Development of a Multiobjective Optimization Capability for Heterogeneous LWR Fuel Assemblies

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For some nuclear fuel cycles, particularly those involving mixed-oxide fuel (MOX), there are benefits in varying the properties of the fuel radially on a pin-by-pin basis and axially along the assembly. Heterogeneity in fuel design inevitably increases fuel fabrication costs, so a capability to explore rigorously and systematically the trade-off between in-core fuel performance and fabrication cost of heterogeneous assembly designs would be a helpful aid to decision-making. Advances in multiobjective optimization methods make the development of such a capability a realistic proposition.

This project will seek to develop just such a capability by combining reactor physics analysis methods and fuel fabrication cost models with state-of-the-art multiobjective optimization algorithms and testing the performance of the resulting design optimization framework on a range of representative fuel design problems, such as the design of with uranium-plutonium MOX for plutonium disposition in PWRs and uranium-thorium and uranium-transuranic MOX for full actinide recycle in reduced-moderation PWRs.