

Nuclear Latency (NL) Dataset
Country Coding Sheets

INDIA

COW COUNTRY CODE: 750

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

1. BARC, Trombay (Pilot)
2. BARC, Laser Enrichment Plant
3. Bhabha Atomic Research Center (at Trombay)
4. Center for Advanced Technology, Laser Enrichment Plant
5. Fast Reactor Fuel Reprocessing Plant (FRFRP)
6. Kalpakkam Reprocessing Plant (KARP) at Indira Gandhi Centre for Atomic Research Madras
7. Kalpakkam Reprocessing Plant (KARP) Laboratory
8. Lead Minicell Facility at Kalpakkam (Coral—Compact Reprocessing facility for Advanced fuels in Lead cells)
9. Power Reactor Fuel Reprocessing (PREFRE), Bhabha Atomic Research Centre
10. Rattehalli Materials Plant, Mysore

Detailed Facility-Specific Information and Sources

1. BARC, Trombay

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

Enrichment, centrifuge.

- 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 of the facility began around 1980 and it became operational in 1985.¹
The facility continues to operate.

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

Yes, the facility was officially revealed in 1986.

¹ The 1985 date is from Perkovich. The NTI states early 1980's as the beginning of the operation. Laughter (2009) provides operation dates.

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

No.

- 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?*

This is a civilian facility with no know (and direct) connection to India's nuclear weapons program (see <http://isis-online.org/uploads/isis-reports/documents/indiannuclearfacilities.pdf>).

- 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.*

The Monterey Institute notes that between 1988 and 1992 BARC received "at least 33 shipments of dual-use goods" from the US, including computers, measuring equipment, laser equipment, and photo-multiplier tubes. The precise end-user of these items is not known however.

- j. *Sources:*

CNS, Monterey Institute Archive. "Selected Indian Facilities: Trombay."
http://cns.mii.edu/archive/country_india/nucfacil/trombay.htm. Accessed 06/15/2015.

Global Security. "Bhabha Atomic Research Centre, Trombay."
<http://www.globalsecurity.org/wmd/world/india/trombay.htm>. Accessed 06/15/2015.

Government of India Department of Atomic Energy. "Annual Report 1985-1986" and "Annual Report 2001-2002." Executive Summary available at www.dae.gov.in. Accessed 06/15/2015.

Laughter, M.D. 2009. "Profile of World Enrichment Programs." Oak Ridge National Laboratory.

Nuclear Threat Initiative. "Bhabha Atomic Research Center."

<http://www.nti.org/facilities/80/>. Accessed 06/15/2015.

UN Occasional Report. "Weapons Material Production and Civilian Facilities."

http://www.princeton.edu/sgs/publications/sgs/pdf/5_1occasional.pdf. Accessed 06/15/2015.

2. BARC, Laser Enrichment Plant

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

Enrichment, laser.

- 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.*

Construction of the facility took place in early 1980s.² The facility became operational in 1993 and experimentation continues.

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

The head of BARC announced in 1987 that India was developing laser technology for enrichment.

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

No.

- 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?*

This is a civilian facility with no know (and direct) connection to India's nuclear weapons program (see <http://isis-online.org/uploads/isis-reports/documents/indiannuclearfacilities.pdf>).

² India admitted to pursuing laser enrichment technology as early as 1983 (*Nuclear Fuel*). The 1980s date is from Perkovich.

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.

j. *Sources:*

CNS, Monerey Institute Archive. "Selected Indian Facilities: Trombay."
http://cns.miis.edu/archive/country_india/nucfacil/trombay.htm. Accessed 06/15/2015.

"India Nuclear Milestones," Wisconsin Project, Risk Report, Volume 16 Number 1 (January-February 2010): <http://www.wisconsinproject.org/countries/india/india-nuclear-miles.html>.

National & International Council for Scientific Research. "Uranium Enrichment Technology has Therefore Been a Closely Guarded Secret."
<http://nicsr.in/new/?p=749>. Accessed 06/15/2015.

Nuclear Threat Initiative. 2003. "Bhabha Atomic Research Center."
<http://www.nti.org/facilities/829/>. Accessed 06/15/2015.

Perkovich, George. 1999. *India's Nuclear Bomb: The Impact on Global Proliferation*. Berkeley, CA: University of California Press.

Woddi, Taraknath V.K., William S. Charlton, Paul Nelson. 2009. "India's Nuclear Fuel Cycle: Unraveling the Impact of the US-India Nuclear Accord." *Synthesis Lectures on Nuclear Technology and Society*. 1(1): 1-104. 24-28.

