U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

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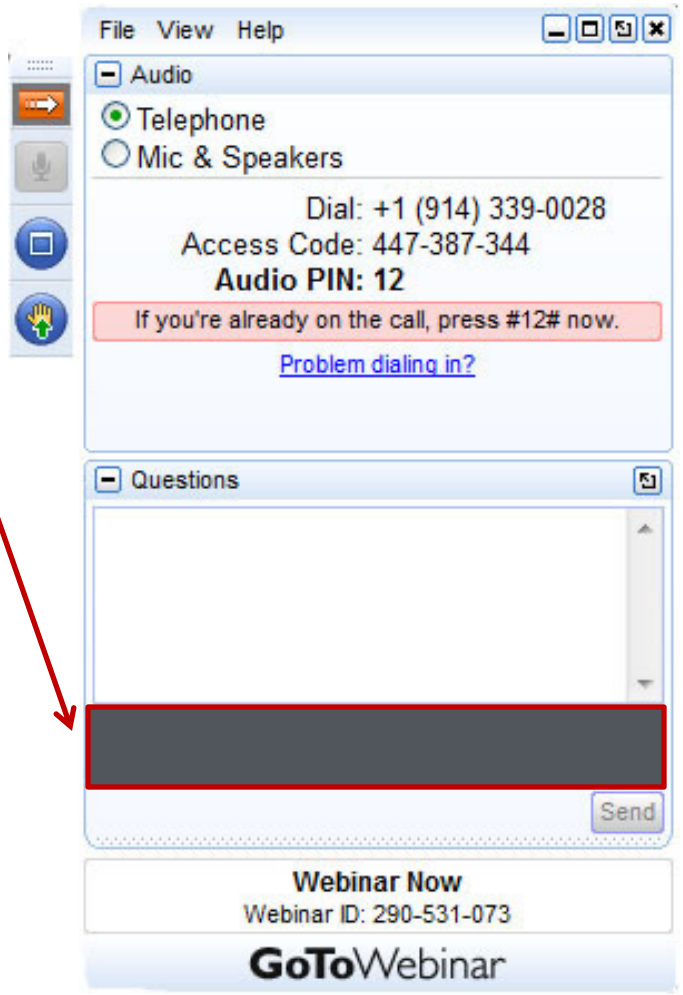
Advanced Materials and Manufacturing Technologies

Dirk Cairns-Gallimore
Office of Nuclear Energy

How to Ask Questions During This Webinar

- Submit questions using the GoToWebinar software by typing in the Webinar ID field.
- Questions that do not get answered during the allotted time will be answered and posted on www.NEUP.gov.
- Specific questions on individual eligibility or workscope detail should be addressed offline.



Background

- In the FY21 appropriations, Congress provided funding for a "new program to strengthen the pipeline of new materials that can make the current fleet, as well as new advanced reactors, more resilient and economically competitive."
- The U.S. Department of Energy's Office of Reactor Fleet and Advanced Reactor Deployment is working to establish the new program, Advanced Materials and Manufacturing Technologies (AMMT).
- The plan is to achieve this through integration and coordination of existing programs and continued collaboration with the best expertise in government and our partners.
- The challenge is to align these material's design, modeling and simulation, manufacturing, and demonstration R&D efforts towards focused goal driven processes and products whose end uses are adapted to market conditions.

Datapoints that help define the program

- The AMMT program is merged from three other existing programs
  - Advanced Methods for Manufacturing (AMM)
  - Nuclear Materials Discovery and Qualification Initiative (NMDQi)
  - Transformational Challenge Reactor (TCR)
- This program is intended to addresses the whole lifecycle for materials, including:
  - Design
  - Material
  - Manufacturing and creation
  - Validation, verification, and testing
  - Performance requirements
  - Certification, acceptance, and qualification
  - Supply chain and sustainment

Vision

- **Programmatic Goals**
  - Strengthen the pipeline of new materials that can make advanced reactors and the current fleet more resilient and economically competitive
  - Establish a wholistic understanding of materials and supply chain needs and priorities, to deploy and maintain reactors and determine priorities of various materials programs
  - Increase collaboration among all stakeholders, driving an iterative process of development, implementation, and acceptance of advanced technologies
- **Defining Success**
  - Deployment of domestic economically viable technology as well as the scientific and engineering expertise to support its use.
  - Ensure solution options that support the current fleet and new advanced reactor technologies.

