DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-21-057

SECTION A. Project Title: Thermal Hydraulics Investigation of Horizontally Oriented Layout Micro HTGRs Under Normal Operation and PCC Conditions Using Integrated Advanced Measurement Techniques – Missouri University of Science and Technology

SECTION B. Project Description

The Missouri University of Science and Technology proposes to experimentally investigate the thermal-hydraulic phenomena in a horizontal micro-high temperature gas reactor (HTGR) under normal operation and pressurized conduction cooldown (PCC) conditions (natural convection at low-velocity flow regime) at pressure up to 5 MPa and temperature up to 1,500°C using a new method of integrated advanced measurement techniques on a block, to obtain benchmark data to validate predictions from computational fluid dynamics (CFD) codes. Quantification of metrics will pertain to convective heat transfer coefficients along the channel and gaps, comparative rates of convective and radiative heat transfer, location of peak temperature and its temporal variation, timescales for onset of natural convection, local gas velocities profiles across the diameter of the channels and thickness of the gaps, gas dispersion inside channels and gaps, crossflows through gaps between blocks, and temperature profiles over channel diameter and gap thickness. Project milestones include: (1) Modify, test, and utilize the horizontal dual-channel P2PF, (2) Obtain new knowledge by comparing the differences in the fluid flow and thermal behavior between horizontally and vertically oriented dual-channel natural circulation, (3) Design, develop, test, and utilize a horizontally oriented scaled down micro-HTGR based on the standard Fort St. Vrain/MHTGR-350 prismatic core at 5 MPa and 1,500°C, (4) Design, develop, test, and utilize a block integrated with advanced measurement tools, (5) Amass new knowledge from key findings listed in Step 2 above including flow velocity field and dispersion, heat transfer rate, temperature profile, peak temperature as a function of time, and the location and heat transfer rate under normal operation and PCC conditions, (6) Assess and quantify the contribution of radiative and convective heat rates under PCC conditions, (7) Develop new benchmarking data and CFD validation with heat transfer calculations, and (8) Perform uncertainty quantification.

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 occurring 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). For purposes of this category, "demonstration actions" means actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial deployment. Demonstration actions frequently follow research and development and pilot projects that are directed at establishing proof of concept.

Justification: The activity consists of an investigation to assess the heat transfer in a horizontal micro HTGR design for both normal operation and PCC conditions.

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

Approved by Jason Anderson, DOE-ID NEPA Compliance Officer, on 08/31/2021.