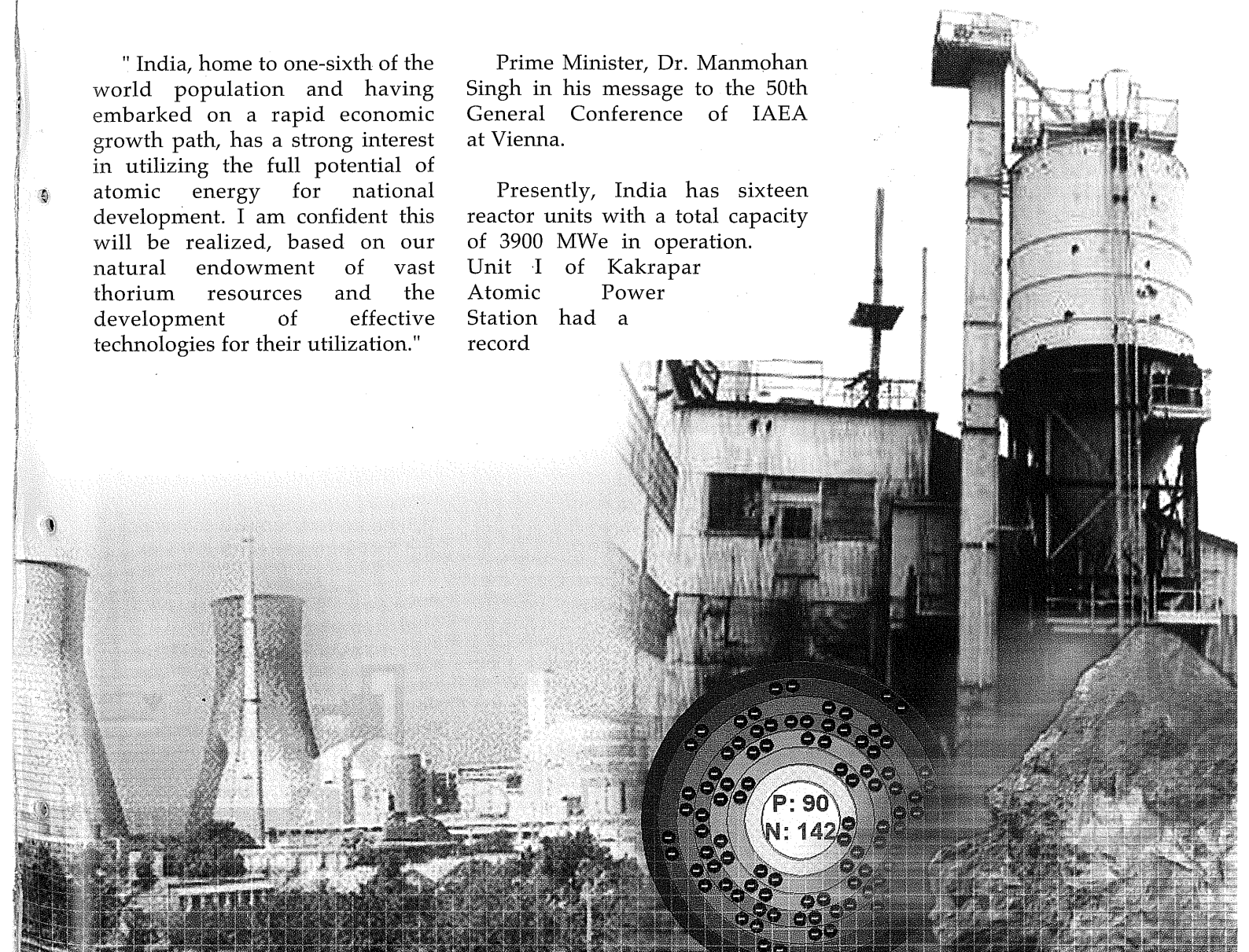
Thorium *for* Energy Independence

" India, home to one-sixth of the world population and having embarked on a rapid economic growth path, has a strong interest in utilizing the full potential of atomic energy for national development. I am confident this will be realized, based on our natural endowment of vast thorium resources and the development of effective technologies for their utilization."

Prime Minister, Dr. Manmohan Singh in his message to the 50th General Conference of IAEA at Vienna.

Presently, India has sixteen reactor units with a total capacity of 3900 MWe in operation. Unit I of Kakrapar Atomic Power Station had a record



continuous operation of 372 days before it was shut down for mandatory inspection. The average duration of outage of biennial shutdown has now been reduced to just 26 days.

