

Gas Fuelling Control System of Aditya Tokamak

Wednesday, October 24, 2018 2:00 PM (20 minutes)

In Tokamak, the “gas fuelling control” plays an important role to produce plasma in different operation phases from plasma current initiation till end. Apart from main gas injection for plasma initiation, several plasma parameters such as density, temperature, and events like recycling, disruption / runaway mitigation etc. are controlled by injecting the fuel gas in different amount and from different locations in the vacuum vessel at different times in the plasma discharge. This requires a programmable, sophisticated and precise gas feed control system for controlling different gas feed valves located on the machine. In Aditya tokamak, a customised gas (feed) fuelling control system has been developed, installed and made operational meeting all the requirements of the plasma operation and control. This control system consists of customised programmable pulse generator, signal condition electronics, power supply, isolation etc. Desirable pulses of designated pulse-widths and amplitudes with designated time delays are generated using LabVIEW [National Instruments] based control panel and fed into the gas-feed valves for gas insertion. This control system is a sub-system of the overall Aditya tokamak central operational system and is properly tagged with central data acquisition. The novelty of this system lies in its capability to control eight different gas feed valves simultaneously with equal precision. The system has three separate and individually controlled gas fuelling modes according to the plasma operational requirements (1) continuous gas-feed mode (2) pulsed pre-fill mode and (3) pulsed/continuous gas puffing mode. Different gas feed valves can be set and operated individually in each of the above modes simultaneously. The pulsed modes can be controlled precisely with a response time $< 100 \mu\text{s}$. This is achieved by applying a threshold voltage to gas feed valve with proper electrical isolation. As the gas is absolutely required for every plasma discharge, the control system is designed with redundant protection mechanisms against failure to work in harsh tokamak environment. Design, development, testing and operation of gas fuelling control system of Aditya tokamak along with the experimental results of the gas fuelling control during plasma operation of Aditya tokamak is presented in this paper.

Country or International Organization

India

Paper Number

EX/P4-29

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Session Classification: P4 Posters