Climate Resilience and Infrastructure Solutions: Risk-Informed Resilience Planning at the Pacific Northwest National Laboratory

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Background/Objectives. Recent Federal, state, and local policies and laws have spurred sites to increasingly incorporate climate change considerations into their resilience planning efforts. Using a risk-informed resilience planning methodology allows sites to better understand level of impacts from climate hazards (including low-frequency but potentially high-impact hazards) and potential gaps in existing mitigation measures. PNNL developed and piloted two resilience planning tools at their Washington state campuses to help identify risk drivers: DOE's Technical Resilience Navigator (TRN) and the Risk Assessment Tool (within DOE's Vulnerability and Resilience Plan guidance).

Approach/Activities. Resilience planning seeks to identify areas where a site is exposed to negative impacts from an initiating event (such as natural hazards) and identify solutions that might be implemented to increase resilience to that event. Using tools based upon standard risk assessment approaches, such as the calculation of risk from hazard likelihood, vulnerability (e.g., mitigation failure), and consequence (e.g., if existing protections fail) provides a more robust framework for assessing how well solutions might address the key drivers of risk at a site. Using the TRN, PNNL identified a set of technological, operational, and institutional measures that would reduce risk and enhance its Richland campus' energy and water resilience to utility disruptions while also supporting broader net-zero emission goals. As the TRN focuses on risk driven by historical data, PNNL leveraged hazard information and conducted research to understand how identified hazards might change in frequency and severity under various climate change scenarios to update its climate vulnerability and resilience plan (VARP). Relatively simple data transformation allowed PNNL to model the potential future frequency of natural hazards at both its Richland and Sequim campuses while maintaining standard risk analysis approaches. Using the Risk Assessment Tool, PNNL generated risk matrices for its critical assets and hazards to identify where resilience solutions could address areas of high risk. Although earthquakes and tsunamis are not climate change hazards, they were included in the analysis to provide a more holistic assessment of natural hazards impacting the sites.

Results/Lessons Learned. Both of PNNL's campuses examined in the VARP Risk Assessment Tool found assets that would experience high impact from a hazard occurring and high vulnerability due to a lack of existing protections or procedures against the hazard for specific assets or infrastructure types. Specific hazards of concern due to their potential high impact include smoke from nearby wildfires, earthquakes, and tsunamis (Sequim campus only). Risk was primarily driven by PNNL's buildings across both campuses, but in general, PNNL found more instances of high risk in the Sequim campus. PNNL identified multiple infrastructure improvement projects to help reduce risk. Specific proposed solutions included master planning updates to Sequim's campus to modernize and expand core buildings to meet mission needs and climate change vulnerability, strengthen building energy efficiency on Richland campus, and evaluating the potential in developing a microgrid in partnership with local utilities to enhance resilience to utility disruptions.