

Nuclear Latency (NL) Dataset
Country Coding Sheets

SOUTH AFRICA

COW COUNTRY CODE: 560

List of Country's Enrichment and Reprocessing (ENR) Facilities

1. Laboratory Enrichment Facility at Pelindaba
2. Valindaba (Laser)
3. Valindaba Y – Plant
4. Valindaba Z – Plant
5. Hot Cell Complex, Pelindaba Nuclear Research Center

Detailed Facility-Specific Information and Sources

1. Laboratory Enrichment Facility at Pelindaba

- a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Uranium enrichment (aerodynamic isotope separation).

- b. *Facility size (laboratory, pilot, commercial).*

Laboratory.

- c. *Is the facility under construction or in operation? If under construction, list the construction years. If in operation, list the years of operation.*

Work on enrichment began in a small warehouse in Pretoria in 1960. South Africa moved these efforts to Pelindaba in the mid-1960s, and had an operational laboratory facility in 1967. The facility operated from 1967-1988.¹ It was only capable of producing minimal levels of enrichment.

- d. *Was the facility developed covertly? If so, identify years that facility was covert.*

Yes, the enrichment program was concealed from the public when it first began (although South Africa announced its intention to build a pilot plant in 1970).

- e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

No. The facility closed prior to coming under IAEA safeguards in 1991.

¹ Albright (2001) states that by 1967 South Africa was moving uranium enrichment to the pilot plant stage. The 1988 end date is an approximation based on Albright and Hibbs' 1993 Bulletin of the Atomic Scientist article (35). Zentner et al. (2005, 57) state the demonstration of technology in 1967 as the start of operation.

f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

No.

g. *Did the facility have a military purpose?*

It is likely that this plant was part of South Africa's effort to develop nuclear weapons.

h. *Was the facility multinational? If so, identify the other countries that were involved.*

No.

i. *Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.*

No evidence of foreign assistance found. The process employed at this site was indigenous to South Africa, though it may have been based off German designs.

j. Sources:

Albright, David and Mark Hibbs. 1993. "South Africa: The ANC and the Atomic Bomb." *Bulletin of the Atomic Scientists*. 49(3): 32-37.

Albright, David. 2001. "South Africa's Nuclear Weapon Program." http://web.mit.edu/ssp/seminars/wed_archives01spring/albright.htm. Accessed 07/06/2015.

World Nuclear Association. 2015. "Nuclear Power in South Africa." <http://www.world-nuclear.org/info/country-profiles/countries-o-s/south-africa/>. Accessed 07/06/2015.

Zentner, M.D., G.L. Coles, and R.J. Talbert. 2005. "Nuclear Proliferation Technology Trends Analysis." Pacific Northwest National Laboratory. Report 14480.

2. Valindaba (Laser)

a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Uranium enrichment (Laser, MLIS).

b. *Facility size (laboratory, pilot, commercial).*

Pilot.

- c. *Is the facility under construction or in operation? If under construction, list the construction years. If in operation, list the years of operation.*

The construction on the facility began in 1983. According to the IAEA, the plant operated from 1995 to 1998. The technology ultimately proved to not be commercially viable due to the lack of international investment.

- d. *Was the facility developed covertly? If so, identify years that facility was covert.*

Initially, attempts were made to keep the uses and capabilities of the facility secret.

- e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

This facility likely came under IAEA safeguards beginning in September 1991.

- f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

No.

- g. *Did the facility have a military purpose?*

South Africa possessed a small nuclear arsenal while work on this facility began. It is therefore likely that the plant had a military dimension, but we do not have definitive evidence of this.

- h. *Was the facility multinational? If so, identify the other countries that were involved.*

No.

- i. *Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.*

No. Beginning in the 1980s, South Africa engaged in AVLIS research. In 1983, an MLIS project for uranium enrichment began. In 1992 the head of the AEC announced the forthcoming testing of a MLIS prototype. From 1983 until 1995 South Africa developed this technology indigenously. In 1994 South Africa announced its intention to build a pilot plant, stating technology would be further developed if international partners could be found. In 1996 Cogema of France signed an agreement for the development of MLIS enrichment. The agreement specified that Cogema would support half of the project's costs for three years. The agreement was described as a 50:50 funding arrangement, implying the French assistance was primarily financial. Another document states that Cogema agreed to help "industrialize" the program.²

² <http://www.polity.org.za/polity/govdocs/pr/1996/pr0229b.html>.