Initiated Activities

- Data Collection
  - Requested information on materials, manufacturing, and infrastructure from industry
  - Initial Literature reviews
  - Functioned to:
    - Ensure that DOE had an up to date understanding of current industry efforts
    - Make sure that future proposed work maximizes support across the stakeholders with limited or no duplication of activities.
    - Provide data to help prioritize research and investments
- Upcoming qualification workshop hosted by EPRI/NEI/GAIN
  - On August 24-25, 2021
  - The purpose of the workshop is to begin to develop an integrated approach to the AMMT qualification processes for materials and components and identify current challenges.
  - More information at: https://gain.inl.gov/SitePages/AMMQualificationWorkshop2021.aspx

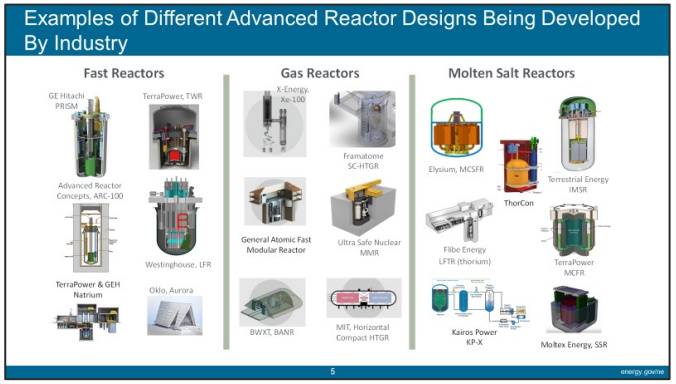
CT-3.1: Multi-Material Systems

Federal POC – Dirk Cairns-Gallimore

Technical POC – Isabella Van Rooyen
Eligible to Lead: Universities Only
Up to 2 years and $500,000

Background:

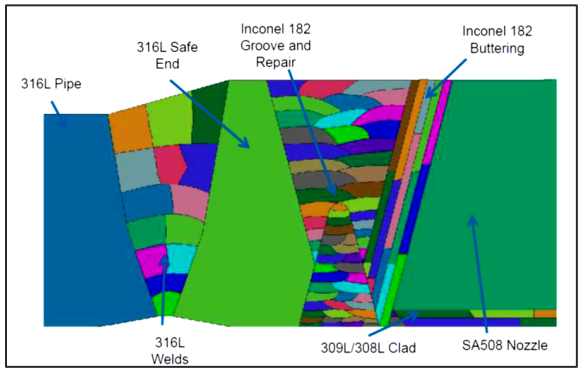
- Economic demand of new advanced reactor technologies under diverse and extreme environments
  - Expanded application envelope of material and product systems from current qualified material portfolio and manufacturing processes.
- Need flexibility in material systems for multiple reactor systems
  - no single material can satisfy comprehensively
  - results in long development processes, or multiple material systems to be developed



[Courtesy: Dr Sam Sham]

Possible Solutions:

- To enhance economics and robustness of designs:
  - Multiple cladding and coating technologies for specific reactor systems
  - Minimizing mechanical transitions or weldments of dissimilar materials
  - Minimize the complexity and number of manufacturing and assembly operations
  - Functional graded materials considered for multiple surface functions as environmental and thermal barriers



[Courtesy: Dr Xiaoyuan Lou (Auburn University)
Award Number: DE-NE0008996]

