UNF-ST&DARDS: A Unique Tool for Automated Characterization of Spent Nuclear Fuel and Related Systems

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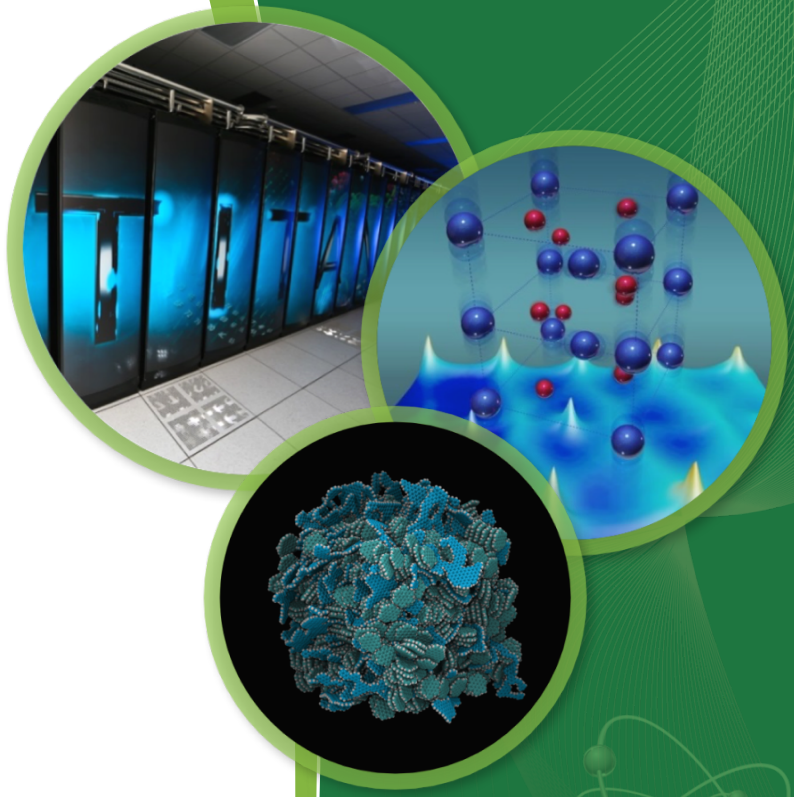

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UNF-ST&DARDS is being developed as an integrating (storage, transportation, and disposal) foundational resource