In 1997 Cogema withdrew from the deal. The program may have also received help from a Bulgarian laser expert, though this sort of assistance would not be included. In 1993 Kalina Bagrova joined the AEC as a consultant to “provide technical assistance to the MLIS project.”³ While most of the technology was indigenously constructed, one ISIS report notes that South Africa imported “machine tools, furnaces, valves, and other equipment for its program” from foreign firms including Leybold. In most cases, these imports did not violate export control laws, but did violate apartheid-era sanctions.

j. Sources:

Fig, David. 2005. *Uranium Road: Questioning South Africa's Nuclear Direction*. South Africa: Heinrich Boll Foundation.

Global Security. “Valindaba.”
<http://www.globalsecurity.org/wmd/world/rsa/valindaba.htm>. Accessed 07/06/2015.

International Atomic Energy Agency. “Integrated Nuclear Fuel Cycle Information Systems.” <https://infcis.iaea.org>. Accessed 06/08/2015.

International Atomic Energy Agency. 1997. *IAEA Annual Report: 1997*. United Nations.
<http://www.iaea.org/Publications/Reports/Anrep2011/index.html>. Accessed 07/06/2015.

International Institute for Strategic Studies. 2007. “Chapter Two: Nuclear Black Markets: Other Countries and Networks.” In *Nuclear Black Markets: Pakistan, A.Q. Khan, and the Rise of Proliferation Networks- A Net Assessment*.
<http://archive.today/UsQbo>. Accessed 06/08/2015.

Mark Hibbs. 1991. “Centrifuges or Lasers May Replace South Africa's Present SWU Plant.” *Nuclear Fuel*. 16(1): 4.

Nuclear Threat Initiative. 2007. “South Africa Nuclear Chronology.”
http://www.nti.org/media/pdfs/south_africa_nuclear.pdf?_id=1316466791. Accessed 07/06/2015.

South Africa Mineral and Energy Affairs. 1996. “Cooperation Agreement Between SA and France.” <http://www.polity.org.za/polity/govdocs/pr/1996/pr0229b.html>. Accessed 07/06/2015.

Van Wyk, Jo-Ansi. 2013. “South Africa's Nuclear Future.” *Governance of Africa's Resources Programme*. 150.

³ http://www.nti.org/media/pdfs/south_africa_nuclear.pdf?_id=1316466791.

World Nuclear Association. 2015. "Nuclear Power in South Africa." <http://www.world-nuclear.org/info/country-profiles/countries-o-s/south-africa/>. Accessed 07/06/2015.

—. 2010. "Nuclear Strategic Concern— South Africa." <http://www.environment.co.za/nuclear-energy-debate/nuclear-strategic-concern-south-africa.html>. Accessed 07/06/2015.

3. Valindaba Y – Plant

a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Uranium enrichment (aerodynamic isotope separation).

b. *Facility size (laboratory, pilot, commercial).*

Pilot.

c. *Is the facility under construction or in operation? If under construction, list the construction years. If in operation, list the years of operation.*

Construction on the pilot facility took place from 1971-1975.⁴ The facility became operational in 1975 with the first production of HEU in 1978. The facility was closed in 1979 due to technical problems but reopened in 1981 after improvements were implemented. The facility operated until February 1, 1990.

d. *Was the facility developed covertly? If so, identify years that facility was covert.*

There was a public announcement in 1970 that South Africa intended to build this pilot plant, once it became clear that the facility would not be able to be kept secret. The intent, however, was to keep the technology secret.⁵ Because the existence of the facility was publicly known, however, we do not code it as a covert plant.

e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

No, the facility was shut down prior to South Africa coming under safeguards in 1991.

⁴ Zentner et al (2005) and Hibbs (1993) provide the operational start date. The IAEA states 1978. A nine-month delay in production may have occurred during the operation according to accounting records. Venter (2008, 79) states that it is likely the production was actually funneled to the nuclear weapons program. Makhijani et al. (2004) states 1978 for operational start date and cite the IAEA INFCIS. Spector (1990) states 1975 as first operation.

