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Advanced Design Features of MOX Fuelled Future Indian SFRs

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India has been operating a Fast Breeder Test Reactor (FBTR) successfully since 1985. Currently, a 500 MWe MOX fuelled pool type Sodium cooled Fast Reactor called Prototype Fast Breeder Reactor (PFBR) is under advanced stage of commissioning. The design, R&D, safety review, construction and commissioning experience from PFBR has motivated the commercial exploitation of MOX fuelled Sodium cooled Fast Reactors (SFR) with closed fuel cycle. Accordingly, six FBRs are planned in which, the first two units (FBR 1&2) will be located at Kalpakkam. These reactors are incorporated with advanced design features towards improved economy and enhanced safety.

FBR 1&2 will be of MOX fuelled to be deployed ahead of metal fuelled reactors in order to capitalize on the experience gained in all the domains of SFR technology and to sustain the program. These future reactors need to have improved economy, enhanced safety and possible higher performance parameters. Economy is achieved by design optimization, reduction of material quantities, adoption of twin unit concept with sharing of facilities, design enabling integrated manufacture and erection leading to reduced construction time. Based on detailed studies, reactor power is enhanced with a slightly larger core and by way of design optimization and exploiting the improved manufacturing technologies, the sizes of major large size components are kept close to the industrial capacity that have been built in the country. This approach has led to raising of reactor power to 600 MWe leading to economic gains.

With regard to safety, the important aspects taken into consideration are the internationally evolving Gen-IV safety criteria especially after Fukushima. The enhanced safety level seek to prevent severe core damage and large radioactivity release to the public and practical elimination of severe accident scenarios involving energy release and public evacuation. The major safety enhancements envisaged are (i) improved core inherent safety characteristics with sodium void coefficient less than 1 $, (ii) passive shutdown features and additional shutdown systems employing alternative working principles to prevent events leading to accident situations and (iii) passive & augmented decay heat removal capacity. This paper presents the advanced design features envisaged, towards enhancing safety and improving economy in the future MOX fuelled Indian SFRs.

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