Design and intelligent optimization of the thermal storage and energy distribution for the TerraPower Molten Chloride Fast Reactor in an Integrated Energy System (IES)

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ABSTRACT:

Thermal energy storage and distribution is the key point of coupling of an Integrated Energy System (IES) that provides nuclear heat to various applications (e.g. electricity generation) and endothermic processes (e.g. hydrogen generation). **The objective of this project is to explore the application of advanced reactors within IES, use extensive existing data for model development and validation, and extend the predictions to larger grids and commercial applications.** Specifically, we will develop interface design for prioritized coupled processes, strategies for real-time optimization of energy dispatch (operation), and a safety/accident evaluation for the integration of a specific advanced reactor coupled within an IES. We will also use this information developed within this project to evaluate accident scenarios in the coupled IES. We have selected three specific systems which we will focus on:

1. The TerraPower Molten Chloride Fast Reactor (MCFR) design at a power level of approximately 200 thermal megawatts will be the reference reactor system. This specific realization of a reactor concept will be used to address coupling of advanced reactors to energy storage, electricity, and process heat within an IES. The UTK PI and all Co-PIs all bring exceptional and extensive molten salt reactor experience to the project.
2. The UIUC campus owns and operates its own **electric, steam, and chilled water utilities**. The UIUC Co-PI will provide data from this system which will be used as an example system for coupling to the MCFR design and concomitant optimization, as well as model validation.
3. The historical BN-350 desalination and co-generation facility will be used to validate and calibrate models and approaches for thermal energy storage and distribution based on available data.