—. 1983. "India is Pursuing Uranium Enrichment Technology." *Nuclear Fuel*. 8(5): 3.

3. Bhabha Atomic Research Center (at Trombay)

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

Reprocessing.

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 took place in 1964. The facility began operation in 1964 and underwent refurbishment from 1970 to 1972. The facility was decommissioned in 1973 but returned to operational status in 1983 and continues to operate. The facility received its first batch of spent fuel from the CIRUS research reactor in July 1964.³

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

No, the facility was not built covertly.

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

No.

- 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, it is likely the facility was used in the nuclear weapons program. The plutonium used in the peaceful nuclear device that was detonated at Rajasthan was reprocessed at this facility. Two of the reactors at the facility are designed for the production of plutonium. Perkovich (1999) states that, “the Trombay plutonium reprocessing plant, on which construction began in April 1961, represented the key facility for an Indian bomb. Yet, again, nuclear proliferation was a secondary concern of American policy throughout the mid-1950s to early 1960s” (52).

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

No.

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

No. While India did receive some measure of assistance from abroad, none of this assistance is thought to be state sanctioned. Much of the reprocessing plant was based on open-source Purex designs available through Atoms for Peace. The US firm Vitro International did provide blueprints for the plant. Cooke (2009) implies the US allowed Vitro International to provide these plans to India “with few strings

³ There is disagreement about the restart dates. CNS lists 1974 as year of decommissioning and 1984 as year of restart. We included Berkhout and Gadekar dates in the data.

attached.” Other sources claim there was even greater foreign assistance. George Perkovich for example notes that though India says the plant was built indigenously, the facility “relied heavily on imported components and materials” (64). These claims are plausible, as there was a large amount of collaboration between the US and India during this time. Between 1955 and 1974 approximately 1100 Indian scientist and engineers were trained in the US on nuclear fuel cycle technology.

j. Sources:

Banerjee, B. and N. Sarma. 2008. *Nuclear Power in India: A Critical History*. New Delhi, India: Rupa & Co. 76.

Berkhout, Frans and Surendra Gadekar. 2012 “Reprocessing in India.”
<http://www.ieer.org/ensec/no-2/india-b.html>.

Bhaba Atomic Research Centre. “Reprocessing: Indian Programme on Reprocessing.” Nuclear Fuel Cycle: BARC Highlights.
<http://www.barc.gov.in/publications/eb/golden/nfc/toc/Chapter%206/6.pdf>. Accessed 06/15/2015. 49-51.

Cooke, Stephanie. 2009. *In Mortal Hands: A Cautionary History of the Nuclear Age*. New York, NY: Bloomsbury USA. 220.

CNS, Monerey Institute Archive. “Selected Indian Facilities: Trombay.”
http://cns.miis.edu/archive/country_india/nucfacil/trombay.htm. Accessed 06/15/2015.

Kansra, V.P. “Status of Power Reactor Fuel Reprocessing in India.” IAEA Document:
http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/30/047/30047648.pdf. Accessed 11/16/2015.

Global Security. “Bhabha Atomic Research Centre, Trombay.”
<http://www.globalsecurity.org/wmd/world/india/trombay.htm>. Accessed 06/15/2015.

Mian, Z. et al. 2006. “Fissile Materials in South Asia and the Implications of the US-India Nuclear Deal.” Report for International Panel on Fissile Materials.
http://www.armscontrol.org/pdf/20060711_IPFM-DraftReport-US-India-Deal.pdf.

Nuclear Threat Initiative. 2003. “Plutonium Reprocessing Plant.”
<http://www.nti.org/facilities/858>. Accessed 06/15/2015.

Nuclear Weapons Archive. 2001. “India's Nuclear Weapons Program: The Beginning.”
<http://nuclearweaponarchive.org/India/IndiaOrigin.html>. Accessed 06/15/15.

Ramana, M.V. 2009. "The Indian Nuclear Industry: Status and Prospects." The Centre for International Governance Innovation.
http://www.princeton.edu/~ramana/Nuclear_Energy_WP9.pdf. Accessed 06/15/2015/. 3.

Perkovich, George. 1999. *India's Nuclear Bomb: The Impact on Global Proliferation*. Berkeley, CA: University of California Press.

Spector, Leonard S. and Jacqueline R. Smith, 1990. *Nuclear Ambitions*. Boulder, CO: Westview Press. p.86.

