

Fusion Energy Sciences Perspective

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Office of Science
Fusion Energy Sciences



U.S. DEPARTMENT OF
ENERGY

Office of Science

Fusion Energy Sciences Advisory Committee Meeting
June 23, 2020



FES in the new Office of Science organization

04/12/2020

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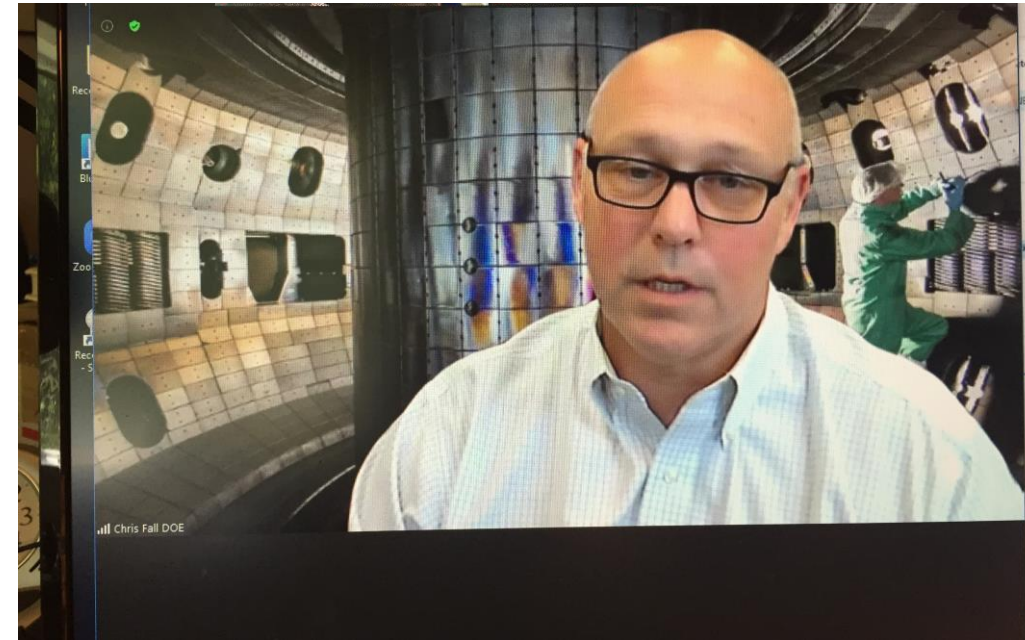
Office of Information Management
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Gina Fisk (A)

Office of IT Services
Vasilios Kountouris

COVID-19 has impacted all of us

- **Many institutions have worked remotely since mid-March**
 - Impressive efforts to continue research
- **DOE has a three-phase “Return to Workplace” plan**
 - Several labs and DOE itself recently went to Phase 1
 - Some other labs are at Phase 2; DOE will go to Phase 2 on June 29
- **Meetings and conferences are being held virtually (or postponed)**
 - IAEA Fusion Energy Conference: Oct 2020 → May 2021
 - APS-DPP Annual Meeting: November 13-17, 2020 (virtual)
 - ITPA meeting: postponed
 - FESAC: virtual (March and June meetings)



*Dr. Chris Fall (SC-1): Office of Science
All-Hands Meeting (virtual) June 4, 2020*

- **FY 2020 Budget:**
 - After a Continuing Resolution for the first quarter, FES received its enacted budget, which was healthy.
 - Eight FES Funding Opportunity Announcements and four Lab Calls were issued. (Some submission deadlines were extended due to the COVID-19 situation, so award selections are taking longer than usual.)
 - The joint FOA with ARPA-E was issued.
 - The FOA and Lab Call for the SC Early Career Research Program were also issued.
 - In addition, another call was issued for LaserNetUS experiments, as well as another round of Requests for Assistance for the INFUSE public-private partnership program.
- **FY 2021 Budget Request:**
 - We are awaiting Congressional marks on the FY 2021 budget request.
 - The FES budget request includes initiatives on quantum information science, artificial intelligence and machine learning, microelectronics, and fusion acceleration.
 - Meanwhile, as FY 2020 supplementary appropriations, Congress has issued several large supplemental bills (e.g., the CARES Act) in response to the COVID-19 pandemic.
- **FY 2022 Budget Request:**
 - FES is currently engaged in the initial stages of budget formulation.
 - FES had held 13 of 14 individual budget planning meetings with major research institutions and also community research coordination organizations.