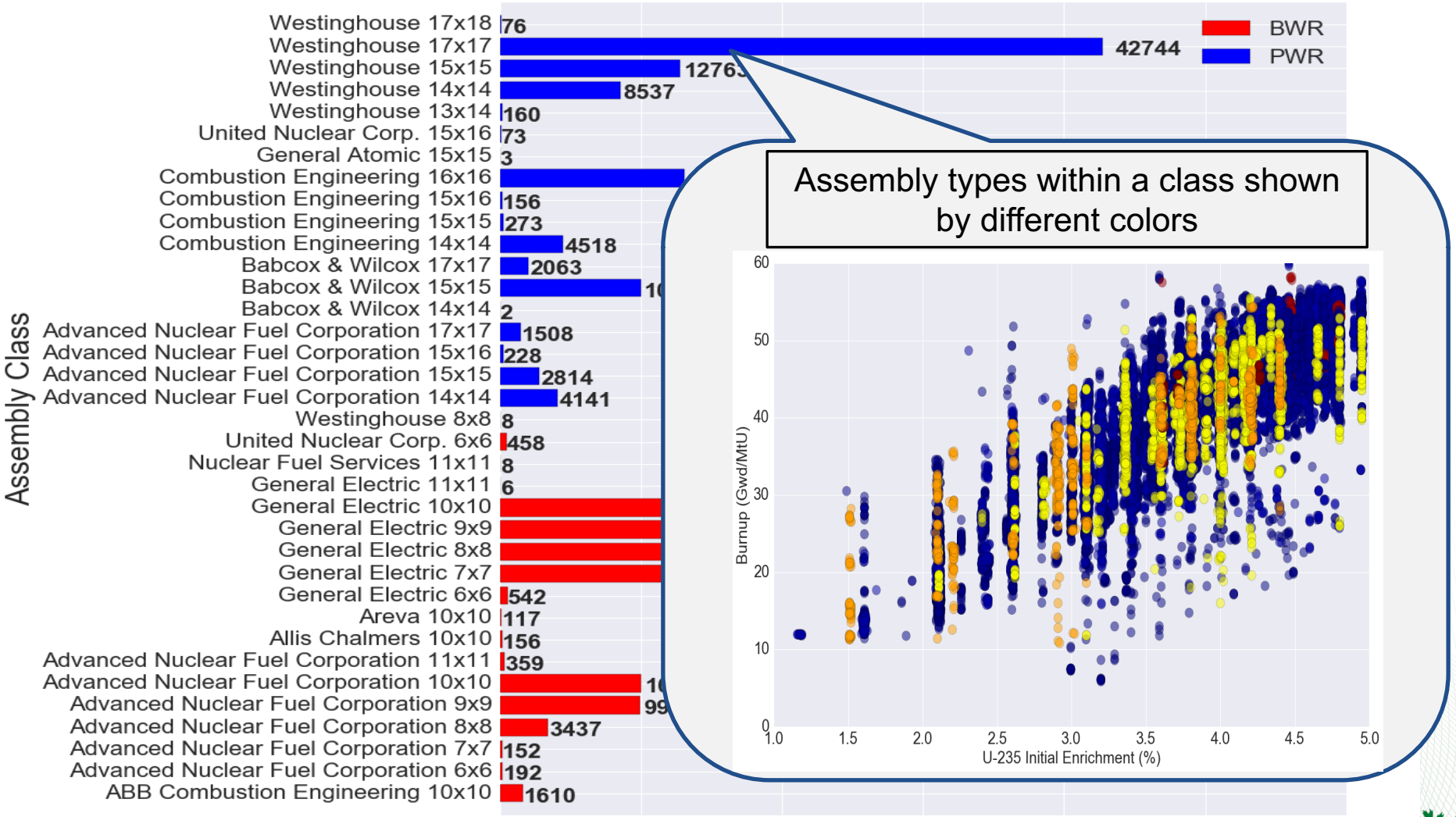
- Used Nuclear Fuel-Storage, Transportation & Disposal Analysis Resource and Data System (UNF-ST&DARDS) provides a spent nuclear fuel (SNF) database and integrated analysis tools
- Objective is to develop a comprehensive system for analysis of the SNF from the time it is discharged from the reactor to the time it is disposed of in a geologic repository
- Applications could include:
  - Identification of potential issues and prioritization of research and development
  - Supply of fundamental data for informed decision making at various stages (storage, transportation, and disposal) of SNF management
    - Example: Determine transportability of loaded canisters
  - Supply of data for fuel cycle analysis as well as safeguard and security determination
  - Various licensing/certification activities (e.g., integration between storage and transportation licensing practices)

U.S. commercial spent fuel inventory is nearly 80,000 MT and growing

- SNF is stored throughout the United States
  - 73 reactor sites* including 14 shutdown sites in 33 states
- SNF inventory increasing annually
  - ~2000 MTHM/y

