nuclear energy. According to van Schalkwyk, Koeberg nuclear power station supplies almost 60% of the province's energy requirements and the visit to EDF demonstrated the government's "commitment to ensuring the highest international safety measures are in place."

— "W. Cape Leader in France to 'Learn' About Producing 'Safe' Nuclear Energy," Financial Times Information, 27 November 2002, www.lexis-nexis.com/universe.

Related content is available on the website for the Nuclear Threat Initiative, www.nti.org.



December 2002

South Africa's Pebble Bed Modular Reactor (PBMR) project announces that it has started up a test rig of its power conversion system. The test model represents the first closed-cycle, multi-shaft gas turbine in the world and replicates the functional layout of the PBMR power plant. According to PBMR CEO David Nicholls, the model "will fairly accurately predict the behaviour of the power plant and addresses one of the main technical risks of the project, namely the integrated controllability of a multi-shaft system."

— "Breakthrough for PBMR," *Nuclear Engineering International*, 19 December 2002, www.lexis-nexis.com/universe.

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2001

January 2001

The South African government agrees to allow two British cargo ships carrying reprocessed nuclear waste to sail past South Africa's Cape of Good Hope to Japan. The government also agreed to allow the British nuclear ships to take in fuel at the Cape without a nuclear license, contrary to Pretoria's laws which require one. The ships left Europe on 19 January and are expected to arrive in Japan in late March. The ships, the Pacific Pintail and Pacific Teal, are carrying MOX fuel, a mixture of plutonium and spent uranium in amounts large enough to build 20 atomic bombs, according to Greenpeace. However, the French nuclear group Cogema SA, which produces MOX fuel, insists the material is not weapons-grade.

— Nuclear fuel cargos to sail by South Africa to Japan," Agence France Presse - English, January 20, 2001; "SOUTH AFRICA GRANTS BRITISH NUCLEAR SHIP PASSAGE," Panafrican News Agency (PANA) Daily Newswire, 22 January 2001.

March 2001

A sectoral task team of South Africa's Minerals and Energy Department considers proposals for restructuring and privatizing parts of the South Africa Nuclear Energy Corporation (NECSA, formerly the Atomic Energy Corporation). While the Pelindaba Nuclear Institute and the Safari-1 reactor would likely remain state-owned, the commercial activities would be privatized. The restructuring would allow the corporation to become a more internationally focused supplier of technologically advanced products and services.

— "Nuclear Restructuring Planned," *Nuclear Engineering International*, 31 March 2001, www.lexis-nexis.com/universe.

April 2001

International Atomic Energy Agency (IAEA) Director-General Mohammad ElBaradei arrives in South Africa for talks on cooperation and nuclear nonproliferation. His visit will include meetings with South African senior government officials, touring nuclear research facilities at Pelindaba, and visiting the nuclear power reactor at Koeberg. South Africa receives more than one million dollars per year from the IAEA's technical cooperation program.

— "International Atomic Energy Chief Arrives in South Africa," Agence France Presse, 9 April 2001, www.lexis-nexis.com/universe.

July 2001

Members of the IAEA's International Nuclear Safety Advisory Group (INSAG) recommend a full review of the safety features of the Pebble Bed Modular Reactor (PBMR). They expressed concern that the safety evaluation would be

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rushed due to the current enthusiasm for the reactor and that some safety issues would be considered resolved based on assumptions from earlier experience with pebble bed high-temperature gas-cooled reactors. Safety issues cited include the vertical axis turbine, which has previously never been used in a nuclear plant, and the quality of the reactor's spherical graphite-clad fuel.

— "IAEA Cautions on PBMR Safety," *Nuclear Engineering International*, 31 July 2001, www.lexis-nexis.com/universe.

August 2001

Eskom's feasibility study for building the 110 MWe pebble bed modular reactor (PBMR) near Koeberg suggests that other sites be considered, since fuel must be transported by road from Pelindaba.

— "Cape Town May Lose PBMR," *Nuclear Engineering International*, 31 August 2001, www.lexis-nexis.com/universe.

August 2001

The U.S. Nuclear Regulatory Commission (NRC) refuses to approve containers made by the Nuclear Energy Corporation of South Africa for transporting hazardous material. The NRC would not validate South Africa's approval of the containers for use in the United States because the application, the South African license, and the design and test data upon which South African approval was based were full of inconsistencies. The containers' heavily shielded seven-ton units are designed for carrying cobalt-60 pencils. Observers consider the rejection a major embarrassment and potential threat to South Africa's efforts to sell revolutionary technology to the world.

— "Setback for Nuclear Industry," AllAfrica, Inc., 10 August 2001, www.lexis-nexis.com/universe.

November 2001

A regional public information seminar to promote public understanding of nuclear energy applications is held in Cape Town. The seminar, titled "Peaceful Uses of Nuclear Energy in the 21st Century" is hosted by the Department of Minerals and Energy (DME) in conjunction with the International Atomic Energy Agency (IAEA).

— "Government to Host Nuclear Seminar," AllAfrica, Inc., 12 November 2001, www.lexis-nexis.com/universe.

November 2001

South Africa commits itself to expansion of its nuclear capacity at a conference hosted by the International Atomic Energy Agency (IAEA). Phumzile Mlambo-Ngcuka, the South African minister of minerals and energy, said the country was striving to expand its role in nuclear technology by developing mini nuclear reactors. Eskom, the state-owned electricity utility, is developing 110 megawatt (MW) pebble bed modular nuclear reactors in partnership with British Nuclear Fuels and Exelon, the U.S. electricity utility. The government believes the reactors have considerable export potential, particularly to the United States, and could earn the country more than R18billion (\$1.9 billion) a year.

A concurrent *Financial Times* article by James Lamont suggests that nuclear expansion should be critiqued in light of possible nuclear terrorism after the attacks on the United States on September 11. Lamont states: "Although [South Africa] has dismantled its weapons-making programme, South African scientists and military procurement agents were feared to be passing on technology to other states, including Iran. The country was most recently linked to the possible sale of nuclear material by the court testimony of Jamal Al Fadl, an aide to Osama bin Laden, the terrorist suspect. Mr Al Fadl said he was involved in an attempt to buy \$1.5 billion of uranium, which he believed had originated in South Africa." According to the article, South African Minister of Minerals and Energy Mlambo-Ngcuka explains: "One of the greatest injustices that has befallen this sector is its development during the era in which security and secrecy were the order of the day. It stigmatized a technology whose discovery had not been intended as a tool for ideological bargaining."

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— James Lamont, "South Africa to expand its nuclear capacity; International Atomic Energy Agency Conference Minister of Minerals and Energy Says Country Aims to Develop Mini," *Financial Times*, 14 November 2001.

December 2001

The decision to pursue construction of the pebble bed modular reactor (PBMR) demonstration plant in South Africa has been delayed for up to 12 months, pending resolution of issues concerning the turbine design and the graphite core internals. Based on the results of a feasibility study, however, the consortium (South Africa's Eskom and International Development Corporation, the UK's BNFL, and the US's Exelon) reaffirmed its support for the project.

— "Pebble Bed Demo Delayed," *Modern Power System*, 31 December 2001, www.lexis-nexis.com/universe.

December 2001

After a feasibility study on the pebble bed modular reactor (PBMR) shows the technology is broadly viable, Exelon, one of the biggest power groups in the United States, negotiates to buy 40 mini nuclear reactors from South Africa. The total order could be worth as much as US\$6 billion.

— "US Firm Negotiating to Buy "40 mini nuclear reactors" from South Africa," *BBC Monitoring Africa*, 5 December 2001, www.lexis-nexis.com/universe.

December 2001

South Africa's Nuclear Energy Corporation (NECSA) hosts nuclear experts from Sweden and The Netherlands for meetings to share expertise and experience in the safe and efficient running of the world's three leading nuclear research reactors: South Africa's Fundamental Atomic Research Installation (SAFARI-1), Sweden's R2 Reactor at Studsvik, and the High Flux Reactor (HFR) at Petten in The Netherlands.

— "Nuclear Experts Meet," *AllAfrica, Inc.*, 5 December 2001, www.lexis-nexis.com/universe.

December 2001

During his first visit to China as president of South Africa, Thabo Mbeki announces that the Chinese and South African governments are close to finalizing a cooperation agreement on the peaceful use of atomic energy. Mbeki stated that Chinese experts already work at South Africa's Pebble Bed Modular Reactor (PBMR). After severing diplomatic ties with Taiwan in 1998, China and South Africa normalized relations and bilateral ties continue to solidify.

— "China, South Africa to Cooperate in Nuclear Energy," *Agence France Presse*, 11 December 2001, www.lexis-nexis.com/universe.

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2000

February 2000

The U.S. Department of Energy issues a joint statement by delegates from Argentina, Brazil, Canada, France, Japan, South Africa, South Korea, the United Kingdom, and the United States, expressing agreement to pursue Generation IV nuclear power systems as a possible future energy alternative. Such advanced power systems are economically competitive and could be deployed in the next 20 years when electricity demand increases worldwide.

— "United States and Eight Countries Issue Joint Statement on Generation IV Nuclear Power Systems," *FDCH Federal Department and Agency Documents*, 10 February 2000, www.lexis-nexis.com/universe.

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February 2000

A team from the United States travels to South Africa to evaluate its small-scale Pebble Bed Modular Reactors. The U.S. team, including the Nuclear Regulatory Commission, the Department of Energy, the State Department, and the Idaho Nuclear Engineering and Environmental Laboratory meet the design team of Eskom (Electricity Supply Commission), an unregulated affiliate of South Africa's state-owned utility. In a subsequent letter dated 31 March, U.S. Energy Secretary Bill Richardson states: "the team believes that the project is viable and can be successful. The design has the potential to provide a new energy production alternative for the US." Eskom continues to seek international investors for its PBMR.

— "US Backing for Pebble Bed," Nuclear Engineering International, August 31, 2000; Rebecca Smith, "US Backing for Nuclear-Power Project in South Africa Raises Hope and Dissent," *Wall Street Journal*, 15 June 2000.

April 2000

National electricity supplier Eskom receives Cabinet approval to proceed with its detailed feasibility study for the pebble bed modular reactor (PBMR), an experimental nuclear reactor. The approval allows Eskom to perform an environmental impact assessment (EIA) for the construction planned for Koeberg in the Western Cape. The next stage of the project, the construction of a demonstration plant and nuclear commissioning, will require another Cabinet authorization. The PBMR utilizes helium coolant, a graphite moderator and ceramic fuel pellets. The process reportedly allows for operation at very high temperatures, increasing the amount of energy for conversion into electricity, and produces less nuclear waste than the current reactors at Koeberg. By exporting the miniature nuclear plants, Eskom predicts it could earn over 18 billion Rand/year.

— "Eskom Gets Go Ahead for Pebble Bed Nuke EIA," Financial Times Information, South African Press Association, 12 April 2000, www.lexis-nexis.com/universe; "Environment-South Africa: No to Nuclear Technology," Business and Industry Interpress Service, 18 April 2000, www.lexis-nexis.com/universe.

April 2000

South Africa and six other countries (Mexico, Brazil, Egypt, Ireland, New Zealand, and Sweden) form a coalition at the 2000 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). Their joint declaration, "Towards a Nuclear Weapon Free World: The Need for a New Agenda" aims to refocus on the NPT agenda, emphasizing the total elimination of nuclear arsenals.

— "Mexico and Six Other Countries Launch Declaration on Nuclear Weapon Free World," Xinhua News Agency, 24 April 2000, www.lexis-nexis.com/universe.

May 2000

A recently deciphered transcript from the flight recorder of the South African Airways Boeing 747 called "the Helderberg," which crashed into the sea off Mauritius in 1987, raises new suspicions that a nuclear bomb was aboard the plane. The crash killed all 159 on board and remains South Africa's greatest aviation mystery. The plane was en route from Taipei to Johannesburg during the time that the apartheid government was developing its nuclear capabilities and engaging in arms trade with Taiwan. Although a three-year judicial inquiry found that no one was to blame for the crash, the new evidence has prompted some to consider reopening the inquiry.

— "Fresh Evidence that Helderberg Carried Nuclear Material," Financial Times Information, 23 May 2000, www.lexis-nexis.com/universe.

May 2000

The South African Nuclear Energy Corporation (NECSA) admits that its Pelindaba facility inadvertently discharged higher than allowed amounts of radioactive liquid material into the Crocodile River in the second quarter of 1999. The National Nuclear Regulator (NNR), which monitors South Africa's nuclear industry, found no negative impact

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on the environment from the radioactive discharge, but gave NECSA 24 hours to demonstrate that it had implemented all necessary measures to remedy the situation.

— "Nuclear Waste Pumped into S. Africa River Exceeds Legal Limit," Agence France Presse, 30 May 2000, www.lexis-nexis.com/universe.

June 2000

British Nuclear Fuels (BNFL) signs an agreement to invest in Eskom's Pebble Bed Modular Reactors in South Africa, acquiring a 20% equity stake in the enterprise. BNFL also agrees to finance the building of the reactor's prototype, with a view to exporting the design to other countries. The plan is attacked by Earthlife Africa as well as local environmental groups.

— "British Nuclear Fuels to finance mini-reactor in South Africa," Deutsche Presse-Agentur 13 June 2000; "US Backing for Pebble Bed," Nuclear Engineering International, 31 August 2000.

July 2000

South Africa's unique compact Pebble Bed Modular Reactor attracts purchasing interest from the United States, Britain, China, Japan, France, Egypt, Indonesia, Morocco, and Tunisia because the unique reactor is "safer, cheaper and cleaner" than conventional nuclear power systems. Public Enterprises Minister Jeff Radebe said that not one of these countries has as yet signed export contracts, as the gravel bed reactor is still in the developmental phase.

He added that the new system will only be sold to countries who have signed the nuclear Non-Proliferation Treaty. — "Foreign interest shown in buying 'unique' nuclear reactor," British Broadcasting Corporation - BBC Summary of World Broadcasts, July 08, 2000; James Lamont, "South Africa to expand its nuclear capacity; International Atomic Energy Agency Conference Minister of Minerals and Energy Says Country Aims to Develop Mini," *Financial Times*, 14 November 2001.

September 2000

The South African and Indian defense ministers sign a cooperation agreement on defense, military research and procurement, saying it could facilitate arms trade between them.

— "S.Africa, India sign defence cooperation agreement," Agence France Presse - English, 27 September 2000.

October 2000

Eskom secures a second international partner for its Pebble Bed Modular Reactor Project: Peco Energy, a United States utility. In June 2000, British Nuclear Fuels took a 20% stake in the project.

— "News Digest: South Africa, Peco Energy," *Power Engineering International*, October 2000, www.lexis-nexis.com/universe.

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1999-1998

1999

South Africa passes the Nuclear Energy Act to "[t]o provide for the establishment of the South African Nuclear Energy Corporation Limited...for the implementation and application of the Safeguards Agreement and any additional protocols entered into by the Republic and the International Atomic Energy Agency in support of the Nuclear Non-Proliferation Treaty acceded to by the Republic; to regulate the acquisition and possession of nuclear fuel, certain nuclear and related material and certain related equipment, as well as the importation and

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exportation of, and certain other acts and activities relating to, that fuel, material and equipment in order to comply with the international obligations of the Republic; to prescribe measures regarding the discarding of radioactive waste and the storage of irradiated nuclear fuel; and to provide for incidental matters."

— Parliament of the Republic of South Africa, "Nuclear Energy Act," 1999, www.polity.org.za.

30 March 1999

South Africa ratifies the CTBT.

— Preparatory Commission for the Comprehensive Nuclear-Test Ban Treaty Organization, "State Information: South Africa," undated, www.ctbto.org.

January 1998

Stumpf states that the first shipments of components from the AEC zirconium tubing plant to China will not "get under way for two to three months." US officials say that an official note from Beijing declared that Chinese firms had already begun construction of the zirconium tubing plant being exported to Iran and that the South African plant would not be shipped to Iran. Hence, the US officials reportedly concluded that the two sales were unrelated. Other US officials expressed reservations about the ultimate destination of the South African plant.

— Mark Hibbs, "Plant Raises Questions on Controls in China, South Africa," *NuclearFuel*, 12 January 1998, p. 4.

February 1998

Former AEC scientists charge that the AEC misused R300 million a year of government funding to pay for commercialization activities instead of other approved projects.

— *Business Report*, February 1998; in "Misuse of Funds Puts AEC in Peril," *Independent Online*, February 1998 www.inc.co.za.

March-April 1998

The NPC is to decide whether to authorize the export of the zirconium tubing plant to China.

— Mark Hibbs, "South African Export to China to Be Decided Later this Month," *NuclearFuel*, 9 March 1998, p. 4.

March 1998

A study by the South African cabinet recommends that the AEC be divided into two divisions, one of which should be privatized. According to the study, a new public company named AEC Technology should be established to develop and market technologies from the Pelindaba and Valindaba facilities. The government, however, would retain responsibility for certain nuclear fuel-related activities, including radioactive waste management.

— "Government May Split AEC," *Mail & Guardian Online*, 19 March 1998, www.mg.co.za.

March 1998

The AEC begins work on sealing and capping the intermediate-level radioactive waste (ILW) trench at the Vaalputs facility. The trench is only two-thirds full, but is being closed earlier than planned due to the discovery in 1997 that concrete drums containing ILW from the Koeberg Nuclear Power Station had developed cracks. The low-level radioactive waste (LLW) trench will also be capped once work on the ILW trench at Vaalputs has been completed. In the future, the AEC will excavate smaller trenches to be used for shorter periods. The AEC has also begun a study to determine if Vaalputs can be upgraded to store spent fuel rods from Koeberg. The rods are currently stored on racks in a reactor pool at the Koeberg nuclear power station.

— SAPA, 7 April 1998; in FBIS Document FBIS-TEN-98-097 (7 April 1998); "'Leaky' Vaalputs to Store Uranium Rods," *Mail & Guardian Online*, 13 April 1998, www.mg.co.za.

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4 March 1998

According to NPC Chair Abdul Minty, the South African media inaccurately reported that Chinese workers packing up the zirconium tubing plant were illegally in the country. In fact, he says that the workers' visas had been approved by the Department of Home Affairs.

— Mark Hibbs, "South African Export to China to Be Decided Later this Month," *NuclearFuel*, 9 March 1998, p. 5.

13 March 1998

South Africa ratifies the Treaty of Pelindaba. It is the fifth African state to ratify the accord.

— "Signatories to the African Nuclear-Weapon-Free Zone Treaty," US Arms Control and Disarmament Agency; US Department of State, "African Nuclear-Weapon-Free Zone Treaty (The Treaty of Pelindaba)," undated, www.state.gov.

27 March 1998

South Africa submits its instrument of ratification of the Treaty of Pelindaba to Organization of African Unity (OAU) Secretary-General Salim Ahmed Salim.

— Panafrican News Agency, 28 March 1998; in FBIS Document FBIS-TAC-98-087, 28 March 1998.

April 1998

The AEC is selling 2,000t of partially depleted uranium in the form of UF₆ to Edlow Resources Limited of the United States. The UF₆ will be re-enriched in Russia and will then be sold for use in commercial power stations.

— Atomic Energy Corporation of South Africa Limited, "Sale of Partially Depleted Uranium," www.anc.org.za.

April 1998

Minerals and energy deputy director general Gordon Sibiya announces that the South African Parliament will table amendments to the Nuclear Energy Act that would give the Mineral Affairs and Energy Minister more power over the AEC. The amendments would curb AEC autonomy on "sensitive issues," such as uranium transactions, and allow the minister to oversee organizational restructuring of the AEC.

— "Maduna Gets Grip on AEC," *Mail & Guardian Online*, 29 April 1998 www.mg.co.za; "Nuclear Energy Bill Will Extend Minister's Powers," African News Service, 29 April 1998.

May 1998

A container holding a radioactive isotope is stolen from the cargo section of Johannesburg International Airport. The isotope, which is en route to Brazil, was produced at the Safari reactor at Pelindaba and cannot be used to produce nuclear weapons. The AEC says that it is "not responsible for nuclear material" once it leaves their facility, and blames the theft on a lapse of "outside safety rules." According to press reports, more than 30 similar containers "have gone missing" since May 1996. [Note: The isotope is described as "extremely hazardous" but is not specified, although the Safari reactor is known to be one of the largest producers of Molybdenum-99, a radioisotope used in the medical industry.]

— "Radioactive Material Stolen from Johannesburg Airport," *SAPA*, 16 May 1998, www.anc.org.za; "NECSA Corporate Profile," Nuclear Technology Products Division, Nuclear Energy Corporation of South Africa, undated, www.radioisotopes.co.za.

May 1998

In response to Indian and Pakistani nuclear weapons tests, the Department of Foreign Affairs issue a statement that "as a matter of principle, South Africa opposes all nuclear tests since they do not contribute to promoting world peace and security. South Africa believes that security is provided by nuclear disarmament rather than by

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nuclear proliferation."

— Department of Foreign Affairs, "South Africa Concerned at Pakistani Nuclear Tests," 28 May 1998; "Foreign Affairs Statement on Indian Nuclear Tests," 12 May 1998; "SA Concern at Subsequent Indian Nuclear Tests," 13 May 1998, gopher://gopher.anc.org.za.

1 June 1998

Eskom spokesman Tony Stott says that development of "pocket-sized" nuclear power stations for South Africa looks "promising," although "much work" is still required. The power stations would be small enough to be located on factory sites or in municipal areas. The plant designers state that the new power stations could not melt down, and would be able to store their own waste for 40 years. The stations will use gas-cooled pebble bed molecular reactors (PBMR). Stott said that Eskom still has to finalize the design, finish environmental impact studies, and obtain licenses from the National Electricity Regulator and CNS.

— "Small, Safe Nuclear Power Stations a Promising Idea: Eskom," *SAPA*, 1 June 1998, www.aec.co.za; David Shapshak, "Science and Health: New Ways to Create Energy," *Africa News*, 5 June 1998.

9 June 1998

In a joint declaration with the ministers of foreign affairs of Brazil, Egypt, Ireland, Mexico, New Zealand, Slovenia, and Sweden, South Africa calls on the nuclear weapon states (NWS) and the "three nuclear-weapons-capable states" (i.e., India, Israel, and Pakistan) to commit to complete nuclear disarmament and to begin work on the specific steps and negotiations to achieve this goal. The foreign ministers call on the NWS to commit to the adoption of legally-binding no-first-use policies regarding their nuclear weapons, and to provide negative security assurances to non-nuclear weapon states. They urge that negotiations on a fissile material cut-off treaty begin immediately, and call on the three nuclear-weapon-capable states to adhere to the NPT and ratify the CTBT without attaching conditions to the treaty.

— Ministry of Foreign Affairs, "Towards a World Free from Nuclear Weapons: The Need of a New Agenda," 9 June 1998, www.mre.gov.br; "South Africa Joins Other in Calling for Nuclear Disarmament," *Xinhua*, 9 June 1998; AP, "Eight States Demand that Power Disarm within a Few Years," 9 June 1998; *Xinhua*, "Conference on Disarmament Hears Joint Declaration on Nuclear Disarmament," 11 June 1998.

July 1998

Eskom has sufficient storage space at the Koeberg Nuclear Power Station for high-level nuclear waste for only one more annual reloading of its reactors. According to the CNS, the decision regarding storage of additional high-level waste will be made in March 1999. Eskom has proposed re-racking its storage ponds in order to create space for the reactors' high-level waste until 2024. However, CNS has not granted a license for the modification.

— John Yeld, "Nuclear Watch Dog Quells Koeberg 'Crisis' Fears," *Cape Argus*, 23 July 1998.

