Regulatory Support for Advanced Light Water Reactor Deployment:

Advanced Boiling Water Reactor Source Term Reduction

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ABSTRACT:

The objective of this project is to explore the development of a set of recommendations to improve the characterization of post-accident radionuclide particle source-terms for advanced Boiling Water Reactors (BWR), which include the Advanced Boiling Water Reactor (ABWR), the Economic Simplified Boiling Water Reactor (ESBWR), and the recently-advertised BWR/X. The potential recommendations will include the various activities required to develop the technical basis that may support possible regulatory amendments to source terms.

The potential for improved source-term characterization is based on recent findings from the investigation of the decontamination potential of Integrated Pressurized Water Reactors (iPWR) conducted by the Electric Power Research Institute. This study empirically demonstrated that iPWR containment vessels are capable of significantly higher post-accident radionuclide particle deposition rates. This is due to the increased effectiveness of certain natural deposition phenomena, which have been shown to have higher particle deposition velocities based on key iPWR thermal-hydraulic parameters, and a relatively high surface-area-to-volume ratio, based on a smaller containment vessel free volume. Outcomes of the iPWR source term reduction effort demonstrated the development of decontamination factors that are four times greater than previously referenced values. Advanced boiling water reactors have a relatively small free volume similar to the iPWR volume size; hence, there may be an opportunity for the nuclear industry to develop higher decontamination factors for advanced boiling water reactors by undertaking a source-term characterization program specifically designed for boiling water reactors. This proposal includes a feasibility assessment of this potential opportunity and a description of the pathway of activities that may be required. The pathway will include activities similar to those conducted for the iPWR program, which included a first phase similar to this proposal. Subsequent phases included design, analysis and experimentation, which culminated in the estimation of higher decontamination factors.

The benefits of improved source-term characterization include the potential for more alternative siting options and reduced capital and operating costs. These benefits may be achieved by informing the regulatory process based on the acquired knowledge.

The project team includes the same participants who performed the recently completed EPRI/DOE Phase 2 iPWR Containment Aerosol Deposition Behavior project: EPRI, Pittsburgh Technical and Carnegie Mellon University. In addition, General Electric has been identified as an advanced boiling water reactor vendor that can provide critical guidance to ensure applicability of the final product.