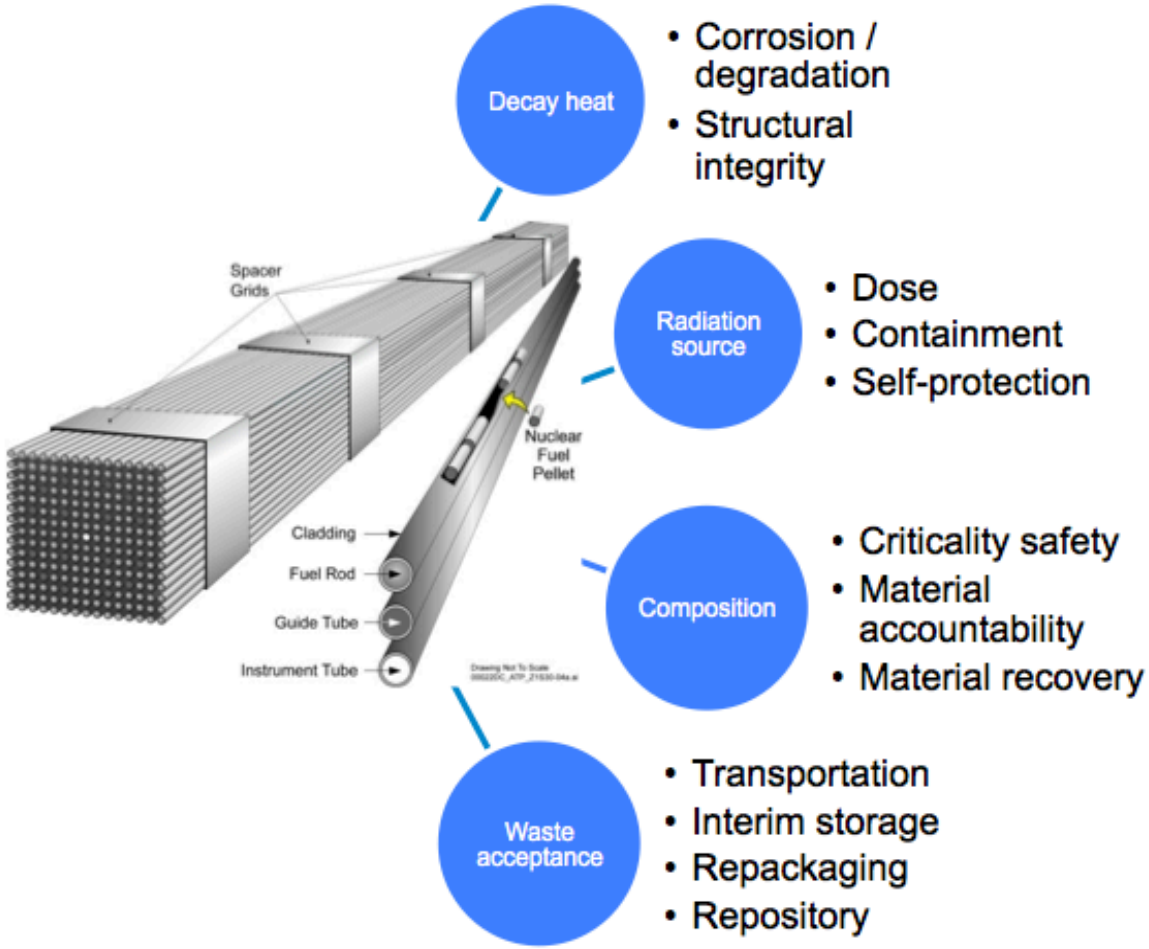
*Hope Creek and Salem counted as a single site

The large SNF volumes and diverse systems in the United States make system-wide planning more complex