17 August 1998

The AEC issues a press release announcing that it is seeking bids for purchase of its "redundant nuclear fuel fabrication equipment." Eskom's pebble-bed reactor program will require a different type of fuel than the Koeberg reactors, and therefore new equipment must be installed. The AEC invites international buyers to submit a tender on equipment that had been used in the manufacture of fuel pellets and fuel assemblies for PWRs. South Africa's conversion facilities are expected to close in mid-1999, and some equipment from the gas-to-powder conversion facility may also be sold. The equipment "in most cases" is only suitable for producing PWR or boiling water reactor (BWR) fuel. The press release notes that the equipment will only be sold to nations that are signatories to the NPT, and that export of the equipment is subject to South African nuclear export controls.

Related content is available on the website for the Nuclear Threat Initiative, www.nti.org.



— Atomic Energy Corporation, "Sale of Nuclear Fuel Fabrication Equipment on Tender," 17 August 1998, www.aec.co.za.

August 1998

Eskom is recruiting specialists to manage the environmental study of its PBMR project. The decision to proceed to the next phase of the project—construction of a pilot plant—depends on the outcome of the environmental study and evaluation of the reactor's commercial competitiveness. According to Eskom, South Africa could construct a PBMR in two years with an investment of \$88 million.

— "Eskom Pursues Study of High Temperature Reactor," *Enerprese*, 26 August 1998.

17 September 1998

Both reactors at the Koeberg Nuclear Power Station are temporarily shut down after technical faults are discovered in the turbine units. This is the first time that both units have been shut down simultaneously.

— *Cape Argus*; in "Koeberg Shut Down Power," *Independent Online*, 17 September 1998, www.inc.co.za.

October 1998

The Western Cape's committee on agriculture, environment affairs, tourism, and gambling conducts a public inquiry into safety at the Koeberg nuclear power plant, the proposal to increase the plant's spent fuel storage capacity, and development of PBMR. Peter Stott, Koeberg public relations officer, testifies before the committee that Eskom has ruled out sending Koeberg's spent fuel abroad for reprocessing due to cost considerations. Instead, Eskom would prefer to double the capacity of Koeberg's existing spent fuel storage rack, which will be filled to capacity in approximately 18 months.

— Sharkey Isaacs, *Saturday Argus*; in "Koeberg Under a Microscope," *Independent Online*, 20 October 1998, www.inc.co.za.

November 1998

Eskom is expected to decide by the end of 1999 whether it will construct a PBMR. A complete plant would consist of 10 modules of 115MW each. Eskom has estimated that the design and construction of a PBMR demonstration unit would cost \$200 million, and that subsequent 115MW units would cost \$100 million each. After it completed prefeasibility studies for the project, Eskom received government authorization in late 1997 to proceed with concept design. Pending the formation of a joint venture, Eskom "is looking at a construction commitment" in late 1999. Eskom is expected to complete design plans by March of 2001. If the project is on schedule, Eskom could load the fuel in the demonstration unit in 2003, with full operations commencing in mid-2004.

— Ann MacLachlan and Elaine Hirou, "Old Technology May Hold Promise for Future Power," *Nucleonics Week*, 19 November 1998, pp. 13-15; *Nikkei Sangyo Shimbun* (Tokyo), 18 November 1998; in FBIS Document FBIS-EAS-98-341, 7 December 1998.

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1997

January 1997

South Africa's Department of Art, Culture, Science and Technology (DACST) publishes its "Review of the Atomic Energy Corporation." The DACST Review Team finds that "the main raison d'être of the AEC no longer applies," as

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South Africa does not foresee investment in nuclear power for electricity generation or nuclear weapons. It concludes that the country "has no obvious need for an indigenous capability in nuclear energy."

The review states that the Safari-1 research reactor is currently using 93 percent HEU from the nuclear weapons program, and notes US pressure to convert the reactor to rely instead on 20 percent enriched uranium. However, due to the lack of financial support for reactor conversion and lower efficiencies in production of the medical isotope Molybdenum99 (Mo99), the AEC is committed to using the HEU stockpile to fuel the reactor. Beginning in 1998, the AEC's Hot Cell Complex will be employed for Mo99 production. The Review Team concludes that because the Safari reactor is used primarily for commercial purposes and its future income will not cover the reactor's operational cost, therefore the "available evidence points to its closure."

The review says that it is "highly unlikely" that South Africa will construct any large-scale nuclear power stations "in the foreseeable future." Eskom, in cooperation with German firms, is conducting pre-feasibility studies into construction of a 100MW pebble-bed high-temperature gas-cooled reactor. Eskom invested R9 million in the project in 1997, and has budgeted R35 million for 1998. The Review Team expresses concern "about the high risks of South African involvement in a new and unproven nuclear power technology whose development costs will be enormous."

The Review Team recommends the creation of a public company to be called AEC Technology Ltd. with responsibility for commercialization and industrialization of Pelindaba and Valindaba technology and products, particularly in the area of fluorine chemicals.

— K. Bharath-Ram, et al., *Review of the Atomic Energy Corporation*, Department of Arts, Culture, Science and Technology, January 1997, www.dacst.gov.za.

June 1997

Giep du Toit, general manager of the MLIS enrichment technology project, says that South Africa is in the "advanced research phase and early development phase" of the program.

— "SWU's Future: Race of the Lasers," *Nukem*, June 1997, p. 8.

July 1997

The Z-plant is being dismantled and its component materials are being sold for scrap. The government spent at least R700 million to construct the facility, and the AEC is spending R85 million to decontaminate and disassemble the plant. AEC officials comment that they "would be lucky" if the sale of scrap from the plant raised R6 million. According to AEC senior consulting engineer Johan Niewenhuys, a pilot enrichment plant will be built in the shell of the plant to develop MLIS technology and produce fuel for Koeberg and other nuclear reactors. However, Dr. Gordon Sibiyi, Deputy Director General of the Department of Minerals and Energy, says that a new plant is "not in the cards." Mojalefa Murphy, a nuclear scientist and AEC spokesperson, declares that there were not more than "30 internationally competitive scientists working here at the moment out of the 1,000 that used to be here."

— Swapna Prabhakaran, "Pelindaba Bomb Fuel Plant Sold as Scrap," *Electronic Mail and Guardian*, 11 July 1997 www.mg.co.za; Freek Robinson, SABC 2 Television Network (Johannesburg), 7 July 1997; in FBIS Document FBIS-TAC-97-191, 10 July 1997.

18 July 1997

Following an international tendering process—but without public disclosure or coordination with government agencies—the AEC approves the sale of its zirconium tubing plant to China in exchange for \$5 million and a titanium processing plant that China will provide to South Africa. The zirconium tubing plant will be sold to Pacific Development Services (PDS) of the Channel Islands, which will arrange for a team of engineers, scientists, and technicians to dismantle the plant. It will then be sold to the China Nuclear Energy Industry Corporation of Beijing, to be re-erected in China. Other sources indicate that PDS will sell the plant to the China National Nonferrous

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Industry Corporation at Shaanxi.

— Andrew Koopman, *Cape Times*, December 1997; in "Tutu Was Broker," *Independent Online*, 12 December 1997 www.inc.co.za; "Nuclear Equipment Sold to China," *Independent Online*; Mark Hibbs, "End-User Statement, Export Permit Still Pending for AEC-China Deal," *NuclearFuel*, 29 December 1997, p. 3.

22 July 1997

South Africa releases its draft Nuclear Energy Act for public comment. The act will reduce the commercial independence and materials control function of the AEC, and transfer safeguards functions from the AEC to the CNS. The CNS is currently responsible for licensing nuclear facilities and ensuring safe transportation of nuclear materials. The bill may also further reduce staffing at AEC. During the 1990-1997 period, AEC personnel were cut from 8,000 to 2,000.

— Marion Bidoli, "Atomic Energy Corp in Danger of Being Vaporized," *Financial Mail*, 15 August 1997, www.fm.co.za.

August 1997

AEC general manager Mojalefa Murphy comments that South Africa has "already lost hundreds of experienced scientists and engineers to overseas research institutions," and that the AEC has "moved so far down the commercial route that we risk losing all capability to do fundamental nuclear research."

— Marion Bidoli, "Atomic Energy Corp in Danger of Being Vaporized," *Financial Mail*, 15 August 1997, www.fm.co.za.

September 1997

Jane's International Defense Review reports that Waldo Stumpf said that Reza Amrollahi, Iran's deputy minister for atomic affairs, visited South Africa in 1996 with "a comprehensive list of requested items essential for the production of weapons of mass destruction," and that South Africa denied the Iranian requests. However, in a letter to the editor of Jane's Information Group, Stumpf writes that he has never met Amrollahi, but said that he had met with Iran's Minister of Petroleum Gholamreza Aghazadeh in March 1995 regarding storage of Iranian oil at Saldanha Bay in South Africa. Former Mineral and Energy Affairs Minister Pik Botha says that Stumpf and Aghazadeh had discussed nuclear issues, including the termination of the South African nuclear weapons program, the country's accession to the NPT, the unfinished Bushehr nuclear power reactor in Iran, and South Africa's uranium export policy. Stumpf denies that he was presented with a list of desired items. Iran had previously approached South Africa about purchasing hundreds of tons of "uranium dioxide concentrate (yellowcake) feedstock" as well as a small quantity of low-enriched uranium. However, Mineral and Energy Minister Penuell Maduna says the AEC has not been involved in "business transactions" with Iran, and that none are presently under consideration.

— Al J. Venter, "Iran's Nuclear Ambition: Innocuous Illusion or Ominous Truth?" *Jane's International Defense Review* 30 (September 1997): 29-30; Inigo Gilmore, "Iran Sought Pretoria Nuclear Deal," *The Times* (London), 16 August 1997 www.sunday-times.co.uk; SAPA, 26 August 1997; in FBIS Document FBIS-TAC-97-238, 26 August 1997; "AEC Has No Business With Iran: Maduna," SAPA, 11 September 1997, www.aec.co.za.

September 1997

South Africa closes its nuclear fuel plant at Vaal Reefs. The closure of the plant will cut uranium production in South Africa from 1,600t in 1996 to 1,300t in 1997. Charles Scorer of NUF COR forecasts that uranium production in South Africa will bottom out at 1,000t per year.

— Stuart Rutherford, "Gold Nukes Thriving Sector: Nuclear Fuels Producer Also Battered by Market Fall-Out," *Uranium*, 26 September 1997, www.fm.co.za.

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October 1997

Forty Chinese nuclear technicians and engineers begin working in secret at Pelindaba to dismantle the South African zirconium tubing plant for shipment to China.

— "Apology to Nuclear Workers," *The Star*, December 1997; in Independent Online, www.inc.co.za AFP, "South Africa Sold Nuclear Hardware to China," 14 December 1997.

November 1997

Following Cogema's withdrawal from the project, the AEC announces that it will cease development of the MLIS uranium enrichment process. Stumpf says that the closure of the project will directly affect a staff of 200, many of them among "the world's most advanced laser specialists."

— Ann MacLachlan and Michael Knapik, "South Africa to End MIS SWU Project," *NuclearFuel*, 29 December 1997, p. 4.

November 1997

According to a senior administrator involved with South Africa's safeguards commitments, personnel from the nuclear program with weapons-related knowledge have either retired or found other employment. However, the administrator is not aware of any formal study to track former personnel from the nuclear program, or of evidence that any of them are involved in the nuclear programs of "threshold" states.

— Rianne van Vuuren, electronic mail communication with Michael Barletta, 28 November 1997.

December 1997

Stumpf says that in early December 1997, the AEC and PDS separately notified South Africa's Council for the Non-Proliferation of Weapons of Mass Destruction Council (NPC) the country's authority for the export of dual-use nuclear goods—that the AEC's zirconium tubing plant would be exported to China. However, neither the AEC, PDS, nor China has filed an export permit request with the Council. Media reports suggest that the sale of the plant "seems to have been rushed through" before the government's review of scientific and technological institutions is reported to the cabinet in 1998. Rajen Govender, the review's coordinator, says that "we unfortunately do not have the jurisdiction to stop the boards [from] selling assets," and that national nuclear energy legislation grants the AEC "tremendous power."

— Mark Hibbs, "Plant Raises Questions on Controls in China, South Africa," *NuclearFuel*, 12 January 1998, p. 4; "Is Iran in RSA-China Zirconium Deal?" *Jane's Pointer*, February 1998, p. 1; "South Africa Sells China Nuclear Plant," *Guardian*, 14 December 1998.

3 December 1997

Police and immigration officers raid AEC premises at Pelindaba, finding the 40 Chinese nuclear technicians working there in secret to dismantle the South African zirconium tubing plant. The workers possess South African business permits, but the Department of Home Affairs says that instead they need work permits. Albert Mokoena, South African Director General of home affairs, later issues a public apology to the Chinese technicians and to "anybody who might have been inconvenienced" by the raid.

— "Apology to Nuclear Workers," *The Star*, December 1997; in *Independent Online* www.inc.co.za.

12 December 1997

A joint probe by the *Sunday Independent* and SABC-TV reveals that the AEC is selling its zirconium tubing plant to China for \$5 million, reportedly in exchange for a titanium processing plant worth \$10 million to be provided to

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South Africa. The report makes public the immigration raid on Pelindaba of 3 December 1997. According to Abdul Minty, deputy-director general of the Department of Foreign Affairs and chairman of the Council for the Non-Proliferation of Weapons of Mass Destruction Council (NPC)—the South African nuclear export control authority—he was previously unaware of the planned sale. Minty said that unless the sale were considered a question of national security, he would not have been personally informed in advance of a regular meeting of the NPC, which take place every four to six weeks.

— Andrew Koopman, "Tutu Was Broker," *Cape Times*, 12 December 1997; in *Independent Online*, 12 December 1997, www.inc.co.za; Mark Hibbs, "Plant Raises Questions On Controls In China, South Africa," *NuclearFuel*, 12 January 1998, 4-5; Mark Hibbs, "South African Export to China to Be Decided Later This Month," *NuclearFuel*, 9 March 1998, p. 4.

18 December 1997

South Africa's Ministry of Foreign Affairs (MFA) states that China has not provided end-user certification for the zirconium tubing plant that South Africa is to supply to China. The MFA says that the sale includes three pieces of equipment, described as computer numerically controlled (CNC) machine tools used to make complex molds, which require authorization for export under the Nuclear Suppliers Group dual-use guidelines. A US State Department spokesperson says that while South Africa has "first rate" nonproliferation credentials, due to the existing China-Iran relationship the United States is seeking assurances that the zirconium tube will not be transferred to Iran. The spokesman acknowledges that in general, "the transfer of zirconium refuel fabrication technology and equipment is not normally a proliferation-sensitive issue," and the equipment is not on the NSG "trigger list."

— Mark Hibbs, "End-User Statement, Export Permit Still Pending For AEC-China Deal," *Nuclear Fuel*, 29 December 1997, p. 3; Simon Barber, "US Seeks Assurance on Atomic Energy Plant Sale to China," *Business Day* (Johannesburg), 18 December 1997; in FBIS-TAC-97-352, 18 December 1997.

19 December 1997

According to Waldo Stumpf, the AEC submits to South Africa's Council for the Non-Proliferation of Weapons of Mass Destruction Council (NPC) a formal application for an export license to ship the zirconium tubing plant to China.

— Simon Barber, "US Seeks Assurance on Atomic Energy Plant Sale to China," *Business Day* (Johannesburg), 18 December 1997; in FBIS Document FBIS-TAC-97-352, 18 December 1997.

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1996

1 March 1996

Stumpf announces that the AEC cannot locate two tons of depleted uranium missing "somewhere in the system." Stumpf says he suspects that the material may be in a nuclear condenser damaged in a 1990 incident, which was contaminated with uranium. The condenser was sealed and buried with other radioactive waste on Thabana Hill (a.k.a. Radiation Hill) at Pelindaba. In April 1995, the AEC began to excavate the site, although it had not obtained the necessary authorization from the CNS. During the excavation, a mechanical digger ruptured many of the waste drums, contaminating the site.

— "Atomic Energy Corporation Missing 2 Tons Treated Uranium," SAPA, 1 March 1996 www.aec.co.za.

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11 March 1996

South Africa and France sign an agreement for joint development of South Africa's MLIS uranium enrichment process, which had been under development since 1983. The AEC projects an annual budget of \$13 million. The French firm Cogema will support half of the project's expenditures for a three-year period.

— Atomic Energy Corporation of South Africa, Annual Report 1998, www.aec.co.za; Ann MacLachlan, "Cogema to Help South Africa's AEC Develop MLIS Enrichment Process," *NuclearFuel*, 11 March 1996, p. 4.

20 March 1996

Mineral and Energy Affairs Minister Pik Botha says that the AEC uranium enrichment plants at Pelindaba will be dismantled by the end of March 1999, "with possibly some continuation of decontamination of equipment over the next year or two."

— "Uranium Enrichment Plants Will Be Nearly Dismantled by 1999: Botha," *SAPA*, 20 March 1996, www.aec.co.za.

11 April 1996

South Africa and 42 other African states sign the African Nuclear-Weapon-Free-Zone Treaty (the Treaty of Pelindaba) in Cairo, Egypt.

— U.S. Department of State, "African Nuclear-Weapon-Free Zone Treaty (The Treaty of Pelindaba)," 11 April 1996, www.state.gov.

June 1996

South Africa is admitted to the UN Conference on Disarmament in Geneva.

— "U.N. Disarmament Conference Admits 23 New Members," *AFP*, 17 June 1996.

June 1996

South Africa's mineral and energy affairs minister, Pik Botha, discloses that South Africa supplied France with uranium in the forms of yellowcake and uranium hexafluoride between 1977-1994. Botha says that modern nuclear weapons use plutonium, and therefore "it is consequently highly improbable that South African uranium could have been used in the recent French nuclear weapon tests."

— "France Imports Uranium from S. Africa," *Xinhua*, 26 June 1996.

24 September 1996

South Africa signs the Comprehensive Test Ban Treaty (CTBT). South Africa is one of 44 countries that must ratify the CTBT for it to take legal force, and South Africa will host five monitoring stations established to verify the treaty.

— Preparatory Commission for the Comprehensive Nuclear-Test Ban Treaty Organization, "State Information: South Africa," undated, www.ctbto.org; and "Status of the 44 States Whose Ratification is Required for the Treaty to Enter Into Force (Article XIV)," undated, www.ctbto.org.

January 1995

Former Foreign Minister Pik Botha says that in 1981, US President Ronald Reagan agreed to assist South Africa in acquiring enriched uranium after Botha assured Reagan that South Africa would not conduct a nuclear test without first informing the United States. Botha states that he raised the issue of the Koeberg reactors with Reagan, and asked "that the United States withdraw its pressure on France not to make the fuel elements" for the reactors.

— "S. Africa Says Reagan Helped It Get Nuclear Fuel," *Reuters*, 10 January 1995.

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March 1995

A delegation headed by South Africa's energy minister Pik Botha reportedly meets with Iranian officials to discuss nuclear cooperation.

— James Adams, "US Fears South Africa Will Sell Nuclear Technology to Tehran," *The Times* (London), 23 April 1995.

March 1995

South Africa closes the Z-plant, which has produced uranium to fuel the Koeberg power reactors since 1987. The plant is closed a year earlier than planned, because South Africa can purchase enriched uranium at a lower cost on the world market. As a result, South Africa will have no domestic enrichment facilities until the AEC's Molecular Laser Isotope Separation (MLIS) program becomes operational. According to AEC executive director Waldo Stumpf, the AEC is currently involved in talks to secure international cooperation on the MLIS project.

— Reuters; in "South Africa to Close Uranium Enrichment Plant," *Executive News Service*, 25 January 1995; Atomic Energy Corporation of South Africa Limited, "Sale of Partially Depleted Uranium," 27 April 1998 www.anc.org.za; Michael Knapik, Wilson Dizard III, Ann Maclachlan, and Ray Silver, "Uncertainty Bedevils Market; USEC Submits APS Deal for Approval, Talks with PG&E," *Nuclear Fuel*, 30 January 1995, p. 20.

April 1995

Armcor Chief Executive Tielman de Waal says that a total of approximately 800 people, including scientists and politicians, knew of South Africa's now-defunct nuclear weapons program. De Waal states that dissemination of "the names of our nuclear scientists are limited to avoid foreign governments coming in and recruiting them."

— "S. Africa Keeps Nuclear Scientists under Wraps," *Reuters*, 6 April 1995.

April 1995

The United States expresses concern that Iran may be seeking assistance from South Africa in developing nuclear weapons.

— James Adams, "US Fears South Africa Will Sell Nuclear Technology to Tehran," *The Times* (London), 23 April 1995.

April 1995

South Africa joins the Nuclear Suppliers Group (NSG).

— *Defence in a Democracy: White Paper on National Defence for the Republic of South Africa*, May 1996, www.polity.org.za.

June 1995

At the 1995 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) Review and Extension Conference in New York, South Africa plays a significant role as the "chief mediator" between the nonaligned movement and the nuclear weapon states. South Africa "support[s] the view that the continued existence of the treaty should not be placed in jeopardy and that the review and extension process should strengthen the non-proliferation regime. South Africa played an active role in the discussions resulting in the adoption of a set of 'Principles and Objectives for Nuclear Non-Proliferation and Disarmament.' The 'Principles and Objectives' focuses, inter alia, on adherence to the NPT, nuclear disarmament, the conclusion of the CTBT, and the establishment of nuclear-weapon-free zones." International officials credit South African diplomacy with building consensus among member states at the conference to extend the NPT indefinitely. This constitutes a historic contribution by South Africa to strengthening the international nuclear nonproliferation regime.

— Jeff Erlich and Theresa Hitchens, "S. Africa Shines as Policy Beacon," *Defense News*, 12-18 June 1995, p. 1; South

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Africa, Department of Foreign Affairs, "Treaty on the Non-Proliferation of Nuclear Weapons (NPT)," www.dfa.gov.za.

July 1995

In the South African "Energy Policy Discussion Document," the Department of Mineral and Energy Affairs (DMEA) notes that it is unclear how or by whom national nuclear policy was made in the past. The DMEA states that it appears that nuclear policy "was made more on an ad hoc basis and by ad hoc committees, such as was the case with the decision to build nuclear weapons." Furthermore, nuclear policy appears to have been "considered in isolation from any coherent national science and technology policy." DMEA points out that the AEC may have a conflict of interest because it is a commercial entity with nuclear fuel production interests, but is granted a nuclear regulatory role. The Council for Nuclear Safety, currently part of the DMEA, also has a nuclear regulatory role, which includes overseeing the nuclear industry and issuing operating licenses.

— Department of Minerals and Energy Affairs, "South African Energy Policy Discussion Document," July 1995, www.polity.org.za.

15 August 1995

The US Department of Energy removes South Africa from a list of countries of proliferation concern, and relaxes restrictions on US firms that seek to export nuclear-related goods and services to the country.

— George Lobsenz, "DOE Lifts Nuclear Restrictions on Four Emerging Markets," *Energy Daily*, 19 September 1995, p. 3.

25 August 1995

South Africa and the United States sign an Agreement for Cooperation for Peaceful Uses of Nuclear Energy. US Department of Energy officials suggest that one of the first projects that South Africa will participate in is the Reduced Enrichment in Research and Test Reactors (RERTR) program, which will allow the United States to help South Africa convert its research facilities from using HEU to LEU fuel.

