

# Baking System of Aditya Upgrade Tokamak

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In tokamaks, baking of vacuum vessel and first wall components is a prerequisite in order to obtain impurity free plasmas. Baking is performed to remove impurities viz. H<sub>2</sub>, H<sub>2</sub>O and Hydro-Carbon from the vessel and first wall components. ADITYA tokamak has been upgraded ADITYA-U tokamak to achieve shaped plasmas. The ADITYA-U is equipped with a comprehensive baking system for heating the SS vacuum vessel, pumping systems, associated diagnostics along with the graphite limiter and diverter tiles up to 150 C. The DC Glow discharge cleaning is also carried out in presence of baking to achieve better wall conditioning for high performance plasma operation. Due to space limitation between vessel and Toroidal field coils at the high-field side, 1.5 mm thick silicon heaters has been designed and procured. In-situ installation of heaters has been quite challenging due to structural complexity. For efficient heat insulation, 6 mm thick silicon jacket designed, fabricated and installed according to vessel profile. A detail analysis carried out in ANSYS for its optimum performance and to examine its effect on vessel, especially on the several weld joints. Whole baking system consists of ~80 heaters installed on different sectors of the vessel, pumps and diagnostics. The heaters are controlled in close loop by in-house developed Programmable Logic Controller (PLC) based automatic control system. It comprises of three main phases, temperature ramp-up, constant heating and ramp-down to room temperature. All these phases are individually controlled as required. The entire baking system has been tested thoroughly for its automatic operations for long hours (~48 hr.), integration, ruggedness, reliability, small form factor. The detailed hardware concept, software design and prototype testing and its regular operation in presence and absence of GDC will be discussed. Partial pressure of impurities is monitored in every baking cycle which decides the controls of the baking temperature and duration automatically. Further, the potency of lithiumization carried out before, during and after baking has been compared for the first time in ADITYA-U by estimating the lithium lifetime on the walls with plasma operation. The improved wall conditioning with baking and its effect on plasma operation along with technical challenges faced during installation will be presented in this paper.

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