NUC Breakouts

August 16, 2017
Hybrid Energy Systems (LWRs, SMRs, vSMRs)

National Need & INL Focus Areas

Advanced nuclear-renewable hybrid energy systems (N-R HES) composed of nuclear and renewable energy sources, industrial energy users, and energy storage systems are being evaluated for their economic benefit.

Low TRL system components and/or subsystems that can be demonstrated at reduced scale to show technical feasibility, economic potential of integration, etc. are also of interest.

Note: Modeling and simulation tools must be able to link with Modelica component models and RAVEN optimization tools under development by the DOE national laboratory team.

Potential University Collaboration Area

- Component models to support integrated system concept evaluation within the HES M&S framework
- Evaluation of the economic potential of new process designs with heat storage over baseload electricity
- Characterization of dynamic energy system behavior to determine impact of thermal cycling on component and system robustness, resiliency, response rates, etc.
- Development of cyber security approaches for reliable, secure operation of complex integrated energy systems that can be adopted during the system design and evaluation stages
- Scaled studies of energy storage concepts, e.g. a scaled down demonstration of thermal energy storage concepts that could later be integrated in the INL Dynamic Energy Transport And Integration Laboratory (DETAIL) for integrated systems testing
- Development/evaluation of efficient temperature amplification technologies, such as chemical heat pumps, that can allow conventional LWRs and near term SMRs to support a wider range of industrial applications; could include upgrading of “waste heat” or primary heat from the systems (Note: Should give consideration to operational, regulatory, and safety constraints associated with an operating nuclear plant.)
Energy storage development is of utmost importance such that it could respond to changing energy demands, store excess energy produced during off-peak hours and address variability inherent to coupled energy systems.

Within the N-R HES effort, INL is evaluating the benefit of coupling nuclear and renewable energy technologies to produce electricity and to support industrial energy users. Benefits may include levelized electricity costs, increased generator flexibility, and reduced greenhouse gas emissions across all energy sectors. These systems may rely on the successful development and demonstration of energy storage technologies to fully achieve the required objectives.

- Experimental Analysis and Modeling for Thermal Energy Storage
  a. Material availability and compatibility
  b. Scale (Distortions)
  c. Verification and Validation
  d. Uncertainty Quantification
  e. Instrumentation challenges, if any
HES and Thermal Energy Storage

Potential Funding Sources

- HES:
  - DOE-NE NEUP
  - DOE-EERE Call for Proposals
  - DOE-FE?
  - DOE-SC BES?
  - NSF?

- vSMRs:
  - DOE-NE
  - ARPA-E

- Industry?

Potential Outcomes

- Focused Workshops?
- Proposals in response to the NE CINR, other proposal calls

https://arpa-e-foa.energy.gov/Default.aspx#Foaldbc9f0638-121e-4f5b-ad37-f53767d3b8bb