— "U.S., South Africa Nuclear Cooperation Agreement Hailed as Precedent for Nonproliferation Regime," *SpentFUEL*, 4 September 1995, www.nuke-energy.com; Leonard S. Spector, *The Undeclared Bomb: The Spread Of Nuclear Weapons 1987-88*, p. 432; Abdul Minty, "South Africa's Nuclear Capability: The Apartheid Bomb," in Phyllis Johnson and David Martin, eds., *Destructive Engagement: Southern Africa at War* (Harare: Zimbabwe Publishing House, 1986), p. 205. Leonard S. Spector, *The Undeclared Bomb: The Spread of Nuclear Weapons 1987-1988* (Cambridge, MA: Ballinger Publishing Company, 1988), p. 303; Mark Hibbs, "South Africa's Secret Nuclear Program: The Dismantling," *Nuclear Fuel*, 24 May 1993, p. 12.

September 1995

AEC Chief Executive Officer Waldo Stumpf says that a delegation of Iranian oil officials who "didn't seem to understand nuclear matters" had approached him during a trip to Cape Town, which began on 15 September 1995. Stumpf says, "they asked what would be the conditions for nuclear cooperation between our two countries... I told them they would have to negotiate some form of government-to-government agreement first, and then talk to our minister... That's as far as it went." [Note: This meeting is apparently the origin for the September 1997 allegations by Jane's International Defence Review that Iranian officials approached Stumpf with a nuclear "shopping list."]

— "South Africa 'Very Circumspect' about N-Deals," *Iran Brief*, 9 October 1995, p. 2.

October 1995

A joint US-South African study concludes that conversion of Safari reactor from burning HEU to LEU is "technically feasible," but would nearly double the reactor's running cost and "threaten its commercial viability." US officials

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disagree, and talks on the subject between the two countries continue.

— Ann MacLachan, "Converting Safari-I to LEU Fuel Would Be Too Costly, Study Finds," *NuclearFuel*, 9 October 1995, p. 10.

1994

South Africa announces that it has decided to construct a MLIS pilot plant, but that MLIS technology would only be developed if the country can find international partners for the project. The MLIS pilot plant is to have a capacity of 10,000 SWU. South Africa has spent \$55 million on the MLIS project over the last ten years, and has allocated another \$5.5 million in 1994.

— Mark Gorwitz, "Section10; South Africa," *Second tier Nuclear Nations: Laser Isotope Separation Programs Technical Citations and Comments*, unpublished paper, January 1996.

1994

Armstrong officials who comprise South Africa's Defence Industry Working Group draft a document entitled "National Policy for the Defense Industry." The paper outlines Armorscor's view of the future of South Africa's defense sector and asserts that the nation should "refrain from trading in weapons of mass destruction, the technology thereof, or any items that run counter to international efforts aimed at controlling the spread of such weapons."

— Martin Navias, "The Future of South Africa's Arms Trade and Defense Industries," *Jane's Intelligence Review*, November 1994, p. 524.

1994

Independent analysts make different estimates of the quantity of HEU remaining in South Africa. According to Institute for Science and International Security director David Albright, South Africa possesses almost 400kg of HEU taken from its dismantled nuclear weapons. Approximately 85 percent of this material is over 90 percent enriched. South Africa also possesses "a comparable quantity" of 20 to 80 percent enriched HEU. The AEC intends to burn the weapons-grade material in its Safari-1 research reactor. The AEC and the US Department of Energy are evaluating the possibility of replacing the HEU in the Safari-1 reactor with LEU. South Africa would then be able to sell its HEU to be blended down to LEU.

However, Natural Resources Defense Council analyst Thomas B. Cochran estimates that at this time, South Africa possesses 731kg, plus or minus 24kg, of approximately 90 percent HEU. Cochran also estimates that the Y-plant produced about 80 kg of 45 percent HEU fuel for Safari-1, and 4.6 to 5 t of 3.25 percent LEU fuel for the Koeberg reactors. There is also an inventory discrepancy of 88-105kg of U235, which South African officials say remains in the tailings produced by the Y-plant. Although Cochran cautions that there remains significant uncertainty regarding South African HEU production, he does not believe that the government is in possession of an undeclared stockpile of the material.

— David Albright, "The Nuclear Weapons Legacy and the ANC," *ISIS Report*, May 1994, pp. 18-19; Thomas B. Cochran, email communication with Michael Barletta, 12 March 1999; Thomas B. Cochran, "High-Enriched Uranium Production for South African Nuclear Weapons," *Nuclear Weapons Databook Working Paper NWD 93-3*, (Washington, DC, Natural Resources Defense Council), prepared for publication in *Security and Global Security 4* (Winter 1993/94).

1994

The African National Congress (ANC) and the AEC reach a "tentative agreement" that South Africa should refuse a US offer to purchase South Africa's stockpile of HEU.

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— Mark Hibbs, "Black South Africa Should Retain Nuclear Weapons Option, OTA Says," *Nucleonics Week*, 3 March 1994, p. 6.

20 February 1994

In an article published in the *Johannesburg City Press*, Commodore Dieter Gerhardt, a convicted Soviet spy and former commander of the Simonstown naval base near Cape Town, says that the flash recorded by the US Vela satellite on 22 September 1979 was produced by a joint Israeli-South African nuclear test code named "Operation Phenix." Gerhardt says that although he was not involved, he learned of the operation "unofficially."

— David Albright, "The Flash in the Atlantic," *ISIS Report*, May 1994, p. 18.

March 1994

A group of 16 former Armscor employees involved in South Africa's nuclear weapons and ballistic missile programs threaten to divulge secret information to the highest international bidder unless they receive \$1 million in unemployment benefits. The Transvaal Supreme Court places a gag order on members of the group, barring them from revealing "details about the supply, export, import, manufacture or research of armaments."

— David Albright, "The Nuclear Weapons Legacy," p. 19; *Business Day*, 30 March 1994; in JPRS-TND-94-008, 1 April 1994, p. 3; Ronelle Rademeyer, "Wetenskaplikes Mag nie Praat oor kerngeheime," *Beeld*, 30 March 1994, p. 1; Marga Ley, "SA 'het geen buitelandse hulp gehad' met kernbomme," *Beeld*, 29 March 1994, p. 2.

April 1994

The US General Accounting Office reports that the United States approved 26 of 31 licenses for dual-use items during Fiscal Years 1988-92 for sensitive end-users in South Africa. The items included computers or electronic/digital-related equipment, lasers/optical equipment, measuring/calibrating/testing equipment, photosensitive components, presses and specialized controls/accessories, and electron tubes and specially designed components. Licenses that were approved "generally involved destinations and items of little or no apparent proliferation concern," while the denied licenses "were typically for technically significant items or involved end users associated with nuclear proliferation activities."

— General Accounting Office, *Nuclear Nonproliferation—Export Licensing Procedures for Dual-Use Items Need to be Strengthened*, GAO/NSIAD-94-119, April 1994, www.access.gpo.gov.

7 April 1994

IAEA Director General Hans Blix comments that IAEA inspections in South Africa have demonstrated how IAEA verification activities can be carried out effectively if there is "a high degree of cooperation and transparency on the part of the inspected country." Blix notes that this was the first time a state that had developed nuclear weapons had chosen to dismantle its nuclear arsenal and terminate its weapons program. He credits the government of South Africa with demonstrating that the purpose of safeguards inspections is to create international confidence that a country's nuclear material and facilities are dedicated solely to peaceful purposes.

— Hans Blix, "Director General's Statement on the Occasion of the Presentation by the Minister of Foreign Affairs of South Africa," 7 April 1994, International Atomic Energy Agency, www.iaea.or.at.

May 1994

The AEC refuses to sell enrichment technology to China because the Chinese government does not provide assurances that it will not sell the technology to Pakistan.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 19, www.isis-online.org.

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25 May 1994

South African Deputy President Thabo Mbeki tells the UN Security Council that the South African "government is also keen that a treaty for an African nuclear-weapon-free zone be concluded as soon as possible."

— Anthony Goodman, "South Africa Calls for African Nuclear-Free Zone," Reuters, 25 May, 1994; in *Executive News Service*, 25 May 1995.

June 1994

In justifying his agency's budget before a parliamentary committee, South African National Intelligence Service Director General Mike Louw testifies that there has been "a huge increase in the number of foreign spies gathering information on South Africa's technological prowess, especially its nuclear weapons know-how."

— Patrick Collings, "Spies Seek South African Technology," UPI, 28 June 1994.

September 1994

South Africa regains a permanent seat on the IAEA Board of Governors, after the IAEA General Conference reinstates it as the country most advanced in nuclear development in Africa.

— Mark Hibbs, "South Africa Reinstatement Ends 18-Year Ban From IAEA Board," *Nucleonics Week*, 29 September 1994, p. 6.

November 1994

The IAEA conducts a PIV of South Africa's nuclear facilities. In a book entitled *The Mini-Nuke Conspiracy: Mandela's Nuclear Nightmare* by Peter Hounam and Steve McQuillan, South African "nuclear weapons specialist" Nick Badenhorst alleges that hundreds of nuclear weapons remain in South Africa. Hounam and McQuillan also allege that South Africa manufactured over 1,000 small tactical nuclear warheads that could be in the hands of an anti-Mandela, right-wing faction. However, Hounam and McQuillan do not present evidence supporting their allegations to the IAEA for examination. President Nelson Mandela says that he has no basis for questioning the completion of nuclear dismantlement under former President de Klerk, and hence will not investigate the "wild and unsubstantiated allegations."

[Note: No evidence emerges subsequently to support Hounam and McQuillan's allegations. The quantity of fissile materials necessary for such an arsenal greatly exceeds South Africa's known production. Their book includes very detailed accounts of efforts in South African to smuggle "red mercury," a material they claim is used in nuclear weapons, but which does not exist except in fraudulent attempts to sell ostensible nuclear material.]

— Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa." *IAEA Bulletin*, 1(1995), www.iaea.org; Peter Hounam and Steve McQuillan, *The Mini-Nuke Conspiracy: Mandela's Nuclear Nightmare* (New York; Penguin Group, 1995), pp. 50, 267-268; Stumpf, "South Africa's Nuclear Weapons Program," p. 7; Anton Ferreira, Reuters, 23 October 1995; in "S. Africa Party Says Nuclear Claims May Be True," *Executive News Service*, 23 October 1995; David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford: Oxford University Press, 1997), pp. 384-391.

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1993

1993

Kalina Bagrova, a laser expert from Bulgaria, joins South Africa's AEC as a consultant to provide technical assistance

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to the MLIS project.

— Mark Gorwitz, "Section10; South Africa," *Second Tier Nuclear Nations: Laser Isotope Separation Programs Technical Citations and Comments*, unpublished paper, January 1996.

1993

The South African Parliament passes the revised Nuclear Energy Act, which prohibits the export of nuclear materials or related equipment or facilities to non-nuclear weapon states unless they have signed a full-scope safeguards agreement with the IAEA, and to nuclear-weapon states unless the items are used solely for peaceful applications.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 8.

1993

Stumpf reports that when the HEU from the dismantled nuclear weapons became available for non-weapons use in 1991, the enrichment level for the Safari-1 fuel elements was increased to 60 percent. The Safari reactor has also been upgraded to 20MW for commercial purposes. Stumpf says that all HEU that is unsuitable for Safari fuel elements is being diluted to LEU, using an AEC process, for use as PWR fuel.

— Waldo Stumpf, "South Africa: Nuclear Technology and Non-Proliferation," *Security Dialogue* 24 (1993): pp. 455-456.

1993

South Africa launches a project to develop a Pebble Bed Modular Reactor (PBMR), with a view to constructing a small 100MW high-temperature reactor for commercial use.

— "South Africa Wants to Develop a High-Temperature Reactor," *Bulletin ASPEA*, 14 September 1998.

March 1993

AEC Chief Executive Waldo Stumpf says that as a result of commercialization, the AEC reduced its dependence on government funds from R685 million in 1991-92 to R300-451 million in 1992-93. AEC reprocesses "low and intermediate level nuclear byproducts from the nuclear industry," but it will not offer this service internationally.

— *Saturday Star*, 6 March 1993, p. 11; in "Atomic Energy Corporation Official on Nuclear Program," *Proliferation Issues*.

23 March 1993

As part of the effort to dismantle South Africa's nuclear weapons capability, the AEC and Armscor destroy all documentation regarding design information and associated documentation on the nuclear weapons program. However, they do not destroy accounting and material transfer records.

— "The IAEA Verification in South Africa," GOV/INF/698, April-May 1993, p. 5; Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

24 March 1993

In a speech before the South African parliament, President F.W. de Klerk announces that South Africa had a nuclear weapons program from "as early as 1974" to 1990, during which time it constructed six of seven planned nuclear weapons. The seventh was dismantled before completion. He cites historical, international, and political reasons such as the Soviet expansionist threat in South Africa and Cuban forces in Angola from 1975 to justify South Africa's decision to develop limited nuclear capacity. South Africa's strategy was that "if the situation in

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southern Africa were to deteriorate seriously," the government would confidentially indicate its deterrent capability to one or more of the major powers—such as the United States—in order to persuade them to intervene. He states that global political changes during 1989, the general world opinion against nuclear weapons, and South Africa's accession to the NPT prompted a complete reversal in South Africa's nuclear policy in the late 1980s and early 1990s. De Klerk hopes that South Africa's "voluntary dismantling of a nuclear deterrent capability, and the voluntary revelation of all relevant information will confirm this Government's effort to assure transparency." De Klerk states the program cost South Africa 800 million rand (about \$400 million) and that there was no collaboration with foreign governments on the project.

Armcor reveals that it operated a clandestine nuclear weapons manufacturing site—formerly known as Kentron Circle, now called Advena—just 25km west of Pretoria. Approximately 1,000 experts were involved during the entire life span of the nuclear program. At its zenith, about 400 were employed in the effort. South African officials say the six devices were assembled using HEU from the Y-plant, and equipped with tungsten reflectors. They were estimated to have a yield of 10 to 18 kilotons (KT)—on the order of the 15KT gun-type fission bomb dropped by the United States on Hiroshima. Armcor states that the devices "were identical in principle, but some changes in detail were made to enhance reliability. Armcor officials say that the "feasibility of a ballistic missile was studied...[but] it was rejected on the grounds that the additional deterrence afforded by such a delivery system was limited in terms of South Africa's nuclear strategy." De Klerk stresses that South Africa neither developed thermonuclear bombs nor carried out a nuclear explosive test in the South Atlantic.

— Mark Hibbs, "A Curious Conversion," *Bulletin of Atomic Scientists*, June 1993, p. 8; David Albright, "Foreign Scientist Helped to Develop 'Apartheid Bomb' " *Times* (London), 26 March 1993, p. 2; "Pretoria Replicated Hiroshima Bomb in Seven Years, then Froze Design." *Nucleonics Week*, 6 May 1993, p. 16; Hibbs, "South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *NuclearFuel*, 28 May 1993, p. 4; Brendan Boyle, "S. Africa Says it Has Destroyed its Nuclear Bombs," *Executive News Service*, 24 March 1993; "De Klerk Tells World South Africa Built and Dismantled Six Nuclear Weapons," *NuclearFuel*, 29 March 1993, pp. 6-8; Embassy of South Africa, "The Nuclear Non-Proliferation Treaty and South Africa's Nuclear Capability," 22 November 1989, classified document partially declassified and released, nsarchive.chadwyck.com.

March 1993

Following President F.W. de Klerk's public acknowledgment of South Africa's nuclear weapons program, Waldo Stumpf, Chief Executive Officer of the AEC, admits that the government did not reveal its nuclear arsenal earlier because it feared that doing so could have led to confrontational inspections similar to those occurring in Iraq. He further claims that the bombs were dismantled starting in February 1992.

— Davis Albright, "South Africa and the Affordable Bomb," *Bulletin of the Atomic Scientists*, July/August 1994, www.bullatomsci.org.

24 March 1993

Officials destroy the last documents on policymaking in the South African nuclear weapons program. South African officials state that they had never sought to develop more advanced devices, or to increase the precision of the yield.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: The Woodrow Wilson Center Press, 1995), p. 23. On the destruction of documents by the apartheid regime, see Truth and Reconciliation Commission, "The Destruction of Records," Volume 1 Chapter 8 of Final Report, 29 October 1998, www.woza.co.za; Mark Hibbs, "South Africa's Secret Nuclear Program: From PNE to a Deterrent," *NuclearFuel*, 10 May 1993, pp. 3-4; Mark Hibbs, "South Africa's Secret Nuclear Program: the Dismantling," *NuclearFuel*, 24 May 1993, p. 10.

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25 March 1993

Two members of an IAEA team at Pelindaba, who are conducting follow-up activities regarding the Y-plant, make preliminary visits to key facilities related to the nuclear weapons program. Over the next five months, the IAEA team and nuclear weapons experts carry out inspections at facilities and locations that South Africa declares were involved in the nuclear weapons program.

— Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa." *IAEA Bulletin*, January 1995, p. 3, www.iaea.org.

26 March 1993

The *Times* of London reports that an unidentified foreign nuclear scientist aided South Africa in developing nuclear weapons. The report says that 30 South Africans worked on the program under the leadership of a veteran nuclear specialist who was a "fellow Westerner," but that no other foreign advisors were brought to South Africa to assist the effort. [Note: However, subsequent accounts provide no indication that foreign personnel were ever involved directly in the South African nuclear weapons program.]

— David Watts, "Foreign Scientists Helped to Develop 'Apartheid Bomb'," *Times* (London), 26 March 1993, pp. 1-2.

26 March 1993

The IAEA negotiates with South African officials to detail procedures for special inspections to verify that South Africa no longer possesses nuclear weapons.

— "IAEA Experts Ready Inspection of S. African Sites," Reuters, 26 March 1993.

28 March 1993

The London *Sunday Times* reports that South Africa contracted with China in the 1980s for access to China's long-range missile technology in order to develop the capacity to launch "ballistic nuclear weapons" and satellites. The South African Consul-General in Hong Kong, Michael Farr, later denies that South Africa received long-range missile technology from China.

— Richard Ellis, "Secret Deal with China Extended Range of Nuclear Firepower," *Sunday Times*, 28 March 1993; "S. Africa Denies Secret Missile Deal with Peking," Central News Agency, 5 April 1993.

April 1993

Cape Town academic Renfrew Christie says that South Africa "had almost certainly developed" 2 kiloton nuclear shells that could be fired by G-5 and G-6 artillery guns, which have a range greater than 25 miles. Christie was imprisoned by the South African government in 1980 for providing "nuclear secrets" to the African National Congress (ANC). [Note: However, subsequent reports provide no evidence that South Africa developed nuclear artillery munitions.]

— David Beresford, "New Doubts on SA Nuclear Admission," *Guardian Weekly*, 4 April 1993, p. 10.

18 May 1993

The South African Parliament passes the Non-Proliferation of Weapons of Mass Destruction Act, which commits South Africa to abstaining from developing nuclear weapons.

— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

June 1993

In a paper presented to the International Enrichment Conference of the US Council for Energy Awareness, P.J.

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Venter, Atomic Energy Corporation (AEC) Executive General Manager for Fuel Production, says that due to stagnant domestic electricity demand, South Africa seeks to market its uranium conversion, enrichment, and fuel fabrication services internationally. Venter estimates that between 1993-97, AEC excess production capacity will be 1,750,000kg uranium hexafluoride (UF₆) at its conversion facilities, 250,000 separative work units (SWU) of enrichment, and 200,000-300,000 kgs of fuel fabrication for pressurized water reactors (PWR).

— Wilson Dizard III, "AEC of South Africa Seeks Export Markets for Fuel Cycle Services," *NuclearFuel*, 21 June 1993, p. 10.

July 1993

In the presence of IAEA inspectors, Armscor renders useless the nuclear test shafts at the Vastrap site in the Kalahari Desert by filling them with concrete.

— Adolf Von Baeckmann, Gary Dillon and Demetrius Perricos, "Nuclear Verification in South Africa." *IAEA Bulletin*, January 1995, p. 7, www.iaea.org; Photographs online at "Rendering Harmless the Kalahari Test Shafts in South Africa," IAEA, undated, www.iaea.org.

July 1993

In a briefing at the South African Embassy in Washington, DC, AEC Chief Executive Officer Waldo Stumpf says that South Africa approached both the United Kingdom and the United States in late 1992 regarding the possible sale of South Africa's surplus HEU. According to Stumpf, the United Kingdom was not interested, but the United States said to "come back later," after the November 1992 US presidential elections. Stumpf notes that the Safari-1 research reactor had been upgraded to 20MW, and that all the HEU not suitable for Safari had been blended down to low-enriched uranium (LEU) for use in the Koeberg plant. However, some US firms continue discussing the possibility of purchasing the HEU and sources say that South Africa is still willing to sell "most, if not all, of the stockpile." Sale of its HEU would net South Africa 15 million rand, while conversion is expected to raise 500 million rand.

— Michael Knapik, "South African AEC Head Says Stockpile of HEU Will Be Maintained for Safari," *NuclearFuel*, 16 August 1993, pp. 5-6; Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993; "South Africa - Country to Retain High Enriched Uranium Stockpile," *Africa Intelligence Report - Business Day* (South Africa), 26 July 1993, in *Arms Transfer News*, Vol. 93, No. 13, Farndon House Information Trust.

August 1993

The IAEA conducts a Physical Inventory Verification (PIV) of South Africa's nuclear facilities.

— Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa." *IAEA Bulletin*, January 1995, www.iaea.org.

August 1993

The AEC ceases production at its zirconium tubing plant at Pelindaba. The plant produced zirconium tubing to sheath nuclear reactor fuel rods. However, in 1992 the Electricity Supply Commission (Eskom) changed specifications for fuel used at Koeberg, making the plant unnecessary. The AEC's zirconium tubing plant at Pelindaba was specifically configured to produce fuel assemblies for Koeberg. However, when anti-apartheid sanctions were lifted, South Africa was able to import fuel assemblies at a lower cost than it could produce them. The AEC purchased equipment from West Germany during the 1979-84 period, which was used to construct the plant. The plant was thus made redundant in 1994 when an AEC agreement with the French firm Cogema precluded export of fuel assemblies from South Africa. During its operation from 1988-93, it produced 75,000

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cladding tubes for use in fuel rod assemblies for the Koeberg nuclear power reactors. The plant cost R200 (\$42 million) to build, and would later be sold for R20 million (\$5 million). A zirconium metal alloy called Zircaloy is extensively used for the canning, or cladding, of nuclear fuel elements for water-cooled reactors.

— SAPA, "SA Sells Pelindaba Nuclear Plant to China," 13 December 1997; "Home Affairs Apologizes to Chinese Technicians," *Business Day*, December 1997, www.bday.co.za; *The Star*, 13 December 1997; in "Nuclear Equipment Sold to China Had Been Redundant for Years, Says AEC," *Independent Online* www.inc.co.za; Mark Hibbs, "End-User Statement, Export Permit Still Pending For AEC-China Deal," *NuclearFuel*, 29 December 1997, p. 3; "Home Affairs Apologizes to Chinese Technicians," *Business Day*, December 1997, www.bday.co.za; Robin Friedland, "Meltdown in a Teacup," *Financial Mail*, 19 December 1997, www.fm.co.za.

16 August 1993

South Africa proclaims the Non-Proliferation of Weapons of Mass Destruction Act, 1993. The legislation creates the South African Council for the Non-Proliferation (NPC) of Weapons of Mass Destruction, which is charged with export control authority for all nuclear dual-use items. The act makes any involvement by South African citizens in the development of nuclear, biological, or chemical weapons, or ballistic missile systems to deliver such weapons, a criminal offence.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 8; "Non-Proliferation of Weapons of Mass Destruction Act," *Government Gazette*, Act No. 87, 1993. The authors are indebted to Rianne Van Vuuren for providing the text of this legislation; Waldo Stumpf, "South Africa: Nuclear Technology and Non-Proliferation," *Security Dialogue*, 1993, p. 458; Non-Proliferation of Weapons of Mass Destruction Amendment Act, 1995 www.polity.org.za; Non-Proliferation of Weapons of Mass Destruction Amendment Act, 1996 www.polity.org.za.