FOA Title	Companion Lab Call	Status
Collaborative NSTX-U Diagnostics	N	Reviews completed
Collaborative Research on International and Domestic Spherical Tokamaks	N	In progress
High-Energy-Density Laboratory Plasma Science	N	Reviews completed
Scientific Machine Learning and Artificial Intelligence for Fusion Energy Sciences	Y	In progress
Measurement Innovations for Magnetic Fusion Systems	Y	Reviews completed
Opportunities in Frontier Plasma Science	Y	Reviews completed
Quantum Information Science Research for Fusion Energy Sciences	Y	Proposals received
Theoretical Research in Magnetic Fusion Energy Science	N	In progress
Early Career Research Program	Y	Reviews completed
Galvanizing Advances in Market-Aligned Fusion for an Overabundance of Watts (ARPA-E / FES; led by ARPA-E)	N/A	Full applications received; review is being planned

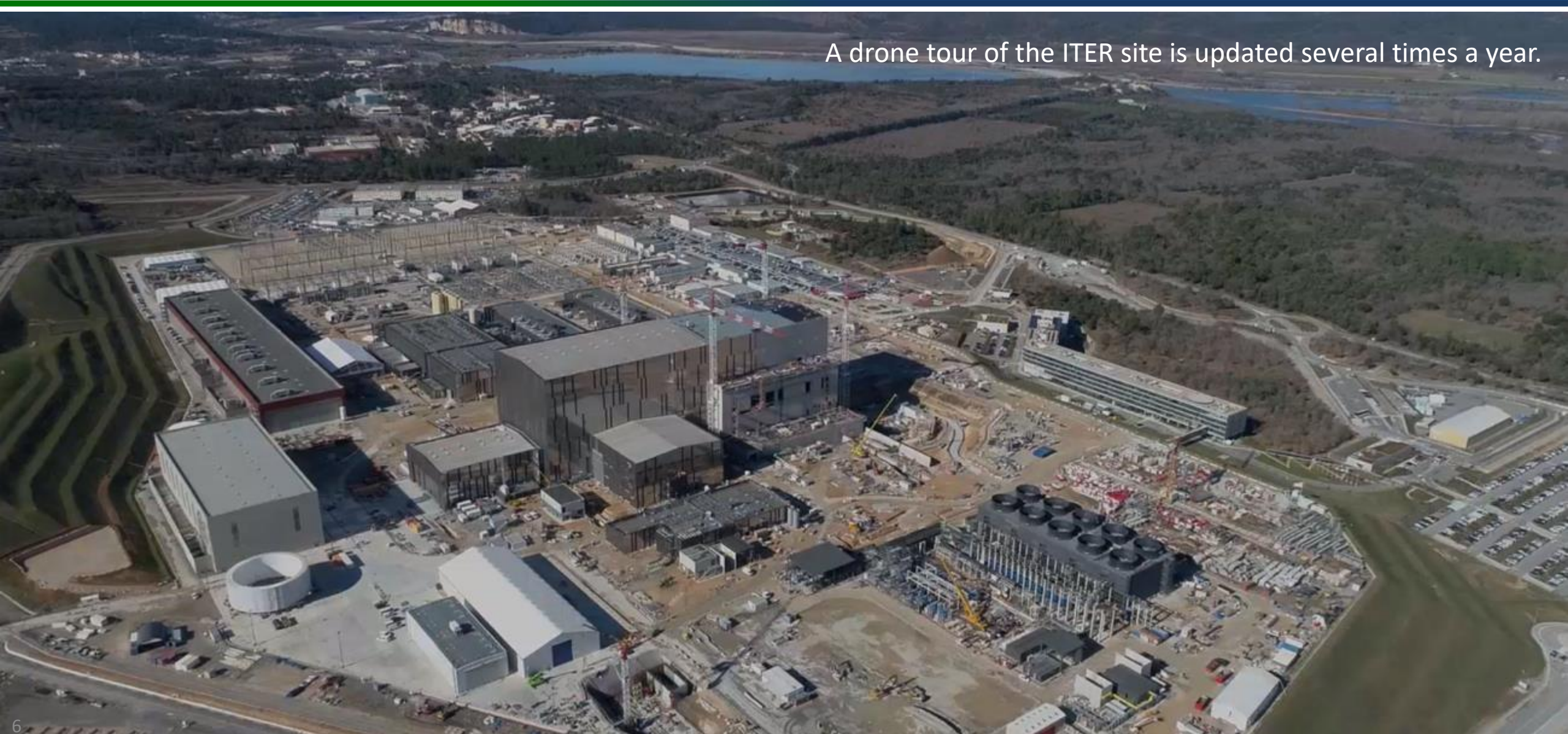


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Progress on the ITER site

A drone tour of the ITER site is updated several times a year.





Fabrication complete on 1st central solenoid module



Module 1 is turned over near the end of fabrication (General Atomics--Magnet Technologies Center)

- When ITER begins operations in 2025, its plasma will be initiated by the largest stacked pulsed superconducting magnet ever built—the ITER central solenoid. The central solenoid, to be installed in the center of the ITER machine, will drive up to 45,000 amps of current in each module during plasma operation. Six modules will be stacked to form the 17-meter-tall solenoid, while the seventh module will serve as a spare.
- Fabrication of each module requires multiple steps over 24 months.
- General Atomics completed fabrication of the first of seven modules in 2020.