⁵ Cock and McKenzie (1998) write: "On 20 July 1970, the then prime minister, B.J. Vorster, stood up in the Houses of Parliament in Cape Town and, for the first time, revealed information about South Africa's enrichment plans."

f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

No.

g. *Did the facility have a military purpose?*

Yes, the facility was secretly developed to enrich fuel for nuclear weapons on the pretext of peaceful nuclear explosions. The facility produced its first HEU in 1978.

h. *Was the facility multinational? If so, identify the other countries that were involved.*

No, the facility was owned by South Africa.

i. *Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.*

No evidence of foreign assistance was found, though some of the equipment may have been clandestinely acquired from foreign firms in the US, West Germany, France, and Switzerland. On July 20 1970 South Africa's Prime Minister announced the discovery of a new type of uranium isotope separation. Abraham Roux, the Chairman of South Africa's Atomic Energy Board, later said the method was "an entirely new process that the South Africans have been working on for the past nine years" (Scientific and Technical Intelligence Report). This process was apparently indigenous to South Africa, but may have been based on a German design.

j. *Sources:*

Albright, David. 2001. "South Africa's Nuclear Weapons Program." Institute for Science and International Security.

http://web.mit.edu/ssp/seminars/wed_archives01spring/albright.htm. Accessed 07/06/2015.

Cock, Jacklyn, and Penny Mckenzie. 1998. "From Defense to Development: Redirecting Military Resources in South Africa." The Group for Environmental Monitoring.

Fig, David. 1999. "Sanctions and the Nuclear Industry." *How Sanctions Work: Lessons from South Africa*. Neta C. Crawford and Audie Klotz, Eds. New York City, NY: St. Martin's. 75-102 and 81-84.

International Atomic Energy Agency. "Integrated Nuclear Fuel Cycle Information Systems." <https://infcis.iaea.org>. Accessed 06/08/2015.

Mark Hibbs. 1993. "South Africa's Secret Nuclear Program: From a PNE to a Deterrent." *Nuclear Fuel*. 18(10): 3

- Nuclear Threat Initiative. "South Africa Nuclear Chronology." http://www.nti.org/media/pdfs/south_africa_nuclear.pdf?_id=1316466791. Accessed 11/16/2015.
- Rogers, Barbara, Zdenek Cervenka. 1978. *The Nuclear Axis: Secret Collaboration Between West Germany and South Africa*. New York City, NY: Times Books.
- Spector, Leonard S. and Jacqueline R. Smith. 1990. *Nuclear Ambitions*. Boulder, CO: Westview Press. 271.
- US CIA. 1971. "Scientific and Technical Intelligence Report." <http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB181/sa04.pdf>. Accessed 07/06/2015. 6-8.
- World Nuclear Association. 2015. "Nuclear Power in South Africa." <http://www.world-nuclear.org/info/country-profiles/countries-o-s/south-africa/>. Accessed 07/06/2015.

4. Valindaba Z – Plant

- a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Uranium enrichment (aerodynamic isotope separation).

- b. *Facility size (laboratory, pilot, commercial).*

(Semi) Commercial.

- c. *Is the facility under construction or in operation? If under construction, list the construction years. If in operation, list the years of operation.*

The construction start date for the facility could not be identified. The facility began operation in 1986.⁶ The facility was shut down in 1995 due to lack of competitiveness on the international market.

- d. *Was the facility developed covertly? If so, identify years that facility was covert.*

Attempts were made to keep the uses and capabilities of the facility secret.

- e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

Yes, the facility came under IAEA safeguards beginning in September 1991.

⁶ The IAEA INFRIC database lists the facility operating from 1986-1995. World Nuclear states commissioning beginning in 1984. Zentner et al (2005, 58) state 1988.

f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

No.

g. *Did the facility have a military purpose?*

The facility may have been intended to enrich uranium for the military program. However, unlike the other facilities, there was no mention of military enrichment in the various consulted resources. The plant produced LEU but not HEU. The IAEA codes this as a commercial facility. We code this as a non-military facility but there is uncertainty about this coding decision, particularly because construction on the plant began while South Africa possessed nuclear weapons.

h. *Was the facility multinational? If so, identify the other countries that were involved.*

No.

i. *Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.*

No evidence of foreign assistance found. One ISIS report notes that South Africa's strong economy, advanced mining and metallurgy infrastructure, early technology transfer agreements with the US, and isolationist behavior during apartheid meant South Africa was more technologically self-sufficient than many other nations.

j. Sources:

International Atomic Energy Agency. "Integrated Nuclear Fuel Cycle Information Systems." <https://infcis.iaea.org>. Accessed 06/08/2015.

