U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Calculating Energy and Water Loads for Resilience Planning

The Pacific Northwest National Laboratory (PNNL) piloted the Technical Resilience Navigator (TRN) on their Richland, Washington campus during 2020-2021. This resource outlines the different methods the team used to identify energy and water requirements at the site as a part of the **Baseline Development** module. The site resilience team started by reviewing the available documentation and data sources that had been collected in **Baseline Development Action 1**.

After critical loads were identified in **Action 2**, the site resilience team realized that not all critical loads had the same level of existing documentation. Thus, they needed to use a combination of data collection methods to identify the energy and water requirements for each critical load. In addition to qualitative data collection from interviews with mission owners and site operators to establish the specific systems required to sustain critical functions, the team also used previous facility-level audits, building-level meter data, existing data center energy requirement data, modeled load requirements, and nameplate research to calculate and verify energy and water requirements.

A view of the Pacific Northwest National Laboratory's Richland, Washington campus.
Photo credit Pacfici Northwest National Laboratory.

Interview Data from Mission and Site Owners

In the interviews with mission and site owners, the site resilience team found that several were already tracking electric and water usage – thus, they were able to directly provide the team with requirements for critical loads. In other instances, the mission or site owner had approximate ranges of energy usage for their equipment, which could be easily verified using real data collected from the campus.

The TRN pilot included critical loads that supported classified project work. Due to sensitivity around those projects, some mission owners were unable to provide detailed information on the equipment and systems. In these cases, the team worked with mission owners to instead understand the higher-level energy and water requirements and did not ask any questions about the types of activities occurring on the equipment within the load.

Energy Independence and Security Act of 2007 (EISA) Audit Data

Several critical loads were located in facilities that had a recent EISA audit, which are required for "covered" federal facilities every four years. Documentation, such as audit reports, notes, and photographs, was used to identify system types and sizes as well as to understand the overall performance of the facility. Where equipment had not been changed since the audit and information on specific energy and water equipment was available, the energy and water requirements reported in those audits were used as an input for identified critical loads.

Meter Data

PNNL had monthly meter data for electricity and water available for a set of buildings within the pilot study as well as some water usage data for a cooling tower. Meter data came from the building energy management system and was supplemented by monthly billing data in a few instances where monthly actual data was lacking. The team calculated

TRN

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estimated daily averages and seasonal peaks from these data. As a best practice, more granular data (e.g., 15-minute interval or daily) would have been preferred; however, the site resilience team used these estimated values instead given the available data. In future years, should interval data become available due to facility or equipment upgrades, the team might recalculate requirements. The estimates provided the team with a starting value to verify and validate against other known energy usage information and to check with mission owners.

Federal Energy Decision System (FEDS) Tool Data

As a part of the regular PNNL audit process, there were a variety of existing facility-level FEDS models available that could be leveraged to estimate particular energy or water requirements for critical loads. FEDS is a building energy-efficiency software tool that simulates building systems, loads, and energy use, requiring minimal user input to help evaluate energy-efficiency options via a site-optimized, life-cycle cost minimization process. Because audits are conducted on a four-year cycle for covered facilities, in some cases the existing FEDS model for a facility with a critical energy or water load was outdated and needed to be updated; in others, the site resilience team only needed to review against the most recent audit findings to check for accuracy.

Using FEDS, the team was able to leverage outputs such as HVAC usage, ventilation, and miscellaneous plug loads associated with laboratory equipment to use for inputs for critical energy load requirements. The team also conducted an optimization run of the FEDS model as a spot-check of the building's load profile to ensure there were no anomalies or problems with the overall model.

Power Usage Effectiveness (PUE) Data

PNNL already tracked and reported information on PUE for its data centers, which provided the energy and water requirements for select critical loads within the site resilience assessment. In some cases, the existing PUE was not a reasonable input for the TRN process given that it included additional loads not deemed critical within the assessment. In those instances, the team used subject matter expertise to derive a proxy PUE figure to double check outputs from FEDS models and to serve as a check on calculated energy requirements in the TRN data.

Inventory and Nameplate Research for Calculated Data

For critical loads without metered data or previous audit information, or with uncertainty after mission owner interviews, traditionally the team would do an on-site walk-through to physically identify and confirm critical equipment and calculate energy and water requirements from nameplate data. However, due to site access restrictions during PNNL's maximum telework posture in 2020-2021, the site resilience team instead used internal data sources such as equipment and inventory lists to identify equipment counts, model numbers, and – in select instances – power draw information.

From there, the team researched manufacturer data sheets to calculate power draw and load requirements for identified critical loads. PNNL checked these calculated requirements with facility subject matter experts against existing metered data, as nameplate calculations can often produce energy calculations higher than the actual load requirement.

Verification

The site resilience team used multiple methods to identify and calculate energy and water requirements of critical loads that support critical functions at the PNNL Richland campus. In all cases, it was important to verify calculations and inputs before considering the data final. The team relied on verification methods that included the following:

- Follow-up conversations with technical subject matter experts familiar with day-to-day operations after initial mission owner interviews (request a point of contact during the first interview).
- Follow-up conversations with building engineers to verify the reasonableness of the mission-critical equipment energy and water requirement calculations when viewed in the context of the overall building or facility to ensure that a specific piece of equipment is not being over- or under-estimated (e.g., represents 90 percent of a facility's metered data).
- Spot-checking FEDS estimates, equipment power draw values, and meter data with site building energy data experts and engineers familiar with sizing buildings loads for reasonableness. ■

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