Public-Private Partnerships

Innovation Network for Fusion Energy: Past Performance, Future Plans and Lessons Learned

Dennis Youchison and Ahmed Diallo
infuse@ornl.gov

FESAC Meeting
August 31, 2021
10 Participating laboratories:

Topical areas:
1) Enabling Technologies including magnets
2) Materials Science
3) Plasma Diagnostics
4) Theory and Simulation
5) Magnetic Fusion Experimental Capabilities

AWARDS
- 40 projects funded to date with a total value of $9.93 M ($7.77 M DOE)
- The 40 awards went to 17 U.S. companies in 9 states involving 8 national labs
- Detailed list: https://infuse.ornl.gov/wp-content/uploads/2021/01/Cumulative_AwardList.pdf

热烈的参与实验室:

主题领域:
1) 支持技术包括磁体
2) 材料科学
3) 等离子体诊断
4) 理论与模拟
5) 磁性融合实验能力

奖项:
- 40 个项目已资助，总价值为 9.93 M 美元（7.77 M 美元 DOE）
- 40 个奖项授予 17 家美国公司，分布在 9 个州，涉及 8 个国家实验室
Program Overview

• INFUSE program is a Public-Private Partnership (P3) Program started by FES with a Pilot Program in FY 2019
  • This is first of a kind P3 program within the Office of Science

• Initiated due to the recent surge in private sector investment in fusion energy - Leverages the many unique and important capabilities are located at DOE National Laboratories

• Focused on providing a quick, streamlined approach for companies to access DOE Laboratory Capabilities. “Time is of the essence”

• The INFUSE Program is modeled after other successful DOE P3 programs, most notably the Gateway for Accelerated Innovation in Nuclear (GAIN) Nuclear Energy Voucher program established by the DOE Office of Nuclear Energy (NE), which has been very successful in providing the nuclear fission industrial community with access to the resources available across the DOE complex.

• The Request for Assistance (RFA) Calls are managed by a consortium of FES funded laboratories, led by ORNL and PPPL.
INFUSE is implemented by the “Point-of-Contacts” POC panel whose members come from each of the participating laboratories. They provide program oversight and facilitate the P3 program at their laboratory.

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Point of Contact</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brookhaven National Laboratory (BNL)</td>
<td>Ramesh Gupta</td>
<td><a href="mailto:gupta@bnl.gov">gupta@bnl.gov</a></td>
</tr>
<tr>
<td>Idaho National Laboratory (INL)</td>
<td>Paul Humrickhouse</td>
<td><a href="mailto:paul.humrickhouse@inl.gov">paul.humrickhouse@inl.gov</a></td>
</tr>
<tr>
<td>Lawrence Berkeley National Laboratory (LBNL)</td>
<td>Steve Gourlay</td>
<td><a href="mailto:sagourlay@lbl.gov">sagourlay@lbl.gov</a></td>
</tr>
<tr>
<td>Lawrence Livermore National Laboratory (LLNL)</td>
<td>Andris Dimits</td>
<td><a href="mailto:dimits1@llnl.gov">dimits1@llnl.gov</a></td>
</tr>
<tr>
<td>Los Alamos National Laboratory (LANL)</td>
<td>John Kline</td>
<td><a href="mailto:jkline@lanl.gov">jkline@lanl.gov</a></td>
</tr>
<tr>
<td>Oak Ridge National Laboratory (ORNL)</td>
<td>Dennis Youchison*</td>
<td><a href="mailto:youchisondl@ornl.gov">youchisondl@ornl.gov</a></td>
</tr>
<tr>
<td>Pacific Northwest National Laboratory (PNNL)</td>
<td>Wahyu Setyawan</td>
<td><a href="mailto:wahyu.setyawan@pnnl.gov">wahyu.setyawan@pnnl.gov</a></td>
</tr>
<tr>
<td>Princeton Plasma Physics Laboratory (PPPL)</td>
<td>Ahmed Diallo**</td>
<td><a href="mailto:adiallo@pppl.gov">adiallo@pppl.gov</a></td>
</tr>
<tr>
<td>Sandia National Laboratories (SNL)</td>
<td>Rob Kolasinski</td>
<td><a href="mailto:rkolasi@sandia.gov">rkolasi@sandia.gov</a></td>
</tr>
<tr>
<td>Savannah River National Laboratory (SRNL)</td>
<td>Jim Klein</td>
<td><a href="mailto:james.klein@srnl.doe.gov">james.klein@srnl.doe.gov</a></td>
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Interfaces:
- SC FES
- Lab SPP office
- DOE site office
- Company PIs and CEOs
- Lab capabilities and PIs
**Request for Assistance (RFA) Details**

**Scope**
- Work is performed in support of the requesting company using expertise at a DOE national lab to conduct research necessary to attain the company’s fusion goals, not further commercialization.
- Focused on unique capabilities at DOE laboratories, not items readily available elsewhere.
- A single institution may submit up to five RFA’s to a single RFA call.

**Budget and Schedule**
- Majority of requests are for single year awards with a value of between $50k - $250k.
- In special cases, applicants may request up to $500k in total value with a duration of up to two years. A 20 percent cost share is required, which can be cash, equipment, or in-kind contributions.