September 1993

The IAEA finds it "reasonable to conclude" that the quantity of HEU that could have been produced by the pilot enrichment plant (the Y-plant) in South Africa is consistent with South Africa's initial report to the IAEA. The IAEA General Conference accepts "the completeness of South Africa's inventory of materials and facilities." The General Conference also accepts South Africa's declarations on the dismantlement and destruction of equipment for its nuclear weapons, on transfer of dual-use equipment and facilities to non-nuclear or civilian nuclear uses, and on destruction of the two Vastrap test shafts under IAEA supervision. [Note: With these determinations, most international experts conclude that South Africa has completed its nuclear disarmament. South Africa is the first and to date only country to build nuclear weapons and then entirely dismantle its nuclear weapons program.]

— Hans Blix, "Director General's Statement on the Occasion of the Presentation by the Minister of Foreign Affairs of South Africa," 7 April 1994, *International Atomic Energy Agency*, www.iaea.or.at; Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 7.

1 November 1993

According to IAEA Director General Hans Blix, 22 IAEA safeguards missions have visited South Africa since the country concluded its full-scope safeguards agreement with the IAEA in September 1991.

— Hans Blix, "Statement to the Forty-Eighth Session of the U.N. General Assembly," 1 November 1993, *International Atomic Energy Agency*, www.iaea.or.at.

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1992-1989

1992

According to a paper presented at the 1992 International Symposium on Isotope Separation and Chemical Exchange Uranium Enrichment, South Africa's MLIS project is in the pilot plant stage, and work continues on "eliminating part of the laser energy by using chemical energy or reactions (CRISLA process)."

— D.M. Kemp, "Uranium Enrichment Technologies in South Africa," paper presented at the International Symposium on Isotope Separation and Chemical Exchange Uranium Enrichment," 1992 in Mark Gorwitz, "Section10; South Africa," Second Tier Nuclear Nations: Laser Isotope Separation Programs Technical Citations and Comments, unpublished paper, January 1996.

February 1992

The AEC considers the commercial packaging of uranium, conversion, enrichment, fabricating and spent fuel storage services. Under one plan, AEC would "rent" fabricated fuel to utilities overseas, and would take it back to South Africa for storage after the fuel had been burned.

— Michael Knapik, "Spot Uranium Price Circles \$8/lb Level," *NuclearFuel*, 17 February 1992, pp. 1-3.

March 1992

AEC Chief Executive Waldo Stumpf announces that South Africa is planning to test a prototype molecular laser isotope separation (MLIS) uranium enrichment unit around 1994. Currently South Africa relies on the indigenous "helikon" jet-nozzle separation process to enrich uranium.

— Ann Maclachlan, "South Africa's AEC Plans to Test Prototype MLIS Enrichment Unit in 1994," *NuclearFuel*, 2 March 1992, pp. 7-8.

April 1992

The South African cabinet decides to commercialize Armscor and establish the Denel group of defense companies. Advena becomes a division of Denel, and subsequently focuses on electronic design and manufacture for medical equipment, powder metallurgy for components and military programs, and pyrotechnical engineering. In total, Denel takes over 23 of 26 Armscor subsidiaries.

— Mark Hibbs, "South Africa's Secret Nuclear Program: The Dismantling," p. 12; David Albright, "A Curious Conversion," *Bulletin of the Atomic Scientists*, June 1993, bulletatomsoci.org.

9 April 1992

Kenya announces that it will propose that South Africa join the African Energy Agency (AFRA) at the organization's annual meeting (25 April 1992-1 May 1992). South Africa and Kenya are to sign a nuclear cooperation agreement that would include exchange of nuclear technology and information for medicine and agriculture.

— "Power: Kenya, S.A. Hold Talks," *Pretoria News*, 9 April 1992.

September 1992

South Africa starts blending down some of its over 20 percent enriched HEU to under 5 percent LEU.

— David Albright and Mark Hibbs, "South Africa: The ANC and the Atom Bomb," *Bulletin of Atomic Scientists*, April 1993, p. 33.

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3 September 1992

The IAEA reports that the high-enriched separation units of the Y-plant have been dismantled and removed, and that the remainder of the plant has been decommissioned and partially dismantled. South Africa is preparing the facility for use as a demonstration module in the laser enrichment project to be commissioned in 1993-94. Using accounting data provided by the AEC, the IAEA estimated the U235 balance of the Y-plant. The calculations "showed an apparent discrepancy in this balance" that could be the result of the material accounting system. The IAEA's balance calculations for the Z-plant also reveal an apparent discrepancy, which may likewise be due to the material accounting system. According to the AEC, blending operations to convert a certain amount of HEU to LEU will begin in September 1992. The IAEA reports that it visited facilities involved in South Africa's abandoned centrifuge enrichment program, including the site of a proposed 48-centrifuge cascade, and reports that the centrifuge program had been halted at all locations visited. The AEC supplied information to the IAEA regarding an unspecified quantity of unsafeguarded LEU imported to fuel the Koeberg reactors. South Africa also imported natural uranium as feedstock for the Y-plant until 1979.

— International Atomic Energy Agency, *Report on the Completeness of the Inventory of South Africa's Nuclear Installations and Material, attachment to Gov/2609*, 3 September 1992, pp. 4-7.

16 September 1992

The AEC and Kenya's National Council for Science and Technology sign an agreement to cooperate on nuclear energy programs. The two countries will collaborate in training, research, and energy supply. The collaboration may lead to a joint energy protocol.

— "S.A. and Kenya in Atomic Power Deal," *The Star*, 16 September 1992.

12 September 1992

The IAEA determines that South Africa's Y-plant likely produced more than 400kg of weapons-grade uranium during the 1970s and 1980s.

— Mark Hibbs, "Iaea Believes South Africa Produced More Than 200 Kg of High-Enriched Uranium," *NuclearFuel*, 28 September 1992, p. 1.

October 1992

The IAEA successfully implements a "near-simultaneous" physical inventory verification (PIV) of all of South Africa's declared nuclear facilities.

— Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa," *IAEA Bulletin*, January 1995, p. 7, www.iaea.or.at.

October 1992

According to unidentified officials, at the September 1992 IAEA general conference in Vienna, South Africa offered to sell its supply of HEU to the United States and the United Kingdom. However, Timothy Walker, undersecretary for atomic energy at the UK Department of Energy, says that South Africa had not made such an offer to the United Kingdom during the conference.

— Mark Hibbs, "Washington Wants to Purchase South African HEU Inventory," *NuclearFuel*, 12 October 1992, pp. 3-4.

8 October 1992

IAEA inspectors discover "evidence of critical assemblies, testing gear, and equipment for metallurgical research and processing" at Building 5000, an abandoned site southwest of the enrichment complex at Pelindaba. Unnamed sources say that South African technicians used the equipment to work on "the shape of spherical fissile cores for a

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[more sophisticated] nuclear explosive device."

— Mark Hibbs, "IAEA Found Evidence of Nuclear Weapons Work in South Africa," *Nucleonics Week*, 8 October 1992, p. 2.

22 December 1992

The African National Congress (ANC) expresses concern regarding reports emanating from Europe and the United States disclosing South Africa's nuclear activities and ambitions. The reports indicate that the IAEA confirmed that South Africa produced several hundred kilograms of highly enriched uranium, a quantity large enough to support an active nuclear program. The IAEA has corroborating evidence from visits to an abandoned facility near the Pelindaba uranium enrichment complex where it found equipment to develop nuclear explosive devices. The US CIA reveals Atomic Energy Council (AEC) chairman, Jacob de Villiers' involvement in designing nuclear weapons at the Pelindaba center up to 1979. The ANC asks that the de Klerk government and the AEC disseminate past and present nuclear program information to the South African people and the international community.

— "ANC Deeply Concerned about Nuclear Program," *SAPA*, 22 December 1996, www.aec.co.za; in FBIS Document FBIS-AFR-92-246, 33 December 1992.

1991

The ANC urges the government to fully disclose the extent of South Africa's nuclear program. US officials believe that the South African government is withholding information because it fears that the ANC will interfere with its efforts to sell off its inventory of weapon-grade uranium to the United States. Furthermore, according to a US official, the ANC is bound to view the sale of the weapons-grade stock as a signal that the governments involved in the transactions do not trust a prospective black majority government.

— David Albright and Mark Hibbs, "South Africa: The ANC and the Atom Bomb," *Bulletin of the Atomic Scientists*, April 1993, www.bullatomsci.org.

1991

According to a member of an IAEA inspection team, the IAEA discovers nuclear design documents and nonnuclear components of nuclear weapons that have not been destroyed.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities*, (Washington, DC: Woodrow Wilson Center, 1995), p. 40.

1991

South Africa terminates all work on the AVLIS project.

— Mark Gorwitz, "Section 10; South Africa," *Second tier Nuclear Nations: Laser Isotope Separation Programs Technical Citations and Comments*, unpublished paper, January 1996.

June 1991

According to Stumpf, by this time the dismantling of South Africa's nuclear weapons program is "essentially complete."

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996), p. 6.

July 1991

The AEC completes dismantling the six Armscor-built nuclear bombs. The de Klerk government shreds all blueprints and minutes of meetings at which the weapons program was discussed.

— "S. Africa Says It Has Destroyed Its Nuclear Bombs," *Reuters*, 24 March 1993; Waldo Stumpf, "South Africa's

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Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

10 July 1991

South Africa accedes to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) as a non-nuclear-weapon state. The IAEA begins inspections of South Africa's nuclear weapon manufacturing facilities to verify the scope and history of the program and its subsequent dismantlement. US President Bush lifts sanctions imposed by the Comprehensive Anti-Apartheid Act of 1986, although an arms embargo and several other measures remain in effect, along with restraints by some state and local governments in the United States.

— US Arms Control and Disarmament Agency, "Signatories and Parties to the Treaty on the Non-Proliferation of Nuclear Weapons," 3 December 1998, dosfan.lib.uic.edu; Seth W. Carus, "Israeli Ballistic Missile Developments," Testimony before the Commission to Assess the Ballistic Missile Threat to the U.S., 15 July 1998, www.fas.org; Rita M. Byrnes ed., *South Africa: A Country Study* (Washington, DC: Federal Research Division, Library of Congress, 1997), 355; Ann Devroy and Helen Dewar, "Citing S. Africa's 'Transformation,' Bush Ends Most Sanctions," *Washington Post*, 11 July 1991, web.lexis-nexis.com/universe.

August 1991

South Africa terminates its gas-centrifuge enrichment program due to financial reasons.

— David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies*, (Oxford University Press, 1997), p. 379.

August 1991

Framatome replaces all 114 control rod guide tube split pins at South Africa's Koeberg-2 and says biological shielding of equipment at Koeberg-1 should be improved.

— "South Africa: Split Pin Replacement," *Nucleonics Week*, 1 August 1991, pp. 15-16.

August 1991

The US firm Edlow International asks the US Nuclear Regulatory Commission for a license to import 1 million kg U3O8 from South Africa for processing in the United States.

— "Edlow Asks for License to Import South African Uranium," *NuclearFuel*, 2 September 1991, p. 14.

13 August 1991

The US Nuclear Regulatory Commission announces that it will lift the ban on South African uranium imports.

— "South African Uranium Can Again Be Imported to the US," *Nuclear News*, September 1991, p. 28.

August 1991

General Magnus Malan, South Africa's minister of defense, bans the "development, manufacture, marketing, import and export of nuclear weapons or explosives." In a notice in the Government Gazette, Malan says that any attempt to produce these devices would be illegal.

— South African Broadcasting Corporation, 30 August 1991; in JPRS-TND-91-014, 12 September 1991, p. 1.

5-6 September 1991

The HEU from the last dismantled nuclear weapon is returned to the AEC.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today*, 25 (December 1995/January 1996), p. 6.

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16 September 1991

South Africa signs full-scope safeguards agreement with the IAEA, which is effective immediately. Under the terms of the agreement, South Africa is to compile an "inventory of all materials and facilities to be safeguarded," and allow inspections at all of its nuclear sites, including the enrichment facilities.

— Capital Radio (Umtata), 16 September 1991 in "Nuclear Sites Open to International Inspection," *Nuclear Fuel*, 29 March 1993, p. 8; *Proliferation Issues*, 27 September 1991, p. 1; "South Africa Has Signed a Safeguards Pact with the IAEA," *Nuclear News*, October 1991, p. 26; "De Klerk Tells World South Africa Built and Dismantled Six Nuclear Weapons," *NuclearFuel*, 29 March 1993, p. 8.

September 1991

South Africa says that it will provide production records for its two unsafeguarded fuel enrichment plants to the IAEA by mid-October 1991.

— Mark Hibbs and Ann MacLachlan, "South Africa Will Provide IAEA Operations Data from SWU Plants," *NuclearFuel*, 30 September 1991, p. 6.

September 1991

South Africa takes its seat at the IAEA General Conference for the first time in 12 years.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 19.

October 1991

AEC Chief Executive Waldo Stumpf declares that South Africa has "abandoned its nuclear weapons program and is seeking instead to become competitive on the world nuclear fuel market within a few years." Stumpf says that the new commercial orientation of the AEC is "absolutely the right direction to go in." Stumpf notes that a "strategic emphasis" had been the catalyst to develop nuclear technology, but that it had become "counterproductive" to South Africa's efforts to revitalize the country's slowed economy. Furthermore, Stumpf says that the "strategic emphasis" of South Africa's nuclear program was "possibly far too narrow for the new South Africa," referring to the country's future black-majority government.

— David B. Ottaway, "South Africa Said to Abandon Pursuit of Nuclear Weapons," *Washington Post*, 18 October 1991, pp. A23, A26; *The Guardian*, 19 October 1991 in "South Africa's Nuclear Arms Programme," *Peace News Bulletin*, p. 15.

10 October 1991

South Africa presents its initial inventory of nuclear materials and facilities to the IAEA.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996), pp. 6-7.

29 October 1991

Information supplied to the IAEA indicates that South Africa possesses weapons-grade uranium. The Y-plant has enriched uranium "far in excess" of the 45 percent level needed for the Safari research reactor.

— Mark Hibbs, "Documents Indicate South Africa Enriched Uranium to Weapons-Grade," *NuclearFuel*, 23 December 1991, pp. 1, 6-7.

15 November 1991

The IAEA begins verifying South Africa's declared inventory.

Related content is available on the website for the Nuclear Threat Initiative, www.nti.org.



— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

December 1991

The IAEA meets with the AEC to discuss the inventory. [Note: Stumpf explains the "completeness exercise" is an instruction given to Hans Blix, Director General of the IAEA, by the IAEA General Conference and the UN General Assembly to report back on the completeness of South Africa's declaration of nuclear materials and facilities.]

— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

1990

The de Klerk government implements its decision to terminate South Africa's nuclear weapons program. All nuclear devices are dismantled and destroyed. Nuclear materials in Armscor's possession are recast and returned to the AEC, where they are stored according to internationally accepted procedures. Armscor's facilities are decontaminated and dedicated to non-nuclear commercial purposes. A date is set for South Africa to accede to the NPT and submit all of its nuclear materials and facilities to international safeguards.

— "De Klerk Tells World South Africa Built and Dismantled Six Nuclear Weapons," *Nuclear Fuel*, 29 March 1993, p. 7.

1990

The AEC decides to substantially diversify its activities, shifting from strategic to commercially oriented production.

— Atomic Energy Corporation of South Africa, "AEC Corporate Profile," www.aec.co.za.

11 February 1990

The de Klerk government lifts the ban on the African National Congress (ANC), and ANC leader Nelson Mandela is released from prison.

1 February 1990

The Y-plant officially ceases operations. [Note: Reiss reports that the Y-plant, which had an annual output of 100kg, stopped enriching uranium in 1989. Albright, Berkhout, and Walker state that the Y-plant stopped producing HEU in November 1989, but was officially closed on 1 February 1990. The IAEA reports that HEU production at the Y-plant began in January 1978 and ended in November 1989.]

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 6; Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 11; David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press, 1997), p. 380; International Atomic Energy Agency, *Report on the Completeness of the Inventory of South Africa's Nuclear Installations and Material, attachment to Gov/2609*, 3 September 1992, pp. 4-5.

Late-February 1990

De Klerk requests a planning and feasibility study to ascertain the best procedures to dismantle South Africa's nuclear weapons.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 17.

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26 February 1990

President de Klerk issues written instructions directing all relevant agencies to begin dismantling the nuclear weapons program. According to Stumpf, this "should stand as the official date of implementation of the termination of South Africa's weapons program."

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 6; David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 16, www.isis-online.org.

30 April 1990

A Norwegian newspaper reports that Norway exported approximately 450 tons of heavy water between the 1930s and 1988, when the Brundtland government banned further exports. The newspaper reports that South Africa received 6-7kg of Norwegian heavy water "figured to be for research purposes."

— "450 Tonnes Sold Abroad," *Stavanger Aftenblad*, 30 April 1990; in JPRS-TND-90-11, 28 June 1990, p. 39.

4 May-10 May 1990

AEC Chief Executive Waldo Stumpf announces that South Africa is considering exporting enriched uranium from its Valindaba plant.

— *The Weekly Mail*, 4-10 May, 1990, p. 13; in "Environmentalists Challenge Nuclear Fuel Export Plan," *Nuclear Developments*, 28 June 1990, pp. 1-2.

July 1990

The dismantlement study commissioned by de Klerk is completed. De Klerk opts to order the dismantlement of one complete nuclear device at a time. An alternative, more rapid disarmament option would have been to destroy one-half of each device before destroying the second half. The slower option allows South Africa to maintain a nuclear deterrent until the last weapon is dismantled. Furthermore, Wynand Mouton, a retired nuclear physicist and university professor whom de Klerk appoints as independent auditor of the dismantlement project, believes the slower option will "help acclimate the dismantlement team to the reality" of de Klerk's decision to eliminate South Africa's nuclear arsenal.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities*, (Washington, DC: Woodrow Wilson Center, 1995), p. 18.

September 1990

The South African Air Force (SAAF) plans to retire the six Buccaneer aircraft stationed at Waterkloof Air Force Base near Pretoria. SAAF had planned to upgrade the aircraft and extend their service life, but an overhaul of the first plane revealed that the program would be too expensive. The Buccaneers entered service in October 1965 and are "believed to have been the SAAF's nuclear weapons strike unit."

— "South Africa to Retire Buccaneers," *Flight International*, 5 September 1990.

September 1990

The West German firm MAN-Energie is scheduled to perform an in-service safety inspection on South Africa's Koeberg nuclear station.

— *Engineering News* (Johannesburg), 6 July 1990, p. 10 in "Koeberg Reactor Vessel to be Inspected," *Nuclear Developments*, 8 August 1990, p. 1.

10 September 1990

In response to a request of resolution 44/113, the U.N. Department of Disarmament Affairs issues the report *South*

Related content is available on the website for the Nuclear Threat Initiative, www.nti.org.



Africa's Nuclear Tipped Ballistic Missile Capability.

— UN Department of Disarmament Affairs, *South Africa's Nuclear Tipped Ballistic Missile Capability* (New York: UN, 1991).

December 1990

Framatome supplies the Koeberg power station with new control rod guide tube split pins and assists South Africa's Eskom in replacing the rods.

— "South Africa: New Split At Koeberg," *Nucleonics Week*, 13 December 1990, p. 16.

1989

South Africa possesses six devices in its nuclear arsenal each containing 55kg of highly enriched uranium (HEU), and enough HEU for a seventh device. The devices are stored unassembled with the front and rear portions of the weapons stored in separate vaults. In order to prevent premature detonation, the weapons are designed to arm only when they reach a certain altitude while on board delivery aircraft.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, www.isis-online.org.

1989

SIPRI researcher Signe Landgren concludes that South Africa is developing "long-range missiles capable of carrying nuclear warheads." The study states that in November 1989, the CIA confirmed that a joint South African-Israeli test of the "Arniston" missile, which could carry a nuclear warhead over 1,200 miles, had taken place.

— Eddie Koch, "South Africa: Capable of Becoming World's Sixth Nuclear Nation," *Inter Press Service*, 28 December 1989.

Late 1980s

Armscor prepares to upgrade the seven gun-type weapons. Armscor plans to "replace the seven cannon-type devices with seven upgraded devices, when they reach the end of their estimated life by the year 2000."

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 14, www.isis-online.org.

January 1989

Argentina's Comisión Nacional de Energía Atómica (CNEA) is reported to have shared design information on nuclear fuel cycle technology with South Africa.

— Richard Kessler, "Menem Reported Ready to Name Castro Madero CNEA Boss Again," *Nucleonics Week*, 12 January 1989, pp. 4-5.

June 1989

The *Washington Times* reports that with assistance from Israel, South Africa plans to test launch a new intermediate-range ballistic missile. In response, an Armscor spokesman confirms that the company has over the last six years built a missile test range at Overberg and that missiles are being fired to test their performance. At the same time, US Intelligence sources report that South Africa is close to launching a modified version of the Israeli Jericho II Intermediate-range ballistic missile (IRBM). Reconnaissance satellite images show that the test launch is likely to be carried out from a facility near Cape Town. The facility is reportedly identical to an Israeli launch site in the Negev Desert. Officials say the new missile has been under development since at least 1987, and will also be used as a booster for launching photo-reconnaissance satellites. A CIA assessment reportedly also suggests that a second test of the more advanced Israeli Shavit (Comet) SLV, which might be converted to a 3,200km-range missile, is also being prepared at the site.

— "South Africa to Test-launch IRBM," *Jane's Defence Weekly*, 1 July 1989, p. 1354; Martin Walker, "S Africa 'About

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to Test Medium-Range Missile," *Guardian* (London), 21 June 1989, web.lexis-nexis.com/universe; Bill Gertz, "S. Africa on the Brink of Ballistic Missile Test," *Washington Times*, 24 June 1989, pp. A1, A10.

5 July 1989

Armcor announces that it has successfully tested a booster rocket from the Overberg test range outside Cape Town. Although South African sources describe the launch as a booster rocket, outside analysts suggest that it may have been a test-flight of an IRBM. A US Defense Intelligence Agency (DIA) Special Assessment calls the missile a "probable SRBM." US intelligence sources report that the rocket plume of the missile bears a striking resemblance to that of Israel's Jericho missile. The DIA report notes that if Israel and South Africa are collaborating, a high-level if not senior-level Israeli delegation was probably present for the test. The missile flies 1,620km southeast toward Prince Edward Island.

— "South African Missile Test," *Jane's Defence Weekly*, 15 July 1989, p. 59; Michael R. Gordon, "U.S. Sees Israeli Help in Pretoria's Missile Work," *New York Times*, 27 October 1989, web.lexis-nexis.com/universe; US Defense Intelligence Agency, "Special Assessment, South Africa: Missile Activity," 5 July 1989, declassified and partially released, in *South Africa and the U.S.: The Declassified History*, ed. Kenneth Mokoena (New York: New Press, 1993), pp. 167-168; William E. Burrows and Robert Windrem, *Critical Mass: The Dangerous for Superpowers in a Fragmented World*, (New York: Simon & Schuster, 1994), pp. 446-448; John Pike, "Overberg Test Range OTB Arniston South Africa," *Federation of Atomic Scientists*, 29 May 2000, www.fas.org.

