Framatome
partnered with
Argonne National Laboratory

NE-19.1-17592, Advanced Fuel Stability Analysis Using High-Fidelity Large Scale Computational Fluid Dynamic Simulations

YEAR AWARDED: 2019

TOTAL PROJECT VALUE: $625k (DOE Funds Awarded: $500k; Awardee Cost Share: $125k)

STATUS: Completed

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DESCRIPTION: During operation, nuclear fuel assemblies are exposed to high axial flow and the fuel assembly undergoes random vibration induced by flow turbulence. The resulting turbulence excitation is well understood and accounted for during fuel assembly design, but in some operating conditions the fuel assemblies can be exposed to more complex flow conditions, leading to significantly higher vibrations and, in some cases, fuel-rod fretting wear and failure. This grid-to-rod fretting wear, induced by the mixed axial and localized crossflow, is of significant importance to plant operators. Supported by a GAIN voucher, Framatome and Argonne National Laboratory are working to develop and validate high-fidelity computational fluid dynamics models using U.S. Department of Energy Nuclear Energy Advanced Modeling and Simulation codes for the investigation of flow-induced vibrations of different fuel rod designs (standardized and advanced) to ensure the robustness of fretting wear performance.

BENEFIT: The goal of this project is to improve nuclear power generation's safety and competitiveness by providing robust information about the flow patterns and formations throughout the simulated fluid domain.

IMPACT: This has the potential to reduce nuclear plant operation costs by eliminating the need for costly experiments that can only be performed for a limited number of reactor conditions.

NEXT STEPS: Ultimately, this capability will enable the accelerated delivery of advanced fuel forms to the light water reactor and advanced reactor fuel markets and the development of robust *industrialized* fully coupled fluid-structure interaction models for flow-induced vibrations.