July 1982

Central Intelligence Agency, Directorate of Intelligence, Intelligence Assessment,'India's Nuclear Program: Energy and Weapons'

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Summary:

This massively excised report indicates the Agency's strong views about releasing its knowledge of India's nuclear weapons activities, even when the information is decades old. That many of the pages are classified "Top Secret Umbra" suggests that some of the information draws on communications intelligence intercepts, another highly sensitive matter.

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CIASW 82-10056C

India's Nuclear Program—Energy and Weapons

An Intelligence Assessment

~~Top Secret~~

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Dissemination Control Abbreviations

Directorate of Intelligence

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[redacted]

India's Nuclear Program—Energy and Weapons [redacted]

An Intelligence Assessment

Information available as of 1 May 1982 has been used in the preparation of this report.

[redacted]

[redacted]

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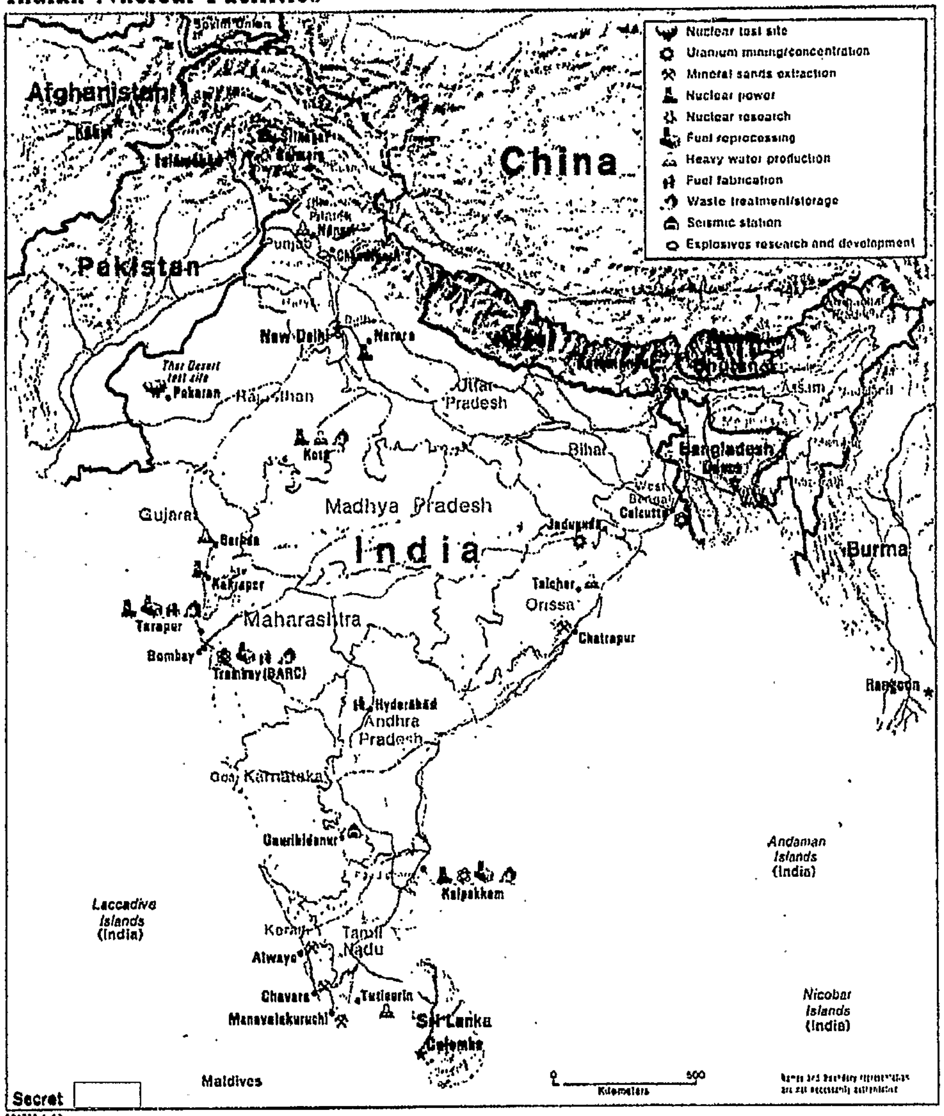
Figure 1
Indian Nuclear Facilities



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Overview

[redacted]

The Indians claimed that the 1974 test was a PNE to study cratering and cracking effects on rocks. The plutonium for this test was recovered from a research reactor supplied to India by Canada under an agreement that prohibits the use of the reactor's plutonium for any military purposes. Because any near-term test would have to use plutonium from this reactor, it would almost certainly be called a PNE. [redacted]

[redacted]