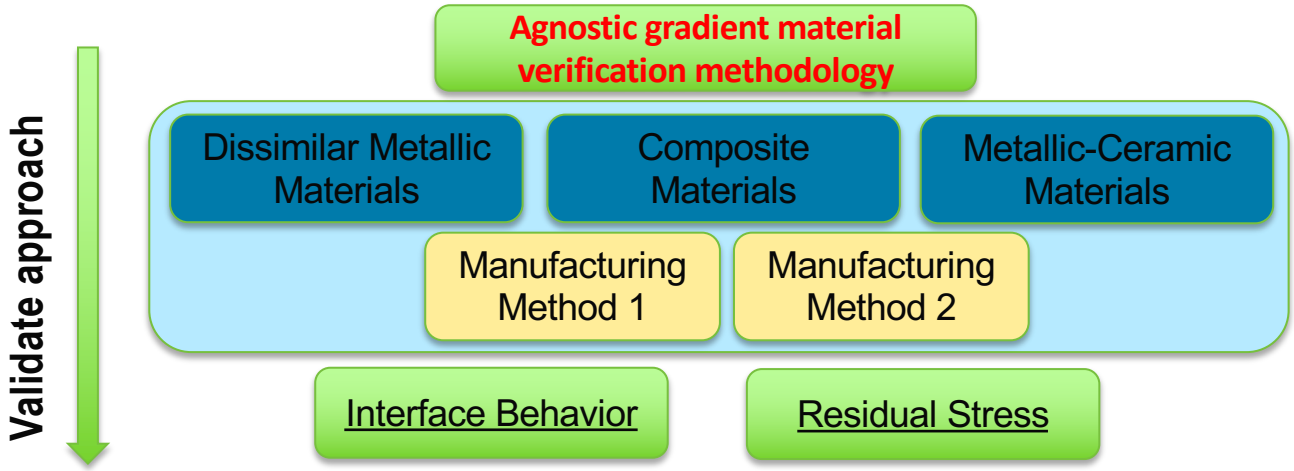
CT-3.1: Multi-Material Systems

Proposal Request:

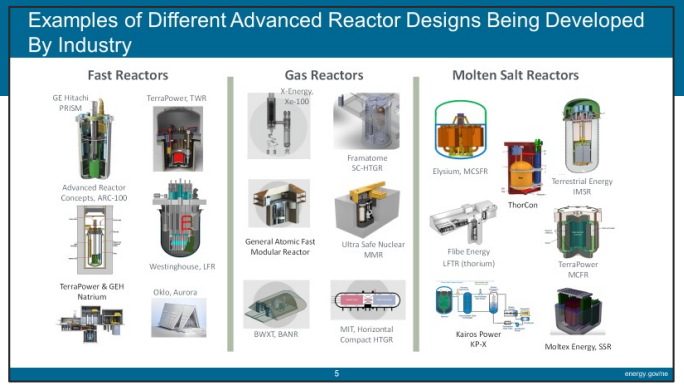
- Seeking an **integrated approach** for an **agnostic gradient material verification methodology** in terms of interface and residual stress requirements.

Required:

- Include a substantive gap-analysis on earlier research and current standards, modeling and simulation activities, the use of digital twins, accelerated testing and characterization for proof of concepts.
- Detailed justification for the material and manufacturing process choices that will be used for the proof-of-concept research.
- Industry Partnership: This research is aiming to aid the deployment of advanced reactor technology in the foreseeing future.