June 1989

South Africa and the IAEA resume talks on opening fuel cycle facilities to inspection.

— "Republic of South Africa's Pressure to Sign NPT," *Nuclear Engineering International*, June 1989, p. 28.

14 September 1989

F. W. de Klerk is elected President of South Africa.

September 1989

At a meeting of his senior political aides and advisors, President de Klerk declares that in order to end South Africa's isolation from the international community, both the political system of apartheid and the nuclear weapons program must be dismantled. He summons AEC Executive Chairman Wynand de Villiers and Waldo Stumpf to inform them of his intention to terminate the nuclear weapons program and accede to the NPT. De Klerk asks them to draw up a schedule to implement his directive.

— Adrian Hadland, "SA's Nuclear Delusions Lie in Ruins, But They Still Cost a Fortune," *Independent Online*, 26 January 1998, www.inc.co.za; Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

12 October 1989

Derek Smith, a British citizen living in Greece, is arrested in Athens and charged with illegally possessing 12.1kg of pure uranium, says that it is a sample from 1210kg stored in a secret location in South Africa. The material was offered by a South African friend for \$180,000/kg.

— *Athens News*, October 12, 1989, 3; in "Uranium Destined For Libya," *Nuclear Developments*, 26 October 1989, p. 3.

25 October 1989

NBC News reports that Israel has "secretly given South Africa access" to the "nuclear club." Quoting anonymous

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intelligence sources, the network says that Israel is in a partnership with Pretoria to produce a missile with a nuclear warhead for South Africa, in exchange for enriched uranium and access to a long-range test site. The report identifies Armscor as builder of the missile and Urdan, an Israeli firm located outside of Tel Aviv, as the front company responsible for transferring missile technology. Israeli General Hagai Ravev, a former senior adviser to Defense Minister Yitzhak Rabin, allegedly oversees the project from Jerusalem. In a follow-up report, NBC claims that Israel is also sharing aviation technology with Pretoria and that at least 75 Israeli engineers have gone to South Africa to work on aviation projects. The report also alleges that South Africa is developing a site to construct a long-range missile with Israel, which the CIA designates as IRAH-3.

— Michael R. Gordon, "U.S. Sees Israeli Help in Pretoria's Missile Work," *New York Times*, 27 October 1989, web.lexis-nexis.com/universe; NBC Nightly News, 25 October 1989, transcript of broadcast 25 October 1989, pp. 1-2.

26 October 1989

Israeli Prime Minister Yitzhak Shamir further denies reports that Israel provided missile technology to South Africa. Shamir tells Israel Radio that there is "no truth" to the NBC News report alleging a partnership between Israel and South Africa to develop nuclear missile capability.

— "S. Africa Nuclear Link Denied," *Los Angeles Times*, 26 October 1989, web.lexis-nexis.com/universe.

28 October 1989

US President George Bush warns that any cooperation on nuclear missiles between Israel and South Africa would complicate US-Israeli relations. Israeli Prime Minister Shamir responds by saying those responsible for leaking information to NBC News sought to sabotage US-Israeli relations.

— Wolf Blitzer, David Makovsky, and Dan Petreanu, "It Would 'Complicate' Jerusalem-Washington Ties. Bush Warns Israel on N-Deal with S. Africa," *Jerusalem Post*, 29 October 1989, web.lexis-nexis.com/universe.

October 1989

The US Senate investigates reports that South Africa has obtained information on detonators, explosives, and firing sets from the US Department of Energy. The information is not classified, but may be used in making and testing nuclear weapons.

— U.S. General Accounting Office Report GAO/RCED-89-116, "Weapons Related Information and Technology Controls," June 1989; in "Developments of Concern for Horizontal Proliferation", *PPNN Newsbrief*, October 1989, p. 8.

November 1989

An "Experts Committee" formed by de Klerk and composed of senior AEC, Armscor, and South African Defense Force (SADF) officials formally recommends the dismantlement of South Africa's nuclear weapons, and outlines dismantlement procedures. De Klerk and the South African cabinet approve the plan. The Y-plant subsequently stops producing HEU.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), pp. 11, 17; David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford: Oxford University Press, 1997), p. 380; International Atomic Energy Agency, *Report on the Completeness of the Inventory of South Africa's Nuclear Installations and Material, attachment to Gov/2609*, 3 September 1992, pp. 4-5.

15 November 1989

Two Americans and three South Africans are charged with trying to export US-origin missile technology illegally to

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South Africa, using the government-owned Israel Aircraft Industries (IAI) as the mediator, thereby violating such US laws as the Comprehensive Anti-Apartheid Act and the Arms Export Control Act.

— US Department of State, "Israel Aircraft Industries Indictment for Illegal Exports to South Africa," 22 November 1989, confidential cable declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

Late 1989

The nuclear test site in the Kalahari Desert is completely abandoned.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 14.

15 December 1989

UN General Assembly Resolution 44/113 notes "with great concern" that "collaboration between Israel and South Africa has resulted in the development by South Africa of a nuclear-tipped missile." The resolution also requests the Secretary-General to report to the General Assembly at its 45th session on the military assistance that South Africa is receiving from Israel, and any other sources in advanced missile technology, and supporting technical facilities.

— UN General Assembly, "Implementation of the Declaration on the Denuclearization of Africa," A/RES/44/113, 15 December 1989, www.un.org.

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1988-1983

1988-1990

Advena Central laboratories construction begins to maintain seven gun-type nuclear weapons. The decision to build more facilities is motivated by South Africa's long-term goal to replace the gun-type devices, and conduct nuclear weapons development work on advanced gun-type and implosion-type devices. The new Advena building contains enough space to load a warhead onto a ballistic missile, and the new storage vaults have space for one reentry body.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, www.isis-online.org.

1988

Research on implosion designs continues. In order to reduce the risk that accidental detonation of high explosives in an implosion device could lead to an unintended nuclear explosion, engineers at the Circle facility begin producing small amounts of TATB, an insensitive high explosive that ignites at a higher temperature than ordinary explosives.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 11, www.isis-online.org.

1988

The Council for Nuclear Safety (CNS) becomes independent of its parent organization, the AEC, making the CNS responsible for licensing nuclear facilities and ensuring safe transportation of nuclear materials.

— Department of Mineral and Energy Affairs, "South African Energy Policy Discussion Document," July 1995, www.polity.org.za.

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1988

The diminishing threat of the Soviet Union and the resolution of regional conflicts during the latter half of 1988 lead to an increased feeling of security by the South African government. A cease-fire between South Africa, Cuba, and Angola in August and the withdrawal of South African troops from Angola by 1 September eventually leads to a tripartite agreement between these nations. The UN agreement is signed on 22 December and provides for the independence of Namibia and the withdrawal of 50,000 Cuban troops from Angola. The improvement of South Africa's security situation is reportedly a pivotal factor in the future decision to dismantle the nuclear weapons program.

— David Albright, "Nuclear Rollback: Understanding South Africa's Denuclearization Decision," in Barry R. Schneider and William L. Dowdy, *Pulling Back from the Nuclear Brink* (London: Frank Cass Publishers, 1998), pp. 81-82.

June-October 1988

Armstrong constructs a concrete floor and hangar around the surface of one of the test shafts in the Kalahari Desert, in order to assess the shaft's condition. The test site is examined in order to guarantee that a nuclear test can be conducted if needed, to fulfill phase three of the nuclear deterrent strategy. US and Soviet satellites detect the preparations. The discovery prompts both the United States and USSR to pressure the South African government to begin peace talks with Soviet-backed forces in the front-line states.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), pp. 13-16; Mark Hibbs, "South Africa's Secret Nuclear Program: The Dismantling," *Nuclear Fuel*, 24 May 1993, p. 9.

August 1988

The Valindaba semi-commercial enrichment plant begins operation. It will supply both Koeberg reactors with fuel.

— Leonard S. Spector and Jacqueline R. Smith, *Nuclear Ambitions: The Spread of Nuclear Weapons 1989-1990* (San Francisco: Westview Press, 1990), p. 277.

August 1988

The South African ministers of foreign affairs and of mineral and energy resources lead a delegation to IAEA headquarters in Vienna to discuss NPT accession with representatives from Britain, the United States, and the USSR.

— David Fischer, "South Africa: As a Nuclear Supplier," in W.C. Potter, ed., *International Nuclear Trade and Nonproliferation: The Challenges of the Emerging Suppliers* (Toronto: Lexington Books, 1990), p. 279.

August 1988

Pik Botha, South African foreign minister, gives the clearest indication to date of South African capability to build nuclear weapons when he publicly announces, "We have the capability to make one [a nuclear bomb]. We have the capability to do so should we want to." When asked by reporters if South Africa already possesses such a device, he states, "I'm not going to enlarge on that statement."

— "Pretoria Says It Can Build A-Arms," *New York Times*, 14 August 1988.

16 September 1988

South Africa sends a letter to IAEA Director General Hans Blix expressing willingness to accede to the NPT if certain conditions are met, primarily that South Africa be allowed to market its uranium subject to IAEA safeguards.

— David Fischer, "South Africa: As a Nuclear Supplier," in W.C. Potter, ed., *International Nuclear Trade and Nonproliferation: The Challenges of the Emerging Suppliers* (Toronto: Lexington Books, 1990), p. 279.

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November 1988

Responding to pressure from the Japanese government and the United States, Japan's utility companies say they will not import any more uranium from South Africa, which had accounted for 11 percent of Japan's uranium imports.

— David E. Sanger, "Utilities in Japan to Shun Uranium from South Africa," *New York Times*, 12 November 1988, p. 1.

1987

The AEC's semi-commercial uranium enrichment plant is expected to achieve commercial production by the end of 1987. Valindaba has the capacity to produce 75 tons of 3.25 percent LEU annually.

— *Energy* (Johannesburg), 24 July 1987, pp. 16-17; cited in "Uranium Enrichment Plant at Valindaba to Start Commercial Product," *Nuclear Developments*, 28 January 1988, pp. 7-9.

1987

A hot cell complex comes on-line at Pelindaba.

— "Implementation of the Declaration on the Denuclearization of Africa," report of the Secretary General, U.N. Document A/42/649, 16 October 1987; cited in Leonard S. Spector, *The Undeclared Bomb: The Spread of Nuclear Weapons 1987-1988* (Cambridge, MA: Ballinger, 1988), p. 303.

1987

South Africa agrees to sell 2,000 tons of yellowcake to Romania, but then cancels the deal because Romania is not forthcoming with information about safeguard measures to be applied on the material.

— David Fischer, "South Africa: As a Nuclear Supplier," in W.C. Potter, ed., *International Nuclear Trade and Nonproliferation: The Challenges of the Emerging Suppliers* (Toronto: Lexington Books, 1990), p. 275.

January 1987

France delivers a Thomson-CSF simulator to the Eskom to simulate that company's two Framatome/Alstom units, as part of a turnkey contract.

— "KEPCO Order Boosts Thomson-CSF Hopes for More Simulator Exports," *Nucleonics Week*, 29 January 1987, pp. 9-10.

21 January 1987

The AEC issues a statement that it has promised the US government that it will observe the spirit and letter of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and adhere to Nuclear Suppliers Group (NSG) guidelines in conducting its nuclear affairs. [Note: See 31 January 1984 entry.]

— David Fischer, "South Africa: As a Nuclear Supplier," in W.C. Potter, ed., *International Nuclear Trade and Nonproliferation: The Challenges of the Emerging Suppliers* (Toronto: Lexington Books, 1990), p. 276.

March 1987

The US firm Edlow International receives a "large quantity of South African origin natural uranium," in spite of a letter dated February 1984 from the US Nuclear Regulatory Commission (NRC) requesting that the company refrain from importing such material until the NRC completes its review of South African imports.

— Nuclear Regulatory Commission, "Record of Meeting with Edlow International Company on South African Uranium Imports," memorandum to Harold R. Denton from James R. Shea, 12 May 1987.

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26 May 1987

AEC Chairman John Marais announces that by 1988, South Africa's nuclear program will be virtually independent of overseas support. He states that the Koeberg nuclear power station will be utilizing locally enriched uranium. Safari-1 has been operating with locally manufactured fuel since 1981.

— Johannesburg Domestic Service, 26 May 1987; in "Nuclear Self-sufficiency Expected in 1988," *Worldwide Report*, 13 July 1987, p. 1.

August 1987

Armscor completes its "first qualified production model" nuclear weapon, which can be delivered by a modified Buccaneer bomber aircraft. By the program's termination, Armscor manufactures four additional deliverable devices as well as the HEU core and some non-nuclear components for a seventh bomb.

— Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa," *IAEA Bulletin*, January 1995, p. 42.

August 1987

South Africa signs and ratifies two IAEA international nuclear safety agreements dealing with responses to nuclear accidents. The first is the Convention on Early Notification of a Nuclear Accident or the "Early Notice Convention," while the second is the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, or the "Assistance Convention."

— "IAEA Headed for September Vote on South African Suspension," *Nucleonics Week*, 27 August 1987, p. 5; IAEA Board of Governors General Conference, "Measures to Strengthen International Co-operation in Nuclear, Radiation and Waste Safety," 11 August 2000, www.iaea.or.at.

21 September 1987

To thwart attempts by the Group of 77 to terminate South Africa's rights and privileges as a member of the IAEA, the United States and other states press President P.W. Botha to declare publicly that South Africa will soon accede to the NPT.

— David Fischer, *Stopping the Spread of Nuclear Weapons: The Past and the Prospects* (New York: Routledge Publishing, 1992), pp. 214-215.

December 1987

South Africa plans to store low-level radioactive waste (LLW) and intermediate-level radioactive waste (ILW) from the Koeberg power station at the Vaalputs radioactive waste facility. Spent fuel from Koeberg will be stored in transportation casks, which "will probably be stored under cover at Vaalputs for several decades" before being shipped to France for reprocessing.

— "South Africa Stores Spent Fuel and Waste," *Nuclear Engineering International*, December 1987, p. 54.

1986

The Vaalputs facility, which is designed for disposal of low- and medium-level radioactive waste, becomes operational.

— Atomic Energy Corporation of South Africa, "AEC Corporate Profile," www.aec.co.za.

1986

South Africa concludes research on excimer pumped dye lasers for the AVLIS project at the National Physical Research Laboratory in Pretoria.

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— Mark Gorwitz, "Section10; South Africa," *Second Tier Nuclear Nations: Laser Isotope Separation Programs Technical Citations and Comments*, unpublished paper, January 1996.

1986

The Y-plant is used to produce LEU for a period of 11 months, because the semi-commercial Z-plant is not fully operational. The 3.25 percent LEU is allocated for use in the first four lead test assemblies.

— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

February 1986

AEC Executive Chairman J.W.L. De Villiers announces that the AEC will offer separative work units (SWU) from its Valindaba semi-commercial enrichment plant on the world market in 1988. The enriched uranium is to be sold at marginal cost, approximately \$119/SWU.

— James Branscome, "South Africa Will Offer SWU on World Market in 1988," *Nucleonics Week*, 27 February 1986, pp. 1-2.

April 1986

Despite sanctions imposed by France against South Africa in July 1985, Framatome is still supplying the Koeberg nuclear power station with nuclear fuel.

— "Indigenous Nuclear Programme Thrives Under Sanctions," *Nuclear Engineering International*, April 1986, pp. 10-11.

23 May 1986

South Africa's nuclear relations with the West degenerate as the United States, West Germany, and the United Kingdom terminate cooperation agreements, thus ending 30 years of close nuclear cooperation. South Africa expresses concern that it may be unable to import equipment necessary to maintain nuclear safety.

— Hamish McIndo, *Business Day* (Johannesburg), 23 May 1986, p. 7; cited in "Impact of Nuclear Cooperation Shutdown Viewed," *Worldwide Report*, 9 July 1986, p. 48.

June 1986

South African negotiations with the IAEA stall, as South Africa demands the right to withdraw safeguarded enriched uranium produced in Valindaba for nuclear submarine propulsion systems, and the right to abrogate the safeguards agreement should its rights and privileges as a member of the IAEA be curtailed. The IAEA finds these conditions unacceptable.

— Leonard S. Spector, *The Undeclared Bomb: The Spread Of Nuclear Weapons 1987-88* (Cambridge, MA: Ballinger, 1988), pp. 294, 438.

July 1986

The US Congress passes the "Anti-Apartheid Act" barring uranium imports from South Africa.

— David Fischer, "South Africa: As a Nuclear Supplier," in W.C. Potter, ed., *International Nuclear Trade and Nonproliferation: The Challenges of the Emerging Suppliers* (Toronto: Lexington Books, 1990), p. 285.

7 August 1986

Two people die and two others are seriously injured as a result of a fire inside the Y-plant. According to Frank Pabian of Lawrence Livermore National Laboratory, who was visiting the plant at the time, the fire was caused by flammable wax polish.

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— Moscow in Zulu to Southern Africa, 7 August 1986; cited in "Accident at Pelindaba Nuclear Plant Reported," *Worldwide Report*, 26 September 1986, p. 61; conversation with Frank Pabian.

October 1986

AEC Executive Chairman Dr. Wynand de Villiers remarks that South Africa's current 3.25 percent enrichment level is insufficient for building a nuclear weapon. De Villiers reiterates assurances that South Africa's semi-commercial enrichment plant is to be used for peaceful means.

— Johannesburg Television Services, 5 October 1986; cited in "Officials Examine Nuclear Technology Prospects," *Worldwide Report*, 13 November 1986, p. 67, Johannesburg Domestic Service, 6 October 1986; cited in "Country Said Self-Sufficient on Nuclear Energy," *Worldwide Report*, 3 November 1986, p. 66.

November 1986

A confidential memorandum from the US embassy in Pretoria to Washington summarizes an article that appeared in the 10 November issue of *Business Day*. In the article, Peter Lomas of the Stockholm International Peace Research Institute (SIPRI) claims the new South African enrichment plant at Valindaba will produce HEU for three purposes: creating nuclear weapons, nuclear fuel to supply their reactors at Koeberg, and a strategic stockpile for use in negotiations with the West and generating foreign revenue.

— US Embassy in South Africa, "Claim that Highly Enriched Uranium for Use in Nuclear Weapons Could Be Produced by the New South African Enrichment Plant," 10 November 1986, confidential memorandum partially declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

1985

Armcor is reorganized to rationalize the nuclear program. The new organizational structure has eight divisions: Program Management and Systems Engineering; Engineering; Technology Development and Explosives; Finances; Security; Health Care; Operations Support; and Personnel.

— Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *Nuclear Fuel*, 10 May 1993, p. 4.

1985

The weapons program stops funding an AEC project to construct a 150MW pressurized water research reactor at Gouriqua, in Cape Province. The reactor is part of an AEC project to produce plutonium and tritium. Only rudimentary civil engineering preparations were carried out on the reactor before its funding was terminated.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 12, www.isis-online.org.

27 February 1985

South Africa's Atomic Energy Corporation's executive chairman, Dr. J.W. de Villiers announces that since the Valindaba semi-commercial uranium enrichment plant will not come into operation until 1987, South Africa's Electricity Supply Commission (Eskom) will have to continue importing enriched uranium.

— SAPA (Johannesburg), 27 February 1985; cited in "Uranium Enrichment Plant to Operate by 1987," *Worldwide Report*, 1 April 1985, p. 53.

4 June 1985

The US House of Representatives adopts an amendment to the Anti-Apartheid Bill that bans nuclear cooperation of any kind with South Africa.

— "The House Has Voted to Ban Nuclear Trade with South Africa," *Nuclear News*, July 1985, p. 17; *Nuclear Developments*, 25 February 1988, pp. 1-3.

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7 July 1985

The second unit of the Koeberg nuclear power station reaches criticality, and commercial service is expected to commence in October 1985.

— "South Africa," *Nucleonics Week*, 1 August 1985, p. 16.

9 September 1985

President Ronald Reagan issues an executive order that places new restrictions on nuclear trade with South Africa, but still allows certain nuclear exports to South Africa. Furthermore, it does not preclude assistance for IAEA safeguards or IAEA programs generally available to member states, for technical programs designed to bolster nonproliferation, or "for exports which the Secretary of State determines are necessary for humanitarian reasons to protect public health and safety." However, Department of Energy Secretary John Herrington refuses authorization to allow US citizens to work at Koeberg.

— "Reagan Places New Restrictions on Nuclear Exports to South Africa," *Nucleonics Week*, 12 September 1985, pp. 7-8.

September 1985

After reviewing the nuclear weapons program, President P.W. Botha confirms that the program will be limited to seven fission devices. The government halts all work related to development of plutonium devices, ceases efforts to produce plutonium and tritium for nuclear weapons, and limits production of lithium-6. The Atomic Vapor Laser Isotope Separation (AVLIS) program is reoriented from production of lithium-6 to production of lithium-7 for water chemistry control in power reactors. However, Advena personnel continue work on implosion designs and theoretical research on advanced weapons. According to Mitchell Reiss, at this time South Africa terminates preliminary studies on thermonuclear weapons.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): p. 6; David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 13. www.isis-online.org; Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa," *IAEA Bulletin*, January 1995, p. 45; Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *Nuclear Fuel*, 10 May 1993, p. 4; Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 16; Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 16.

October-November 1985

Senator Alan Cranston and India's Chief of Army Staff General Arlia Vattadys accuse the People's Republic of China (PRC) of exporting nuclear technology to South Africa. The Senator also alleges that South Africa is importing LEU from China. The Chinese foreign ministry and Qian Jiadong, special consultant to the UN delegation, deny allegations of nuclear cooperation between the PRC and South Africa. The PRC's foreign ministry announces that notices have been sent to all countries receiving nuclear exports from the PRC that they must accept IAEA safeguards.

— John Felton, "China Nuclear Supplies," *CQ Weekly Report*, 26 October 1985, p. 2152; *Worldwide Report*, 25 November 1985, p. 18; *Fujian Ribao* (Fuzhou); cited in "China's Stand on Nuclear Cooperation Reiterated," *Worldwide Report*, 21 February 1986, pp. 4-5.

December 1985

At the request of US Congressman Edward Markey, chairman of the Subcommittee on Energy Conservation and

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Power, a fact-finding team from the Department of Energy investigates possible criminal violations by 22 American citizens employed by South Africa's Electricity Supply Commission (Eskom). The Justice Department concludes that the unintentional violation of the Atomic Energy Act by the 22 Americans does not warrant further criminal investigation.

— US Department of Justice, "American Citizens Employed at Koeberg Nuclear Power Station in South Africa," 9 December 1985, unclassified memorandum released, Digital National Security Archive, nsarchive.chadwyck.com.

Mid-1980s

With approximately half of the tritium it received from Israel in the 1970s lost to natural decay, AEC decides to use the remaining material in radioluminescent exit signs.

— David Albright, "Slow but Steady," *Bulletin of the Atomic Scientists*, July-August 1993, p. 6.

Mid-1980s

Ten buildings are added to the Advena facility (previously Kentron Circle) to facilitate replacement of the gun-type devices with implosion type devices and to allow Armscor to diversify into conventional military pyrotechnics and missile control components.

— David Albright, "Slow but Steady," *Bulletin of the Atomic Scientists*, July-August 1993, p. 5.

1984

The AEC commissions the initial elements of the Valindaba semi-commercial enrichment plant. It is meant to produce low-enriched uranium (less than 5 percent U235).

— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

1984

South Africa continues construction of a hot cell complex at Pelindaba that will be used to handle spent fuel. The South African government states that the facility will be used to examine "nuclear fuel associated with fabrication development," and not for reprocessing plutonium.

