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Microreactor Applications, Research, Validation, and Evaluation (MARVEL) Reactor –Status, Construction, and Testing

This paper presents the current status of the Microreactor Applications, Research, Validation, and Evaluation (MARVEL) microreactor design, qualification testing, fabrication, and high-level construction schedule. An overview of initial criticality, low power physics testing, and start-up testing is included, as well as an overview of the envisioned processes in which end-users can engage the project for access to operational data or specific demonstrations. Designed by the Idaho National Laboratory (INL) under the auspices of the US Department of Energy's Microreactor Program for construction and operation at the INL, MARVEL is a small, fully functional advanced reactor with UZrH fuel and thermal output of 85 kW. It offers a unique opportunity for scaled demonstrations that can dramatically accelerate the design, licensing, and deployment of commercial microreactors for power production or process heat applications.

MARVEL's objective is to build a small liquid-metal thermal reactor at the INL to demonstrate design and operating processes for microreactors, microgrid integration, and process heat applications. MARVEL finished 90%-final-design in September 2023 and completed an independent project assessment in early 2024. Fabrication of long-lead components and fuel, safety analysis review, and procurement for construction are underway. MARVEL assembly and construction will start in 2025 and fuel loading is expected in early 2026. Initial criticality will be performed in a dry condition late in 2026, followed by loading of NaK coolant and start-up testing. Approximately six months later, release for unrestricted operations will enable subsequent testing of microreactor characteristics, microgrid integration and select heat extraction applications.

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