The Indian nuclear power program has been plagued with reactor maintenance problems that have been magnified by repeated repairs to reactor components and by the inadequacy of reactor operators in dealing correctly with problems (and potential radiation hazards). As a result, frequent reactor shutdowns have sharply reduced the electrical output of the nuclear power plants. [redacted]

India has adequate resources and has mastered most of the fuel cycle technology necessary to support its nuclear power program. India has sufficient uranium reserves for at least the short term and is capable of fabricating natural uranium and enriched uranium into reactor fuel. For several years India operated a small plant for reprocessing research reactor fuel. A much larger plant for reprocessing power reactor fuel is operational and another is planned. [redacted]

India has a solid base in nuclear research and industry. A large cadre of nuclear scientists, working at several well-equipped research centers, covers a wide range of theoretical and applied research topics. Also, Indian industry is well equipped and capable of supporting most aspects of the nuclear program.

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[redacted]

A multidisciplinary group of scientists drawn from other parts of BARC have been involved in research on the laser isotope separation (LIS) method of uranium enrichment. This group has succeeded in separating sulphur isotopes using LIS but has not progressed beyond that level. [redacted]

[redacted]

Plutonium Recycling Project. Another BARC project is research in the recycling of plutonium for use in mixed oxide (MOX) fuel. MOX, a combination of oxides of plutonium and natural (unenriched) uranium, could be an alternative to the US-supplied enriched uranium that has been used to fuel the power reactors at Tarapur. [redacted]

[redacted]

[redacted]

for the FBTR (see next section). With the anticipated cutoff of enriched uranium from the United States, the Indian scientists evidently were directed to shift emphasis of their research to developing MOX fuel for the Tarapur reactors. [redacted]

[redacted]

Calcutta Variable Energy Cyclotron
The newest major facility for nuclear physics research in India is a particle accelerator—the variable energy cyclotron (VEC)—located in the Salt Lake area of Calcutta. The Indians consider the accelerator a particularly satisfying scientific achievement, because they constructed it without foreign assistance. The cyclotron is capable of accelerating protons to energies from 6 to 60 million electron volts (MeV), deuterons to energies from 12 to 65 MeV, and alpha particles to energies from between 25 to 130 MeV. The VEC was commissioned in June 1977 with much fanfare, but did not start functioning until January 1981 because of the lack of a steady power supply from the electrical grid in West Bengal. Diesel generators had to be installed to obtain reliable, uninterrupted power to operate the cyclotron and to offset the erratic local power situation.

The VEC is to be used in fundamental studies on the structure of atoms, in the production of isotopes not producible in a research reactor, and in studies of radiation damage to reactor materials—especially the materials the DAE is considering for constructing breeder reactors. Indian scientists have begun investigations on a higher energy accelerator (synchrotron) as a future project.

Several other research facilities are under the auspices of BARC and the DAE. These are a nuclear research laboratory in Srinigar, a high-altitude research laboratory near Gulmarg (both in Kashmir), and the Gauribidanur seismic station (80-km north of Bangalore). The research in the Kashmir facilities is oriented toward cosmic ray physics, astrophysics, and solar terrestrial physics. The seismic station is deployed over a 25-kilometer-square area. It is used in the detection and identification of underground nuclear explosions and also for seismic research.

Other institutions such as the Tata Institute of Fundamental Research in Bombay, the Saha Institute of Nuclear Physics in Calcutta, and the Tata Memorial Center in Bombay receive grants-in-aid from the DAE. These are basically teaching institutions that are heavily involved in various fields of research—both applied and theoretical. The Tata Institute of Fundamental Research is the national center for nuclear science and mathematics. As such, it has a computation facility equipped with the most advanced computers in India. A bubble chamber group of the institute is active in a number of experimental high-energy physics projects. A 400-keV ion accelerator, a 1-MeV cascade generator, and a 3.5-MeV electron linear accelerator are available for studies in nuclear spectroscopy, solid-state physics, and nuclear reactions

Nuclear Power

India's nuclear power program, as planned in the 1960s, was to follow three steps. The first generation of power reactors would be of the CANDU design—a natural uranium-fueled, heavy water-moderated type. These were to be followed by plutonium-fueled fast breeder reactors, which—while producing power—were also to produce plutonium and uranium-233 from thorium. In the final stage of the program, India's large resources of thorium would be used to fuel thorium-uranium-233 breeder reactors.

Current Program

India hopes to have 1,800 megawatts-electric (MWe) of nuclear power generating capacity by 1987. It has four operating power reactors—two US-supplied, 210-MWe boiling water reactors (BWR) at Tarapur and two 220-MWe, pressurized-heavy water reactors (PHWR) of the CANDU type at the Rajasthan station near Kota (table 1). Four 235-MWe heavy water reactors are under construction—two at Kalpakkam in Tamil Nadu and two at Narora in Uttar Pradesh. The first reactor at Kalpakkam (also known as the Madras Atomic Power Station) is expected to be commissioned soon. The other Kalpakkam reactor and the two at Narora are scheduled for completion between 1984 and 1987. When all of these reactors are in operation, the 1,800-MWe cumulative nuclear generating capacity will still constitute less than 5 percent of the country's total electrical generating capacity.