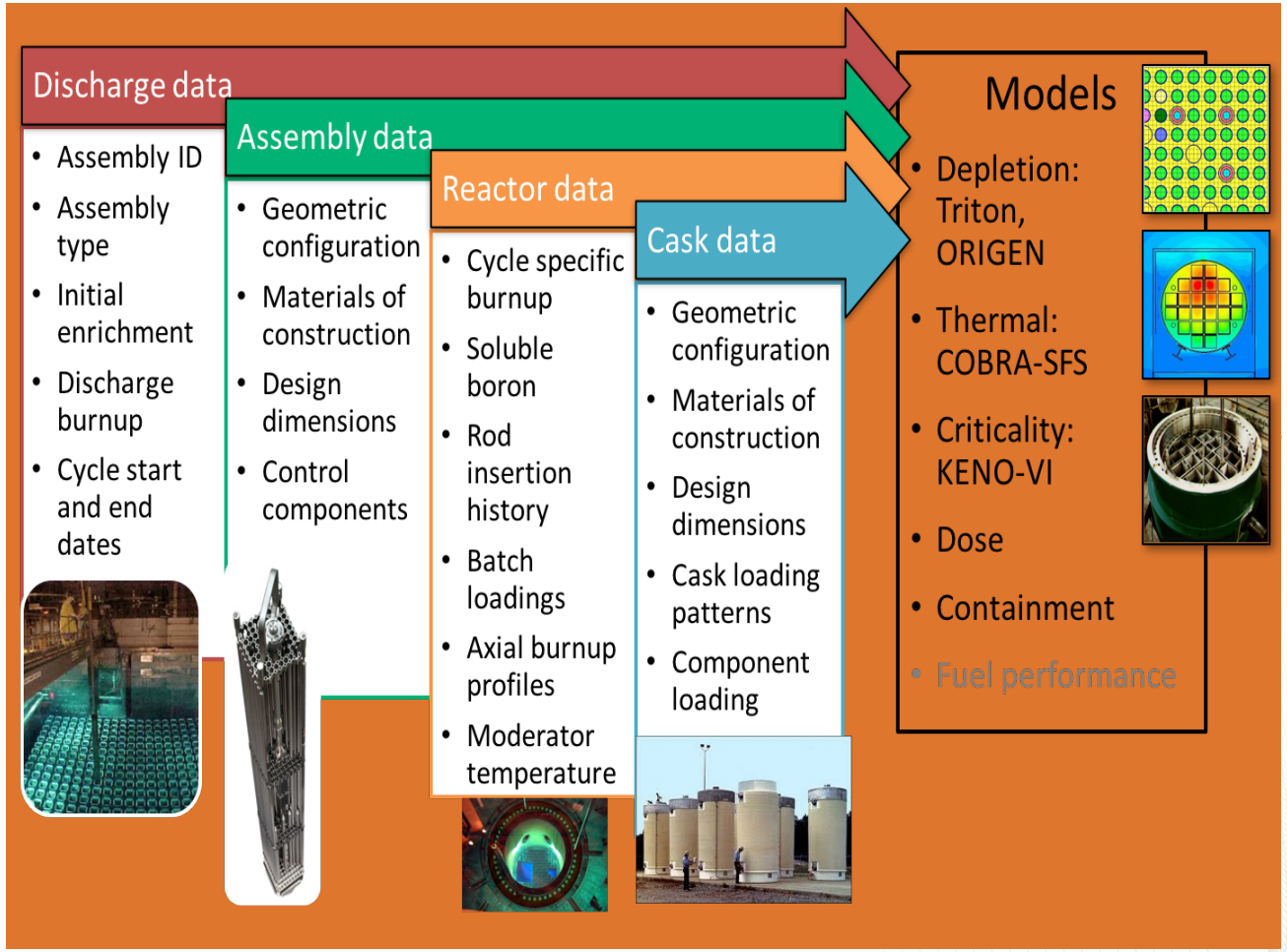
Any SNF related activity starts with understanding the SNF characteristics

- SNF and related systems characteristics can be categorized into:
  - **Base Characteristics:** fuel geometry, materials, reactor irradiation histories (e.g., cycle length, specific power etc.), cask system, cask loading patterns used to store SNF
  - **Derived Characteristics:** decay heat, isotopic composition, radiation sources, cask criticality, transportation cask dose rates