International Atomic Energy Agency. 1997. *IAEA Annual Report: 1997*. United Nations. <http://www.iaea.org/Publications/Reports/Anrep2011/index.html>. Accessed 07/06/2015.

International Institute for Strategic Studies. 2007. "Chapter Two: Nuclear Black Markets: Other Countries and Networks." In *Nuclear Black Markets: Pakistan, A.Q. Khan, and the Rise of Proliferation Networks- A Net Assessment*. <http://archive.today/UsQbo>. Accessed 06/08/2015.

Mark Hibbs. 1991. Centrifuges or Lasers May Replace South Africa's Present SWU Plant." *Nuclear Fuel*. 16(1): 4.

5. Hot Cell Complex, Pelindaba Nuclear Research Center

- a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Reprocessing, hot cells.

- b. *Facility size (laboratory, pilot, commercial).*

(Semi) commercial.

- c. *Is the facility under construction or in operation? List the start and end year for construction and operation.*

Construction of the facility began around 1984.⁷ The facility started to operate in 1987 and operation continues. In 1998, the facility's nine hot cells started to produce Molybdenum-99.

- d. *Was the facility developed covertly? If so, identify years that facility was covert.*

No, the government made announcements that facility is not for plutonium production in 1984 during the construction phase.

- e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

Yes, the facility has been under IAEA safeguards in accordance with INFCIRC/66 type safeguard agreements in 1986.

- f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

No.

- g. *Did the facility have a military purpose?*

No. The government announced that the facility was not to be used for plutonium production. However, SPIRI states that the facility is technically capable of producing plutonium. The facility is large, having over 25 hot cells.

- h. *Was the facility multinational? If so, identify the other countries that were involved.*

No.

- i. *Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.*

⁷ The 1984 date is used as this is when the South African government made public announcements about the facility.

No evidence of foreign assistance found. Spector lists the Pelindaba complex as being indigenous to South Africa.

j. Sources:

Global Security. "Pelindaba Nuclear Research Center."

<http://www.globalsecurity.org/wmd/world/rsa/pelindaba.htm>. Accessed 07/06/2015.

Lacey, Jennifer Megan. "South Africa." Stockholm International Peace Research Institute.

http://www09.sipri.org/research/disarmament/nuclear/researchissues/past_projects/issues_of_concern/south_africa/southafrica.

Spector, Leonard S. and Jacqueline R. Smith. 1990. *Nuclear Ambitions*. Boulder, CO: Westview Press.

United Nations. 1986. "Implementation of the Declaration on the Denuclearization of Africa: Nuclear Capability of South Africa."

[http://disarmament2.un.org/Library.nsf/e727f970e8a73c3b8525755c00535f8f/8db9a27ba41e0d88852575850065be6b/\\$FILE/A-41-490.pdf](http://disarmament2.un.org/Library.nsf/e727f970e8a73c3b8525755c00535f8f/8db9a27ba41e0d88852575850065be6b/$FILE/A-41-490.pdf).

Van Wyk, Jo-Ansi. 2013. "South Africa's Nuclear Future." *Governance of Africa's Resources Programme*. 150.

Zentner, M.D., G.L. Coles, and R.J. Talbert. 2005. "Nuclear Proliferation Technology Trends Analysis." Pacific Northwest National Laboratory. Report 14480.

Additional Notes:

Several sources have reported that South Africa may have plans to restart its enrichment program at Valindaba.

Nuclear Threat Initiative. 2012. "South Africa Could Resume Uranium Enrichment."

<http://www.nti.org/gsn/article/south-africa-could-resume-uranium-enrichment>. Accessed 07/06/2015.

Wild, Sarah. 2013. "Back to Valindaba: SA's Plan to Enrich Uranium." *Mail and Guardian*.

<http://mg.co.za/article/2013-10-11-00-back-to-valindaba-sas-plan-to-enrich-uranium>. Accessed 07/06/2015.