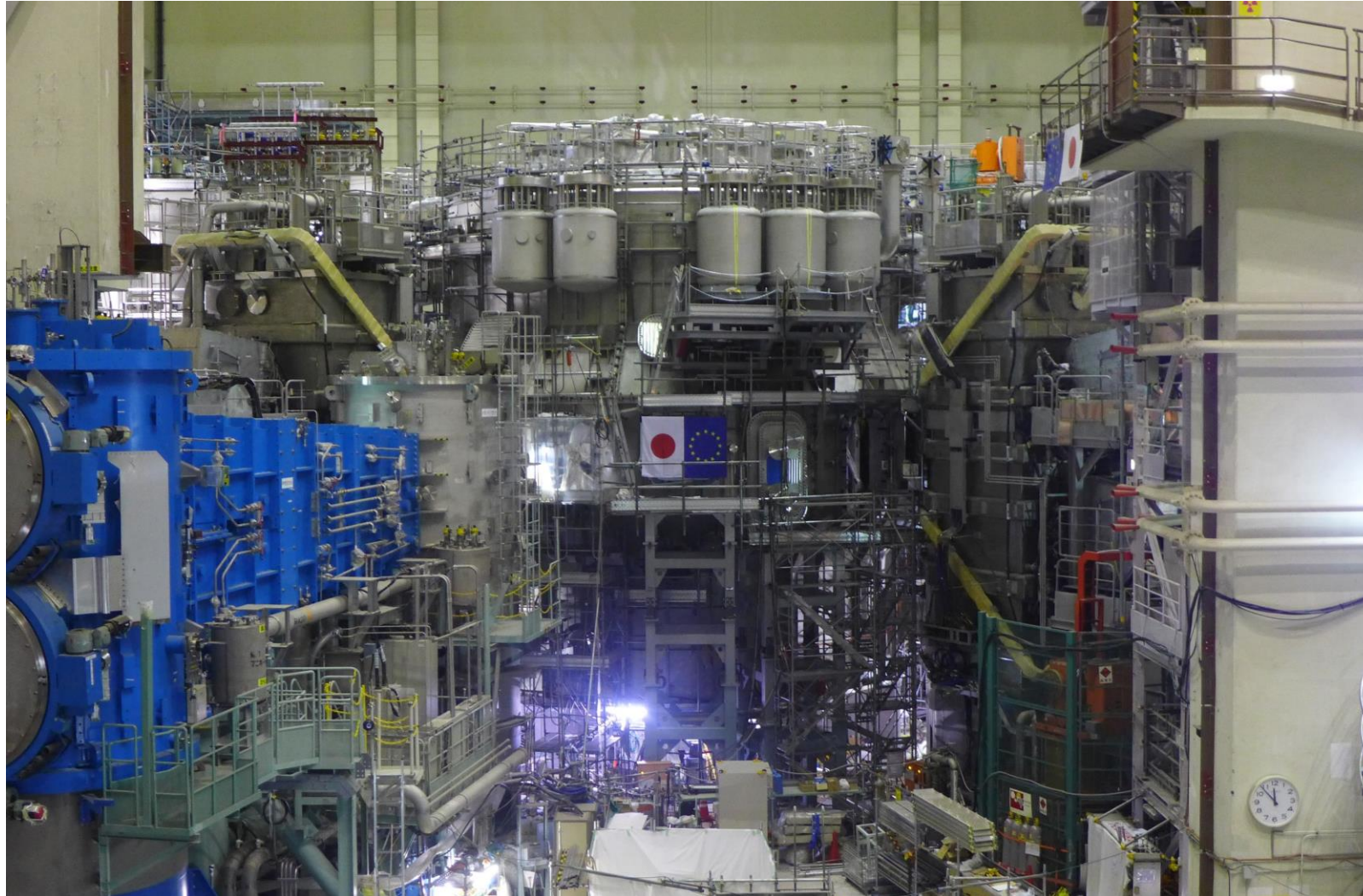


Recent ITER Council meeting (June 17-18, 2020 -- virtual)



ITER Director-General Bernard Bigot listening to the biennial Management Assessment report during the ITER Council meeting

- The ITER Council commended the ITER Organization and the Domestic Agencies for rapid deployment of a COVID-19 continuity plan. The plan permitted critical activities to move forward, while ensuring the health and safety of staff and collaborators. To date, there have been no instances of infection on the ITER worksite.
- The ITER Organization and the Domestic Agencies have maintained productivity in design activities and progress on many schedule-critical activities. However, the extended manufacturing shutdowns for key components, and the slowdown in some assembly activities might have potential consequences for the project schedule. The Council will review a follow-up report at its next meeting in November.
- The Council also noted the number of project achievements since its last meeting, including delivery of multiple first-of-a-kind components. Project execution towards First Plasma is nearly at 70%.