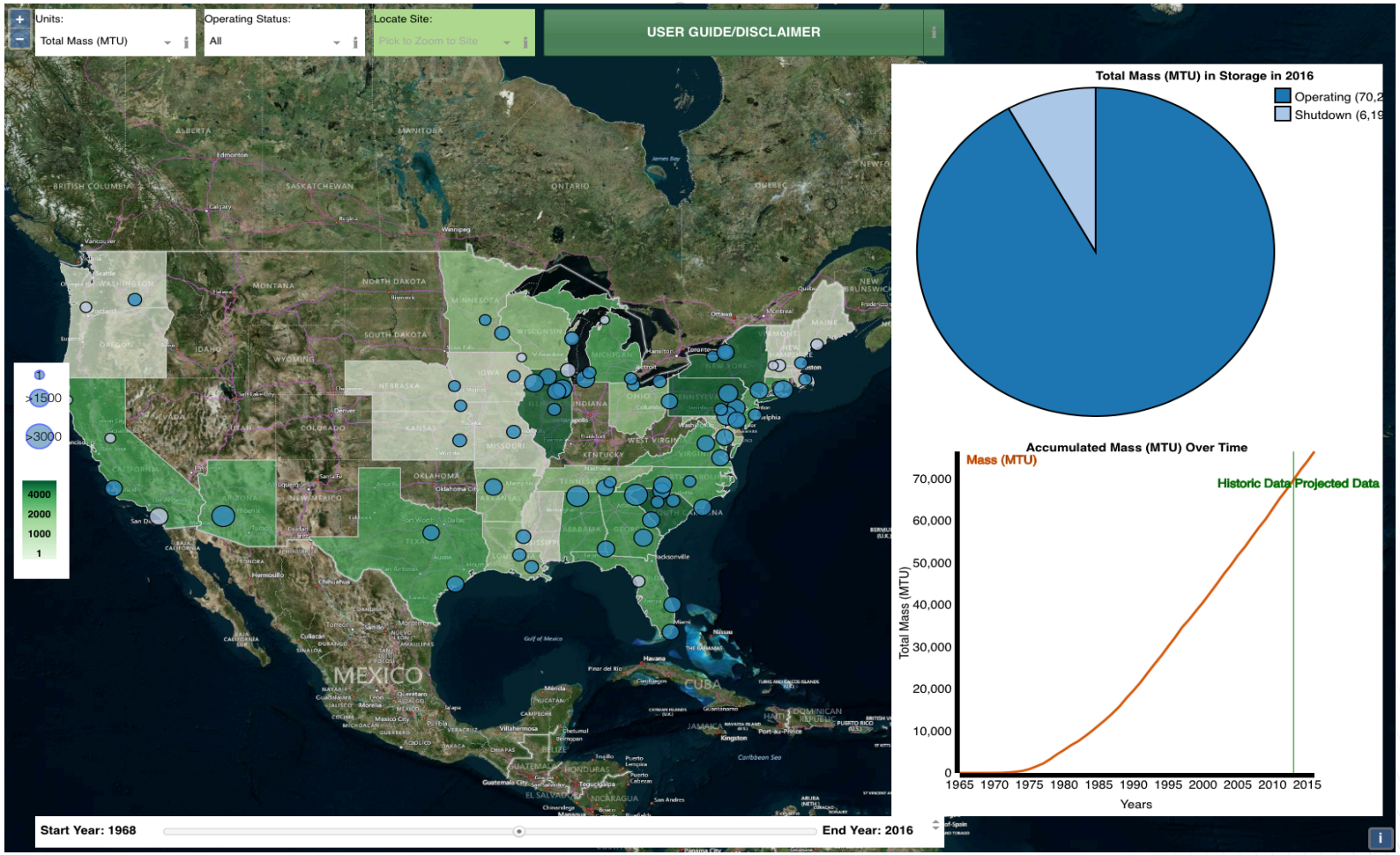


UNF-ST&DARDS integrates data with analysis capabilities to simplify SNF characterization process

- Unified Database consolidates key information from multiple sources and preserves data
- Data relations facilitate analysis automation



The Unified Database within UNF-ST&DARDS provides reference tracebility through curie.ornl.gov



