

## Nuclear energy

## India joins enrichment club

New Delhi

INDIA has developed the capability to enrich uranium, according to Dr Raja Ramanna, chairman of the Atomic Energy Commission (AEC); he did not reveal the size of the enrichment plant nor the amount of U-235 produced. Ramanna was speaking at a press conference and reacting to US press reports that Pakistan is now able to make bomb-grade uranium.

For the past four years, the Bhabha Atomic Research Centre (BARC) has been operating a gas centrifuge pilot plant at Trombay near Bombay. Its operation and progress have been closely guarded secrets until now. Unlike Pakistan, which relied on secret imports of design and parts for its Kahuta enrichment facility,

BARC is believed to have designed the plant itself.

There are rumours that, based on the pilot facility, BARC is setting up a full-scale gas centrifuge plant near Mysore in Karnataka state in South India. But Iyengar, in an interview on All-India Radio, said the enrichment project was part of BARC's efforts to develop expertise in all aspects of nuclear energy and that there was no plan to set up a bigger plant.

India has no need for enriched uranium as its Candu-type reactors are based on natural uranium fuel and heavy-water moderator. Only the two US-built light water reactors (LWR) at Tarapur at present depend on U-235 fuel imported from France. Under an agreement with the United States, US permission is required for operating the reactors with India's own enriched uranium fuel. According to Iyengar, the enriched uranium will be required for nuclear physics experiments.

India is self-reliant in the total nuclear fuel cycle technology — from mining uranium and commissioning power plants to reprocessing spent fuel. Enrichment was one area where it lagged behind. Having developed the gas centrifuge technology, India is now on equal terms with Pakistan, but AEC sources have dismissed speculation that India's enrichment activity is re-

lated to a weapons programme.

US news reports that Pakistan is on the verge of building a bomb have undoubtedly caused alarm in India, but the government has said it will not take any hasty decisions about going nuclear. Replying to questions about the possible nuclear threat from India's neighbour, Mr Natwar Singh, Minister of State for External Affairs, told parliament that India "will keep its powder dry" while at the same time exploring all avenues for preventing a nuclear race in the subcontinent. India, which conducted a nuclear test at Pokhran 12 years ago, has consistently denied having a weapons programme.

Meanwhile, AEC has announced an ambitious plan to build 22 more nuclear power plants in the next 15 years to raise India's nuclear power capacity from the present 1,100 MW to 10,000 MW. Ten of the reactors will be 500-MW units (now in the design stage) and the rest will be similar to the 235-MW plants in operation in Madras and Rajasthan. The 15-year plan would cost \$14,000 million at 1983 prices. Because government resources are limited, it has been decided to bring nuclear power generation under a public limited company that will raise funds through the issue of bonds and shares. Although AEC is confident of launching the Nuclear Power Corporation, it remains to be seen whether the Indian public will invest in this programme after Chernobyl.

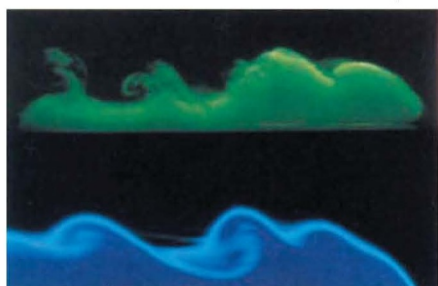
K.S. Jayaraman

## Storm flow simulation by computer

Washington

A NUMERICAL simulation of thunderstorm outflows by Kelvin Droegemeier of the University of Oklahoma is being used to program a 727-passenger jet flight simulator at the Federal Aviation Administration's training academy in Oklahoma City. It is hoped that pilots can learn to recognize and avoid dangerous wind shear associated with outflows, which has caused several fatal crashes.

Droegemeier has produced a film of his simulations, which were run on a Cray X-MP supercomputer at Omnibus Simulation Inc. of Los Angeles. The blue image shows a still from the numerical model; the



green image shows a laboratory tank study in which the same phenomenon is modelled by releasing salt water into less dense fresh water. The simulation, which has about 40,000 grid points, reproduces clearly the features seen in tank studies 20 years ago. The turbulent eddies on top of the outflow in both images are corroborated by Doppler radar images of real outflows, and probably explain the seemingly random pressure fluctuations observed on the ground beneath. Production of Droegemeier's film was paid for by the National Science Foundation's Office of Advance Scientific Computing. Tim Beardsley

## AIDS

## German survey's gloomy outlook

THREE-QUARTERS of those infected with the AIDS (acquired immune deficiency syndrome) virus will enter the final and fatal stages of the disease within seven years, according to a research team from the University of Frankfurt.

The predictions from the study, claimed to be the first long-term project in Europe, are based on "continuous observation" of 543 patients, largely the sexual partners of the first AIDS victims to die in Frankfurt, who have been attending outpatients' clinics since 1982. On the basis of the rate of deterioration of these patients — 377 proved positive in original antibody tests — and from computer forecasts, the researchers conclude that half the antibody carriers will have progressed to the final stage of AIDS within five years of first exposure and three-quarters within seven years.

The research team is led by Professor Eilke Brigitte Helm from the Zentrum der Inneren Medizin at the University of Frankfurt and the findings are published in the *Deutsche Medizinische Wochenschrift* (No. 32/32, 1986). The team placed all the patients in one of four categories, depending on the seriousness of the symp-

toms. They were those whose antibody tests proved positive but who had no obvious sign of the disease; those with a slight immunological weakness and showing symptoms of lymph-node swelling; those with pronounced immunological defects; and those with the full symptoms of the disease. The progress of the patients was monitored for three years.

At the end of that period, only 30 of the original antibody-positive patients were still healthy and, within a year, half of the patients with no symptoms moved into the next category. Within two years, half of those with slight or pronounced immunological defects were entering the final stages of the disease or suffering severe disintegration of their defence systems. With one exception, all those in the final stages of the disease died within two years.

According to the researchers, the belief that AIDS would develop only in a minority of cases infected with the virus is unfounded. The predicted size of that minority has increased with time from 5 or 10 per cent to at least 30 per cent in some cohorts of patients, but the German prediction of 75 per cent is unprecedented.

Bill Johnstone