Indian energy

Fast breeder goes critical

New Delhi

INDIA'S Fast Breeder Test Reactor (FBTR), using what is said to be a new indigenous fuel, went critical on 19 October, making India the first developing country to embark on a breeder programme. Built with French help, the 40-MW (th) sodium-cooled plutonium-fuelled loop-type fast reactor at Kalpakkam near Madras is similar in design to the fast reactor *Rapsodie* at Cadarache in France, but with two major modifications; the £46 million FBTR uses an unorthodox indigenous fuel and can also produce 13 MW of electricity.

FBTR is the third Indian reactor to be commissioned this year. A 100-MW research reactor, DHRUVA, in Bombay and a 230-MW power reactor at Kalpakkam went critical two months ago. The Department of Atomic Energy (DAE) says that with the successful completion of the FBTR project, India has joined the select group of countries that have mastered fast breeder reactor (FBR) technology.

The event also marks the beginning of the second phase of India's three-stage nuclear power development programme. Natural-uranium-fuelled pressurized heavy water reactors such as those in Rajasthan and Madras (four more under construction) constitute the first phase. Plutonium produced in these reactors will fuel fast breeders to be built in the second phase. These FBRs will breed uranium-233 from thorium blanketing the reactor core. In the third phase, FBRs utilizing the ^{232}Th–^{233}U cycle are to be built and DAE hopes the abundant reserves of thorium (360,000 tonnes) in India will sustain the nuclear power programme for 1,000 years. According to DAE, its breeder programme is essential to India whose uranium reserves will support a nuclear power capacity of only 15,000 MW until 2030 AD.

India's FBR programme began in 1968 with French collaboration with the Commisariat à l'Energie Atomique (CEA) supplying the designs of the *Rapsodie* reactor. Four French companies helped the Indian companies with knowhow on the manufacture of the major components such as the reactor vessel, sodium pump, heat exchangers and control drive mechanism. Most materials for their manufacture came from France under a special French credit of FF35 million.

But work on FBTR has slowed down particularly since the Indian nuclear test in 1974. France, which had earlier agreed to provide highly enriched uranium fuel for FBTR, backed down, so that India was forced to develop its own fuel with a high concentration of plutonium instead of enriched uranium. The FBTR is loaded with a fuel mixture of 70 per cent plutonium carbide and 30 per cent uranium carbide, thus making it the world's first fast reactor with a plutonium-rich carbide fuel. Reactors operating elsewhere in the world use oxides of 30 per cent plutonium and 70 per cent uranium, and most investigations elsewhere with carbide fuel have been limited to fuels with a low concentration (30 per cent) of plutonium.

The team at the Bhabha Atomic Energy Research Centre (BARC), which has developed and tested the fuel in five years, claim that, despite a lower melting point, it is superior to the traditional oxide fuel. If the fuel fulfils its promise, India will stick to it in future commercial breeders.

BARC is also proud of having indigenously developed the technologies for purifying and handling molten sodium, 90 tonnes of which are required by the FBTR. The exact amount of plutonium in its core has not been disclosed, but all of it is said to have come from the country's stockpile not subject to safeguards. "The way the Indian industry has met the stringent requirements of FBTR equipment is an important pointer to the success of the country's future FBR programme, when larger reactors would be constructed", DAE says. DAE has already made a beginning on the design of a 500-MW prototype FBR that will need 1,800 kg of plutonium, and hopes to build its first commercial FBR in 2000 AD.

Meanwhile BARC has scored another success in a different area of technology; the country's experimental 5-MW (th) coal-based magneto-hydrodynamic (MHD) generator at Tiruchirapalli, in south India, started producing 100 kW of electrical power in mid-August. For the past 10 years, the Moscow high-temperature institute has been helping BARC and the state-owned Bharat Heavy Electricals Ltd in the setting up of the MHD pilot plant, which uses high-ash Indian coal. Water-gas obtained by passing steam over red hot coal in a combustor is used as the feed gas, which is seeded with potassium iodide. The combustor and the 300-tonne iron core magnet that can carry up to 1,300 amperes without water cooling were designed by BARC.

The test run in August, which lasted for two hours, produced a plasma at 2,800 K, 100 kW of power at a Faraday voltage of 5 volts and a 0.7-tesla field. The Soviets, whose MHD plants are fuelled by oil or natural gas, had much to learn from the operation of the coal-fired Indian MHD plant. The basic data had helped the Soviet Union build a 25-MW (th) coal-based MHD plant from which extraction of up to 5 MW of electricity has already been achieved. India, which has no plans to scale-up its pilot plant, has declared it a national facility for studying properties of glass and ceramics at high temperatures.

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Romanian energy

Too soft on soft energy

ROMANIA'S Minister of Electric Power Supply, Nicolae Busui, was dismissed two weeks ago, and the electricity generating industry placed under military control, because of inefficient management and failure to achieve the planned output. Under the emergency regulations, all coal-fired power stations will be placed under a military commander, who will be responsible for the "strict observance of technological, exploitation and maintenance norms" as well as for order and discipline. Power workers are forbidden to change their jobs, and all vacant posts must be filled from outside, not by transfer within the industry.

Romania, formerly a net energy exporter, has for almost a decade suffered from a growing energy crisis culminating in the virtual shut-down of the country during last winter's cold snap. During the 1970s the over-expansion of the petrochemical industry (largely on the initiative of Dr Elena Ceaucescu, wife of the President) decreased indigenous petroleum supplies, with the result that thermal power stations are, for the most part, coal fired. The official statistics carry glowing reports of record coal and lignite outputs and of deliveries ahead of schedule to the power stations, so that what has gone wrong at the generating plants is far from clear; there appear to have been considerable delays in the servicing of existing stations and the installation of new ones, but such delays are endemic throughout the Romanian economy.

To some extent, the coal-fired generating plants may have been made the scapegoat for other sectors. The nuclear power station at Cerna Voda, for example, in spite of a recent, much publicized speed-up, is well behind schedule. So too are plans for a network of hydroelectric plants with a total generating capacity of 13,000 MW.

The emergency decree urges modernization and technological innovation in the Romanian power industry. In fact, the Romanians are prolific in technological novelties, including wind-powered turbines, wave power, solar power and biogas. In 1984, under a programme coordinated by the National Council of Science and Technology on unconventional and renewable energy, facilities equivalent to about 115,000 tonnes of conventional fuel were put into operation, while the planned equivalent this year is 214,000 tonnes. How much of the planned investment in the generating industry (37,500 million lei this year) goes on these unconventional projects is unknown, but the emergency suggests that more attention should be paid to the conventional sector.

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