

SECTION A. Project Title: Experimental Verification of Post-Accident Integrated Pressurized Water Reactor (iPWR) Aerosol Behavior, Phase 3 – Electric Power Research Institute**SECTION B. Project Description**

The Electric Power Research Institute (EPRI) proposes to further improve the aerosol models used to estimate post-accident radionuclide concentration levels for integrated pressurized water reactors (iPWRs). By improving aerosol estimation models, iPWR designers will have a better understanding of containment vessel radionuclide particle retention capabilities for post-accident conditions. In order to improve the estimation models, EPRI proposes the following experiments:

- Experiments using particles of the same size (instead of a particle size distribution) need to be carried out for several sets of thermal-hydraulic parameters (pressure, temperature of the fluid, temperature of the RV and the CV, A/V ratio, steam concentration). These will provide results relevant to several phenomena: particle deposition by impaction, particle resuspension, particle agglomeration, and most importantly, how varying and fluctuating thermal-hydraulic parameters affect these phenomena.
- Experiments with tracer particles need to be carried out to analyze flow patterns. They will help to evaluate direction of convective flow, turbulence and even particle resuspension. In addition, it may be possible to estimate flow velocities from these tracer particles.
- Experiments with a temperature gradient across the walls as well as an uninsulated top wall need to be carried out to analyze how the wall temperature affects particle deposition and decontamination.
- Experiments with pressurization and depressurization of the CV need to be carried out. Particle injection during pressurization will help in understanding how the pressurization phase affects particle distribution. Also, these experiments will help in studying the effects of pressure on thermal-hydraulic parameters, and consequently, fluid flow patterns and particle deposition.

The EPRI / DOE Phase 2 project included the development of a significant and novel set of hardware for experimentation. The test loop design models a range of iPWR surface-area-to-volume ratios at near-/post-accident temperatures and pressures and includes features such as containment cooling to simulate immersion under water. The system also uses a novel laser system to map the movement of aerosol particles inside the volume and can run in dry or steam environments.

The current test loop was developed to address previous research questions; however, because the test vessel was designed with additional ports and nozzles, Phase 3 is not expected to require significant modifications to the equipment.

For development of the test loop for this proposal, the key parameters for each experiment will be identified. The following aspects require careful consideration:

- Tracer particles to analyze fluid flow and turbulence.
- Several sets of particles of the same size to study particle size effects experimentally.
- Particles of large sizes (>10 μm) to study their deposition behavior.
- Multiple locations for laser imaging to aid the study of particle distribution throughout the vessel as well as flow patterns in multiple regions of the CV. This may also help in the study of particle agglomeration.
- Multiple coupon locations to study effects of particle deposition by impaction at different locations.
- Multiple pressure and temperature sensor locations to estimate the distribution of pressure and temperature throughout the CV, as well as capture their time-dependence.
- Variation of CV wall coolant flow rate to create a temperature distribution/gradient on the CV wall to study its effects.

This proposal assumes no changes to the vessel itself but does assume that some additional equipment will be needed to support the new experiments.

SECTION C. Environmental Aspects / Potential Sources of Impact

EPRI 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 facility.

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.

DOE-ID NEPA CX DETERMINATION

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 research and development activities aimed at improving containment vessel radionuclide particle retention capabilities.

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 10/22/2018