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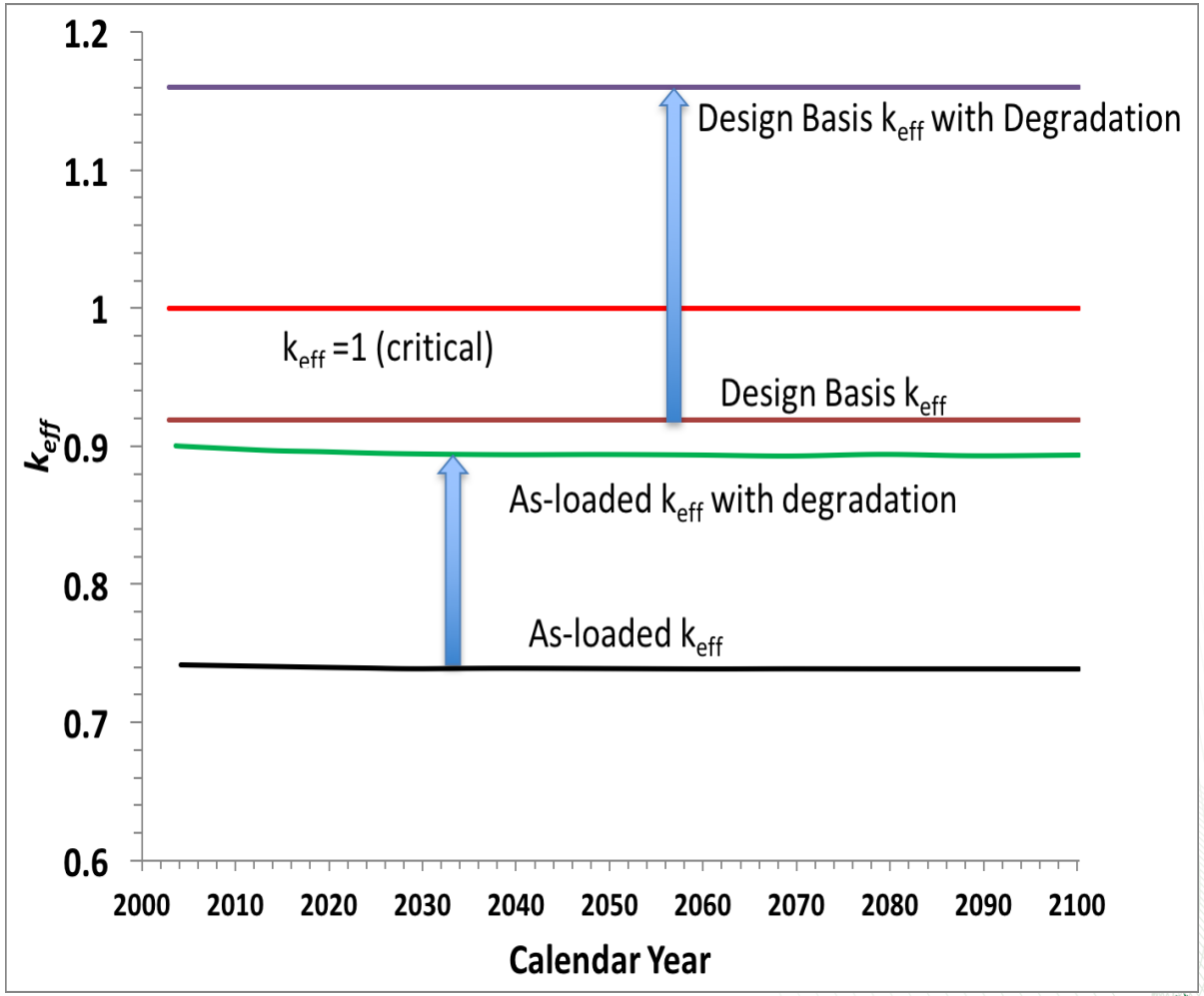
A unique capability within UNF-ST&DARDS is the performance of actual assembly-specific and cask-specific evaluations

- Understanding current conditions and practice versus hypothetical bounding scenarios (i.e., realistic margins)
  - Enables practical approaches to address SNF structural integrity related issues (aging management)
  - Enables improved operational flexibility
  - Potentially enable direct disposal of existing canisters



