Contribution ID: **731** Type: **Poster**

Manufacturing and Commissioning of Large Size UHV Class Vacuum Vessel for Indian Test Facility (INTF) for Neutral Beams

Wednesday, 19 October 2016 14:00 (4h 45m)

Indian Test Facility (INTF) is designed for "Full characterization of the Diagnostic Neutral Beam (DNB)"for ITER, to unveil the possible challenges in production, neutralization and transportation of neutral beam over the path length of ˜20.67m. This facility consist of a vacuum vessel (of volume >180m3) which has been designed and manufactured as per ASME Sec.VIII Div. 1, to house and provide an ultra-high vacuum (UHV) environment for DNB components i.e Beam Source, beam line components, high voltage bushing and cryopumps.

As per functional requirements, INTF vessel is fabricated from AISI 304L, in cylindrical shape (4.5m D, 9m L), with the unique attribute of 'detachable top lid'to allow access for internal components during installation and maintenance. As per the best of authors'knowledge, it is the biggest UHV vessel with this configuration realized ever, it was therefore essential to establish a systematic approach when moving from the 'non-conventional design'to 'non-conventional manufacturing', while respecting all the UHV protocols. During this manufacturing, top lid is cut from the shell itself which demands controlling the deflection, arising due to stress relaxation caused by welding and shell rolling. Further, distortion monitoring during the welding of large flanges was carried out and following to that machining parameters was controlled to achieve the flatness ˜1.2mm over the area of 9mx5m for achieving leak rate of 10-9 mbarl/sec. In addition, methodology of stage machining was adopted to nullify the distortion caused by large amount of welding for top flange to collar welding and top lid flange to top lid welding.

Following fabrication, vacuum level of 8E-06 was demonstrated with corresponding local and global leak rates as per the UHV requirements (better than 1E-09mbarl/sec and 1E-07mbarl/sec respectively).

This paper presents the experience, methodologies and learning generated in the establishing the manufacturing protocols and practices to achieve the distortion control, deflection requirements and vacuum demonstration for large size UHV vessel with detachable top lid configuration.

Paper Number

FIP/P4-36

Country or International Organization

India

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Session Classification: Poster 4

Track Classification: FIP - Fusion Engineering, Integration and Power Plant Design