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CHALLENGES DURING CONSTRUCTION OF SODIUM PIPING SYSTEMS FOR 500MWe PROTOTYPE FAST BREEDER REACTOR

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Prototype Fast Breeder Reactor (PFBR) consists of Primary Sodium Circuit (PSC), Secondary Sodium Circuits (SSC), Safety Grade Heat Removal Circuits (SGDHRC) and Steam-Water circuit. The principal material of construction for sodium piping circuits is austenitic SS316LN/SS304LN.

Manufacturing of thin and big bore piping with tight tolerances along with the high distortion in stainless steels due to high thermal expansion and low thermal conductivity makes fabrication extremely challenging. With strict rules of sloping to be given to the piping to make conducive for full draining of the sodium loops, the fabrication challenges become multifold. All sodium pipelines inside Reactor Containment Building (RCB) are provided with hot guard pipe and are inerted with nitrogen. The guard piping and the containment penetrations require sequential welding. Limited space at site for the erection of sodium piping along with welding at inaccessible areas with confined space makes the work all the more challenging. Terminal joints hook-up to tanks having frozen sodium inventory needs to be done meticulously adhering to highest level of industrial safety standards.

The welding standards and acceptance criteria of PFBR sodium piping system is very stringent compared to conventional piping systems. Due to pyrophoric nature of sodium, the boundaries of various sodium piping systems must possess a high degree of reliability against failure. The welding of sodium piping systems are carried out by combination of Shielded Metal Arc Welding (SMAW) and Gas Tungsten Arc Welding (GTAW) process. Due to complex constructional features of the sodium piping systems, the argon gas purging, welding and non-destructive examinations are extremely difficult and challenging task. Apart from deployment of innovative purging methodologies, various special tools and fixtures were designed, developed and used for welding & fabrication. All the sodium pipe lines and components are provided with surface heaters, thermocouples, wire type leak detectors and insulation. Measurement of deflections of the sodium pipe lines during preheating and comparing with the analysis results is a vital step during the commissioning of sodium systems.
This paper highlights on welding and fabrication aspects, challenges faced and innovations during construction of sodium piping circuits for 500MWe Prototype Fast Breeder Reactor.

Key Words: Sodium piping, welding, fabrication

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