Major upgrades for ageing management and safety were completed on three Pressurized Heavy Water Reactor (PHWR) units. The safety upgrades at the two Boiling Water Reactors that started commercial operations in 1969, were completed in just four and a half months.

The replacement of all reactor feeders of one of our PHWRs was accomplished for the first time in the world. One of our latest 540 MWe PHWRs was offered for pre-start-up peer review by an expert team of World Association of Nuclear Operators (WANO). This was the first ever review of its kind in Asia. India is now ready for implementation of the newly designed 700 MWe PHWR units which would enable further significant reduction in the capital cost per MWe of indigenous PHWR units.

Closed Nuclear-fuel Cycle

India considers a closed nuclear fuel cycle of crucial importance for implementation of its three stage nuclear power programme with its long-term objective of tapping vast energy available in Indian thorium resources, based on development of effective technologies for their utilisation. This is central to India's vision of energy security and the Government is committed to its full realisation through development and deployment of technologies pertaining to all aspects of a closed nuclear fuel cycle.

Thorium utilization is the long-term core objective of the Indian nuclear programme for providing energy independence on a sustainable basis.

As a part of its development efforts in high level radioactive waste management technologies, India achieved two major landmarks this year namely (i) hot commissioning of Advanced Vitrification System (AVS) which employs Joule-heated ceramic melter and (ii) demonstration of Cold Crucible Vitrification Technology.

Kalpakkam Reactor

The Fast Breeder Test Reactor (FBTR) at Kalpakkam, which has been the foundation of our fast reactor programme, has shown excellent performance with an availability factor of over 90% in the last few campaigns. The unique U-Pu mixed carbide fuel used in FBTR has reached a record burn-up of 154.3 GWd/t without a single fuel pin failure. This achievement has been possible through a combination of stringent fuel specifications, quality control during fabrication and inputs obtained from the detailed post irradiation examination of fuel at different stages combined with the modeling of the behaviour of the fuel clad and wrapper materials.

The construction of 500 MWe Prototype Fast Breeder Reactor (PFBR) is on schedule and is expected to be commissioned by the year 2010. In keeping with the philosophy of efficient utilization of a fuel material by closing the fuel cycle, India has embarked on the design and construction of a fuel cycle facility to cater to the PFBR. The facility will be commissioned by 2012.

Core Objective

Thorium utilization is the long-term core objective of the Indian nuclear programme for providing energy independence on a sustainable basis. The advanced stage of the programme is based onThorium-Uranium-233 cycle. India is actively engaged in developing 300 MWe Advanced Heavy Water Reactor (AHWR). The design of this reactor incorporates several advanced features to meet the objectives being set out for future advanced nuclear reactor systems. A critical facility to validate physics design of AHWR will be functional this year. The facility is flexible enough to study the physics of advanced systems, including source driven systems, in future. Development of high current proton accelerator and spallation source for Accelerator Driven Sub-Critical Systems (ADS) is also being pursued. Such systems would offer the promise of shorter doubling time, even with Thorium, and incineration of long lived actinides and fission products, thus leading to the possibility of eliminating long-lived radioactive waste. A Compact High Temperature Reactor (CHTR), with 100 kW thermal power rating, is being developed as a demonstrator of technologies relevant for next generation high temperature reactor systems. Such reactor systems will address the needs such as electricity generation in remote places, production of

alternative transportation fuel such as hydrogen, and refinement of low-grade coal and oil deposits to recover fossil fluid fuel.

Excellent Safety Record

The excellent safety record of Indian reactors and other facilities has been achieved through sustained Research and Development programmes. As part of the safety studies on nuclear containment structures, the construction of a 1:4 size containment test model has been initiated at Tarapur.

Over the years India has developed advanced capabilities in the utilization of thorium, as a part of its strategy to enhance nuclear capacity through a closed nuclear fuel cycle that would enable timely deployment of its thorium reserves. This is a viable and sustainable strategy for India's and global long term energy security. Seen in the context of nuclear power becoming a significant fraction of energy supply in a world where everyone is assured of a minimum of 5000 KWh of energy in a year, entire global uranium if used in once through mode would last only a few tens of years.

Even with a shorter term perspective of deployment of a proliferation resistant nuclear energy system that could address the need for incineration of available surplus plutonium, the use of thorium, in reactors using proven technologies, presents a vastly superior option as compared to other options based on fast reactors. ■

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