— *Nuclear Fuel*, 8 October 1984; cited in J.D.L Moore, "The Development of South Africa's Nuclear Capability," in *South Africa and Nuclear Proliferation* (New York: St. Martin's Press, 1987), p. 102; Director of Central Intelligence, "Trends in South Africa's Nuclear Security Policies," 4 October 1984, top secret document partially declassified and released on 27 April 1997, www.foia.ucia.gov.

31 January 1984

The AEC announces that South Africa "will conduct and administer its external nuclear affairs in a manner which is in line with the spirit, principles and goals of the Nonproliferation Treaty [NPT] and the nuclear supplier's group guidelines." The AEC will require safeguards as a condition of exporting nuclear material and equipment. South Africa is also ready to resume discussions with the IAEA on safeguarding the Valindaba semi-commercial enrichment plant, but not the Y-plant, saying that its new enrichment technology may be "compromised" if the Y-plant were open to international inspection.

— "South Africa: Nuclear Safeguards and Exports Announcement," *Department of State Bulletin*, March 1984, p. 57; Stephanie Cooke, "South Africa Will Require Safeguards as Condition for Nuclear Exports," *Nucleonics Week*, 9 February 1984, p. 1; Allister Sparks, "S. Africa Pledges to Abide by Nuclear Treaty," *Washington Post*, 10 February 1984, p. A34.

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January 1984

In response to South Africa's announcement, the US Department of State sends a telegram to the US embassies and consulates in South Africa containing guidance questions and answers for the embassy spokesman to use on an "if-asked basis." In response to a sample question inquiring whether South Africa had already developed nuclear weapons, the spokesman is instructed to reply that the Department of State "cannot state that South Africa has produced nuclear weapons," and that US-South African discussions on the nuclear issue are "designed to convince the SAG [South African government] that such a step would not be in its interests."

— US Department of State, "South African Public Announcement of 31 January 1984 Regarding Nuclear Export Policy and International Safeguards," telegram from the US Secretary of State to the US Embassy in Pretoria, January 1984, pp. 8-9, confidential document declassified and released on 2 September 1987.

17 April 1984

Koeberg-1 commences operation.

— Leonard S. Spector and Jacqueline R. Smith, *Nuclear Ambitions: The Spread of Nuclear Weapons 1989-1990* (San Francisco: Westview Press, 1990), p. 288.

25 May 1984

Pieter van Vuuren, South Africa's ambassador to Taiwan, says that South Africa will supply Taiwan with uranium if that country wants to increase imports for the generation of nuclear power. South African exports meet about 70 percent of Taiwan's uranium needs.

— Johannesburg Domestic Service in English, 25 May 1984; cited in "Uranium Pledged for Taiwan," *Worldwide Report*, 7 June 1984, p. 33.

July 1984

The Swiss Foreign Affairs Department investigates charges that Sulzer Brothers, a Swiss firm, is considering selling a heavy water plant to South Africa.

— "U.S. Asks Swiss about Rumor of Heavy Water Sale to South Africa," *Nucleonics Week*, 30 July 1984, p. 1.

5 July 1984

After being questioned by Brian Goodall, a Progressive Federal Party energy specialist, South African Prime Minister P.W. Botha confirms that since 1979, a number of countries have inquired about dumping radioactive waste in South Africa and Namibia. A sum of one billion rand was offered by the FRG and the United States for a radioactive waste site. The matter was referred to South Africa's Atomic Energy Board.

— *Rand Daily Mail* (Johannesburg), 30 July 1984, p. 36; cited in "Radioactive Waste," *Worldwide Report*, 30 July 1984, p. 36.

27 July 1984

AEB Chairman Dr. J.W.L. de Villiers denies reports that Sulzer Brothers of Switzerland will sell South Africa a heavy water production plant.

— *Daily Dispatch* (East London), 27 July 1984, p. 14; cited in "Heavy Water with Swiss Denied," *Worldwide Report*, 28 August 1984, p. 14.

August 1984

South Africa and the IAEA resume safeguards negotiations, which had broken off seven years earlier, on placing the Valindaba semi-commercial enrichment plant under IAEA safeguards. South Africa remains unwilling to place

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the Y-plant under safeguards.

— "The IAEA and South Africa Resumed Negotiations on Safeguards," *Nucleonics Week*, 16 August 1984, p. 9.

21 August 1984

The French contractor turns Koeberg-1 over to South Africa's Electricity Supply Commission (Eskom). In June 1984, the AEC had given consent for pushing energy generation up to 100 percent. Koeberg was issued its commercial operating license in August 1984, and Koeberg-2 is expected to go into full operation in May 1985.

— *Die Burger* (Cape Town), 21 August 1984; cited in "French Nuclear Power Reactor," *Worldwide Report*, 15 October 1984, p. 39.

October 1984

A secret US CIA National Intelligence Estimate concludes that South Africa has the capacity to produce nuclear arms "on short notice," and that it has stockpiled components for "several test devices or first generation nuclear weapons that use enriched uranium." The estimate says that South Africa could have produced enough fissile material for a first nuclear device by 1979. Furthermore, the estimate states that South Africa may have "leapfrogged the testing phase" to focus on weaponization and delivery of nuclear explosive devices.

— Director of Central Intelligence, "Trends in South Africa's Nuclear Security Policies," 4 October 1984, pp. 1, 16, 25, top secret document partially declassified and released on 27 April 1997, www.foia.ucia.gov.

29 November 1984

As agreed by France, South Africa, and the IAEA, South Africa's high-level radioactive waste products from the Koeberg plant are to be exported to France for reprocessing. France will be responsible for storing the final waste product.

— "International Nuclear Waste Dump Considered," *Worldwide Report*, 14 January 1985, p. 1; *The Star* (Johannesburg), 29 November 1984.

1983-1984

South Africa secretly hires 25 US reactor operators and technicians to work at the Koeberg nuclear power plant. The specialists are contracted without proper authorization from the US government.

— Leonard S. Spector, *The Undeclared Bomb: The Spread of Nuclear Weapons 1987-1988* (Cambridge, Massachusetts: Ballinger Publishing Company, 1988), p. 291.

1983

South Africa begins a project on molecular laser isotope separation (MLIS) for uranium enrichment.

— D.M. Kemp et al., "Uranium Enrichment Technologies in South Africa," Atomic Energy Corporation of South Africa Ltd., paper presented at the International Symposium on Isotope Separation and Chemical Exchange Uranium Enrichment, 29 October-1 November 1990, Tokyo, Japan; cited in David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press, 1997), p. 384.

March 1983

A US CIA report concludes that research on both a gun-type device, using two modified naval guns, and on the firing system of an implosion device was conducted at the Somerset West explosives installation in South Africa, beginning in the 1973-77 period. Possible tests of nuclear-related high explosives were conducted at the Kalahari test site in 1977-78. The report notes that South Africa considered constructing a plutonium separation facility in 1977. The South African enrichment plant at Valindaba has been producing HEU since 1978, and the CIA estimates

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that it has produced HEU for "several nuclear weapons." The report states that the test site in the Kalahari Desert was intended for nuclear weapons, and that South African scientists expected a yield of 20 kilotons if they had tested a device. According to the report, the 1979 discovery of a probable nuclear test site in the Kalahari Desert and the "international uproar" that followed, led Prime Minister Vorster to "order a halt to further nuclear weapons development." The report concludes that the CIA has not had any "direct indication of any subsequent activities in the weapons program." The report also says that South Africa provided Israel with 10 tons of uranium in 1963, and depleted uranium and natural uranium rods during 1972-75.

— Directorate of Intelligence, *New Information on South Africa's Nuclear Program and South African-Israeli Nuclear Military Cooperation*, 30 March 1983, pp. 1-3.

August 1983

Framatome of France sends a repaired set of 18 control rod drive mechanisms to the Koeberg plant in South Africa. Meanwhile, the Koeberg plant undergoes re-welding and will be examined for leaks as a result of the disclosure that the Framatome-supplied plant had an undercladding cracking problem.

— "The Koeberg Nuclear Power Plant...," *Nucleonics Week*, 4 August 1983, p. 7; "South Africa Probably Would Not Buy Its Next Nuclear Reactor From Framatome," *Nucleonics Week*, 1 September 1983, pp. 9-10.

22 September 1983

The US government allows Westinghouse Corporation to provide technical equipment and maintenance at South Africa's nuclear power station.

— *Die Transvaler* (Pretoria), cited in "Paper Welcomes U.S. Decision on Nuclear Plant," *Worldwide Report*, 24 October 1983, p. 86.

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1982

1982

MAN-Energie of the Federal Republic of Germany supplies the Koeberg nuclear power station with a central mast manipulator and other inspection equipment that will be used to conduct pre-service inspections on Koeberg-1 and -2 reactor pressure vessels.

— *Engineering News*, 6 July 1990, p. 10; cited in "Koeberg Reactor Vessel to be Inspected," *Nuclear Developments*, 8 August 1990, p. 1.

1982

The first three batches of UF₆ for South Africa's Koeberg power plant arrive at the Franco-Belge de Fabrication de Combustibles nuclear fuel fabrication plant in Roman, France. The UF₆ comes from Synaton of Belgium and the Kaiseraugst nuclear power firm, a joint venture of France, Switzerland, and West Germany. The material was enriched at the Tricastin gaseous diffusion plant, a Eurodif facility.

— "The First Batches of UF₆ for South Africa," *Nuclear News*, January 1982, pp. 25-26.

1982

South Africa passes the Nuclear Energy Act, making it illegal to divulge information concerning uranium reserves and actual or potential output without government permission.

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— David Fischer, "South Africa: As a Nuclear Supplier," in W.C. Potter, ed., *International Nuclear Trade and Nonproliferation: The Challenges of the Emerging Suppliers* (Toronto: Lexington Books, 1990), p. 275.

1982

UCOR and the AEB are incorporated into the Atomic Energy Corporation (AEC).

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 8.

1982

After four years of research and development commissioned by Armscor's Systems Engineering Division, the gun-type device is refined and its hardware qualified and "requalified." In an April 1993 statement, an Armscor spokesperson states that as of 1982 the improved devices exceeded the safety requirements applicable to a gun-type device.

— Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to Deterrent," *NuclearFuel*, 10 May 1993, p. 5.

1982

The Reagan administration approves the sale of computers to South Africa that could be used in the design and manufacture of nuclear weapons. The Council for Scientific and Industrial Research (CSIR) in Pretoria receives a "powerful Amdahl 470/V7 computer" from a California firm. The Control Data Corporation also sells a sophisticated Cyber 170/750 computer to the same agency. [Note: CSIR is involved in nuclear- and military-related research, as well as private and scientific studies. Some US officials fear that these large-capacity computers will enhance South Africa's nuclear development. Official US policy is to curtail nuclear ties until Pretoria agrees to complete safeguards for its nuclear facilities and signs the Nuclear Non-Proliferation Treaty.]

— Alan J. Kuperman and Paul L. Leventhal, "Nuclear Proliferation is Everybody's Business," *Los Angeles Times*, 25 February 1988, web.lexis-nexis.com/universe; Reed Kramer, "Questions raised over US High-Tech Sales to South Africa," *Christian Science Monitor*, 28 October 1982, web.lexis-nexis.com/universe.

February 1982

South Africa's purchase of enriched uranium from Swiss power utility Kaiseraugst reduces US leverage over South Africa, which had been provided by a long-term South Africa-US Department of Energy uranium enrichment contract.

— "Kaiseraugst Purchase Seen as Freeing South Africa from Contract," *Nucleonics Week*, 18 February 1982, p. 1.

April 1982

The Koeberg nuclear power plant is scheduled for completion within 78 months, as stipulated by a contract between South Africa and a French consortium led by Framateg. The plant was provided by Framatome. The project features technology from Westinghouse and quality assurance practices from the US firm Gilbert/Commonwealth.

— "French and South African Crew Are Striving to Complete Koeberg-1," *Nucleonics Week*, 22 April 1982, pp. 3-4.

April 1982

Armscor produces its first nuclear explosive device. The South African nuclear weapons arsenal increases at the rate of one device approximately every 18 months, until it includes six weapons by the late 1980s. During this period, the older devices are upgraded. However, according to Stumpf and IAEA specialists, the "first prototype deliverable device" built at the Armscor facility is not completed until December 1982. Public sources concur, however, that until 1982 South Africa did not possess a deliverable nuclear weapon.

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— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 10, www.isis-online.org;
Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to Deterrent," *NuclearFuel*, 10 May 1993, p. 5;
Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 11; Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 5; Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa." *IAEA Bulletin*, January 1995, p. 42.

April 1982

Advena manufactures its first nuclear device after a long delay caused by a technical fault at the Y-plant. The device is dubbed a "pre-qualification" model. Design refinement is carried out for another two to three years, after which the design is "frozen" for production.

— David Albright "A Curious Conversion," *Bulletin of the Atomic Scientists*, June 1993, p. 9.

April 1982

Exploiting increased HEU production at the Y-plant, South Africa completes assembly of a third nuclear weapon. The weapon production rate is planned to coincide with the Y-plant's HEU production.

— Mark Hibbs, "Pretoria Replicated Hiroshima Bomb in Seven Years, then Froze Design," *Nucleonics Week*, 6 May 1993, p. 16; Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to Deterrent," *Nuclear Fuel*, 10 May 1993, p. 5.

April 1982

Before the end of the year, 50 or more modules of UCOR's 300,000 SWUs will be delivered to the Valindaba semi-commercial enrichment plant. UCOR's funding has been reduced by 15 percent. The reduction will delay the plant's output, which otherwise would be at least 3 million SWUs.

— Rob Laufer, "Inside Valindaba: South African Enrichment Plant Steadily Taking Shape," *Nucleonics Week*, 8 April 1982, p. 2.

14 April 1982

Swuco and Edlow International, US brokers that purchased enriched uranium on behalf of South Africa from Belgium's Synatom in 1981, are asked to apply for an export license before the material can be transferred to South Africa.

— "The EEC Commission is Trying to Persuade Edlow International to Comply," *Nucleonics Week*, 3 June 1982, p. 5.

12 May 1982

US Secretary of Commerce Malcolm Bridge responds to Senator Charles Percy's queries concerning the export of 95 grams of helium-3 to South Africa's Atomic Energy Board (AEB). He insists that the export of helium-3 to the AEB does not contradict US policy since the export will be used in nuclear safety-related testing, and the administration has a "more flexible policy with respect to approvals of export of dual-use commodities and other materials and equipment which have nuclear-related uses in areas such as health and safety activities."

— US Department of Commerce, "US Department of Commerce Response to Questions on the Proposed Export of 95 Grams of Helium-3 to the Atomic Energy Board of the Republic of South Africa," 12 May 1982, confidential document declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

June 1982

Swuco and Edlow International of the United States broker a deal between the Swiss Power Utility Consortium,

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Belgium's Synatom, and South Africa's Electricity Supply Commission (Eskom) for transfer of approximately 100 tons of excess enriched uranium to South Africa.

— "US Firms Involved in Koeberg Fuel Deal," *Nuclear Engineering International*, June 1982, p. 9.

16 July 1982

Chris Von Christierson, South African representative of Nuexco (an international uranium broker), predicts an increase in South Africa's exports of uranium.

— Adam Payne, *Rand Daily Mail* (S.A. Digest), 16 July 1982, p. 8; cited in "S.A. Set to Become No. 2 in Uranium," *South African Digest*, 16 July 1982, p. 11.

11 September 1982

During a press conference, the chairman of the board of directors of Armscor states that its G-5 and G-6 SP howitzers are capable of firing 155mm rounds with special nuclear warheads developed in the United States, but that they were not intended for this purpose.

— Kenneth Mokoena, ed., *South Africa and the U.S.: The Declassified History* (New York: The New Press, 1993), p. 31.

9 December 1982

UN General Assembly Resolution 37/69 condemns the actions of multinational corporations that continue to enhance the military and nuclear capabilities of South Africa through collaboration with the regime, and deplores "the attitude of those States, in particular the US of America and Israel, which have continued and increased their political, economic and other collaboration with South Africa." The resolution also "[r]equests the International Atomic Energy Agency to refrain from extending to South Africa any facilities which may assist it in its nuclear plans and, in particular, to exclude South Africa from all its technical working groups."

— Timothy U. Mozia, "Chronology of Arms Embargoes against South Africa," in *Effective Sanctions on South Africa: The Cutting Edge of Economic Intervention*, ed. George W. Shepherd, Jr. (New York: Greenwood Press, 1991), p. 98. U.N. General Assembly, "Policies of the Government of South Africa," A/RES/37/69, 9 December 1982, www.un.org.

22 December 1982

The African National Congress (ANC) bombs South Africa's Koeberg-1 reactor in retaliation for a South African Defence Force raid on Maseru, Lesotho, in which 42 ANC members and Lesotho citizens were killed. The damage caused by a series of four explosions to the R1.8 billion complex is reportedly extensive.

— *Nucleonics Week*, 27 January 1983, p. 1; Abdul Minty, "South Africa's Nuclear Capability: Apartheid Bomb," in Phyllis Johnson and David Martin, eds., *Destructive Engagement: Southern Africa at War* (Harare: Zimbabwe Publishing House, 1986).

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1981

1981

The Elprod fuel fabrication facility comes on-line, and produces sufficient fuel to supply the Safari-1 reactor.

— J. Goldblat, ed., *Nonproliferation: The Why and the Wherefore* (Philadelphia, PA: Taylor and Francis, 1985), p.

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315; in Leonard S. Spector, *The Undeclared Bomb: The Spread of Nuclear Weapons 1987-1988* (Cambridge, Massachusetts: Ballinger, 1988), p. 303.

1981

Armstrong completes construction of two buildings at the Kentron Circle facility. The main building is for designing, manufacturing, and storing gun-type nuclear weapons, while the other is dedicated to conducting environmental tests. The environmental testing installation involves "testing the reliability of the device under real-world conditions." This testing service is important because the nuclear weapons are expected to be reliable without requiring full-scale nuclear testing.

— David Albright "A Curious Conversion," *Bulletin of Atomic Scientists*, June 1993, bullatomsci.org, p. 8; David Albright, "Slow but Steady," *Bulletin of Atomic Scientists*, July-August 1993, p. 5.

1981

South Africa approves a project sited at Gourquia to develop commercial pressurized water reactor (PWR) technology, and for the possible future production of tritium and plutonium.

— Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa." *IAEA Bulletin*, January 1995, p. 45.

April 1981

One day prior to South African general elections, the Minister of Mines and Energy discloses that the AEB produced 45 percent enriched uranium fuel elements that will allow the Safari-1 research reactor to continue operating at 5MW.

— J.D.L. Moore, "The Development of South Africa's Nuclear Capability," in *South Africa and Nuclear Proliferation* (New York: St. Martin's Press, 1987), pp. 98-99; Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 37.

3 April 1981

The US Department of State issues a set of talking points stating that the United States values resuming nuclear cooperation with South Africa and will provide fuel for the Koeberg reactors if South Africa complies with alternative interim supply arrangements from France, as detailed in Paris on 30 March 1981. The State Department expresses concern regarding South Africa's reluctance to join the NPT and the government's desire to work directly with a French supplier of fuel.

— US State Department, "South Africa — Nuclear Issue," 3 April 1981, secret memorandum declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

May 1981

Armstrong's Kentron Circle facility is commissioned, which "essentially duplicate(s), under one roof, most of the development and manufacturing capabilities at Pelindaba." The AEB nuclear device that had been provided with HEU in November 1979 is subsequently transferred from temporary storage in an abandoned coal mine at Witbank to a special vault at the Kentron Circle facility. Armstrong later notes that this AEB device is not a "qualified" design, indicating there is "not an adequate degree of assurance that it would detonate as intended or that it would not detonate accidentally." It is later dismantled and turned over to Armstrong for safekeeping. Each half of the device is stored in different high-security vaults.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, pp. 9-10. www.isis-online.org; David Albright "A Curious Conversion," *Bulletin of Atomic Scientists*, June 1993, bullatomsci.org; Mark Hibbs,

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"South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *Nuclear Fuel*, 10 May 1993, pp. 4-5; Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 5; Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 11; Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa," *IAEA Bulletin*, January 1995.

July 1981

The first HEU is withdrawn from the Y-plant since its 1979 shutdown.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 4; Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 11.

December 1981

As of 1981, Safari-1 has been operating at approximately 5MW with domestically produced 45 percent HEU. A telegram from the US State Department to the US Embassy in Pretoria reports that the South African government raised the issue of possible US assistance in the conversion of the Safari-1 research reactor to use LEU fuel, in discussions with a US safeguards delegation. The embassy is instructed to express US willingness to invite South African scientists to visit the Oak Ridge and Argonne national laboratories, and to assist South Africa with LEU fuel-fabrication technology for research reactors.

— US Department of State, "Safari Research Reactor Fuel Conversion to Low Enriched Uranium," telegram from the US Secretary of State to the US Embassy in Pretoria, December 1981, declassified and released 12 April 1991.

End of 1981

South Africa obtained 130t of LEU from a Swiss power utility, Kaiseraugst, and an unspecified amount of LEU from the Belgian utility Synatom, to fuel the Koeberg reactors.

— J.D.L. Moore, "The Development of South Africa's Nuclear Capability," in *South Africa and Nuclear Proliferation* (New York: St. Martin's Press, 1987), p. 100.

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1980

January 1980

The CIA issues a classified intelligence memorandum detailing possible South African nuclear policy options, which include maintaining the nuclear weapons program at current levels, scaling back weapons development, or advancing the program. The memorandum concludes that further advancement is in the interest of the South African government, and that the program must remain covert in order to avoid sanctions against its commercial nuclear program. Statements by South African government officials regarding the possible nuclear event of 22 September and the covert nature of the event are consistent with South Africa's purposefully ambiguous policy towards nuclear weapons development.

— US Central Intelligence Agency, Directorate of Intelligence. "South Africa: Defense Strategy in an Increasingly Hostile World," January 1980, classified interagency intelligence memorandum, partially declassified and released 10 July 1990, Digital National Security Archive, nsarchive.chadwyck.com.

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Early 1980s

South Africa begins research on Atomic Vapor Laser Isotope Separation (AVLIS) for uranium enrichment.

Preliminary work focuses on copper-laser and excimer-pumped dye laser systems.

— Mark Gorwitz, "Section 10; South Africa," *Second Tier Nuclear Nations: Laser Isotope Separation Programs* Technical Citations and Comments, unpublished paper, January 1996.

1980s

Armcor's nuclear assembly group places strong emphasis on weapons certification and qualification. A unique feature of Armcor's weapon design is the capability to mate air-deliverable warheads to ballistic missiles. South Africa is able to mount its limited nuclear stockpile on either aircraft or ballistic missiles.

— Roy E. Horton III, "Out of (South) Africa: Pretoria's Nuclear Weapons Experience," *USAF Institute for National Security Studies, Occasional Paper #27*, www.usafa.af.mil.

1980

In compliance with the Nuclear Non-Proliferation Act (NNPA) of 1978, the Carter administration formally terminates US nuclear reactor and fuel exports to South Africa. The United States had suspended shipments of nuclear fuel to South Africa in 1975.

— Leonard S. Spector, *The Undeclared Bomb: The Spread of Nuclear Weapons 1987-1988* (Cambridge: Massachusetts: Ballinger, 1988), pp. 290, 432.

1980

South Africa completes construction of a laboratory designed for handling tritium.

— Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa," *IAEA Bulletin*, January 1995, p. 6, www.iaea.or.at.

1980

Two German firms, Neue Technologien GmbH and Physikalisch-Technische Beratung, export an ultrasound device to South Africa that is used in the fuel fabrication process.

— Mark Hibbs, "Germany May Have Approved Exports Alleged by Prosecutor to be Illegal" *NuclearFuel*, 9 January 1989, p. 2.