Woddi, Taraknath V.K., William S. Charlton, Paul Nelson. 2009. "India's Nuclear Fuel Cycle: Unraveling the Impact of the U.S.-India Nuclear Accord." *Synthesis Lectures on Nuclear Technology and Society*. 1(1): 1-104. 24-28.

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

—. 2011. "India's Prime Minister Inaugurates Country's Fourth Reprocessing Plant." *Nuclear Fuel*. 36(1): 1.

—. 2001. Hearing on Energy and Scientific Research, Development, Technology Deployment, Education and Training, Before the Committee on Energy and Natural Resources, US Senate, Testimony of Thomas B. Cochran, July 18, 2001.
http://docs.nrdc.org/nuclear/files/nuc_01071801a_216.pdf.

4. Center for Advanced Technology, Laser Enrichment Plant

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

Enrichment, laser.

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.*

Construction of the facility began 1984⁴ with scientists and equipment arriving in 1986. The facility started to operate in 1986⁵ and continues to operate.

⁴ The construction dates and arrival of scientists dates are from the Government of India website and are confirmed by the NTL.

⁵ The operational date is from the Government of India website while Woddi, Charlton and Nelson (2009) list 1993 as the start date. Makhijani Chalmers and Smith (2004) state 1993 as start date.

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

No. Evidence from Perkovich suggests that general understanding of the nuclear facilities were known, even if the progress of research was not.

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

No.

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?*

This is a civilian facility with no known (and direct) connection to India's nuclear weapons program (see <http://isis-online.org/uploads/isis-reports/documents/indiannuclearfacilities.pdf>).

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.

j. *Sources:*

Ciricione, Joseph, Jon B. Wolfsthal, and Miriam Rajkumar. 2011. *Deadly Arsenals: Nuclear, Biological, and Chemical Threats*. Second Edition. Washington, D.C.: Carnegie Endowment for International Peace.

Government of India. "Raja Ramanna Centre for Advanced Technology." <http://www.cat.gov.in/organization/cat/index.html>. Accessed 06/15/2015.

Perkovich, George. 1999. *India's Nuclear Bomb: The Impact on Global Proliferation*. Berkeley, CA: University of California Press.

Makhijani, Arjun, Lois Chalmers, and Brice Smith. 2004. "Uranium Enrichment: Just Plain Facts to Fuel an Informed Debate on Nuclear Proliferation and Nuclear Power." *Institute for Energy and Environmental Research, Nuclear Policy*

Research Institute. <http://www.helencaldicott.com/uranium.pdf>. Accessed 06/15/15.

Woddi, Taraknath V.K., William S. Charlton, Paul Nelson. 2009. "India's Nuclear Fuel Cycle: Unraveling the Impact of the US-India Nuclear Accord." Synthesis Lectures on Nuclear Technology and Society. 1(1): 1-104. 24-28.

5. Fast Reactor Fuel Reprocessing Plant (FRFRP)

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

Reprocessing for thorium.

- 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 of the facility began in 2000 and started operation in 2011.

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

No.

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

No.

- 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, though the NTI notes the plutonium could be used for military purposes.

- 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.

- j. *Sources:*

Albright, David and Susan Basu. 2005. "Separating Indian Military and Civilian Nuclear Facilities." Institute for Science and International Security.
<http://www.isis-online.org/publications/southasia/indiannuclearfacilities.pdf>.
Accessed 06/15/2015.

Woddi, Taraknath V.K., William S. Charlton, Paul Nelson. 2009. "India's Nuclear Fuel Cycle: Unraveling the Impact of the US-India Nuclear Accord." Synthesis Lectures on Nuclear Technology and Society. 1(1):1-104. 24-28.

World Nuclear News. 2011. "India Opens New Reprocessing Plant." http://www.world-nuclear-news.org/WR_India_opens_new_reprocessing_plant_1601111.html.
Accessed 06/15/2015.

Zentner, M.D., G.L. Coles, R.J. Talbert. 2005. "Nuclear Proliferation Technology Trends Analysis." Pacific Northwest National Laboratory. 101.

—. 2011. "India's Prime Minister Inaugurates Country's Fourth Reprocessing Plant." *Nuclear Fuel*. 36(1): 1.

6. Kalpakkam Reprocessing Plant (KARP) at Indira Gandhi Centre for Atomic Research Madras

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

Reprocessing.

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

Commercial (It is estimated that the facility will be able to handle all of India's commercial reactor fuel).⁶

- 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 of the facility began in 1996 and it became operational in 1997.⁷
Production continues to this day.