**Company Certification**
- Requestors must certify that they will accept one of the two standardized Cooperative Research and Development Agreements (CRADAs).
- Requestors must certify that they will provide the required 20 percent cost share upon selection for a partnership award.
Request for Assistance (RFA) Details

Eligible Requester
• U.S. based private entity with U.S. ownership
• U.S. based private entity with foreign ownership so long as that entity’s participation is in the economic interest of the U.S.

RFA Execution Requirements
• Most* work under an INFUSE award must be performed in the U.S.
• Products embodying intellectual property developed under the assistance must be substantially manufactured in the U.S.
• The transfer of technology and data resulting from INFUSE awards are subject to U.S. export control laws.

Merit Review
• The Review Process is organized by the INFUSE POC panel, with input provided to FES for final selection
• RFA applications are evaluated and competitively selected in accordance with the Office of Science Review Criteria
• 3 reviewers are asked to comment on the value of the RFA and impact to fusion overall


<table>
<thead>
<tr>
<th>Requests</th>
<th>Awards</th>
<th>Rate</th>
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<tbody>
<tr>
<td>All RFA's</td>
<td>78</td>
<td>40</td>
</tr>
<tr>
<td>FY19</td>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td>FY20-A</td>
<td>25</td>
<td>10</td>
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<tr>
<td>FY20-B</td>
<td>16</td>
<td>10</td>
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<tr>
<td>FY21-A</td>
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<td>9</td>
</tr>
<tr>
<td>FY21-B</td>
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- FY19 RFA Call included restriction of one request per topical area
### Funding Statistics

<table>
<thead>
<tr>
<th>Lab funds</th>
<th>Total Requested</th>
<th>Total Awarded</th>
<th>Average Size</th>
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<tr>
<td>All RFA’s</td>
<td>$14,601 k</td>
<td>$7,773 k</td>
<td>$177 k</td>
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<td>$2,870 k</td>
<td>$1,543 k</td>
<td>$137 k</td>
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<tr>
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<td>$1,949 k</td>
<td>$179 k</td>
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<td>FY20-B</td>
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<td>$2,150 k</td>
<td>$214 k</td>
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<tr>
<td>FY21-A</td>
<td>$3,824 k</td>
<td>$2,131 k</td>
<td>$237 k</td>
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<tr>
<td>FY21-B</td>
<td>$2,522 k</td>
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- **DOE share only** – does not include cost share
- **FY20 RFA Calls increased the funding level to $500k total**
### Company Diversity

<table>
<thead>
<tr>
<th></th>
<th>Total Requests</th>
<th>Unique Requesters</th>
<th>Unique Awardees</th>
</tr>
</thead>
<tbody>
<tr>
<td>All RFA’s</td>
<td>78</td>
<td>19</td>
<td>12</td>
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<tr>
<td>FY19</td>
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<td>11</td>
<td>8</td>
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- One company selected in FY19 was dropped due to insolvency
- Of the 7 other companies who were unawarded, 5 only submitted once

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![Award Distribution Chart](chart.png)
FES and the INFUSE Team are continuing to evaluate the INFUSE Program moving forward to ensure success

- 2019 pilot projects ended or are near completion - Awardees will submit final reports, including highlight, publications, and other metrics of success
- Two INFUSE Workshops have been held to help bring the labs and private industry together as well as to provide feedback on room for improvement
  - FY21 Workshop was cohosted by FES, the Electric Power Research Institute (EPRI), and the Fusion Industry Association (FIA)
  - Included over 195 Participates from private companies, DOE laboratories, universities, international organizations and utilities
  - FY22 Workshop will again be virtual in December
- FES is considering additional modifications to INFUSE to address company recommendations
  - Include university participation in FY22
  - Access other laboratories?
- FES is actively exploring other P3 programs for engaging private industry directly (larger FOAs, milestones)
CFS: Alpha Particle Diagnostics Simulation

“This INFUSE program informed the maximum allowable Toroidal Field ripple for SPARC, which in turn affects decisions regarding the number, size and fabrication tolerances of the TF coils. These decisions directly impact the total system cost. The program also compared and improved the ASCOT and SPIRAL codes for fusion alpha particle distribution, directly benefiting the fusion community as a whole. The work led to a publication in the Journal of Plasma Physics.”

—Shiyun Ruan

CFS: Divertor Component Testing

“Travis and Dennis, I’d like to personally thank you for helping us get to the 30% milestone on time. We held the review all last week and it was a success. SPARC is now ready to construct. The INFUSE PFC testing is an important part of the SPARC program. Special thanks in addition to Dennis for his work on the INFUSE program. Onwards to 60%!“

—Dan Brunner

TAE: Simulations of Global Stability in the C-2W Device

In collaboration with TAE researchers, Elena Belova (PPPL) performed global stability simulations of FRC plasmas and found a new fast-ion driven compressible mode which, as it saturates at small amplitude, may explain some of the stable low-order fluctuations which have been observed in the C-2W experiment.

—Sean Dettrick
Lessons Learned

- Structure of the US Government
- Eligibility issues and cost share
- Participating labs and sr. bandwidth
- COI mitigations and the INFUSE POCs
- Managing the FWP cycle
- CRADA processing (NDAs, IP and ECI)
- CRADA amendments
- Press releases, cyber security
- INFUSE supplemental requests
- University involvements
- INFUSE workshops – Dec. 2021 (virtual)
• What can we improve about INFUSE?
• What is the proper balance between public and private research or investment in fusion energy?
• How is the broader fusion community outside the labs engaged?
• General Q&A