

Remote Operation of DIII-D Under COVID-19 Restrictions*

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The DIII-D National Fusion Facility is a large international user facility with over 800 active participants. Experiments are routinely conducted throughout the year with the control room being the focus of activity. Although experiments on DIII-D have involved remote participation for decades, and even have been led by remote scientists, the physical control room always remained filled with ~40 scientists and engineers all working in close coordination. The severe limitations on control room occupancy required in response to the COVID-19 pandemic drastically reduced the number of physical occupants in the control room to the point where DIII-D operations would not have been possible without a significantly enhanced remote participation capability. Leveraging experience gained from General Atomics operating EAST remotely from San Diego [1], the DIII-D Team was able to deploy a variety of novel computer software solutions that allowed the information that is typically displayed on large control room displays to be available to remote participants. New audio/video solutions were implemented to mimic the dynamic and ad-hoc scientific conversation that are critical in successfully operating an experimental campaign on DIII-D. Secure methodologies were put into place that allowed control of hardware to be accomplished by remote participants including DIII-D's digital plasma control software (PCS). Enhanced software monitoring of critical infrastructure allowed the DIII-D Team to be rapidly alerted to issues that might affect operations. Existing tools were expanded and their functionality increased to satisfy new requirements imposed by the pandemic. Finally, given the mechanical and electrical complexity involved in the operation of DIII-D, no amount of software could replace the need for "hands on hardware." A dedicated subset of the DIII-D team remained on site and closely coordinated their work with remote team members which was enhanced through extensions to the wireless network and the use of tablet computers for audio/video/screen sharing. Taken all together, the DIII-D Team has been able to conduct very successful experimental campaigns in 2020 and 2021. This presentation will review the novel computer science solutions that allowed remote operations, examine the efficiency gains and losses, and examine lessons learned informing what changes implemented as a result of the pandemic, should remain in-place post-pandemic.

[1] D.P. Schissel, et al., Nucl. Fusion 57 (2017) 056032.

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