Fuel Selection and Dose Optimization Software (HI-FRED)

HTB – Fuel Selection for Dose Optimization & Decommissioning Planning Service

Holtec has developed a fuel selection software called **H**oltec **I**nternational **F**ast **R**eduction of **E**stimated **D**ose (HI-FRED) that enables input of a plant's spent fuel pool inventory to develop dose-optimized fuel loading plans that map each fuel assembly to a cask number, basket position, and loading date. The software has the ability to include the complete spent fuel inventory of the plant, including projected fuel inventory and histories developed with the utility. The inputs to HI-FRED are the i) site-specific cask model, ii) CoC limits for storage (and transport, if applicable), and iii) design parameters and core history of fuel inventory (current and projected), iv) and planned cask loading frequency. Developed with the intent of reducing operational dose, Holtec has found that through the use of HI-FRED we can reduce dose for clients by more than 30% relative to even the most well-crafted, hand-selected fuel loading plans. An example comparison is provided for one US Plant in Figure 1, where an estimated surface dose rate reduction of more than 50% was achieved compared to the hand-selected regionalized plan.

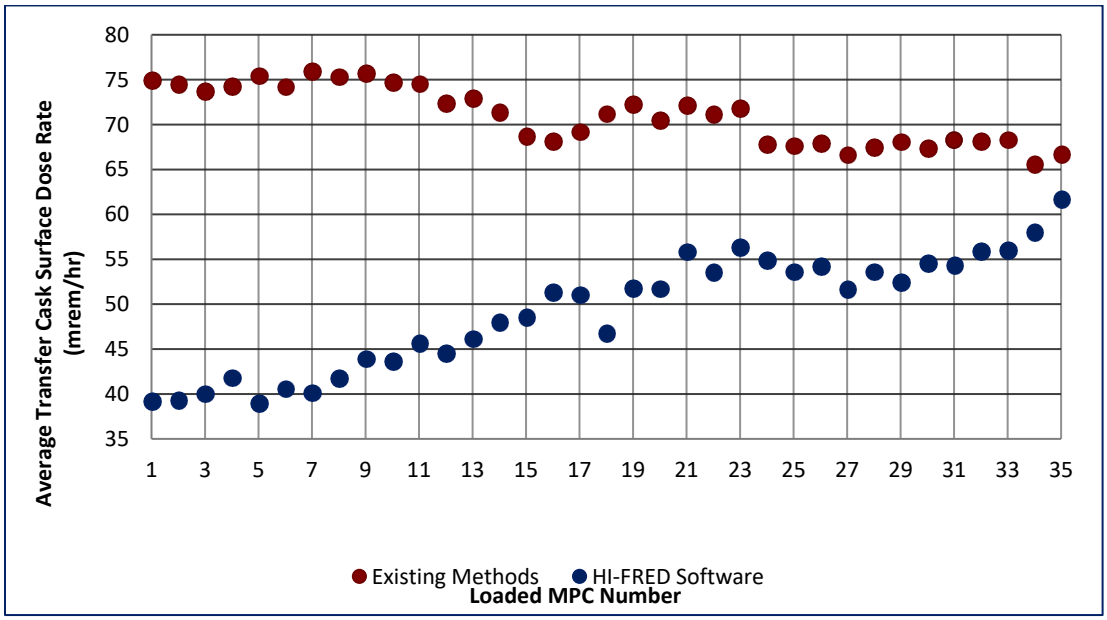

Figure 1. Comparison of projected surface dose rates produced by traditional methods or through use of HI-FRED.

Operational data has shown this reduction in estimated surface dose is directly translatable into savings in crew loading dose, as well as reduced operational dose rates during storage, reduced site-boundary dose, and reduced dose rates during eventual transport. As shown in Figure 2, once curve fit to account for site-specific parameters, the surface dose projections from HI-FRED become highly predictive of crew performance. This predictability allows for comprehensive ALARA planning and performance assessments. HI-FRED's value as an ALARA planning tool also enables optimization of the cask extends to development of optimized loading patterns during cask design or addition of new patterns to support to support ALARA measures.

HI-FRED is an important tool for developing and maintaining decommissioning plans as well as similar requirements in foreign markets. The pool defueling period can have a significant impact on decommissioning costs and associated funding provisions. In particular, HI-FRED has been used to develop and evaluate loading plans to accommodate accelerated decommissioning by defueling the pool in less than 3 years post-shutdown. Input of projected data from high heat-load and underburned assemblies from the last core can be used to identify whether cask licensing amendments are necessary for rapid defueling. By virtue of HI-FRED's wholistic approach considering

both past and projected fuel inventories, the software provides our clients with the ability to begin proactively performing cask campaign fuel selections, while understanding the downstream impact of such selection upon a rapid final fuel offload date that may be years or decades away.

