An overview of Instrumentation and control for ITER ECH&CD system

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The ITER Electron cyclotron Heating and current Drive (ECH &CD) system operating at 170GHz is designed to inject 20MW CW power. The major components of ECH&CD system are 26 gyrotrons, the corresponding 13 Power Supplies, 24 transmission lines (typical length of 160m) connected 1 Equatorial and 4 Upper launching antennas. This system is being procured 5 domestic agencies via 10 procurement arrangements, which imply diverse types of equipments and complex interface management. This places a challenge on the instrumentation & Control system architecture that has to be adaptable to the various sub-systems as well as distributed and modular. The envisioned architecture is to use local control units (provided by each supplying agency) and a supervisory Plant Controller (provided by ITER). This offers a reliable control configuration for such delicate and complex system as the EC plant. The control plant is envisioned to monitor the whole plant and perform automated tasks that are today performed via direct human intervention. For example, automated gyrotron conditioning and active control of the EC plant to respond to requests from the plasma control system (PCS). This later aspect requires rapid shut down of the gyrotrons and power supplies, deviation of the actuators to direct the power from an equatorial to upper launcher and then restart of the power generation for rapid stabilization of the magneto hydrodynamic (MHD) instabilities that occur in high performance plasma operation. The plant controller will be designed for optimized performance with the Plasma Control System and the feed back control system used to actively control the power and launching direction for MHD stabilization. The MHD control also imposes a requirement for the control of the EC power modulation at frequencies up to 5 kHz and implementation of complicated processing to operate Launchers.

The Instrumentation is designed to achieve control action in less than 10μS with having cross-interface in internal subsections and over the global ITER instrumentation. A distributed data Acquisition system is proposed with sampling speed in order of 100nS for post shot analysis of events. The design proposes automated conditioning of Gyrotron tube in event of ARC or tripping by interlock action. More than 5000 Input-Output signals having response time from few nanoseconds to hundredth of milliseconds are processed to achieve unified Control. This paper will present the overall schematic design of this control system and how its design is optimized for achieving the above functionalities as well as interfacing with the CODAC plant.