CT-3.2: Advanced Creep Mechanisms



[Courtesy: Dr Sam Sham]

Federal POC – Dirk Cairns-Gallimore

Technical POC – Robert Roach

Eligible to Lead: Universities Only

Up to 2 years and $500,000

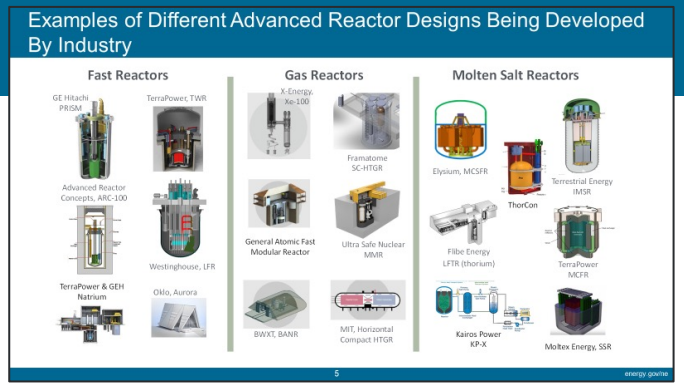
Background:

- Deployment of advanced reactor concepts requires materials that can withstand extreme environments.
  - Innovations in radiation, high temperatures, and non-aqueous corrosion.
  - Innovative materials design, manufacture, and testing is required to accelerate the development and qualification of materials.
- A new approach to the nuclear material design cycle is desired.
  - Focuses on transformational materials design, advanced additive manufacturing, and accelerated materials testing
  - Develops novel approaches to assess time-dependent phenomena relevant to reactor licensing and operation on a reduced timeline such that it accelerates test results

Proposal Request:

- Modeling, simulation, and/or machine learning methodology for clarifying creep mechanisms to overcome the traditional surface-to-bulk constraints limiting sample specimen sizes and to interpret experimental data
- Methods developed by proposals, e.g., characterization techniques, should be ones that can be deployed in irradiation environments such as hot cells

CT-3.3: High Throughput Testing for Advanced Manufactured Materials



[Courtesy: Dr Sam Sham]

Federal POC – Dirk Cairns-Gallimore

Technical POC – Ben Betzler
Eligible to Lead: Universities Only
Up to 2 years and $500,000

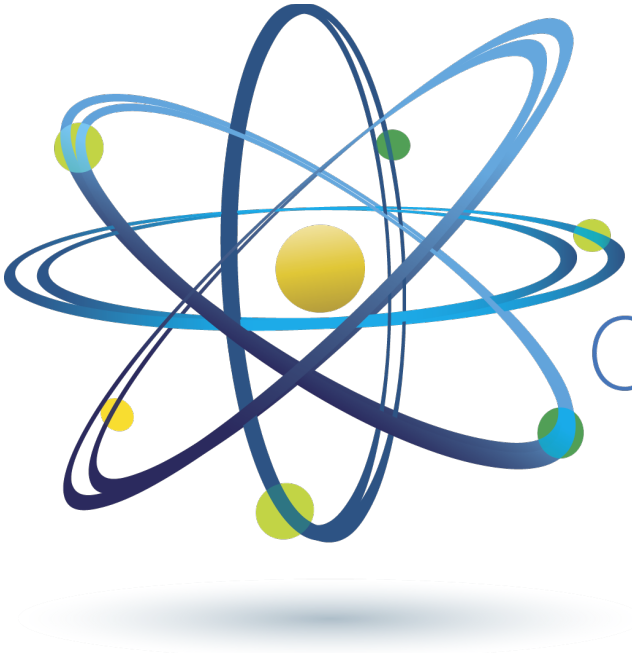
Background:

- Additive manufacturing techniques can yield large amounts of location-specific in situ data that are stored in a digital thread for a given part or component.
- A corresponding manufacturing digital platform uses artificial intelligence techniques to establish links between characteristics within these digital threads and post-manufacturing testing datasets.
- Generating testing data for a variety of material properties is critical for developing and demonstrating a digital platform informed approach to component certification.

Proposal Request:

- This call focuses on the development and application of novel high throughput thermophysical or mechanical property testing techniques that can yield spatial data with at least 1 mm resolution for additive manufactured builds.
- Proposals should include detailed description of the proposed measurement technique(s) and the methods to store and track spatially resolved data.
- The choice of material and additive manufacturing process should be appropriately justified.

Questions?



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