India's FBR Programme - Towards Realisation of Visionary's Mandate

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To ensure the country's long term energy security, Dr Homi Jehangir Bhabha, the father of India's Nuclear Programme, conceived three stage nuclear power programme based on the available Uranium & Thorium resources within the country. While the first stage exploits the available limited Uranium resources, the third stage is designed to use the vastly available Thorium resources. In between these two stages, the second stage is formulated to interconnect the two stages, ensuring optimum utilisation of available Uranium resources and transition to thorium programme, smoothly. As part of this strategy, the ultimate mandate under second stage is to build fleet of fast reactors, breeding large quantity of plutonium using spent nuclear fuel from the first stage programme in the beginning years and slowly introducing thorium into these reactors to convert it into Uranium - 233, which once accumulated in large quantity, will be used in third stage reactors. In line with this mandate, country's first fast breeder reactor, FBTR, a 40 MWt test reactor was commissioned at Kalpakkam in 1985. The reactor used a UC-PuC fuel to tide over restrictions placed in importing enriched Uranium fuel as well as the limitations in Pu enrichment in Oxide based fuels. Continuing the work, Prototype Fast Breeder Reactor (PFBR), a 500 MWe, MoX fuelled sodium cooled fast breeder reactor was indigenously designed, developed and installed. Though the breeding potential of oxide fuel is limited, the objective was to master the large scale reactor technology, before going for metal fuel programme (with large breeding potential), which needed large scale R&D in fuel fabrication & re-processing technologies. In this quest towards reaching the ultimate objective of use of metal fuels, full scale metal fuel SA irradiation in reactor environment is identified as prerequisite for full pledged metal fuel reactor technology. In this context, a 100 MWt test reactor, FBTR-2 has been conceptualised with sodium bonded U-23%Pu-6%Zr as test fuel and UC-PuC as driver fuel. The fuel SAs will be of same scale as that expected in 500 / 1000 MWe commercial scale reactor. As the performance of metal fuel SA is demonstrated, the core will be transitioned to full metal core to study the metal core dynamics. Besides demonstrating the metal fuel performance, the FBTR-2 will serve as replacement for FBTR, which is nearing its life, to continue the material irradiation programme, isotope production as well as demonstrate MA burning potential. Further, pyro-reprocessing and prefabrication of reprocessed fuel is also integrated with the reactor so as to demonstrate closing of metal fuel cycle. In-principle approval for taking-up FBTR-2 along with integrated metal fuel cycle demonstration facility (MFCDF) has been obtained from Atomic Energy Commission.

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About Speaker: Sriramachandra Aithal, SO/H is a Mechanical Engineering Graduate from Kuvempu University, Karnataka and is from the 43rd Batch of BARC Training School. Since completion of training, he is posted at Indira Gandhi Centre for Atomic Research, Kalpakkam and presently, he is heading Reactor Core & Assembly Division under Reactor Design Group. He has 25 Years of experience in the field of design & development of fast reactor components, experimental design validation and has significantly contributed in the construction & commissioning activities of PFBR. As Head of Division, he is responsible for the design and developmental activities in Reactor Core and Reactor Block. He is the recipient of DAE-Scientific & Technical Excellence Award as well as several DAE Group Achievement Awards for his contribution in the field of design & development of fast reactor components. Presently, he is also functioning as Project Manager for FBTR-2.