Energy Northwest
Partnered with
Argonne National Laboratory (ANL)

NE-24-32454 – Future Climate Projections for Dry and Wet Condenser Cooling Options

YEAR AWARDED: 2024

TOTAL PROJECT VALUE: $606,250K

STATUS: Completed

PRINCIPAL LAB INVESTIGATORS: Lisa Williams (Energy Northwest), Richard Vilim (Argonne)

DESCRIPTION: Energy Northwest is a public power joint opera�ng agency located in Richland, Washington looking to build a steam cycle power plant featuring four X-Energy Xe-100 nuclear reactors. Selecting the design for a heat rejection (cooling) system for a nuclear power project in a borderline arid climate that is rapidly changing is a challenge, especially as reactors are designed to have expected lives of 60 to 80 years. This project involved evaluating potential climate impacts in the northwestern United States from climate models and using those results to model plant performance using various cooling options. The results will be used to determine the range of plant performance and cost distributions to help understand the factors that need to influence the selection of an ultimate heat sink for a nuclear reactor in the region. Energy Northwest partnered with Argonne National Laboratory (ANL) to support the modeling effort and evaluate the various deployment options.

BENEFIT: The study provided a detailed, qualitative comparison between the tradeoffs of wet and dry cooling systems. Two wet cooling systems were evaluated: once-through and recirculating wet systems and direct and indirect dry systems. The wet cooling design with a mechanical draft wet cooling tower (Figure 2) was used as the base case.

IMPACT: To understand how potential climate changes could affect cooling system performance, researchers analyzed climate data provided by the team at Argonne National Laboratory for three ten-year periods: past (1995-2004), mid-century (2045-2054), and end-of-century (2085-2094). For each data set, ten-year average distributions of the climate variables were calculated then detailed calculations of the annual costs of dry cooling and wet cooling were demonstrated using climate data from since 2004. The same calculations were then applied to the ten-year average climate data from each period to illustrate the effects of potential changes in climate conditions on cooling system performance.

SIGNIFICANT CONCLUSIONS: The cost comparison results indicate that, for the target application in central Washington, wet cooling is more economically advantageous than dry cooling. This advantage is driven primarily by lower capital costs and better thermal efficiency, which outweigh the associated expenses of water use. Although future climate projections suggest slight ambient temperature increases resulting in marginal operational cost rises for both systems, wet cooling remains the more cost-effective option unless water costs escalate significantly.

NEXT STEPS: These results can be updated if new assumptions or revised values for these operational parameters become available.