Westinghouse Electric Co.

partnered with

Oak Ridge National Laboratory

NE-18-16167, Development and Testing of Alumina-forming Austenitic Stainless Steels for Lead Fast Reactor Application

YEAR AWARDED: 2018

TOTAL PROJECT VALUE: $525k (DOE Funds Awarded: $420k; Awardee Cost Share: $105k)

STATUS: Completed

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DESCRIPTION: For the nuclear industry and Westinghouse Electric Co. in particular, an alumina-forming austenitic alloy optimized for a lead fast reactor (LFR) application would eliminate a key technical challenge: the corrosive nature of liquid lead at high temperature. This same barrier is also limiting the feasibility of proposed concentrated solar energy projects. Alumina-forming austenitic (AFA) steels have been developed by Oak Ridge National Laboratory (ORNL) for high-temperature applications in other environments, showing very promising high-temperature performance. Westinghouse has identified alumina-forming austenitic steels as a key enabler to its LFR design achieving competitiveness with natural gas power plants. Under the GAIN voucher, ORNL worked with Westinghouse to optimize AFA steels for applications specific to LFRs, as reliable materials for key components such as fuel rod cladding, heat exchangers, reactor internals and the reactor vessel. The performance metric for the new AFA compositions was performance testing in liquid lead at 500°-700°C.

BENEFIT: The availability of evidence supporting the high-temperature operation scenario for LFRs is aimed at reducing business uncertainties and development risk, increasing confidence, and accelerating timelines for achieving targeted economic performance.

IMPACT: The ability to operate at temperatures higher than current LFR concepts would permit the Westinghouse LFR to effectively implement a heat storage system for non-reactor-based load following operation (envisioned for renewables complementation) and address non-electricity applications such as process heat generation.

NEXT STEPS: Currently in conceptual design stage, the Westinghouse LFR is to be developed through a staged approach that leverages the adequate readiness of LFR's "base technology" and progressively introduces selected innovations to enhance performance and ease existing challenges. This staged approach commences with a lower-power prototype LFR (PLFR) intended to demonstrate LFR technology's overall safety and performance characteristics, and enable testing of materials, components, and technology in a relevant environment. Following a demonstration phase, the PLFR design will be enhanced and uprated to a higher-temperature, higher-efficiency unit for commercial deployment.