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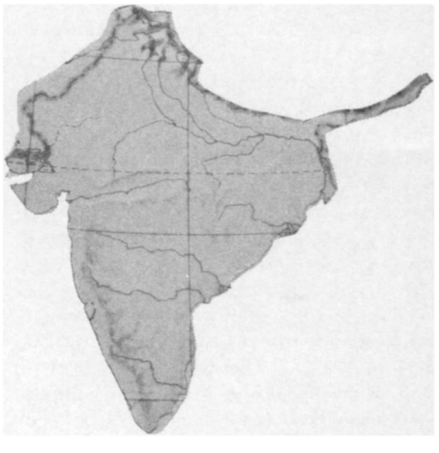

# Toward breeder reactors

## India's choices in reactor development point to an independent national capability

by S. K. Ghaswala

Since the start of the nuclear age, 15 countries have joined the select fraternity that possesses nuclear power reactors. In July, the newest member will enter officially when a reactor in western India goes to full capacity. Although the Indian Atomic Energy Commission has others in the works, it will have to nurse the country's fledgling nuclear power industry along slowly because of shortages in technical manpower, money and uranium.

To take care of the uranium problem, the Indian AEC is pushing the development of new, advanced breeder reactors. Essentially, these breeder reactors take nonfissionable material, such as uranium 238 or thorium, which India is rich in, and by bombarding it with neutrons from fissionable U-233, U-235 or plutonium, change it into a fissionable nuclear fuel. Initial Indian breeders would convert U-238 to plutonium. Nuclear fuel would be created where there was none before and at the same time heat would be produced to generate electricity.

After the plutonium reactors will come the thorium-U-233 thermal breeders.

But the process is a long one, and India's first small fast breeder is not expected until 1974 or 1975. India will not have enough nuclear fuel for a fast breeder power plant until the end of the decade. In comparison, U.S. fast breeders have been around since 1951, and the U.S. AEC hopes to have three plants capable of providing commercial power by 1980 (SN: 6/14, p. 571). Both the first U.S. and Indian fast breeder power plants would have about the same capacity: 300 to 500 megawatts.

Dr. Vikram Sarabhai, chairman of the Indian AEC, feels that in less than 10 years India will have the capacity to produce enough plutonium for the construction of one 400 to 500 megawatt fast breeder every year. He thinks that India will be able to produce power as cheaply as 0.2 cent per kilowatt hour by 1980 through an accelerated power production program of fast breeder reactors.

In developing its fast breeder program, India is relying on foreign assistance, a policy that has raised some internal debate. Since fast breeders are experimental the world over, why should India enlist outsiders in developing its breeder technology, critics argue, and thereby inhibit progress toward self-reliance in nuclear science?

This controversy was heightened by a recent Indo-French agreement to construct a prototype breeder at Kalpakkam in southern India, for which a sum of nearly $31 million has been budgeted. Since none of the countries that have fast breeders—and that includes the United States, the Soviet Union, England and France—has fully ironed out the technical problems involved in using them to produce power on a commercial scale, the feeling is that India should not choose foreign collaboration but should make its own way and place.

Much of the criticism is leveled at the Indian Department of Atomic Energy, which some feel has taken on more work than it can handle. They point to its new projects which include a nitric acid plant, a zirconium power plant, the experimental satellite communications earth station and satellite launching station. The department is being accused of spreading itself over a range of activities, which may be too formidable to be managed.

One suggestion is to establish a separate group of nuclear scientists to supplement the department's efforts. Such a group would be responsible principally for evaluating broad policy matters affecting important scientific decisions, such as the need to go into foreign collaboration for setting up a fast breeder reactor.

India is limited in its choice of nuclear reactors to three types:

- Thermal reactors that use natural uranium.
- Plutonium-based fast breeders.
- Molten salt breeder reactors that produce uranium 233 and thorium.

Because of India's present state of knowledge, coupled with the extreme cost and complexity of advanced reactors, it is forced to pick the natural uranium fueled thermal reactor, which uses deuterium oxide, or heavy water, to moderate the neutrons. Such a reactor can be designed so that it need not be shut down during fuel changing operations, but it also has a heavier and less compact vessel than do the other two types of reactors.

Although molten salt reactors don't have a fuel change problem either, their technology is not as well advanced.

However, the main problem is that presently known sources of uranium in India are limited and would only support about 5,000 to 10,000 megawatts of nuclear power based on heavy water reactor technology for the lifetime of these reactors.

Clearly, therefore, breeders are the only sensible solution.