NE-26-38811 Investigating Moisture Carryover Behavior on Current and Power Uprate Operation in Constellation Boiling Water Reactors

Constellation Energy, headquartered in Kennet Square, PA is the leading U.S. provider of nuclear energy, delivering reliable, baseload power year-round. The company operates the nation's largest fleet of nuclear plants—and is an innovation leader, leveraging advanced technologies such as AI and machine learning to enhance fleet sustainability, improve safety, and support national goals for expanding nuclear capacity.

Moisture Carryover (MCO) in boiling water reactors (BWRs) limits fuel cycle optimization, plant performance, and planned power uprates across Constellation's fleet. Elevated MCO can increase shutdown dose rates, contribute to turbine corrosion, and reduce operational margins, particularly in high power density and uprated cores. Current mitigation strategies rely on conservative fuel loading practices that increase fuel cycle costs without addressing the underlying physics.

Constellation proposes to partner with Oak Ridge National Laboratory (ORNL) to apply high-fidelity multiphysics modeling and high-performance computing to improve predictive understanding of MCO phenomena. ORNL will utilize the Virtual Environment for Reactor Applications (VERA) and complementary computational fluid dynamics simulations to analyze historical operating cycles and identify core- and bundle-level mechanisms driving carryover. Results will support development of reduced-order predictive models that can be integrated into Constellation's operational and power uprate evaluation tools to lower fuel cycle costs, improve capacity factors, and enable safe and economically competitive power uprates across the existing BWR fleet.