MEITNER
Modeling-Enhanced Innovations
Trailblazing Nuclear Energy Reinvigoration

Overview of the MEITNER Program & FOA

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Program Director, ARPA-E
Overview of Webinar

- About ARPA-E
- Program Motivation
- Program Overview
- Technologies of Interest
- Application Process & Anticipated Timeline

**NOTE**: The contents of the MEITNER Funding Opportunity Announcement (FOA) are controlling. This slide presentation is a high-level summary only. The MEITNER FOA is available on ARPA-E’s application portal, [https://arpa-e-foa.energy.gov/](https://arpa-e-foa.energy.gov/)
Mission: To overcome long-term and high-risk technological barriers in the development of energy technologies

Means:
- Identify and promote revolutionary advances in fundamental and applied sciences
- Translate scientific discoveries and cutting-edge inventions into technological innovations
- Accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty
What Makes an ARPA-E Project?

- **impact**
  - High impact on ARPA-E mission areas
  - Credible path to market
  - Large commercial application

- **transform**
  - Challenges what is possible
  - Potential to disrupt existing learning curves
  - Leaps beyond today’s technologies

- **bridge**
  - Translates science into breakthrough technology
  - Not researched or funded elsewhere
  - Catalyzes new interest and investment

- **team**
  - Comprised of best-in-class people
  - Cross-disciplinary skill sets
  - Translation oriented
MEITNER Program Concept

- ARPA-E is looking for *transformational technologies* that will enable advanced nuclear reactors to be commercially desirable products.

- The new technologies will be evaluated in the context of a full advanced reactor plant design.

- Modeling & Simulation, Subject Matter Experts, and Techno-Economic Analysis will feed back into the designs for integrated evaluation and strategic improvement.

- Key experiments may also be done to strategically improve and/or demonstrate the technology.

- **Result:** well-characterized reactors and technologies that can create a domestic supply chain.
Motivation

‣ Supposition:
  – Advanced Nuclear Reactors can be commercially desirable products

‣ Implication:
  – If we can build and operate them so they are “walkaway” safe, quickly deployable, safeguardable, cost competitive, and relevant in a variety of markets

‣ The Question:
  What technologies can be developed to enable advanced reactors to meet these goals?
Motivation

- New build construction costs and times are large and unpredictable
- O&M is the bulk of operating cost

Avg. plant operating expenses (2015 $/MWh)

<table>
<thead>
<tr>
<th>Plant Type</th>
<th>Operation</th>
<th>Maintenance</th>
<th>Fuel</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>11.17</td>
<td>7.06</td>
<td>7.48</td>
<td>25.71</td>
</tr>
<tr>
<td>Fossil Steam</td>
<td>5.16</td>
<td>5.41</td>
<td>26.70</td>
<td>37.26</td>
</tr>
<tr>
<td>Gas Turbine</td>
<td>2.34</td>
<td>2.68</td>
<td>28.22</td>
<td>33.24</td>
</tr>
</tbody>
</table>
Motivation

- A substantial reduction of construction cost, O&M cost, and construction time is required

- Nuclear reactor plants are complex systems where many types and scales of technologies must work together seamlessly

- Design choices at each of those scales and for each of those technologies impact the rest of the system in terms of functionality, cost, and constructability

- ARPA-E is targeting development of enabling technologies that requires understanding the inter-relatedness of design choices
MEITNER Program

**Goal:** Develop and demonstrate technologies that improve advanced reactor performance

<table>
<thead>
<tr>
<th>ID</th>
<th>Metric</th>
<th>Units</th>
<th>State-of-the-Art</th>
<th>With New Technology*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overnight construction cost</td>
<td>$/We</td>
<td>2-7</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>On-site construction time</td>
<td>Months</td>
<td>&gt; 60</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Total staffing level (on-site &amp; off-site)</td>
<td>FTE/GWe</td>
<td>450-750</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Emergency planning zone (EPZ)</td>
<td>Miles</td>
<td>10 and 50</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Time before human response required for an accident</td>
<td>Days</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Onsite backup power</td>
<td>kW$_e$</td>
<td>&gt; 0 kW</td>
<td></td>
</tr>
<tr>
<td>7a</td>
<td>Ramp rate without steam bypass</td>
<td>power capacity/min</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>7b</td>
<td>Process heat temperature</td>
<td>°C</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

*Applicants are required to provide the projected performance based on the inclusion of their new technology into advanced reactors.*
MEITNER Resource Team

Awardees will leverage a separately-funded Resource Team

1. Modeling & Simulation

2. Subject Matter Experts

3. Techno-Economic Analysis

Result: detailed design and impact characterization, better experiment design, strategic technology improvement
Technologies of Interest

- Sensors, data analytics, advanced controls, machine learning, model-based fault detection, and secure networks
- Robotics
- Advanced construction and manufacturing techniques
- Dramatic simplifications to balance of plant
- Reactor-specific technologies that must be demonstrated, e.g. high-temperature materials, corrosion control, chemistry
- Systems that dramatically improve plant performance, e.g. power conversion, system efficiency
- Technologies to enable grid integration
Technologies of Interest

Controls & diagnostics

Diagnostics & maintenance

Construction: welding, inspection, additive manufacturing, system simplification, modularization

HX / Power Conversion

Materials & chemistry

Process Heat

Grid Integration
Application Process & CP Deadline


- Concept papers for MEITNER due **Monday, December 4, 2017** by 5:00pm EST

- Questions? Please email the ARPA-E Contracting Officer at [ARPA-E-CO@hq.doe.gov](mailto:ARPA-E-CO@hq.doe.gov)
  - Deadline for questions on the MEITNER FOA Concept Papers are due November 24th at 5:00pm EST