18.1 MANUFACTURING OF COMPONENTS OF POWER / RESEARCH REACTOR

Manufacture of components for both power reactors and research reactors are being done in the manufacturing facility built over a period in BARC. This research centre pioneered in the field of process development and manufacture of the several critical components of the nuclear reactors like fuelling machine heads, sensor stop & pusher assemblies for fuelling machine, seal discs, components for control rod guide tubes of BWR (TAPS) etc.

- **Fuelling machine components for 540 MWe PHWR**

Technology for the manufacture of ram housing assemblies, pressure housings and end covers for fuelling machines of 540 MWe PHWRs has been developed. In addition, technology for electrolysing sealing plug jaws for use on these reactors has been developed and matured to a level of batch production of this component.

- **End fitting body and liner tube for 540 MWe PHWR**

End Fitting Bodies and Liner Tubes (1700 each) required for TAPS 3 & 4 have been manufactured. The tubular shaped end fitting body, with a maximum outer diameter of 188.5 mm and length of 2516 mm is made out of solid AISI 403 type stainless steel forging. The raw material in the form of solid forging undergoes 20 different stages of machining operations. The components are subjected to thermal stress relief operation for relieving residual stresses induced during the manufacturing operation. Ultrasonic flaw detection, magnetic particle testing and hydrostatic testing are being carried out at appropriate stages to qualify these components.

The liner tube is made out of a seamless stainless steel tube AISI SS 410 grade. It has 111.86 mm outer diameter, 104 mm bore and 2135 mm length, demanding IT7/IT8 grade dimensional tolerances, with stringent geometrical features like cylindricity and straightness of the order of 0.01 mm / 100 mm.

All the tooling, the manufacturing process and the qualification procedures required for these components have been developed in-house.
Control Rod & Shut off Rod Mechanisms

Indigenous development of manufacturing of control rod and shut-off rod drive mechanisms involved development of procedures to weld dissimilar alloys, procedures for machining of intricate, high precision components and rigorous destructive and non-destructive quality assurance plans. Many important sub-systems of this equipment were manufactured and delivered.

Critical components for other reactors

250 Seal Shield Plug Assemblies of improved design, which will replace the existing assemblies were manufactured for the DHRUVA research reactor. Among the other critical components related to power/research reactors manufactured in BARC include bearing sleeve for sodium pump for Fast Breeder Test Reactor (FBTR) and sleeve for Prototype Fast Breeder Reactor (PFBR).

Components for AHWR critical facility

Reactor tank

The Reactor tank is made of aluminium of grade ASME SB-209 / Al-1060. The outside diameter of tank is 3320 mm. The shell thickness is 10 mm and the height is 5000 mm. The thickness of the base plate is 25 mm which is fabricated from 40 mm thick Al-1060 plate. The welding is carried out as per the requirements of ASME section III.

About 50-meter length of welding of 10 mm thick plates (including both the longitudinal and circumferential welds) and 4-meter length of welding of 40 mm thick plate are involved. All the welds were qualified by 100% radiography. Exhaustive preparations ligs / fixtures / pre-heating arrangements etc. are made to execute this large vessel. For this purpose, Vertical Welding (3G-position) with Twin Welders Technique was developed, established and used.

AHWR Critical Facility Square Box

The square box, made of Austenitic SS 304L material, is in direct communication with reactor tank and forms the outer
boundary of the Critical Facility. The lattice girder assembly, placed inside the square box, carries and positions the fuel assembly. The square box is a fabricated leak-tight enclosure of overall size 4610 mm sq x 1550 mm height. The top and bottom plates are 20 mm thick and the side plates are 6 mm thick. Neoprene gasket is used to achieve leak-tightness between the top plate and the square box. The bottom plate has a circular opening of 3300 mm diameter. A ring of 3470 mm diameter welded concentric to this opening facilitates its connection to the reactor tank through an elastomer seal ring.

The top plate has a circular opening of 3350 mm diameter to allow access to the reactor tank. A revolving floor supported on a bearing closes this opening. An ingeniously designed oil seal comprising of two metallic ring shells of appropriate diameter and height welded to the top plate of the square box and another similar ring shell welded to the revolving floor, isolates the atmosphere from the environment inside the box. The lattice girder system carries AHWR and PHWR test fuel assemblies, with flexibility of configuring the reactor core at any desired square pitch between 206 mm and 286 mm. All lattice positions within the variable square pitch are accessible through a set of 4 flanged, oblong openings on the revolving floor. These openings are provided with appropriate closures to ensure leak tightness and are positioned and sized in such a way that rotating the revolving floor to the required extent accesses all lattice positions in the Reactor Core.

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