

# Institute Lecture

## Challenges in the design of Fast Breeder Reactors from a mechanics perspective



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Friday, 31<sup>st</sup> January 2014, Time: 5.15 PM, Venue: L-17,  
Lecture Hall Complex

### Abstract

The talk will explain the basis of design of fast breeder reactors. Mechanical and thermal design of the reactor components are particularly of interest. Nuclear reactors are designed to a very high level of safety. In this respect, several design innovations have been implemented, leading to enhanced safety of the system as a whole. The configuration of a fast breeder reactor is inherently complicated. For a start, components as well as processes are coupled. Resolving thermal-mechanical-chemical coupling in the design context is a challenge. Analysis precedes design and the knowledge of mechanics, understood here in the broadest terms, is a pre-requisite. The primary aim is to predict critical macroscopic parameters such as peak stress or maximum temperature or largest deformation or highest current density or incipient failure of a mechanical system, given knowledge of its interaction with the environment, and the stress response of the material composing the system. Even for materials whose constitutive law is well tested and compactly represented, characterizing it macroscopically for its response remains a difficult problem. Progress is awaited in the domains of both analytical and computational modeling. Fluid flow and chemical reactions determine the loading patterns of a reactor, apart from thermal and electromagnetic fields. The geometric features range from the micron-scale to several meters in size, demanding a multiscale approach to analysis. Nuclear reactors designed with this level of detail can be operated safely and reliably over a prolonged period, even more than 100 years, under hostile environment, such as high temperature, sodium reactivity, and irradiation apart from high strain and strain rates.

### About the speaker

Dr. Chellapandi is Distinguished Scientist and Director, Reactor Design Group, IGCAR. He obtained M.Tech. in 1983 and Ph.D. in 1995 in Applied Mechanics from IIT Madras. He started his career in IGCAR in 1979. Having specialized in design, analysis and qualification of Nuclear Reactor Components, he provided design support to the 40 MW Fast Breeder Test Reactor, conceptual design of 500 MWe Prototype Fast Breeder Reactor (PFBR), detailed analysis of various structural mechanics failure modes and design validation. He is the convener of the task force responsible for manufacture and erection of reactor assembly components of PFBR, under construction at Kalpakkam. Recently, the main and safety vessels were successfully erected at the site, which is an international benchmark for such structures.

Dr. Chellapandi is a Fellow of the Indian National Academy of Engineering, Professor at the Homi Bhabha Institute, Adjunct Professor at PSG College of Technology, Coimbatore, and at Satyabama University, Chennai. He is a member of the Technical Working Group on Fast Reactor in International Atomic Energy Agency, Vienna. Dr. Chellapandi has won many awards, notable among them being the National Design Award in Mechanical Engineering in 2006 and National Design Award in 2013 from Institution of Engineers (India), Agni Award for Excellence in Self-Reliance from DRDO and recently, Vasvik award in 2013.

In recognition of his outstanding professional accomplishments and sustained contributions to the Nuclear Engineering Group of IGCAR, Dr. Chellapandi has been conferred the Distinguished Alumnus Award of IIT Madras.

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**Tea at 5.00 PM**

**All interested are welcome.**

Ajit Kumar Chaturvedi  
Dean of Research and Development