REAL TIME CONTROL OF DIII-D PLASMA DISCHARGES USING A LINUX ALPHA COMPUTING CLUSTER*

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This paper describes an upgrade for the real-time computing system responsible for monitoring and controlling various aspects of plasma discharges on the DIII–D tokamak [1] at General Atomics (GA).

The DIII–D Plasma Control System (PCS) continues to play an important role in support of the fusion experimental program by providing a highly reliable and flexible architecture for specifying and controlling plasma shape and position parameters.

Improvements to the PCS are being made in support of current experimental needs such as Resistive Wall Mode Feedback Control and also in anticipation of future experimental plans including Current Profile Control, Pressure Profile Control and Multiple Input Multiple Output Control (MIMO) [2].

Work has commenced on integration of a new computing system which will significantly improve the processing power by as much as a factor twenty over the existing system. The increased performance will provide a framework for improving the accuracy of the real time equilibrium reconstruction calculations [3] now being routinely performed and also provide for improved frequency response for shape control.

The new system currently in the development stages is based on PCI form high speed Alpha 21264 processors running customized real time Linux kernels connected together in a 1.2 gigabit per second Myrinet cluster.

The migration to PCI Myrinet computer clustering represents a major design departure from the present VME interconnect employed by the current PCS. This new interconnect will greatly enhance the PCS data acquisition capabilities by allowing access to additional DIII–D diagnostics including temperature and density measurements from the Thomson laser system in real-time.

This paper discusses details of the design for the upgrade and the work accomplished to date in replacing the existing system which has been in service for the past ten years. Descriptions of the new computing hardware, interconnect configuration, GA custom real time Linux operating system solution and plasma control software are given.

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[3] J.R. Ferron, M.L. Walker, L.L. Lao, H.E. St.John, D.A. Humphreys, J.A. Leuer, "Real Time Equilibrium Reconstruction for Tokamak Discharge Control," Nucl. Fusion **38**, 1055 (1998).

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