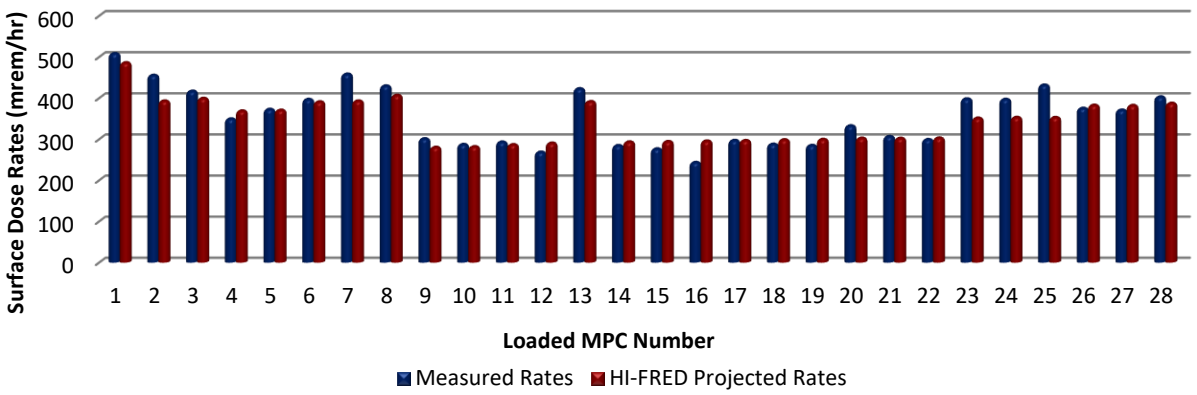

Figure 2. Comparison of projected and measured crew dose rates.

Through its direct dose optimization and campaign planning capabilities, HI-FRED inherently provides the ability to perform cost benefit analysis in the context of dose rates and final fuel offload dates for common operational decisions such as loading campaign schedule and size, administrative cask heat load limits, timing of amendment upgrades, and loading of damaged fuel and fuel debris often kept in the pool until the final clean-out phase. Damaged fuel and debris can not only have a significant impact on the dose rates but can also introduce additional constraints with respect to their placement within the Multi-Purpose Canister (MPC) if not properly accounted for early in the plant's lifecycle. Finally, the software is also adaptable to evaluate optimized packaging of high-activity waste from decommissioning, if well characterized in discrete components.

The HI-FRED software has been developed over the past three years under a pilot program working with three US utilities. Holtec is now offering this service to all of our clients. The deliverable is a comprehensive fuel loading plan that can be customized for each client. Please contact us for more information.

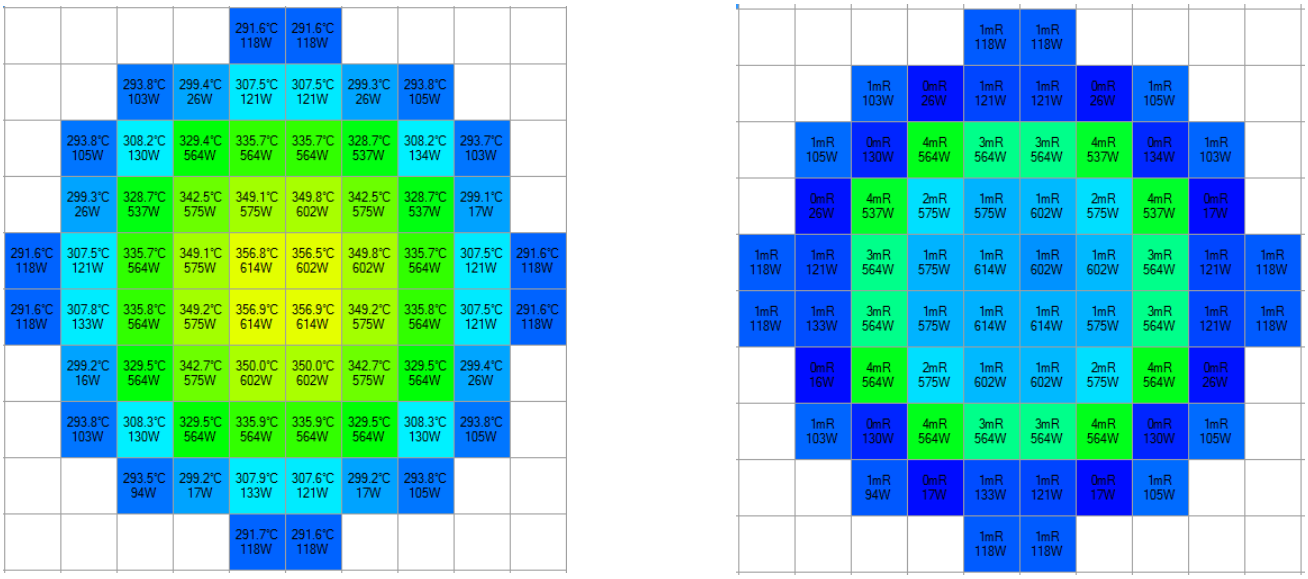

Figure 3. Estimated fuel peak cladding temperatures (PCT) and estimated per-assembly surface dose contribution for a sample cask.