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Assessing Resilience at Pacific Northwest National Laboratory

The Energy Sciences Center is a new facility at the Pacific Northwest National Laboratory campus in Richland, Washington. *Photo credit Andrea Starr | Pacific Northwest National Laboratory*

Pacific Northwest National Laboratory (PNNL) completed its pilot of the Federal Energy Management Program's Technical Resilience Navigator (TRN) at its Richland, Washington, campus in early spring 2022. This resource provides a summary of PNNL's lessons learned that may prove helpful to others interested in leveraging the TRN's resilience planning process for their own facilities, installations, or campuses.

Timing

While the PNNL technical assistance (TA) engagement was formalized in fall 2019, kick-off for the process did not begin until early 2020. The overall timeline was originally anticipated for fiscal years 2020 to 2021; however, the COVID-19 pandemic caused the team to revise the schedule due to the need to re-work the envisioned methodology for getting data inputs. Originally data collection had been planned for in-person meetings in Richland, Washington, but the move to a curtailed operation by maximizing telework posture for staff at PNNL required a move to virtual stakeholder engagement.

In general, the team found it took approximately six months to complete each TRN module; where possible, the team worked on two or more actions or modules in parallel to maintain overall progress. The timeline was driven by the scope of PNNL's assessment (more than 40 individual critical loads across 21 individual buildings, which required a significant lift in conducting over 50 unique interviews, calculating energy and water requirements, modeling within the TRN, and scoping and sizing solutions). PNNL had originally discussed a more limited TRN assessment by focusing on one or two buildings, which likely would have resulted in a shorter timeline. However, in the interest of fully testing the TRN methodology and to gain Laboratory-wide insight for its Richland campus, a more expansive scope, consisting of more than 70 buildings, was ultimately decided on (with leadership support). Several of the critical loads included in PNNL's assessment had unique backup systems (or weren't connected with existing building backups), which required the team to have more granularly defined critical loads to ensure that the risk to individual critical loads was accurately assessed.

Staffing

The core PNNL TA team consisted of four team members from the Energy and Environment Directorate (two engineers and two project managers) and two members of the PNNL's Facility and Infrastructure Operations directorate. The team met weekly throughout the process. The team estimates that no individual spent more than 15 percent of their time on the project consistently over the course of the TA engagement, though time commitments varied depending on assigned responsibilities and TRN modules/actions.

The team changed in several key ways throughout the TA engagement, including bringing in replacements for staff departures and one team member reducing their participation considerably due to new responsibilities. The TRN TA engagement also met with multiple staff members at PNNL and stakeholders across the two-and-a-half-year process, including staff from PNNL's business continuity office, individual building engineers, research program managers and principal investigators, staff from master planning, and leadership across operations and research directorates.

Best Practices and Lessons Learned

Engage with Leadership. PNNL found that engaging with leadership regularly—reporting on progress as each module was completed—helped to get buy-in for findings and to institutionalize the process on campus. While this did take time away from making progress on TRN actions and modules to develop presentation decks and briefing papers, the team felt this was worthwhile because it resulted in the final analysis being accepted. A major benefit was also leadership responding to identified critical missions and functions and requesting changes to make the analysis more in line with how leadership envisioned key activities—crucial feedback that resulted in re-work upfront but more accepted results at the end of the pilot project.

Be Prepared for Both Online and Offline Data Collection, Analysis, and Entry. Overall, there is a large volume of data collected in TRN assessment, and not all of it gets directly entered into the web tool. Sometimes a lot of data needs to be collected and then translated into TRN inputs (e.g., water requirements for critical loads), and those calculations need to be stored somewhere that can be referenced at a later point, if necessary. PNNL developed several Excel documents that mapped the results of interviews, the identification of critical loads within facilities, and energy and water requirements to ensure that all data was easily referenceable. This also allowed the team to more easily make updates as new information was available and identify where figures came from for referencing over time.

Find a Balance in Developing Resilience Solutions. Identifying solutions and how much detail needed to be defined at this stage in the solution was difficult for the team. Ultimately, the team had to seek a balance in available information, time, and resources on engineering estimates and calculations to site and size a solution. While the team was able to leverage several existing solutions (PNNL leveraged National Renewable Energy Laboratory's REopt and PVWatts® tools, as well as its internal Microgrid Component Optimization for Resilience tool), not all of the information those tools provided was a fit for the solutions that PNNL developed. As a result, the team spent significant time and effort trying to develop more customized solution sizing estimates. Additionally, many of the tools that are available provide solutions in terms of the size of the solution, but the TRN input is in hours of supply provided by the solution. This requires additional translation of values, and, for solutions that include distributed energy resources, the duration of resource the redundant system provides can vary dramatically based on the time of year or the time of the outage. The team had to develop guidelines for how much time the redundant system would provide backup to the site that didn't over-promise supply during winter (for a photovoltaic array) but also didn't overly discount the contributions of the array during the summer (because why have photovoltaic included otherwise?).

Iterate Identified Resilience Solutions with Stakeholders Before Solution Prioritization. Once solutions were developed, PNNL socialized them with many stakeholders to ensure no major issues were identified. During this review, PNNL encountered some timing inefficiencies when it reviewed potential solutions with master planners, who pointed out that several sites identified for solutions were slated for development in upcoming years. Talking with master planners prior to brainstorming (after identifying resilience gaps) may help others to complete the Solution Development module more efficiently.

Informing the Development of the TRN

The TRN pilot at the Richland campus resulted in several updates to the TRN in 2021 and 2022, specifically related to usability. In the initial version of the TRN web tool, the Risk Assessment Action 3: Review Vulnerabilities module would automatically generate the risk scenarios for evaluation, and the user had to go into every scenario line-by-line to answer information about the redundant system. For an expansive TRN framework like PNNL's, this resulted in over 400 individual risk scenarios that had to be examined, despite having significant duplication of effort across scenarios. This action alone required multiple hours of effort to complete, even with all of the data easily accessible. In response to this feedback, the TRN web tool was updated to collect the vulnerability information related to redundant systems earlier in the Baseline Development module (where initial redundant system information was entered) to automatically generate the vulnerability scoring in Risk Assessment Action 3. In this new workflow, the user now only has to review the calculation of each risk scenario, representing a major efficiency improvement for the user.

Leveraging TRN Data for PNNL Priorities

The site resilience team used the data, findings, and lessons learned from the TRN in several follow-on efforts, including its Net Zero Labs Pilot Initiative (known as NZERO) and in completing its Vulnerability Assessment and Resilience Plan required by DOE under its Climate Adaptation and Resilience Plan, developed in response to Executive Order 14008. ■

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