Considerations for assessing Seismic Risk for Multiple Nuclear Facilities in the Central and Eastern United States

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Natural Phenomena Hazard (NPH) Assessments are required to be performed for individual operating nuclear sites and plants. However, NPH events impact an entire region, and the performance of the surrounding infrastructure will affect the success of emergency response measures. Additionally, there is the potential for cascading or concurrent failures, such as the failure of a dam upstream of an operating plant that may increase the potential for material release. When assessing risk to a spatially distributed infrastructure system or portfolio of facilities, it is important to consider the impacts of spatial correlation of NPH intensity measures.

Most of the research done in this area has been in relation to seismic hazard analyses and the development of design ground motions. The spatial correlation of ground motion prediction errors has been characterized with empirical relationships that incorporate site separation distances. Much of the work in this area is applicable to the Western United States (WUS) given the higher seismic hazard and extensive available data sets. However, seismicity in the Central and Eastern United States (CEUS) is especially important to the nuclear industry given the concentration of facilities.

This presentation will include a discussion of considerations for incorporating spatial correlation of ground motion prediction errors in the CEUS. The first aspect addresses the influence of the lower ground motion attenuation associated with CEUS events on the distances at which correlation of ground motions would be expected. The second aspect assesses the influence of a seismic grid source on potential correlation. For example, much of the seismic hazard in the WUS is characterized by fault sources. Seismicity is thus clustered in a more concentrated area than in grid sources that are more common in the CEUS. The physical variability associated with the grid source may be so large, that it might be unnecessary to incorporate the spatial correlation of ground motion prediction errors when assessing seismic risk to a portfolio of facilities, depending on site separation distance.

Two potential scenarios of importance to the nuclear industry will be discussed. The first scenario captures an event where two sites are separated by a few kilometers, such as a dam and a nuclear facility, and reflect the influence of spatial correlation associated with a background seismicity grid. The second scenario will model the potential for a large magnitude event occurring on the New Madrid Seismic Zone and implications to sites separated by large distances. These discussions will help inform the preparation for seismic events and the potential impacts to an entire region.