RECENT IMPROVEMENTS TO THE DIII–D NEUTRAL BEAM INSTRUMENTATION AND CONTROL SYSTEM*

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The DIII–D neutral beam (NB) instrumentation and control (I&C) system provides for operational control and synchronization of the eight neutral beam injection systems, as well as for pertinent data acquisition and safety interlocking. Portions of the system have been in use for as many as eighteen years. Over this time, equipment has aged, available technology has improved, and experimental requirements have changed. Recently, improvements were made to the I&C system to address these issues. With the replacement of the NB control computers, new signal interfacing was required to accommodate the elimination of physical operator panels, in favor of graphical user interface control pages on computer terminal screens. The program in the mode control (MC) programmable logic controller (PLC), which serves as a logic-processing interface between the NB control computers and system hardware, was modified to improve the availability of NB heating of DIII–D plasmas in the event that one or more individual beam systems suddenly become unavailable while preparing for a tokamak experimental shot sequence. An upgraded computer platform was adopted for the NB control system operator interface, and new graphical user interface pages were developed, to more efficiently display system status data. A failure mode of the armor tile infrared thermometers (pyrometers), which serve to terminate beam pulsing if beam shine-through overheats wall thermal shielding inside the DIII–D tokamak, was characterized, such that impending failures can be detected and repairs effected to mitigate beam system down-time. A scheme for remote testing of the pyrometers was also developed. The hardware that controls gas flow to the beamline neutralizer cells was upgraded to reduce susceptibility to electromagnetic interference (EMI), and interlocking was provided to terminate beam pulsing in the event of insufficient neutralizer gas flow, thereby preventing overheating of some beamline internal components from excessive residual ions. Ion source gas flow monitoring was also incorporated, to aid in troubleshooting while conditioning beams. Finally, the beam pulse modulation system was upgraded to provide modulation while firing beam conditioning pulses into the calorimeters, allowing operators to optimize modulated beams before injecting them into the DIII–D tokamak. Motivation, implementation, and results of these improvements are presented.

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