⁶ It is unclear the exact date the Kalpakkam Reprocessing Plant obtained commercial capabilities.

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

No.

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

No.

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?*

This is a civilian facility with no know connection to India's nuclear weapons program (see <http://isis-online.org/uploads/isis-reports/documents/indiannuclearfacilities.pdf>).

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, this plant was built indigenously.

j. *Sources:*

Berkhout, Frans and Surendra Gadekar. "Reprocessing in India."

<http://www.ieer.org/ensec/no-2/india-b.html>.

Bhaba Atomic Research Centre. "Reprocessing: Indian Programme on Reprocessing." Nuclear Fuel Cycle: BARC Highlights.

<http://www.barc.gov.in/publications/eb/golden/nfc/toc/Chapter%206/6.pdf>.

Accessed 06/15/2015. 49-51.

Hibbs, Mark. 2003. "DAE Reprocessing Program Remains Modest in Scope."

Nuclear Fuel. 28(8): 9.

⁷ Berkout and Gadekar cite the facility as beginning "hot" production in 1996, one year after cold run tests were conducted at the facility.

Nuclear Threat Initiative. 2003. "Kalpakkam Atomic Reprocessing Plant."
<http://www.nti.org/facilities/851/>. Accessed 06/15/2015.

Perkovich, George. 1999. *India's Nuclear Bomb: The Impact on Global Proliferation*. Berkeley, CA: University of California Press.

—. 2011. "India's Prime Minister Inaugurates Country's Fourth Reprocessing Plant."
Nuclear Fuel. 36(1): 1.

7. Kalpakkam Reprocessing Plant (KARP) Laboratory

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

Reprocessing.

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.*

Construction year could not be identified. The facility became operational in 1985 and operations continue to this day.⁸

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

No.

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

No.

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?*

We code this as a civilian site because the larger reprocessing facility at the same location has no known connections to India's bomb program.

⁸ Ciricione et al say the facility was completed in 1986.

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.

j. Sources:

Berkhout, Frans and Surendra Gaddekar. "Reprocessing in India."
<http://www.ieer.org/ensec/no-2/india-b.html>.

Bhabha Atomic Research Centre. "Reprocessing: Indian Programme on Reprocessing."
Nuclear Fuel Cycle: BARC Highlights.
<http://www.barc.gov.in/publications/eb/golden/nfc/toc/Chapter%206/6.pdf>.
Accessed 06/15/2015. 49-51.

Nuclear Threat Initiative. 2003. "Kalpakkam Atomic Reprocessing Plant."
<http://www.nti.org/facilities/851/>. Accessed 06/15/2015.

Perkovich, George. 1999. *India's Nuclear Bomb: The Impact on Global Proliferation*.
Berkeley, CA: University of California Press.

8. Lead Minicell Facility at Kalpakkam (Coral—Compact Reprocessing facility for Advanced fuels in Lead cells)

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

Reprocessing for FBTR and PFBR fuel.

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 of the facility began around 2001.⁹ The facility began operation in 2003 and continues to this day.

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

⁹ The 2000 construction date is an estimate based on the Indian stated reprocessing plan.

No.

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

No.

- 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?*

This is a civilian facility with no known connection to India's nuclear weapons program (see <http://isis-online.org/uploads/isis-reports/documents/indiannuclearfacilities.pdf>).

- 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.

- j. *Sources:*

Natarajan, Rajamani and Baldev RAJ. 2007. "Fast Reactor Fuel Reprocessing Technology in India." *Journal of Nuclear Science and Technology*. 44(3): 393-397.

Woddi, Taraknath V.K., William S. Charlton, Paul Nelson. 2009. "India's Nuclear Fuel Cycle: Unraveling the Impact of the US-India Nuclear Accord." *Synthesis Lectures on Nuclear Technology and Society*. 1(1): 1-104; 24-28.

World Nuclear News. 2011. "India Opens New Reprocessing Plant." http://www.world-nuclear-news.org/WR_India_opens_new_reprocessing_plant_1601111.html. Accessed 06/15/2015.

Zentner, M.D., G.L. Coles, R.J. Talbert. 2005. "Nuclear Proliferation Technology Trends Analysis." Pacific Northwest National Laboratory. 101.

9. Power Reactor Fuel Reprocessing (PREFRE), Bhabha Atomic Research Centre

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

Reprocessing.

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

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.*

Construction of the facility began in 1969. The facility began operation in 1977¹⁰ and continues to this day.

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

No, there is no evidence to suggest that India hid the development of the facility.

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

No, the facility is only under safeguards when safeguarded materials are present at the facility.