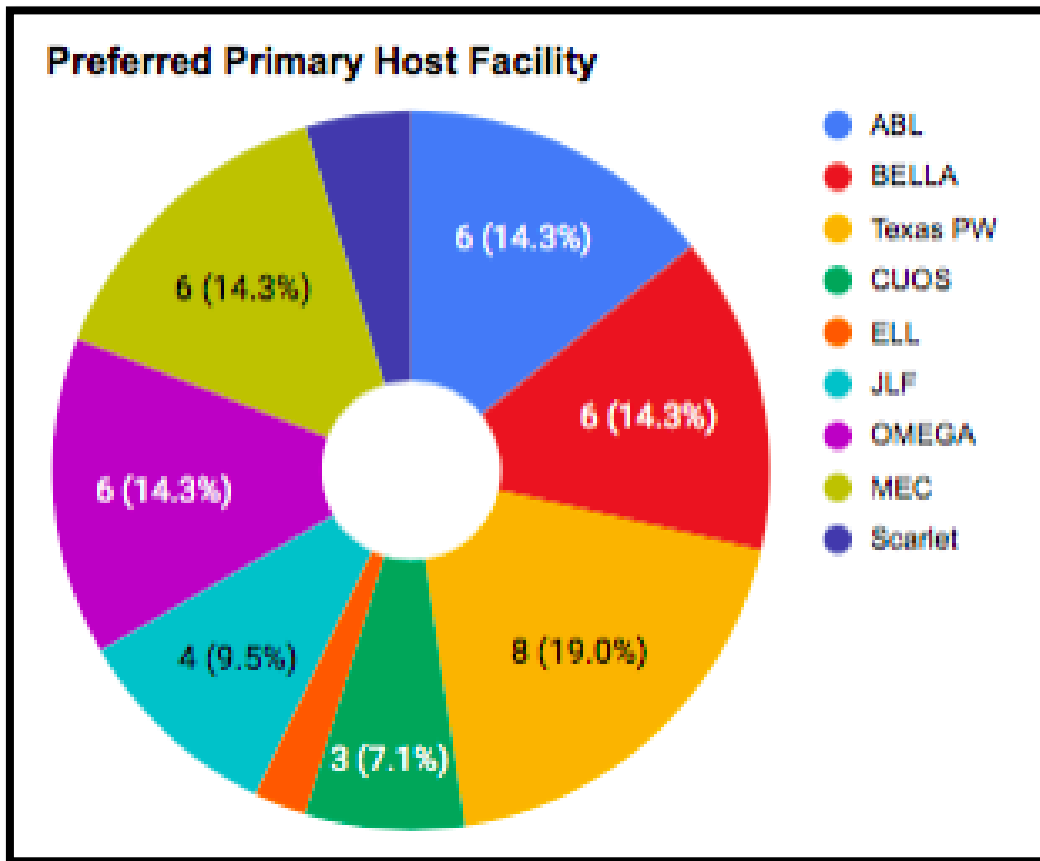


- National Institutes for Quantum and Radiological Science and Technology (QST) completed assembly of JT-60SA device in March 2020
- This was achieved under the JA-EU Broader Approach program
- Integrated commissioning will now start checking in sequence the operation of each system, including evacuating the JT-60SA plasma chamber and cooling the superconducting coils, leading up to the first plasma operation expected in the autumn of 2020

2020 marks the 40th anniversary of US-Japan cooperation in fusion and plasma physics research

LaserNetUS Cycle 1 (July-Dec 2019)

39 experiments were performed



Center: Prof. Donna Strickland (2018 Nobel), SAB member

- **Scientific Advisory Board meeting (March 3, 2020)**
 - LaserNetUS facility access and capability development plans, including key priorities and milestones, consistent with the DOE-approved work scope
 - Major new research thrusts to be proposed to federal sponsors
 - Adjustments to facility priorities



Innovation Network for Fusion Energy (INFUSE) - \$4M in FY20

- In FY 2020, INFUSE expanded eligibility to foreign companies whose participation is beneficial to the U.S., raised the funding level and duration of awards, and relaxed limits on number of proposals per topical area
- The proposals submitted to the first FY 2020 RFA call have been reviewed and award selection is in progress
- A second RFA may be issued later this FY
- More information in: <https://infuse.ornl.gov/>

Request for Information (RFI) Issued for Cost-Share Program

- FES issued an RFI in April on “**Cost-Sharing Partnerships With the Private Sector in Fusion Energy**”
- The objective of this RFI was to gather input about the topical areas, program objectives, eligibility requirements, program organization and structure, public and private roles and responsibilities, funding modalities, and assessment criteria of such an initiative.
- Thirty submissions were received by the May 15 deadline
- The input will be publicly available in <https://www.regulations.gov/>



First 2020 Request for Assistance Call was issued in February

The screenshot shows the regulations.gov website interface. The main heading is "Cost-Sharing Partnerships With the Private Sector in Fusion Energy". Below the heading, it states: "This Notice document was issued by the Department of Energy (DOE). For related information, [Open Docket Folder](#)".

