

Topical Report: Guidelines for Implementing Seismic Base Isolation in Advanced Nuclear Reactors to Reduce Risk and Overnight Capital Cost

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Pathway: Regulatory Assistance Grants (Pathway-III)

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Abstract

Seismic isolation drastically reduces site-dependent seismic demands and can therefore provide significant economic and safety benefits to nuclear power plants. Studies have been conducted in the past decade (e.g., by University at Buffalo and Idaho National Laboratory) identifying the benefits, as well as the technical and regulatory challenges, in implementing seismic isolation in safety-critical nuclear facilities. Some guidance is documented in the recently-published standard ASCE/SEI Standard 4-16, “Seismic Analysis of Safety-Related Nuclear Structures,” and the US Nuclear Regulatory Commission (USNRC) publication, NUREG/CR-7253, “Technical Considerations for Seismic Isolation of Nuclear Facilities”. These documents provide initial guidance for implementing seismic isolation in nuclear power plants.

There is no clear regulatory pathway to licensing a seismically isolated nuclear reactor. The primary objective of this project is to provide a pathway acceptable to and vetted by the USNRC that an applicant could follow to develop, document and qualify a seismic isolation system for an advanced reactor, proposed or future. The pathway will be presented in a Topical Report to be submitted to the USNRC for review. The Topical Report will be technology neutral with respect to both the reactor developer and the isolator type. Engagement with the NRC staff over the course of the project will ensure that the deliverable submitted for review will be of sufficient depth and breadth to satisfy NRC requirements for topical reports.

This cradle-to-grave project will integrate, through ten tasks, existing knowledge, proven isolator hardware, verified and validated isolator models, analysis, design and testing methods in consensus ASCE standards, and open-source DOE tools for seismic probabilistic risk assessment of isolated nuclear facilities. The process/methodology will be demonstrated using the Kairos Power reactor KP-1 as a testbed but be applicable to all reactor types. The project will develop plans for commercial grade dedication and dynamic testing of seismic isolators as well as draft sample specifications for procurement of isolators.

The project will provide significant, positive economic impact, reducing both overnight capital cost and regulatory risk. The economic competitiveness of US advanced reactor designs will be improved by providing a pathway to licensing a seismically isolated reactor, eliminating a critical regulatory barrier to cost-effective design by retiring regulatory risk surrounding seismic isolation, and enabling standardized designs for all sites, thus helping build the US nuclear supply chain. The project will deliver significant technical and regulatory benefits by providing the technology-neutral pathway needed by both applicants and the USNRC to implement seismic base isolation. The methodology will be applicable to all reactor designs, current and future. The Topical Report, once approved, could be referenced by any reactor developer. By implementing the methodology in the Report, the reactor developer will have both economic and regulatory certainty that the design of their isolated reactor, including risk assessment, isolator testing, and isolator quality, will be acceptable to the USNRC.