- 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?*

Possibly. The facility is dedicated to reprocessing materials from CANDU, Dhruva and Cirus reactors. While some sources state this facility had a military purpose, others list it as a civilian. We code it as non-military based on an ISIS report (<http://isis-online.org/uploads/isis-reports/documents/indiannuclearfacilities.pdf>).

- 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.*

¹⁰ The 1977 date is from the Perkovich. The NTI says there were initial tests in 1977, trials in 1979, and full reprocessing activities in 1982.

No. While reports indicate the facility operated domestically produced centrifuges, some of the materials and manufacturing equipment may have come from abroad. Albright and Basu note, “India depended extensively on foreign procurement of equipment and materials for the RMP,” adding that the RMP received equipment and materials from German, Swiss, and French firms. Specifically, the RMP obtained a flow-forming machine from the German firm Leiffield.

India has made attempts to refute these claims and to establish the indigenous nature of the plant. In 1992 the head of India’s DAE P.K. Iyengar said that scientists from BARC both built and operate the plant, and that the plant is composed of “several hundred... centrifuges made of domestically produced maraging steel” (CNS Monterey). ISIS’s David Albright has conducted extensive research on the procurement strategies of the RMP. His research shows that Indian Rare Earth Ltd. (IRE), a public sector company based out of Mumbai, is responsible for procuring sensitive technologies and materials for the plant. Albright writes, “Based on information from knowledgeable European and American officials, IRE has received a wide variety of equipment, components, and materials for RMP from overseas companies through the IRE procurement system” (IPRI Factfile). In addition to placing ads in newspapers, Albright discovered that key BARC personnel travelled to Europe to arrange procurement of necessary items for the RMP. For example, Shri Bishweswar Bhattacharjee, a senior BARC official, and T.K. Bera, a senior manager of RMP travelled abroad to oversee the procurement of items from European firms. In addition to European assistance, Albright notes that in the late 1980’s and early 1990’s there was support from a South African firm as well as from individuals who had been involved in the AQ Khan network, though these were not necessarily state-sanctioned actions. While it is difficult to determine with certainty whether or not the European suppliers made their activities clear to their governments, it is likely that at least in some cases the transfers were state-sanctioned. Albright’s research shows that IRE rarely revealed the true end-use and users of items to its suppliers, adding that middlemen such as private export/import companies and wholesalers might have taken additional steps to hide the true end use of items (Albright & Basu).

j. Sources:

Berkhout, Frans and Surendra Gadekar. “Reprocessing in India.”
<http://www.ieer.org/ensec/no-2/india-b.html>.

Bhaba Atomic Research Centre. “Reprocessing: Indian Programme on Reprocessing.”
Nuclear Fuel Cycle: BARC Highlights.
<http://www.barc.gov.in/publications/eb/golden/nfc/toc/Chapter%206/6.pdf>.
Accessed 06/15/2015. 49-51.

CNS. “Selected Indian Facilities: Mysore.” Monterey Institute for International Studies.
http://cns.miis.edu/archive/country_india/nucfacil/mysore.htm. Accessed
06/15/2015.

Hibbs, Mark. 2003. "DAE Reprocessing Program Remains Modest in Scope." *Nuclear Fuel*. 28(8): 9.

International Atomic Energy Agency. 2011. "Annual Report." http://www.iaea.org/About/Policy/GC/GC56/GC56Documents/English/gc56-2-att1_en.pdf. Accessed 06/15/2015.

Haq, Noor Ul, Ed. "Nuclear Proliferation: The Indian Profile." IPRI Factfile. <http://ipripak.org/factfiles/ff97.pdf>.

Nuclear Threat Initiative. 2003. "Bhabha Atomic Research Center" <http://www.nti.org/facilities/829/>. Accessed 06/15/2015.

Woddi, Taraknath V.K., William S. Charlton, Paul Nelson. 2009. "India's Nuclear Fuel Cycle: Unraveling the Impact of the US-India Nuclear Accord." *Synthesis Lectures on Nuclear Technology and Society*. 1(1): 1-104; 24-28.

Zentner, M.D., G.L. Coles, R.J. Talbert. 2005. "Nuclear Proliferation Technology Trends Analysis." *Pacific Northwest National Laboratory*. 101.

10. Rattehalli Materials Plant, Mysore

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

Enrichment, centrifuge.

- 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 of the facility began around 1986 and the facility became operational in 1991.¹¹ Operation continues to this day. The estimated range in production capacity is from 2 to 28 kg of HEU a year.