Action
Request for information (RFI).

Summary
The United States Department of Energy is developing a plan for a possible cost share program in fusion reactor technologies. This RFI invites interested parties to provide DOE-SC input on the topical areas, program objectives, eligibility requirements, program organization and structure, public and private roles and responsibilities, funding modalities, and assessment criteria of such an initiative.

Dates
Written comments and information are requested on or before May 15, 2020.

Addresses
The DOE Office of Science is using the <http://www.regulations.gov> system for the submission and posting of public comments in this proceeding. All comments in response to this RFI are therefore to be submitted electronically through <http://www.regulations.gov>, via the web form accessed by following the "Submit a Formal Comment" link near the top right of the Federal Register web page for this RFI.

For Further Information Contact
Requests for additional information may be submitted to Dr. John Mandrekas, (301) 903-4923, CostShareFusion@science.doe.gov.

Supplementary Information
Recognizing the recent surge in interest and investments by the private sector in the development of fusion energy, the DOE-SC FES program has been exploring partnership initiatives to leverage the private sector efforts, with the objective of accelerating progress toward the realization of fusion energy and solidifying U.S. leadership in this critical energy technology of the future. As a first step, FES launched the Innovation Network for Fusion Energy (INFUSE) (1) program which provides private-sector fusion companies with access to the expertise and facilities of DOE's national laboratories to overcome critical scientific and technological hurdles in pursuing development of fusion energy systems. INFUSE is modeled after the successful Gateway for Accelerated Innovation in Nuclear (GAIN) voucher program (2) established by the DOE Nuclear Energy (DOE-NE) Office. As in the GAIN voucher program, INFUSE does not provide funding directly to the private companies, but instead provides support to the partnering DOE laboratories to enable them to collaborate with their industrial partners.

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Related Documents:



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Plasma Science: Enabling Technology, Sustainability, Security, and Exploration

Committee on a Decadal Assessment of Plasma Science

Board on Physics and Astronomy

Division on Engineering and Physical Sciences

A Consensus Study Report of

The National Academies of

SCIENCES • ENGINEERING • MEDICINE

THE NATIONAL ACADEMIES PRESS

Washington, DC

www.nap.edu

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- **Chairs:** Prof. Mark Kushner (Michigan) and Prof. Gary Zank (Alabama-Huntsville)
- **Task:** Conduct a study of the past progress and future promise of plasma science and technology and provide recommendations to balance the objectives of the field
- **Multiple federal sponsors:**
 - DOE: Fusion Energy Sciences, High Energy Physics, National Nuclear Security Administration, Advanced Research Projects Agency-Energy
 - National Science Foundation
 - DOD: Air Force Office of Scientific Research, Office of Naval Research
- **Public release of report:** May 28, 2020
- **Thank you!**

Thanks to FESAC long-range planning subcommittee

Subcommittee Members	Institution
Baalrud, Scott [2]	University of Iowa
Betti, Riccardo	University of Rochester
Carter, Troy (CHAIR) [1]	UCLA
Cary, John	U. Colorado/Tech-X
Ellis, Tyler	Commonwealth Fus Syst
Foster, John	University of Michigan
Geddes, Cameron	LBL
Gleason, Arianna [2]	SLAC
Holland, Chris [2]	UCSD
Humrickhouse, Paul [2]	INL
Kessel, Chuck [1]	ORNL

Subcommittee Members	Institution
Lasa, Ane [2]	University of Tennessee
Ma, Tammy [1]	LLNL
Maingi, Rajesh [1]	PPPL
Schaffner, David [2]	Bryn Mawr College
Schmitz, Oliver	University of Wisconsin
Shumlak, Uri [2]	University of Washington
Snead, Lance	SUNY Stony Brook
Solomon, Wayne [2]	General Atomics
Trask, Erik [1]	TAE Technologies
Waelbroeck, Francois	University of Texas - Austin
White, Anne [1]	MIT
Rej, Don (EX OFFICIO) [1]	LANL