With the exception of the Tarapur station, the nuclear power program is based on CANDU-type reactors. The CANDU design was selected because of its adaptability to indigenous manufacture of reactor components and natural uranium fuel elements. India can construct and operate these reactors with minimum dependence on foreign aid or supplies.

The earlier Tarapur reactors were supplied and constructed by US General Electric. The 1963 Tarapur agreement basically was a turnkey arrangement whereby India was dependent on the United States for equipment replacements and fuel supplies. Under the contract, the United States agreed to supply the necessary low-enriched uranium (less than 3-percent uranium-235) over the 30-year projected lifetime of the reactors

With the passage of the US Non-Proliferation Act of 1978, the United States cannot supply the enriched uranium required by the contract unless India accepts full-scope safeguards on all its nuclear facilities. Of two shipments approved for export in 1980, after a near Congressional veto, only one consignment of 19.8 metric tons (mt) of enriched uranium (a one year's supply for both reactors) was released and sent to India—approximately two years after it was applied for. The other shipment, also of 19.8 mt, has been held for release later, pending assurances that India is not engaged in nuclear weapon development. The delays and uncertainties of fuel supplies have restricted the power generation at each of the Tarapur

reactors to 160 MWe, and in fiscal 1980-81 the station achieved a capacity factor of only 48.9 percent (compared to a normal 60 percent)

[redacted]

Thorium and Other Nuclear-Related Minerals.
India possesses the largest thorium resources in the world. The reserves of thorium oxide are estimated to be 363,000 mt. Most are in monazite sands, which are found along coastal beaches in the states of Kerala, Tamil Nadu, and Orissa. [redacted]

Indian Rare Earths, Ltd. (IREL), another public company established by the DAE, is responsible for recovering and marketing monazite and associated rare-earths minerals. IREL commissioned a plant at Chavara in January 1971 to separate these minerals from the sand. An older (1967) mineral separation plant is located at Manavalakurichi. The monazite from these two plants is sent to a rare-earths plant at Alwaye for further processing. The annual processing capacity at Alwaye is 4,500 mt of monazite, from which a thorium hydroxide concentrate is produced. The concentrate is shipped to the IREL thorium plant at Trombay. The end products of this plant—thorium nitrate, thorium oxide, and a few other thorium and rare-earths compounds—are for export. Some thorium, however, is stockpiled, and more can be added to the inventory whenever its use as nuclear fuel nears reality. [redacted]

Another minerals sand complex is being developed on the seacoast near Chatrapur, in Orissa. This project will add to India's production of thorium and other rare-earth elements. The new sand separation plant was scheduled to be completed by mid-1981 but has been delayed. When it is completed, it is expected to produce 2,000 mt of monazite annually. (U)

Mining and concentration of niobium, tantalum, beryllium, and other nuclear-use metals[4] are under way in various parts of India. The rare-earths plants at Chavara and Manavalakurchi also yield large quantities of zircon and the titanium-bearing minerals ilmenite and rutile. A zirconium chemical plant and a rutile plant are being constructed as part of the Chatrapur complex. The niobium-bearing mineral pyrochlore occurs in Meghalaya, and a small plant is to be set up in the Sung Valley. It is expected to start producing niobium concentrates by late 1982. Minerals containing niobium and tantalum are also recovered in the Hazaribagh district in Bihar. Beryl mining also is located in Bihar in the Nulukera area, and a beryllium pilot plant is under construction at Vashi near Bombay [redacted]

[redacted]

Fuel Fabrication

India's main plants for fabricating fuel assemblies and coolant tubes for power reactors are in the nuclear fuel complex at Hyderabad (table 2). Operations there include the production of zircaloy reactor structural components, the conversion of uranium concentrates to uranium oxide (UO_2) fuel assemblies, and the manufacture of a wide variety of metal products for nuclear and other industrial uses [redacted]

[redacted]

[redacted]

The two plants for handling US-supplied, low-enriched uranium are the only plants in the Hyderabad fuel complex subject to IAEA safeguard inspections. The refueling of both Tarapur reactors requires about 125 fuel assemblies a year (about 20 mt of UO_2), which is slightly less than the designed capacity. The scrap from the fuel fabrication line is accounted for by the IAEA before it is recycled to the oxide plant. [redacted]

[redacted]

[4] Certain metals have various uses in nuclear reactors. For example, niobium can be used as a sheath material, beryllium as a neutron reflector, titanium as a structural material, and zirconium as a fuel cladding material. [redacted]

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