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Nuclear Power Programme in India—Past, Present and Future

FOREWORD

India has been amongst the frontrunners to have an elaborate nuclear programme since its inception immediately after independence. At present, India is among the few countries recognized to have mastered all aspects of nuclear fuel cycle and leader in heavy water reactor technology. India is poised for multifold growth in nuclear power generation to match the needs of sustained economic growth and improving the standard of living for masses. Nuclear power is currently the fourth-largest source of electricity in India after thermal, hydroelectric and renewable sources of electricity. Thorium utilization for large scale power production and associated technology development are one of the important aspects of Indian nuclear power programme. This is important due to its security in terms of fuel reserves; since India has one of the largest reserves of Thorium. Operation in closed nuclear fuel cycles, which involves reprocessing and recycle of fissile materials is thus inevitable for India. A three stage nuclear energy programme based on closed cycle is the flagship of Indian atomic programme. Stage one aims at developing natural uranium fuelled Pressurized Heavy Water Reactors; the second stage aims for utilizing plutonium-based fuels in fast breeder reactors. The third stage focuses on the development of advanced nuclear power systems for utilization of thorium. Currently, India has 20 nuclear reactors in operation generating approximately 4,780 MWe and seven other reactors are under construction which are expected to generate an additional 5,300 MWe. Apart from currently operating water cooled reactors, the country plans to build innovative nuclear reactors such as Advanced Heavy Water Reactor, Prototype Fast Breeder Reactor, High Temperature Reactor and Molten Salt Breeder Reactor. The country has made serious R&D programmes towards development of Accelerator-driven system (ADS) and Fusion reactor concepts. Important objectives of the future designs would be not only burning of thorium but also to minimize the need for exclusion zone so that the new reactors can be located in close proximity to large population. In view of this, the new designs would be practically safe and would satisfy the design requirements for 'no impact in public domain'. While the country was smoothly riding on the planned 3-stage programme, the Fukushima accident has given a temporary setback to the nuclear industry due to public apprehension on safety of nuclear reactors.

In this special issue, emphasis has been laid to bring out the design and safety aspects of Indian operating reactors as well as future ones. The special issue also discusses how the extreme events are prevented in the design or mitigated in Indian nuclear power plants, which require development of appropriate materials, control and instrumentation systems, and technologies. Apart from safety, the special issue discusses on management of radioactive waste and preparedness for Indian fusion reactor programme. Since India has an elaborate nuclear power programme based on closed fuel cycle, development of skilled nuclear scientists and engineers is an important aspect, who not only should be ready to take present responsibility but also can dream for a better tomorrow. The special issue brings out this aspect of development of human resources for

the nuclear power programme. The articles in this issue are primarily review articles and targeted for public education.

The Guest Editors of this special issue are thankful to all the authors for submission of their articles and also to all the reviewers who took all the care to ensure that the articles maintain the standard so that its archival value is assured.

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A K NAYAK
Reactor Engineering Division,
Bhabha Atomic Research Centre,
Trombay, 400 085, Mumbai, India
e-mail: arunths@barc.gov.in

B K DUTTA
Reactor Safety Division,
Bhabha Atomic Research Centre,
Trombay, 400 085, Mumbai, India
e-mail: bkdutta@barc.gov.in

(Guest Editors)