Integrated Multisite SSHAC Level 3 Probabilistic Volcanic Hazard Assessment (PVHA) for Facilities at Idaho National Laboratory (INL): Part 2: Application of SSHAC Process and Innovations

Kevin J. Coppersmith[1], Suzette M.J. Payne[2], William R. Hackett[3]

[1]Coppersmith Consulting, Inc., kevin@coppersmithconsulting.com
[2]SMJP Consulting Service, LLC, SMJPConsultingService@outlook.com
[3]WRH Associates, wrhackett@comcast.net

As discussed in Part 1, the INL PVHA was conducted using a SSHAC Level 3 (SL3) process, which has seen considerable application for nuclear and critical facilities throughout the US and internationally. Typically, the experience gained from these projects has been for probabilistic seismic hazard assessments (PSHA), but the SL3 approach is applicable to any natural hazards assessments where the hazards are uncertain and quantifiable. SSHAC implementation guidance, such as NUREG-2213, states the procedures are adaptable to accommodate a wide range of Natural Phenomena Hazards (NPH) assessments and the INL PVHA is a notable example.

The INL PVHA includes all of the essential aspects of the SL3 process, including: the fundamental goal of capturing the center, body, and range of technically defensible interpretations; detailed project planning to define the project organization; expert selection criteria; roles and responsibilities for all participants; project activities that occur during the evaluation, integration, and documentation phases; database compilation, dissemination, and new data collection; and clear definition of the site-specific hazard products for each facility. The INL PVHA workflow was designed to follow the guidance in NRC Regulatory Guide 4.26 regarding the basic steps and development of conditional and integrated hazard probabilities. The screening activity was extensive, given the potential for both proximal and distal volcanic hazards, and the geologically young (Quaternary) evidence of diverse basaltic and silicic volcanic processes in the INL region. Database development was a critically important activity and tapped the long history of geologic and geophysical studies and monitoring at INL. The PVHA model was built by the Technical Integration (TI) team with due consideration of the available data, and uncertainties were quantified using well-known tools such as logic trees and probability distributions.

Successful innovations of the SL3 process in the INL PVHA include the following.
- Database: The secure, web-based platform housed and disseminated data developed over several decades at INL, including data from INL PSHA, USGS geologic mapping and subsurface investigations. New data collection and analysis (NDCA) focused on hazard-significant issues, within cost and time constraints.
- Focus on engineering/risk application of results: Because there are few precedents in terms of product definitions, a "Resource Engineer" was included as a designated SSHAC participant with roles and responsibilities to aid the TI team with development of hazard products including probabilistic expression of hazards at designated facilities and summations across multiple hazards, all defined in a Hazards Products Document (HPD).

- <u>Site-focused approach to hazard definition</u>: Identification of applicable volcanic hazards and their spatial extent were made using hazard footprints centered on sites. Logic trees incorporated uncertainties in the key temporal and spatial assessments, which were propagated into the hazard results and probability distributions.
- <u>Hazard calculations and documentation</u>: Model calculations for the TI team were conducted by volcanic hazard analysts and final hazard calculations in the HID were conducted under NQA-1 procedures by the probabilistic hazard analyst team for hazard products in the HPD.
- <u>Implementation of quality assurance processes</u>: The SL3 process provides for participatory peer review of the evaluation, integration, and documentation processes. The web-based project platform provided an efficient means of documenting the extensive data evaluation process, which included several hundred references and datasets.
- <u>Implementation of INL PVHA</u>: The approach taken anticipated use of the results at multiple existing sites of interest for design safety assessments with future definition of characteristics of each hazard (e.g., lava flow, tephra fall) as needed. The comprehensive multisite PVHA provides a basis for future applications at other sites as well as a basis for periodic NPH updates at INL.