

SECTION A. Project Title: Direct Cooled Reactor with Supercritical Brayton Power Conversion – University of Wisconsin**SECTION B. Project Description**

The University of Wisconsin proposes to design a direct cooled reactor that is integrated with a supercritical power conversion system. This will be accomplished by:

1. Separately construct models of the turbomachinery, recuperative heat exchangers, reactor, and heat rejection system that are sufficient to accurately capture the trade-off between performance, mass, and operating conditions. These models will be “fluid-neutral” but based in part on the extensive experience of the project team with sCO₂ power cycles.
2. Integrate the models developed in Step 1 in order to allow a careful optimization of the space power system for total mass. Carry out parametric studies that include varying heat rejection temperatures, cycle configurations, fluids, and component designs.
3. Experimentally study the compatibility of the materials required by the system with sCO₂.
4. Experimentally investigate the stability and friction behavior of hydrodynamic journal and thrust bearings by installing a brassboard turbomachine in a CO₂ loop and mapping the performance over a range of operating conditions.
5. Theoretically study the operation of the hydrodynamic journal and thrust bearing performance at the conditions required in the cycle and validate semi-empirical but physics-based models against the data collected in Step 4.
6. Train several students in various aspects associated with the supercritical power cycle, including tribology, materials, nuclear reactor cooling and neutronics, systems analysis and optimization, and the design of space power systems.
7. Develop useful modeling tools that can be used to guide further development of the technology.
8. Develop a baseline, optimal system design that can be used for further development efforts.

SECTION C. Environmental Aspects / Potential Sources of Impact

The university has procedures in place to handle any waste that will be generated through this project. The action would not create additional environmental impacts above those already permitted at the university.

SECTION D. Determine the Level of Environmental Review (or Documentation) and Reference(s): Identify the applicable categorical exclusion from 10 CFR 1021, Appendix B; give the appropriate justification, and the approval date.

Note: For Categorical Exclusions (CXs) the proposed action must not: 1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, including requirements of DOE orders; 2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; 3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; 4) adversely affect environmentally sensitive resources. In addition, no extraordinary circumstances related to the proposal exist which would affect the significance of the action, and the action is not “connected” nor “related” (40 CFR 1508.25(a)(1) and (2), respectively) to other actions with potentially or cumulatively significant impacts.

References: B3.6 Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). Not included in this category are demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial development.

Justification: The activity consists of university-scale research aimed at designing a direct cooled reactor that is integrated with a supercritical power conversion system.

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) Yes No

Approved by Jason Sturm, DOE-ID NEPA Compliance Officer on 06/29/2017