

# DOE-ID NEPA CX DETERMINATION

**SECTION A. Project Title: 3-D Chemo-Mechanical Degradation State Monitoring, Diagnostics and Prognostics of Corrosion Processes in Nuclear Power Plant Secondary Piping Structures – Vanderbilt University**

**SECTION B. Project Description**

The Vanderbilt University proposes to develop a generalizable 3-D sensor network for the chemo-mechanical degradation state monitoring, diagnostics, and prognostics of corrosive processes in representative secondary pipe structures applicable to Nuclear Power (NPP) structures. This will be accomplished by:

- (1) Printing multi-physics transducers for both power harvesting and sensing/actuation on secondary pipe structure, simulated with a subscale cooling circuit testbed, to monitor it within and across a 3-D sensor network;
- (2) Exploiting the dynamic nature of pipe flow to increase the sensitivity of our 3-D damage monitoring techniques by utilizing vibro-acoustic methods to sense the all-important oxide layer that protects the inner wall of the passive piping structural component in addition to material loss;
- (3) Recognizing that chemical changes at an interface often precede measurable mechanical changes during the process of corrosion, so we will develop a smart surface layer to train our algorithms to illuminate the chemo-mechanical state of the inner wall of the structural component; and
- (4) Optimizing the 3-D sensor network configuration and our data analytic algorithms for diagnosis and prognosis of corrosive processes using a Bayesian method as a network design tool in the presence of uncertainty.

**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 developing a 3-D sensor network for chemo-mechanical degradation state monitoring, diagnostics, and prognostics.

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 07/10/2017