1980

Construction begins on Armcor's Kentron Circle facility, which later becomes Advena. The facility is located near Pretoria.

— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

February 1980

The US Executive Office of Science and Technology Policy requests that the Naval Research Laboratory undertake a scientific study (the Presidential Panel Review) to determine the source of the light signal detected by the Vela satellite on 22 September 1979.

— John Marcum, 31 January 1980, memorandum from US Executive Office of Science and Technology Policy, declassified and released, Digital National Security Archive, nsarchive.chadwyck.com; Alan Berman, 1 February 1980, memorandum from US Naval Research Laboratory, declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

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2 February 1980

The US Central Intelligence Agency (CIA) tells the US Congress that South African naval vessels were conducting military exercises in the South Atlantic at the time of the Vela event on 22 September 1979.

— US Department of State, "Press Report Re: Suspected Nuclear Incident," 2 February 1980, classified cable declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

7 February 1980

The Presidential Panel Review of the South Atlantic Event finds insufficient evidence to support a definite correlation between the light signal of the Vela Event and a nuclear explosion. "There were ambiguities in interpretation of this disturbance, and the information was not persuasive at this time as corroborative evidence for a nuclear event." The Presidential Panel Review hopes to clarify the Vela event with more detailed statistical analyses of previous signals and a thorough investigation of meteorological data.

— US Department of State, "Pres. Panel Review of South Atlantic Event," 7 February 1980, confidential cable declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

11 February 1980

Producers of the Public Broadcasting Service (PBS) film "Hot Shells," which reports on the alleged Space Research Corporation (SRC) smuggling of artillery shells to South Africa, testify before the UN Special Committee against Apartheid. They indicate that the US Department of State, Commerce, and Treasury as well as the US CIA and government officials from Antigua, Barbados, Canada, and the United Kingdom were aware of the illegal arms shipments by SRC. One of the producers alleges a US Department of Defense role in "shipping 53,000 rough steel forgings from artillery shells to SRC without an export license." He also alleges that the Vela event may have been a test of nuclear warheads to fit the 155 mm gun system from the SRC.

— US Mission to the U.N., "South Africa Arms Embargo: Space Research Case: Nuclear Matters," 14 February 1980, confidential cable declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

25-29 February 1980

The UN Expert Group on South Africa's Nuclear Capability convenes to discuss South Africa's nuclear plans and capabilities. Two US specialists, Edward Wonder of International Energy Associates, Ltd. and George Questor of Cornell University, speak about South Africa's nuclear facilities and capacity. Questor warns the Expert Group that "the press had been more alarmist than necessary" and concludes that the international community should refrain from premature accusations in regards to South Africa's nuclear weapons capacity.

— US Mission to the U.N., "Expert Group on South Africa's Nuclear Capability Hold Initial Session," 4 March 1980, classified cable declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

27 February 1980

An internal memorandum between scientists at the US Naval Research Laboratory discuss data to confirm whether or not South Africa conducted nuclear weapon tests on 22 September 1979. One scientist suggests that they expand upon the following data: relative position of the solar (earth-sun-moon) systems at the time of the Vela signal, ionosonde records, digital seismic information, and free atmospheric internal gravity waves (AGW) calculations.

— US Department of the Navy, "Progress Report on Project SEARCH," 27 February 1980, unclassified memorandum, Digital National Security Archive, nsarchive.chadwyck.com.

1 March 1980

J.W.L De Villers, president of the South African Atomic Energy Board, asserts on a national radio program that

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South Africa is not developing nuclear arms as a by-product of its nuclear energy program. He also adds that "regular inspections would be made of the Koeberg plant to see that none of the nuclear material was diverted for military purposes."

— US Consulate General in Cape Town, "South Africa Nuclear Policy," 1 March 1980, classified cable declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

13 June 1980

The Presidential Panel Review of the Vela event in the South Atlantic concludes that the lack of corroborative evidence that a nuclear explosion caused the light signal on 22 September leads them to consider that a micro-meteorite impact on the satellite could have caused the signal.

— US Department of State, "Press Panel Review of South Atlantic Event," 13 June 1980, secret cable declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

Mid-1980

The US panel of scientists assembled by President Carter releases its public report on the double flash detected by the Vela satellite in 1979. The panel concludes that the "signal was probably not from a nuclear explosion," but it does not "rule out the possibility." The CIA, the Naval Research Laboratory, Los Alamos National Laboratory, and the Defense Intelligence Agency contest the panel's conclusions, saying they believe that the data indicates a nuclear explosion.

— David Albright and Corey Gay, "A Flash from the Past," *Bulletin of the Atomic Scientists*, November/December 1997, bullatomsci.org.

Early 1980s

AEC closes Building 5000, which had been used for conducting the criticality experiment.

— David Albright, "Slow but Steady," *Bulletin of the Atomic Scientists*, July-August 1993, p. 5.

10 September 1980

The Soviet newspaper *Pravda* alleges that the United States, United Kingdom, Federal Republic of Germany, and France assisted South Africa's efforts to build an "atomic bomb of the racists."

— US Embassy in the Soviet Union, "Soviet Press Again Attacks South African Nuclear Activities," 10 September 1980, classified cable declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

3 November 1980

The director of research at the US Naval Research Laboratory informs the President's senior policy advisor for Technology and Arms Control that a sample of sheep thyroid collected from Australia between late October and early November 1979 revealed high levels of radioactive materials that also correlates with data from meteorological research on precipitation, making it likely that the Vela event observed in September 1979 is related to a nuclear weapon test.

— US Department of Navy, "Evidence of the Possible Detection of Fission Products Related to Vela Event of 22 September 1979," 3 November 1980, Digital National Security Archive, nsarchive.chadwyck.com.

5 December 1980

Israel, South Africa, and Taiwan are reported to have reached an agreement to start collaboration on the joint production of strategic cruise missiles and small unmanned jets capable of delivering nuclear warheads. US intelligence sources are aware of the nuclear collaboration and report that South Africa and Taiwan are seeking to keep their cruise missile plans secret. Information on the joint collaboration remains restricted to the national

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security community.

— "3 Nations to Begin Cruise Missile Project," *Washington Post*, 5 December 1980, web.lexis-nexis.com/universe.

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1979

1979

The South African government decides to reorganize its weapons program. It assigns Armscor with the tasks of designing and building additional gun-type devices. The AEB is tasked with providing HEU and expertise in theoretical and neutron physics. The principal components of the Armscor nuclear weapons program include: development and production of deliverable gun-type devices; studies of implosion and thermonuclear technology; research and development on production and recovery of plutonium and tritium; and separation of lithium-6 for tritium production, for possible use in nuclear weapons with boosted yield.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 5; Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa." *IAEA Bulletin*, January 1995, p. 5, www.iaea.or.at.

1979

South Africa is barred from participating in the IAEA General Conference held in India, in accordance with a resolution urging South Africa to sign the NPT and submit its nuclear activities to IAEA safeguards.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 5.

July 1979

An "Action Committee" created by Botha to develop plans for the production of nuclear devices recommends production of a total of seven nuclear weapons.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 9.

August 1979

The Y-plant is shut down "due to a massive catalytic in-process gas reaction between the uranium hexafluoride (UF₆) and the hydrogen carrier." When the thermodynamically unstable UF₆ and hydrogen gas mixture is contaminated by certain impurities, it reacts to form uranium tetrafluoride (UF₄) and hydrofluoric acid. The "catalytic impurities" are later identified and removed from the process. The Y-plant resumes operations eight months later.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 11.

22 September 1979

A US Vela surveillance satellite detects a "brief, intense, double flash of light near the southern tip of Africa." Due to its characteristics, US officials estimate that the flash could have resulted from the test of a nuclear device with a yield of 2 to 4 kilotons. South Africa emerges "as the prime suspect," but the South African government denies that it has conducted a nuclear test. Subsequently, noting that South Africa did not supply a complete nuclear device with HEU until November 1979, AEC head Waldo Stumpf said that "this should put to rest speculations as to

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whether South Africa was responsible for the 'double flash' over the South Atlantic Ocean on 22 September 1979. There are also rumors that Israel conducted a nuclear test, either alone or in conjunction with South Africa. US President Jimmy Carter assembles a panel of non-governmental scientists to determine whether the flash registered by the Vela was the result of a nuclear explosion.

— Waldo Stumpf, "South Africa: Nuclear Technology and Nonproliferation," *Security Dialogue* 4 (1993): 458. David Albright and Corey Gay, "A Flash from the Past," *Bulletin of the Atomic Scientists*, November/December 1997, www.bullatomsci.org.

26 October 1979

J.W.L. De Villiers, president of the Atomic Energy Board (AEB), flatly denies South African involvement in the suspected nuclear event while Foreign Minister Pik Botha refuses to deny South Africa's involvement, simply stating that he knew nothing of the event. The US State Department issues guidance to diplomatic posts worldwide on reaction to press reports of a possible low-yield nuclear explosion in the South Atlantic. The memorandum states that if diplomatic charges d'affaires feel it prudent, they may inform the host government of the incident. The memorandum emphasizes "that evidence remains ambiguous and the US government continues to investigate whether an event has taken place."

As information begins to circulate about the crash, the US State Department issues additional guidance to embassies on answering press questions regarding an alleged cover-up of an intelligence failure, failure to inform congress of the nuclear event in a timely manner, status of efforts to get South Africa to join the NPT, and possible sanctions if South Africa is responsible for the event. US policy is to not respond to any of these questions until conclusive evidence of a South African nuclear test is found.

— US Department of State, "Guidance on Suspected Nuclear Event," 26 October 1979, confidential memorandum declassified and released, Digital National Security Archive, nsarchive.chadwyck.com; US Embassy in South Africa, "South Africa: Suspected Nuclear Event," 26 October 1979, confidential memorandum declassified and released, Digital National Security Archive, nsarchive.chadwyck.com; US Department of State, "Guidance on Suspected Nuclear Event," 26 October 1979, unclassified memorandum released, Digital National Security Archive, nsarchive.chadwyck.com.

28-31 October 1979

The South African press speculates that the nuclear event could have been caused by an accident aboard a Soviet Echo II class nuclear submarine, known to have been in the area at the time of the event. South Africa's *Sunday Times* also speculates that US accusations of a nuclear test could be strong-arm tactics to pressure South Africa into signing the NPT or to derail South Africa's uranium enrichment program in order to maintain a US monopoly on lucrative enrichment contracts. The US Embassy in Mozambique addresses fears by Mozambican Foreign Minister Chissano of possible radiation effects from the purported nuclear event. The United States assures the foreign minister that no radiation has been measured and that no health hazard exists.

— US Embassy in South Africa, "Suspected Nuclear Event: South African Press Speculation," 28 October 1979, unclassified memorandum released, Digital National Security Archive, nsarchive.chadwyck.com; US Embassy in South Africa, "Suspected Nuclear Event: Editorial in South Africa's Sunday Times," 29 October 1979, unclassified memorandum released, Digital National Security Archive, nsarchive.chadwyck.com; US Embassy in Mozambique, "Mozambican Reaction to Suspected Nuclear Event," 29 October 1979, confidential memorandum declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

November 1979

The Y-plant produces sufficient HEU to provide 55kg of 80 percent enriched U235 for use with the AEB's second nuclear device, which had been built in 1978. The AEB assembles the device to ensure that "everything fits

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properly." The AEB device is a "non-deliverable demonstration device," designed for use in an underground nuclear test that would prove South Africa's nuclear weapons capability.

— Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *Nuclear Fuel*, 10 May 1993, pp. 4-5; Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 5; Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), pp. 11-12; Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa." *IAEA Bulletin*, January 1995, p. 6, www.iaea.or.at.

November 1979

A report issued by South Africa's AEB details a monitoring program designed to detect airborne radioactive material. The Board asserts that data analyzed up to 22 October 1979 shows no trace of fresh fission products.

— US Embassy in South Africa, "Suspected Nuclear Event: South Africa Says Local Tests Show No Trace of Fresh Fission Products," 1 November 1979, confidential memorandum declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

December 1979

The CIA issues a report titled "The 22 September 1979 Event." The report assumes that a nuclear explosion of approximately 3 kilotons had taken place on 22 September and attempts to identify which country or countries may have been responsible. The report examines the possibilities of a Soviet, South African, Israeli, or a joint South African/Israeli test. The report concludes that South Africa is the most likely candidate to have performed such a test, citing evidence of security measures imposed during the days leading up to 22 September. Such measures include closure of Simonstown harbor and naval base for the period of 17-23 September for defense exercises (the closure could have been used to mask sensitive loading and unloading operations); placing the naval base at Saldanha Bay on alert for the period of 21-25 September; and the fact that the chief of South Africa's Defense Force was reportedly touring South America, but this could have been a cover story designed to allow his observation of the test.

— US Central Intelligence Agency, Directorate of Intelligence, "The 22 September 1979 Event," December 1979, classified interagency intelligence memorandum, partially declassified and released 10 July 1990, Digital National Security Archive, nsarchive.chadwyck.com.

Late 1970s

South Africa conducts a test of a gun-type device at Building 5000 at Pelindaba. "For a brief moment, the HEU (goes) critical, providing confidence that the device would work as predicted by theoretical calculations." After this first test, the device is never again loaded with HEU.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, pp. 7-8, www.isis-online.org

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1978-1970

30 January 1978

The first small quantity of HEU is withdrawn from the Y-plant. For the next 19 months, the Y-plant produces HEU enriched to approximately 80 percent U235. The nominal capacity of the plant is believed to be between 10,000 and 20,000 separative work units (SWUs) per annum.

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— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): p. 4; Waldo Stumpf, "South Africa: Nuclear Technology and Non-Proliferation," *Security Dialogue* 4 (1993): p. 458; David Albright and Mark Hibbs, "South Africa: The ANC and the Atom Bomb," *Bulletin of the Atomic Scientists*, April 1993, p. 34; Mark Hibbs, "Pretoria Replicated Hiroshima Bomb in 7 Years, then Froze Design," *Nucleonics Week*, 6 May 1993, p. 16.

1978

As a result of success of the Y-plant, a second and smaller nuclear device is built by the AEC for loading with a uranium core, in order to conduct a "rapidly deployed, fully instrumented test at the Kalahari site, if required."

— Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to Deterrent," *Nuclear Fuel*, 10 May 1993, p. 4.

April 1978

Prime Minister Vorster formally approves a draft document prepared by senior officials outlining South Africa's future nuclear course as defense minister, P.W. Botha approves adoption of a three-phase nuclear deterrent strategy. In phase one, the government will neither acknowledge nor deny its nuclear capability. If South African territory were threatened, the government would move to phase two and consider privately revealing its nuclear capability to certain international powers, such as the United States, to catalyze international intervention. If aid were not forthcoming, the government would move to phase three and consider demonstrating its nuclear capability in public, perhaps by conducting an underground nuclear test.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 9; Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 5.

October 1978

Botha creates an "Action Committee" to recommend plans for production of nuclear devices.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 9.

December 1978

The Y-plant produces its first load of HEU, with an enrichment level at 80 percent. Although the HEU is suboptimal, the first device is fitted with this HEU. Later, the material is removed, recycled, and the enrichment level upgraded.

— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

1977

A second nuclear explosive test shaft is completed at the Vastrap testing range.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 7, www.isis-online.org.

1977

The AEB completes manufacture of South Africa's first full-scale nuclear explosive device based on a gun-type design. The device does not contain a highly enriched uranium (HEU) core, however, because the Y-plant has not yet produced a sufficient quantity of HEU. The device is loaded with a depleted uranium core in preparation for a "cold" test planned for August 1977 at the Kalahari test site. The AEB plans to conduct a "true" test using a HEU pit in 1978. The device with the depleted uranium pit is later "dismantled and scrapped."

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control*

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Today 25 (December 1995/January 1996), p. 5; Mark Hibbs, "South Africa's Secret Nuclear Program: The Dismantling," *Nuclear Fuel*, 24 May 1993, p. 9; Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 10; Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *Nuclear Fuel*, 10 May 1993, p. 4.

1977

Vorster assembles senior officials to discuss the future of the nuclear program and directs them to draft an outline for South Africa's future "nuclear course."

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 9.

1977

South Africa breaks off negotiations with the International Atomic Energy Agency (IAEA) regarding safeguards for a semi-commercial enrichment plant at Valindaba.

— Ann MacLachan, "The IAEA and South Africa Have Resumed Negotiations on Safeguards," *Nucleonics Week*, 16 August 1984, p. 9; Leonard S. Spector, *The Undeclared Bomb: The Spread of Nuclear Weapons 1987-1988* (Cambridge: Massachusetts: Ballinger Publishing Company, 1988), p. 303.

1977

The World Conference for Action against Apartheid urges states and firms to cease all assistance and cooperation enabling South Africa to acquire nuclear technology.

— Neta C. Crawford and Audie Klotz, eds., *How Sanctions Work: Lessons from South Africa* (New York: St. Martin's Press, 1999), p. 284.

1977

South Africa trades 50 metric tons of yellowcake for 30 grams of Israeli tritium. The material is code-named "Teeblare" (Afrikaans for "tea leaves") and is shipped secretly to South Africa in small "capsules each containing 2.5 grams."

— David Albright, "Slow but Steady," *Bulletin of the Atomic Scientists*, July-August 1993, p. 6.

1977

As a result of the suspension of US nuclear fuel shipments, Safari-1 is down-rated to 5 megawatts (MW) and operated only five days per week.

— Mark Hibbs, "South Africa's Secret Nuclear Program: The Dismantling," *Nuclear Fuel*, 24 May 1993, p. 12.

June 1977

The IAEA removes South Africa from its Board of Governors.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 9.

Mid-1977

The AEC's design and engineering team finishes its work on the first gun-type device after experiencing timing and projectile-velocity problems. South Africa obtained tungsten from Rhodesia, Zaire, and Zambia in the 1970s. By this point AEC has gained "expertise in internal ballistics...as well as experience related to igniters and propellants." These developments confirm that South Africa has opted for a gun-type device rather than an implosion bomb.

— Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *Nuclear Fuel*, 10 May 1993, p.

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4; Mark Hibbs, "South Africa's Secret Nuclear Program: The Dismantling," *Nuclear Fuel*, 24 May 1993, p. 10; Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

Mid-1977

The AEB transfers the nuclear weapons program from Somchem to the weapons research and development facilities that it built at Pelindaba.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 7, www.isis-online.org.

30 July 1977

A Soviet surveillance satellite discovers the nuclear test site in the Kalahari desert.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities*, (Washington, D.C.: Woodrow Wilson Center, 1995), p. 10.

6 August 1977

A second Soviet satellite completes four more passes over the test site. The Soviet Union immediately informs the United States that South Africa is making preparations for a nuclear test. Under international pressure, South Africa subsequently covers the test shafts with concrete slabs and abandons the site. The Soviet Union begins to intensify its allegations that the United States is helping South Africa acquire nuclear weapons technology. At the same time, behind-the-scenes cooperation between the Soviets and Americans is underway to pressure South Africa into foregoing planned tests of a nuclear device in the Kalahari Desert.

— Mitchell Reiss, "South Africa: Castles in the Air," in *Bridled Ambition: Why Countries Constrain Their Nuclear Capabilities* (Washington, DC: Woodrow Wilson Center, 1995), p. 10; U.S. Mission UN, "News Coverage," 29 August 1977, unclassified memorandum released, Digital National Security Archive, nsarchive.chadwyck.com; US Department of State, "Your Meeting with Gromyko: South African Nuclear Issues," 21 September 1977, secret memorandum partially declassified and released, Digital National Security Archive, nsarchive.chadwyck.com; US Mission to the UN, "Non-proliferation Issues at the 32nd UNGA: South Africa Nuclear Issues," 6 October 1977, confidential memorandum partially declassified and released, nsarchive.chadwyck.com.

October 1977

A delegation of African states calls for a UN Security Council resolution pressing tougher sanctions on South Africa, including a ban on nuclear cooperation. The US government states it will veto any such resolution and proposes a compromise that consists of a temporary arms embargo. The United States asserts that any break in nuclear cooperation will be counterproductive and that maintaining a nuclear relationship is necessary in order to exert pressure on South Africa to sign the NPT.

— U.S. Department of State, "Milton R. Benjamin Article in Washington Post," 31 October 1977, unclassified memorandum, Digital National Security Archive, nsarchive.chadwyck.com.

December 1977

The Y-plant commences operation.

— Leonard S. Spector and Jacqueline R. Smith, *Nuclear Ambitions: The Spread of Nuclear Weapons 1989-1990* (San Francisco: Westview Press, 1990), p. 288.

1976

One nuclear explosive test shaft is completed at the Vastrap testing range in the Kalahari Desert.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 7, www.isis-online.org.

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1976

The AEB team at Somchem tests a full-scale model of a gun-type device, using natural uranium as the projectile. [Note: Natural and depleted uranium have the same physical and chemical properties as HEU, and can be used to test the design and function of an HEU-based nuclear explosive assembly, although they can not produce nuclear explosions.]

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 6, www.isis-online.org.

1976

The Ford administration suspends shipments of nuclear fuel for the Safari isotope production reactor. The first nuclear weapons site at Vastrap is completed.

— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993; Leonard S. Spector, *The Undeclared Bomb: The Spread Of Nuclear Weapons 1987-88* (Cambridge: Massachusetts: Ballinger Publishing Company, 1988), p. 432.

1976

According to Deiter Gerhardt, Soviet officials ask for US cooperation in stopping the South African nuclear weapons program. One of the options mentioned by the Soviets is a preemptive strike on the Y Plant. US officials reject this option.

— Davis Albright, "South Africa and the Affordable Bomb," *Bulletin of the Atomic Scientists*, July/August 1994, www.bullatomsci.org.

1976

According to a 1984 CIA report, the South African Air Force (SAAF) employs Buccaneer S MK 50 bombers to practice nuclear delivery techniques. The Buccaneers drop conventional bombs to destroy a decommissioned World War II salvage ship off the coast of Cape Town. The bombers release the conventional bombs three to five miles away from the target, and "then pulled up sharply and veered away." The SAAF describes the exercise as using "computerized technique to deliver nuclear bombs and escape the effect of the resulting explosions."

— US Central Intelligence Agency, Directorate of Intelligence, *Trends in South Africa's Nuclear Security Policies and Programs*, 4 October 1984, top secret report partially declassified and released 27 April 1997, www.foia.ucia.gov, p. 17.

March 1976

West Germany's STEAG cancels its contract with UCOR because the two firms cannot agree on conditions for investment or supply of natural uranium feed for a commercial enrichment plant.

— J.D.L Moore, "The Development of South Africa's Nuclear Capability," in *South African and Nuclear Proliferation* (New York: St Martin's Press, 1987), p. 89.

April 1976

In an uncorroborated report, James Adams claims that South Africa and Israel signed a technical cooperation agreement during the visit of South African Prime Minister John Vorster to Israel. Under the terms of the accord, Israel provides South Africa with nuclear information and sends technicians and scientists to assist in nuclear research, including development of atomic weapons. Israeli scientists travel to South Africa to provide advice on establishment of Safari-2, a nuclear research reactor.

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— *Davar* (Tel Aviv), 13 April 1984, pp. 1-2; cited in "Cooperation with South Africa on Nuclear Pursuits Alleged," *Worldwide Report*, 7 June 1984, pp. 30-31.

5 August 1976

The South African Energy Supply Commission (Eskom) and the French Framatome-Framateg consortium sign a contract to construct the Koeberg nuclear power station. According to the contract, the French consortium is to "supply capital works, nuclear fuel and services for Koeberg Units 1 and 2." [Note: Although Framatome-Framateg is commonly used in referring to this French consortium, Newby Fraser calls it Framatome-Alsthome-Spie Batignolles-Framateg.]