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

Yes, the facility was developed covertly as the government initially claimed the location was for processing of rare earth materials. However, the government indicated that the facility was used for plutonium enrichment following domestic calls

¹¹ The operational date is from Woddi, Charleston, and Nelson (2009). CNS and NTI lists 1990 as operation start date. Hibbs (1992) is the source for each CNS and NTI. The original article states construction began in 1987 and took four years to complete which confirms the 1991 date.

for transparency at the facility. The government confirmed the existence of the facility in 1992.

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

No.

- 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 may have been the source of the material for the low-yield tests in 1998. Because of India's near exclusive use of natural uranium and heavy water reactors, the facility provides LEU for nuclear submarines and two US-built light-water reactors.

- 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. While reports indicate the facility operated domestically produced centrifuges, some of the materials and manufacturing equipment may have come from abroad. Albright and Basu note, "India depended extensively on foreign procurement of equipment and materials for the RMP," adding that the RMP received equipment and materials from German, Swiss, and French firms.¹² Specifically, the RMP obtained a flow-forming machine from the German firm Leifield. India has made attempts to refute these claims and to establish the indigenous nature of the plant. In 1992 the head of India's DAE P.K. Iyengar said that scientists from BARC both built and operate the plant, and that the plant is composed of "several hundred... centrifuges made of domestically produced maraging steel."¹³

- j. *Sources:*

Albright, David and Susan Basu. 2006. "India's Gas Centrifuge Enrichment Program: Growing Capacity for Military Purposes." Institute for Science and International Security.

¹² Albright & Susan Basu.

¹³ CNS.

<http://isis-online.org/uploads/isis-reports/documents/indiaenrichment.pdf>. Accessed 06/15/2015.

CNS. "Selected Indian Facilities: Mysore." Monterey Institute for International Studies. http://cns.miis.edu/archive/country_india/nucfacil/mysore.htm. Accessed 06/15/2015.

Global Security. "Rare Materials Plant." <http://www.globalsecurity.org/wmd/world/india/ratechalli.htm>. Accessed 06/15/2015/

Global Security. "Overview—India Special Weapons Facilities." <http://www.globalsecurity.org/wmd/world/india/facility-overview.htm>. Accessed 06/15/2015.

Haq, Noor Ul, Ed. "Nuclear Proliferation: The Indian Profile." IPRI Factfile. <http://ipripak.org/factfiles/ff97.pdf>.

Hibbs, Mark. 1997. "India to Equip Centrifuge Plant with Improved Rotor Assemblies," *Nuclear Fuel*. 22(24): 7-8.

Hibbs, Mark. 1992a. "India and Pakistan Fail to Include New SWU Plants on Exchanged Lists." *Nuclear Fuel*. 30: 6-7.

Hibbs, Mark. 1992b. "Second Indian Enrichment Facility Using Centrifuges is Operational." *Nucleonics Week*. 26: 9-10.

International Panel on Fissile Material. 2011. "Global Fissile Material Report 2011."

Koch, Andrew. 1999. "Selected Indian Nuclear Facilities." Center for Nonproliferation Studies.

Laughter, M.D. 2009. "Profile of World Enrichment Programs." Oak Ridge National Laboratory.

Makhijani, Arjun, Lois Chalmers, and Brice Smith. 2004. "Uranium Enrichment: Just Plain Facts to Fuel an Informed Debate on Nuclear Proliferation and Nuclear Power." Institute for Energy and Environmental Research. Nuclear Policy Research Institute.

Nuclear Threat Initiative. "Ratthali Enrichment Facility." <http://www.nti.org/facilities/79/>. Accessed 06/15/2015.

Perkovich, George. 1999. *India's Nuclear Bomb: The Impact on Global Proliferation*. Berkeley, CA: University of California Press.

Woddi, Taraknath V.K., William S. Charlton, Paul Nelson. 2009. "India's Nuclear Fuel Cycle: Unraveling the Impact of the US-India Nuclear Accord." Synthesis Lectures on Nuclear Technology and Society. 1(1):1-104. 24-28.

Additional Notes:

India began construction of a new centrifuge facility in 2014 in Challakere Taluk, Chitrandurga district. The facility was announced in 2011 and will have both military and civilian roles.

Albright, David and Serena Kelleher-Vergantini. 2014. "India's New Uranium Enrichment Plant in Karnataka." Institute for Science and International Security.
http://isis-online.org/uploads/isis-reports/documents/SMEF_Brief_July_1_2014_FINAL.pdf.