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DIII-D National Fusion Program Completes Year-Long Facility Upgrade

Enhancements will enable research into the physics of advanced fusion reactors and potentially accelerate the realization of fusion energy

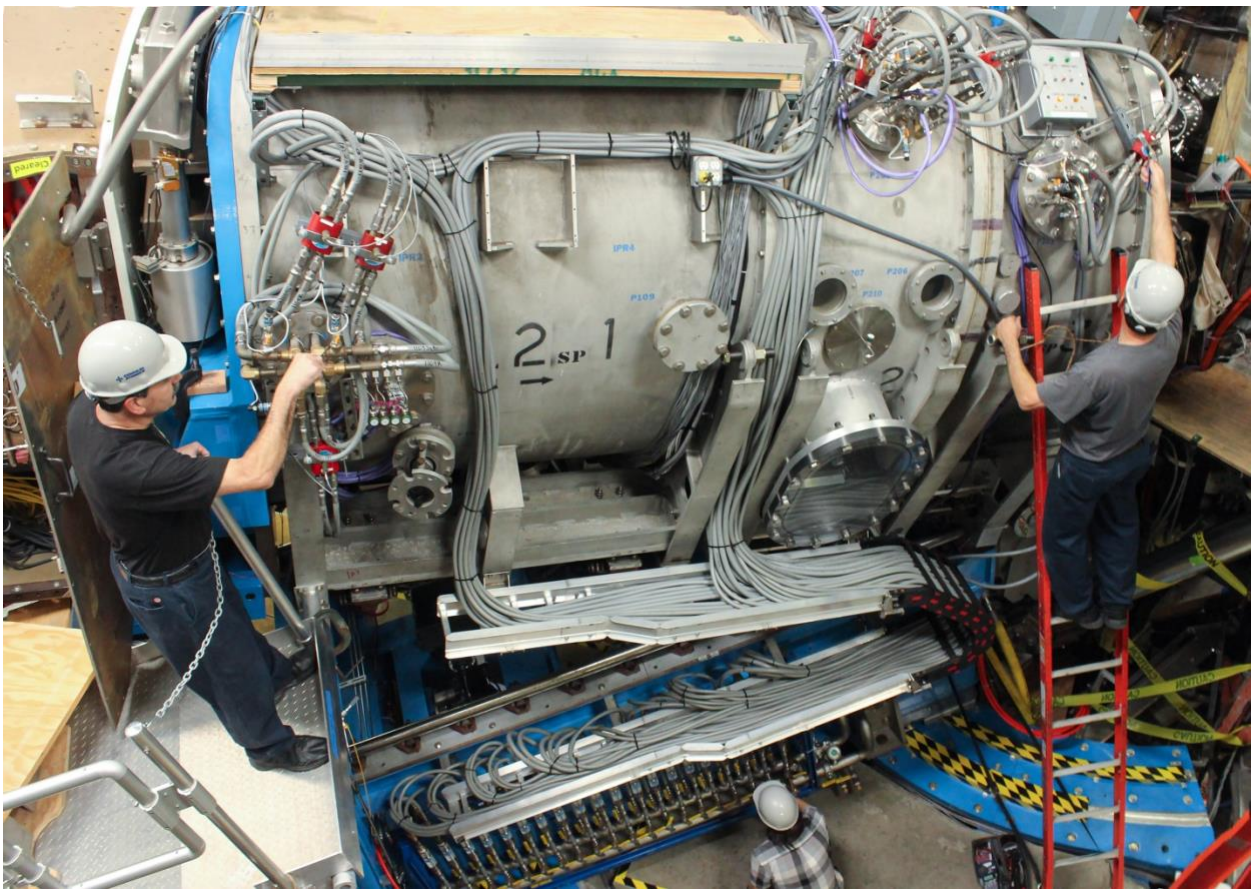

Image courtesy of General Atomics
DIII-D personnel complete final checks on a steerable neutral beam injector, one of several new state-of-the-art tools installed during a recently completed facility upgrade.

The Science

The DIII-D National Fusion Program, a DOE User Facility operated by General Atomics (GA) in San Diego, has completed a series of important enhancements to its fusion facility, providing researchers with several first-of-a-kind tools for controlling and understanding the function of fusion plasmas. These upgrades will strengthen DIII-D's standing as one of the most flexible and capable magnetic fusion research facilities in the world. The new technologies installed during the 11-month upgrade will play a

key role in developing the scientific basis for fusion energy. When experiments restart in early June 2019, researchers will use these tools to optimize the performance of fusion plasmas and help bring practical fusion energy closer to realization.

The Impact

The largest upgrade project was modification of one of the 50 ton neutral beam systems to make is steerable. This will allow researchers to vary the angle at which high-energy atoms are injected into the plasma for heating and control, enabling researchers to produce, study and exploit advanced physics important in making fusion reactors economical in the future. The team also installed an innovative system that researchers expect will significantly reduce the amount of power required to drive electrical current in the plasma. This system is predicted to double the current-drive efficiency by injecting microwaves from the top of the tokamak, rather than from the side. Significant progress was also made toward installing a new, advanced antenna to launch ultra-high frequency “helicon” radio waves, which are more efficient and work over a wider range of plasma densities than earlier radio wave systems. Final installation of the helicon antenna is planned during the next opening of the tokamak this fall. In other work, the team used a new 3-D laser scanning system to precisely align the upper divertor. This upgrade, in combination with newly installed measurement systems, will allow researchers to assess how heat generated during plasma operation is best exhausted from the tokamak.

Summary

DIII-D is a world-class fusion laboratory where researchers explore a wide range of topics from fundamental plasma science to fusion power plant operations. The facility was offline between May 2018 and April 2019 as a team of more than 100 engineers and technicians from GA and collaborating institutions worked to install new capabilities for driving current in the tokamak. Controlling how this current is distributed is a key tool for optimizing performance in fusion plasmas.

Contact

Zabrina Johal

General Atomics

zabrina.johal@ga.com

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Publications

A.G. Kellman, DIII-D status and upgrade plans, IEEE Symposium on Fusion Engineering, June 2-6, 2019.