— A.R. Newby-Fraser, *Chain Reaction: Twenty Years of Nuclear Research and Development* (Pretoria: Atomic Energy Board, 1979), pp. 131-132.

15 October 1976

The governments of South Africa and France formalize the Koeberg negotiations by signing a bilateral agreement.

— A.R. Newby-Fraser, *Chain Reaction: Twenty Years of Nuclear Research and Development* (Pretoria: Atomic Energy Board, 1979), p. 132.

1975

The South African government, believing that it faces a "total onslaught" from the Soviet Union, urges scientists working on the nuclear weapon program at the Pelindaba plant to redouble their efforts toward conducting the first test detonation before the end of the year.

— David Watts, "Foreign Scientists Helped to Develop 'Apartheid Bomb'," *Times* (London), 26 March 1993.

1975

Safari-1 operates using approximately 105kg HEU enriched to 45 percent supplied by the United States.

— Mark Hibbs, "South Africa's Secret Nuclear Program: The Dismantling," *Nuclear Fuel*, 24 May 1993, p. 12.

1975

South Africa, which had been producing uranium hexafluoride (UF₆) on a laboratory scale since the early 1970s, commissions a small UF₆ production plant at Pelindaba. The plant, which has a capacity to produce 200t UF₆ per year, is to become fully operational in 1978.

— J.D.L Moore, "The Development of South Africa's Nuclear Capability," in *South African and Nuclear Proliferation* (New York: St. Martin's Press, 1987), p. 94.

October 1975

The *International Herald Tribune* reports that South Africa negotiated a contract to supply Iran with enriched uranium in exchange for Iranian investment in a commercial enrichment facility in South Africa. The agreement was cancelled when Iran's nuclear power program was suspended, following the Islamic revolution in 1978-79.

— J.D.L Moore, "The Development of South Africa's Nuclear Capability," in *South African and Nuclear Proliferation* (New York: St Martin's Press, 1987), p. 91.

1974

Israeli Prime Minister Shimon Peres and South African President John Vorster hold a secret meeting in Geneva. The two reportedly sign an agreement for strategic cooperation between the two countries. The agreement is a mutual defense pact according to which "the two countries would assist each other in wartime by supplying spare parts and ammunition from emergency stocks. Each country agreed that its territory would be used to store all types of

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weapons for the other country." According to Dieter Gerhardt, a senior commander in the South African Navy who for many years spied for the Soviet Union, under a later clause in the agreement called "Chalet," Israel agreed to arm eight Jericho II missiles with "special warheads" for South Africa.

— "Treasons of Conscience," *Weekly Mail & Guardian*, 11 August 2000, www.sn.apc.org.

1974

South African and other international sources provide different estimates on the initiation of the nuclear weapons program. According to F.W. de Klerk, president of South Africa from 1989-1994, the decision to "develop a limited nuclear deterrent capability" is made "as early as 1974." International Atomic Energy Agency (IAEA) safeguards officials charged with verifying South Africa's past nuclear activities likewise report that the prime minister approves a "limited program for development of nuclear weapons as a deterrent" in 1974. However, according to Waldo Stumpf, head of the Atomic Energy Corporation (AEC), the government officially does not change the objective of its nuclear explosive program from peaceful purposes to developing a nuclear deterrent capability until 1977. Alternatively, Armaments Corporation (Armscor) officials maintain that in October 1978, Prime Minister P.W. Botha decides to shift the emphasis of the nuclear program from peaceful nuclear explosives to developing nuclear weapons, just one month after taking office.

— "De Klerk Tells World South Africa Built and Dismantled Six Nuclear Weapons," *NuclearFuel*, 29 (March 1993): 7; Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa," *IAEA Bulletin*, January 1995, p. 4. www.iaea.or.at; Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): pp. 5-8; Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *Nuclear Fuel* 10 (May 1993): 4; David Albright, "A Curious Conversion," *Bulletin of the Atomic Scientists*, June 1993, bulletomsci.org.

1974

In a report to Prime Minister John Vorster, the AEB concludes that it can build a nuclear explosive device. Vorster approves the development of PNE's and construction of an underground nuclear test site.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 4; David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 6.

1974

West Germany's Steinkohlen Elektrizitaia AG (STEAG), a government-controlled firm charged with commercialization of the Becker jet nozzle uranium enrichment process, states in a press release that it has signed a contract with UCOR "to carry out a joint comparative economic feasibility study" of the process developed in South Africa. The feasibility study will be used to consider the construction of a commercial enrichment facility in South Africa.

— J.D.L Moore, "The Development of South Africa's Nuclear Capability," in *South Africa and Nuclear Proliferation* (New York: St. Martin's Press, 1987), p. 89; U.S., Embassy in South Africa, "Vorster Comments on SA Uranium Enrichment Project," May 1974, classified memorandum declassified and released 22 December 1985.

1974

The United States enriches uranium ore for fuel fabrication in France to supply South Africa's Koeberg nuclear power station. ESKOM, the South African electric utility, operates a two-unit site at Koeberg Nuclear Power Station near Capetown. Each unit is a three-loop Framatome Pressurized Water Reactor rated at 920MWe. Unit 1 started up in 1984 and Unit 2 in 1985.

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— "Pressure on SA to Sign Nuclear Pact," *The Star*, 14 April 1982, p. 21; "Nuclear Power Plants - South Africa," *The Virtual Nuclear Tourist*, www.nucleartourist.com.

1974

A pilot uranium enrichment plant, referred to as the Y-plant by the South African government, begins operation. According to Waldo Stumpf, head of the Atomic Energy Corporation, the first stages at the lower end of the cascade at the Y-plant were commissioned at the end of 1974, but the full cascade was not operational until March 1977. Other reports state that the plant came on line in 1975 and was not safeguarded. On 7 April 1975, Prime Minister Vorster announces in the South African House of Assembly that the pilot enrichment plant had commenced operations on 5 April 1975. [Note: Conflicting statements have been made about the location of the Y-plant; some sources say that the plant is located at the Pelindaba site; others say it is at the Valindaba site, one-quarter of a mile away. The confusion has been compounded by the fact that South Africa changed the name of Valindaba to "East Pelindaba."]

— Mark Hibbs, "IAEA Believes South Africa Produced More Than 200 kg of High Enriched Uranium," *NuclearFuel*, 28 September 1992, p. 2; Leonard S. Spector, *The Undeclared Bomb: The Spread of Nuclear Weapons 1987-1988* (Cambridge, Massachusetts: Ballinger Publishing Company, 1988), p. 303; Waldo Stumpf, "South Africa: Nuclear Technology and Non-Proliferation," *Security Dialogue* 4 (1993): p. 458; U.S. Embassy in South Africa, "South African Uranium Enrichment," April 1975. classified memo, partially declassified and released 19 August 1987.

1974

Construction begins on a bore hole at the test site in the Kalahari Desert.

— Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to a Deterrent," *Nuclear Fuel*, 10 May 1993, p. 3.

May 1974

The AEB team at Somchem tests a scale model of a gun-type device using non-nuclear material as a projectile.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 6.

22 May 1974

South Africa and the United States sign amendments to their cooperation agreement on the civil uses of nuclear energy. The amendments extend the 1957 agreement, which would have expired in 1977, until 2007, and will allow South Africa to import increased quantities of enriched uranium fuel for two nuclear power reactors. The amendments also allow South Africa to import relatively small quantities of U235 for fuelling research and testing reactors, as well as plutonium for fueling purposes. According to a Department of State memorandum, the US government believes that continuing a nuclear relationship with South Africa is important in order to maintain nuclear safeguards in the country and to avoid alienating South African actors who oppose communism. The memorandum notes that "South Africa contains 27 percent of the free world's supply of uranium."

— US Department of State, "Signing of Amendment to U.S./S.A. Atomic Energy Agreement," memorandum, 21 May 1974, unclassified memo released 19 August 1987.

October 1974

The Director of Central Intelligence issues a Special National Intelligence Estimate (SNIE) in which the prospective capabilities and motivations for a number of countries seeking nuclear weapons are addressed. The SNIE states that South Africa's decision to pursue nuclear weapons will be based on its "growing feeling of isolation and helplessness, perceptions of major military threat, and desires for regional prestige" although the estimate does not foresee a serious military threat from any of its African neighbors during the 1970s.

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— US Central Intelligence Agency, Directorate of Intelligence, "Prospects for Further Proliferation of Nuclear Weapons," 2 October 1974, classified interagency intelligence memorandum, partially declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

1973

South Africa begins research on the separation of lithium isotopes for use in boosted-fission nuclear explosive devices.

— Adolf Von Baeckmann, Gary Dillon, and Demetrius Perricos, "Nuclear Verification in South Africa," *IAEA Bulletin*, January 1995, p. 6, www.iaea.or.at; David Albright, "South Africa and the Affordable Bomb," *Bulletin of the Atomic Scientists*, July 1994, p. 10.

1973

According to a 1983 US intelligence report, "[deleted passage] indicates that South Africa formally launch(es) a weapons program in 1973," and scientists are instructed to develop gun-assembly, implosion, and thermonuclear weapon designs. The report also concludes that research on both a gun-type device, using two modified naval guns, and on the firing system of an implosion device was conducted at the Somerset West explosives installation in South Africa.

— US Central Intelligence Agency, Directorate of Intelligence, "New Information on South Africa's Nuclear Program and South African-Israeli Nuclear and Military Cooperation," 30 March 1983, secret report partially declassified and released on 27 April 1997, www.foia.ucia.gov.

6 October 1973

Syria and Egypt attack Israel, beginning the October 1973 War. The war results in all but three black African states (Malawi, Lesotho, and Swaziland) breaking off relations with Israel, eliminating much of the need for Israel to keep its growing relationship with South Africa secret.

— James Adams, *The Unnatural Alliance* (London: Quartet Books, 1984), pp. 23, 35-36; "Arab-Israeli Wars," Encyclopedia Britannica Online, undated, search.eb.com.

1971

Before South Africa returns the enriched uranium from the abandoned critical assembly at Pelindaba to the United States, it sends the slightly irradiated fuel to the United Kingdom for reprocessing.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 4, www.isis-online.org.

1971

Uranium Enrichment Corporation (UCOR) is assigned responsibility for overseeing the uranium enrichment program, and construction of a pilot-scale uranium enrichment plant—the "Y-plant"—is initiated.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today* 25 (December 1995/January 1996): 3.

March 1971

Inspired by the Plowshares Peaceful Nuclear Explosion (PNE) Program promoted by the US government and Lawrence Livermore National Laboratory, South African Minister of Mines Carl de Wet approves research on PNEs, which are expected to be useful to the mining industry. The AEC is put in charge of the research. The AEC is said to have "a good technological base with respect to electronics and metallurgy because of its uranium enrichment program," but it has "no expertise in internal ballistics." The AEC acquires information on nuclear weapons construction from open sources, including volumes of declassified data from the Manhattan Project. According to

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Armaments Corporation (Armcor) officials. South African Minister of Mining Carl de Wet authorizes the AEB to conduct research on constructing the first nuclear explosive device.

— Mark Hibbs, "South Africa's Secret Nuclear Program: The Dismantling," *NuclearFuel*, 24 May 1993, p. 10; Michael Barletta, "Pernicious Ideas in World Politics: Peaceful Nuclear Explosives," paper presented to the Annual Meeting of the American Political Science Association, San Francisco, CA, 30 August 2001, cns.miis.edu; Mark Hibbs, "South Africa's Secret Nuclear Program: From a PNE to Deterrent," *NuclearFuel*, 10 May 1993, p. 3.

1972-1975

South Africa provides Israel with depleted uranium and natural uranium rods.

— US Central Intelligence Agency, Directorate of Intelligence, *New Information on South Africa's Nuclear Program and South African-Israeli Nuclear and Military Cooperation*, 30 March 1983, top secret report partially declassified and released 27 April 1997, www.foia.ucia.gov.

1972

Lacking adequate facilities at Pelindaba, a small team of AEB staff begins working on mechanical and pyrotechnic subsystems for a gun-type nuclear explosive device at a propulsion laboratory at Somchem, in Cape Province.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 6, www.isis-online.org.

1970s

The Atomic Energy Corporation of South Africa (AEC) constructs the "Building 5000" complex at Pelindaba "with high explosive, criticality, and weapons-manufacturing capability."

— David Albright, "Slow But Steady," *Bulletin of the Atomic Scientists*, July-August 1993, p. 5.

1970s

South Africa begins research on uranium enrichment using ultracentrifuges.

— D.M. Kemp et al., "Uranium Enrichment Technologies in South Africa," Atomic Energy Corporation of South Africa Ltd., paper presented at the International Symposium on Isotope Separation and Chemical Exchange Uranium Enrichment, 29 October 1990, Tokyo, Japan; cited in David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies* (Oxford University Press, 1997), p. 383.

20 July 1970

Prime Minister John Vorster informs Parliament of the government's 1969 decision to construct a pilot uranium enrichment facility based on an indigenous technique involving jet-nozzle enrichment and a sophisticated cascade process. The project seeks to demonstrate the validity of the design on an industrial scale.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today*, p. 25 (December 1995/January 1996), p. 3; Seymour Hersh, *The Samson Option: Israel's Nuclear Arsenal and American Foreign Policy* (New York: Random House, 1989), p. 266.

23 July 1970

The UN Security Council adopts Resolution 282 calling on member states to revoke all licenses and military patents granted to the South African government or to South African companies for the manufacture of arms and ammunition, aircraft and naval craft, or other military vehicles. It also prohibits investment or technical assistance for the manufacture of these items.

— Timothy U. Mozia, "Chronology of Arms Embargoes against South Africa," in *Effective Sanctions on South Africa*:

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The Cutting Edge of Economic Intervention, ed. George W. Shepherd, Jr. (New York: Greenwood Press, 1991), pp. 97-98.

November 1970

South Africa establishes the Uranium Enrichment Corporation (UCOR) to oversee the uranium enrichment program and the construction of the new enrichment pilot plant.

— Waldo Stumpf, "South Africa: Nuclear Technology and Non-Proliferation," *Security Dialogue* 4 (1993): 458.

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1969-1944

1969

The AEB forms an internal committee to research the technical and economic aspects of peaceful nuclear explosions (PNEs) for the mining industry, to excavate harbors and underground cavities for oil storage.

— International Atomic Energy Agency (IAEA), Director General, "The Denuclearization of Africa," GC(XXXVII)/1075, 9 September 1993; Peter Liberman, "The Rise and Fall of the South African Bomb," *International Security*, Vol. 26, No. 2 (Fall 2001), p. 50.

1969

The AEB proposes using lasers to separate uranium isotopes, but the vortex method of separation is given priority.

— Mark Gorwitz, "Section 10; South Africa," Second Tier Nuclear Nations: Laser Isotope Separation Programs Technical Citations and Comments, unpublished paper, January 1996.

1969-70

South Africa abandons the critical assembly at Pelindaba and heavy water reactor project because it is draining resources from the uranium enrichment program that was initiated in 1967, and moreover is not competitive with light-water reactors. The assembly is dismantled in 1970.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 4, www.isis-online.org; J.D.L. Moore, "The Development of South Africa's Nuclear Capability," in *South Africa and Nuclear Proliferation* (New York: St. Martin's Press, 1987), p. 84.

1967

An indigenously constructed reactor (also known as Pelinduna, Pelindaba-Zero or Safari-2) located at Pelindaba goes critical using 606kg of 2 percent enriched uranium and 5.4 metric tons of heavy water, both supplied by the United States. It is part of a project to develop a reactor moderated by heavy water, fueled by natural uranium, and cooled by sodium.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 4, isis-online.org; J.D.L. Moore, "The Development of South Africa's Nuclear Capability," *South Africa and Nuclear Proliferation* (New York: St. Martin's Press, 1987), pp. 83-84.

1967

The CDA transfers Calprod's assets to the South African gold mining industry, and the Nuclear Fuels Corporation (NUFCOR) is founded to process uranium ore into yellowcake and market it internationally.

— Nuclear Fuels Corporation of South Africa (Pty) Limited, "Company Profile;" U.N. Center for Disarmament, *South*

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Africa's Plan and Capability in the Nuclear Field, Disarmament Study Series No. 2 (New York: U.N., 1981), p. 7; cited in Steven Flank, "Exploding the Black Box: The Historical Sociology of Nuclear Proliferation," *Security Studies*, p. 3 (Winter 1993/94), p. 290.

1967

As part of its policy to increase mineral exports, South Africa decides to initiate uranium enrichment projects.
— Waldo Stumpf, "South Africa's Limited Nuclear Deterrent Programme and the Dismantling thereof Prior to South Africa's Accession to the Nuclear Non-Proliferation Treaty," press conference, Washington, DC, 23 July 1993.

Late 1967

South Africa enriches uranium at the laboratory scale.

— David Albright, "South Africa's Secret Nuclear Weapons," *ISIS Report*, May 1994, p. 4, .isis-online.org.

1965

The US firm Allis Chalmers Corporation supplies South Africa with the 20MW Safari-1 nuclear reactor and 90 percent highly enriched uranium (HEU) to fuel it. Safari-1 is located in Pelindaba, near Pretoria. The facility is commissioned the same year.

— *The African Guardian* (Lagos), 12 November 1987, pp. 7-9, 11; in "Akinoyemi's Call for Black Bomb Spurs Debate," *Nuclear Developments*, 25 February 1988, pp. 1-3; Leonard S. Spector, *The Undeclared Bomb: The Spread of Nuclear Weapons 1987-1988* (Cambridge, MA: Ballinger Publishing Company, 1988), p. 303; Atomic Energy Corporation of South Africa, "AEC Corporate Profile."

1964

The first batch of enriched uranium-235, to be used in the Allis Chalmers Safari-1 nuclear reactor, is scheduled for shipment in late August 1964, but is delayed until February of the following year while a trilateral agreement is worked out between the United States, South Africa, and the IAEA for safeguarding the transfer of the nuclear fuel.

— US Department of State, "Fuel for South African Nuclear Reactor," 22 December 1964, confidential memorandum declassified and released, Digital National Security Archive, nsarchive.chadwyck.com; US Department of State, "South African Reactor Fuel Problem," 23 December 1964, secret memorandum declassified and released, Digital National Security Archive, nsarchive.chadwyck.com; US Department of State, [US Delivery of Fuel Elements for First Core Safari I Reactor], 29 December 1964, confidential memorandum declassified and released, Digital National Security Archive, nsarchive.chadwyck.com.

1963

South Africa provides Israel with 10 tons of uranium.

— US Central Intelligence Agency, Directorate of Intelligence, "New Information on South Africa's Nuclear Program and South African-Israeli Nuclear and Military Cooperation," 30 March 1983, top secret report partially declassified and released 27 April 1997, www.foia.ucia.gov.

10 October 1963

South Africa accedes to the Limited Test Ban Treaty, which prohibits nuclear testing in the atmosphere.

— US State Department, "Limited Test Ban Treaty Signatories," 5 August 1963, dosfan.lib.uic.edu; US Central Intelligence Agency, Director of Central Intelligence, "Trends in South Africa's Nuclear Security Policies and Programs," 4 October 1984, top secret report partially declassified and released on April 27 1997, www.foia.ucia.gov.

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1961

The AEB initiates research at the Pelindaba Nuclear Research Center, 30km west of Pretoria.

— Waldo Stumpf, "South Africa's Nuclear Weapons Program: From Deterrence to Dismantlement," *Arms Control Today*, 25 (December 1995/January 1996), p. 3.

1961

Britain forces South Africa to leave the Commonwealth, largely in response to the Sharpeville Massacre.

— James Adams, *The Unnatural Alliance* (London: Quartet Books, 1984), p. 30.

21 April 1961

The Commission of Inquiry into the Application of Nuclear Power in South Africa publishes its findings, envisioning two five-year phases for national nuclear development. The first period is to focus on surveying the country's natural resources, training scientists in the United States and Europe, and establishing facilities. The Commission concludes that only during the second phase, which is to commence in 1964, will South Africa acquire sufficient information and technical expertise to estimate costs and determine which type of power generating reactors would most productively exploit the country's resource endowments.

— *Report of the Commission of Enquiry into the Application of Nuclear Power in South Africa* (Pretoria: Government Printer, 1961).

Late 1950s

With the approval of the South African Cabinet, the AEB conducts research on heavy water production technology.

— US Central Intelligence Agency, Directorate of Intelligence, "South Africa's Turn to Heavy Water Technology: History and Implications," 8 April 1984, classified memorandum, partially declassified and released 14 August 1997, www.foia.ucia.gov.

1959

The research and development program for processing natural uranium is launched by the AEB.

— A.R. Newby-Fraser, *Chain Reaction: Twenty Years of Nuclear Research and Development* (Pretoria: Atomic Energy Board, 1979), p. 92.

July 1957

Under the aegis of the "Atoms for Peace" program, South Africa and the United States sign a bilateral 50-year agreement for nuclear collaboration. Under the agreement, South Africa acquires the Safari-1 reactor and assured supply of highly enriched uranium (HEU) fuel for the reactor.

— Abdul Minty, "South Africa's Nuclear Capability: The Apartheid Bomb," in P. Johnson and D. Martin, eds., *Destructive Engagement: Southern Africa at War* (Harare: Zimbabwe Publishing House, 1986), p. 205; A.R. Newby-Fraser, *Chain Reaction: Twenty Years of Nuclear Research and Development* (Pretoria: Atomic Energy Board, 1979), p. 8.

March 1955

As of this date, 16 mines have been authorized to produce uranium.

— A.R. Newby-Fraser, *Chain Reaction: Twenty Years of Nuclear Research and Development* (Pretoria: Atomic Energy Board, 1979), p. 5.

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September 1952

The first South African uranium plant is opened at West Rand Consolidated Mines, near Johannesburg.

— A.R. Newby-Fraser, *Chain Reaction: Twenty Years of Nuclear Research and Development* (Pretoria: Atomic Energy Board, 1979), p. 5.

Late 1951

The Combined Development Agency (CDA), which was established by the United States and the United Kingdom in 1944 to procure uranium for the two countries' nuclear weapons programs, establishes the South African firm Calcined Products (Pty) Limited (Calprods), with the objective of producing uranium as a by-product of the country's gold mining operations. CDA finances Calprods and manages the firm in cooperation with South Africa's Chamber of Mines. The uranium produced is owned by the AEB, which approves the sales to the United States and the United Kingdom.

— "Company Profile," Nuclear Fuels Corporation of South Africa Limited (Nufcor), 28 August 1996.

1948

Based on the findings of the Uranium Committee and following promulgation of the Atomic Energy Act of 1948, the South African Atomic Energy Board (AEB)— forerunner to the Atomic Energy Corporation (AEC)— is established.

— A.R. Newby-Fraser, *Chain Reaction: Twenty Years of Nuclear Research and Development* (Pretoria: Atomic Energy Board, 1979), p. 5.

1945

Dr. Basil Schonland chairs the first meeting of the Uranium Committee.

— "AEC Corporate Profile," Atomic Energy Corporation of South Africa, www.aec.co.za.

1944

The British government asks South Africa Prime Minister Jan C. Smuts to survey South Africa's uranium deposits. The study reveals the existence of large deposits of low-grade ore.

— David Fischer, "South Africa: As a Nuclear Supplier," in W.C. Potter, ed., *International Nuclear Trade and Nonproliferation: The Challenges of the Emerging Suppliers* (Toronto: Lexington Books, 1990), p. 273.

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