[1] FESAC member

[2] CPP Program Committee



Follow-Up NASEM Study on Fusion Pilot Plant

- FES is supporting the National Academies to carry out a fast-track study on the construction of a pilot plant in the U.S. that produces electricity from fusion at the lowest possible capital cost.
- In the study, to be completed within eight months of project initiation, the committee of experts assembled by NASEM shall provide a concise report that addresses the following points:
 - In developing and carrying out a plan for building a Pilot Plant, key goals need to be established for all critical aspects of the Pilot Plant. Identify those key goals, independent of confinement concept, which a Pilot Plant must demonstrate during each of its anticipated phases of operation.
 - List the principal innovations needed for the private sector to address, perhaps in concert with efforts by DOE, to meet the key goals identified in the first bullet.
- The NASEM study is (1) follow-up to 2019 NAS Burning Plasma Research report and (2) complementary to the ongoing FESAC Long-Range plan for FES
- More details can be found at: <https://www.nationalacademies.org/our-work/key-goals-and-innovations-needed-for-a-us-compact-fusion-pilot-plant>



The National Academies of Sciences, Engineering, and Medicine shall assemble a committee to provide guidance to DOE and others that are aligned with the objective of constructing a pilot plant in the U.S. that produces electricity from fusion at the lowest possible capital cost (“Pilot Plant”). In the study, to be completed within eight months of project initiation, the committee shall provide a concise report that addresses the following points:

- In developing and carrying out a plan for building a Pilot Plant, key goals need to be established for all critical aspects of the Pilot Plant. Identify those key goals, independent of confinement concept, which a Pilot Plant must demonstrate during each of its anticipated phases of operation.
- List the principal innovations needed for the private sector to address, perhaps in concert with efforts by DOE, to meet the key goals identified in the first bullet.

Further Committee Guidance

In addressing the first bullet in the statement of task, the committee should consider the key goals for each of the plant’s anticipated phases of operation. Areas for key goals that the committee might consider include scientific (e.g., materials and systems performance and integration), technical (e.g., electrical output and availability), economic (e.g., capital costs and time frame, operating and maintenance costs), environmental (e.g., level of radioactive wastes), and safety-related (e.g., regulatory, tritium inventory).

In carrying out the statement of task, the committee is encouraged to seek input from potential “future owners” of power plants, such as electric utility companies, and potential manufacturers of fusion power plant components, to broadly characterize the energy market for fusion and to provide input on what they would look for in a fusion pilot plant and how such plants can contribute to national energy needs.



New ORNL Fusion Energy Division Director

- Dr. Mickey Wade became the director of the Fusion Energy Division at the U.S. Department of Energy's Oak Ridge National Laboratory, in April 2020
- Most recently, he served as deputy director of the Magnetic Fusion Energy Division for General Atomics

FES staff

- FES is currently recruiting for three program manager positions:
 - stellarators/international collaborations
 - public-private partnerships
 - project management
- Opportunities for Intergovernmental Personnel Act (IPA) or detailee assignments may also be available.

FES made three university awards and three laboratory awards in FY 2020



Dr. Elijah Martin
ORNL

Investigation of Helicon and Lower Hybrid Wave Coupling with the Edge Plasma for Current Drive Optimization in the Tokamak Using Laser Spectroscopy



Dr. Federica Coppari
LLNL

Expanding Capabilities to Unlock the Mysteries of Complex Warm Dense Matter



Prof. Paul Humrickhouse
INL

Toward a Technology-Inclusive Whole Device Model



Prof. Benedikt Geiger
Univ. Wisconsin

Experimental study of turbulent impurity transport in 3D magnetic fields



Prof. Kevin Field
Univ. Michigan

Precipitate Stability and Helium Trapping in Advanced Steels



Prof. Ranganathan Gopalakrishnan
Univ. Memphis

Thermodynamics and Transport Models of Strongly Coupled Dusty Plasmas