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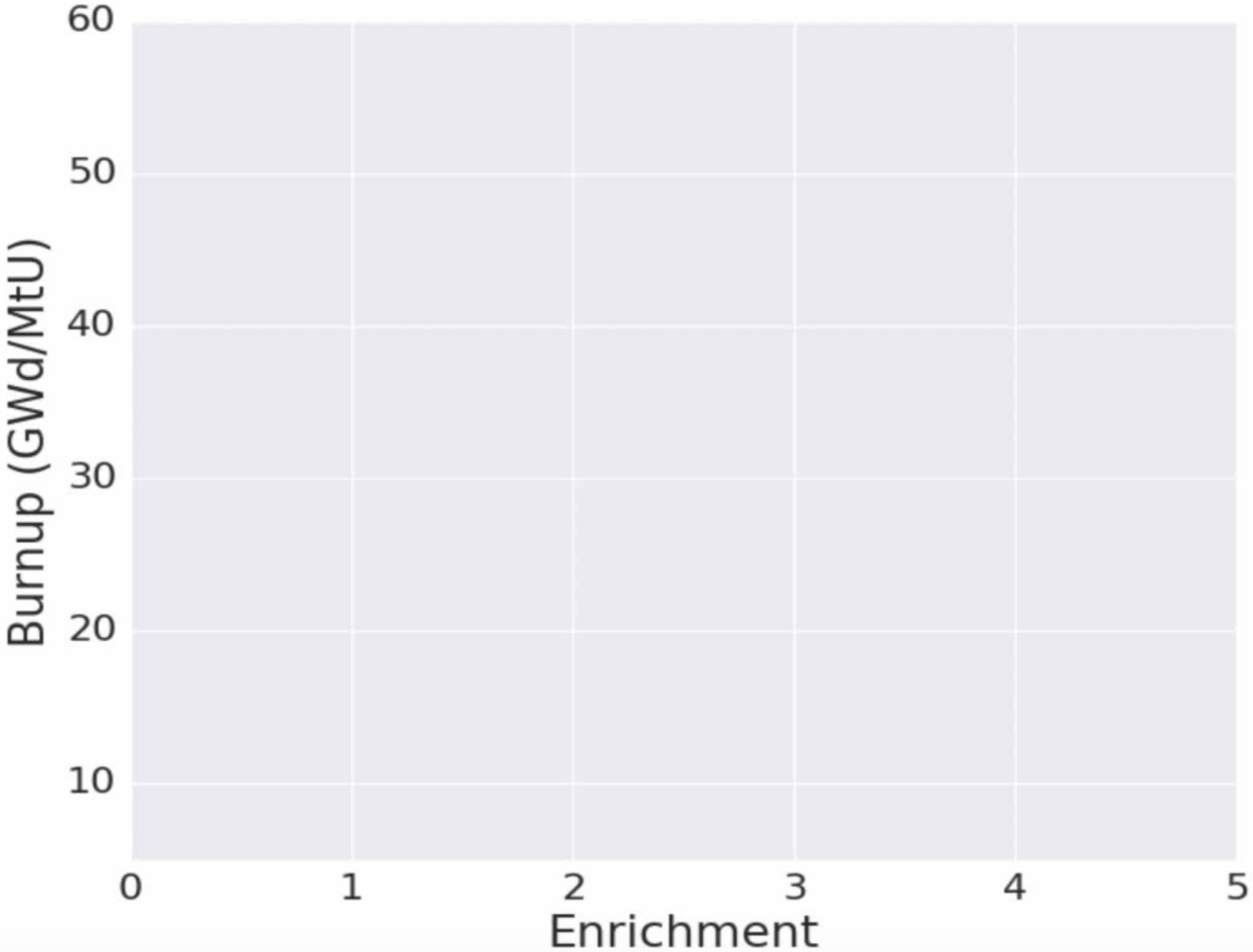
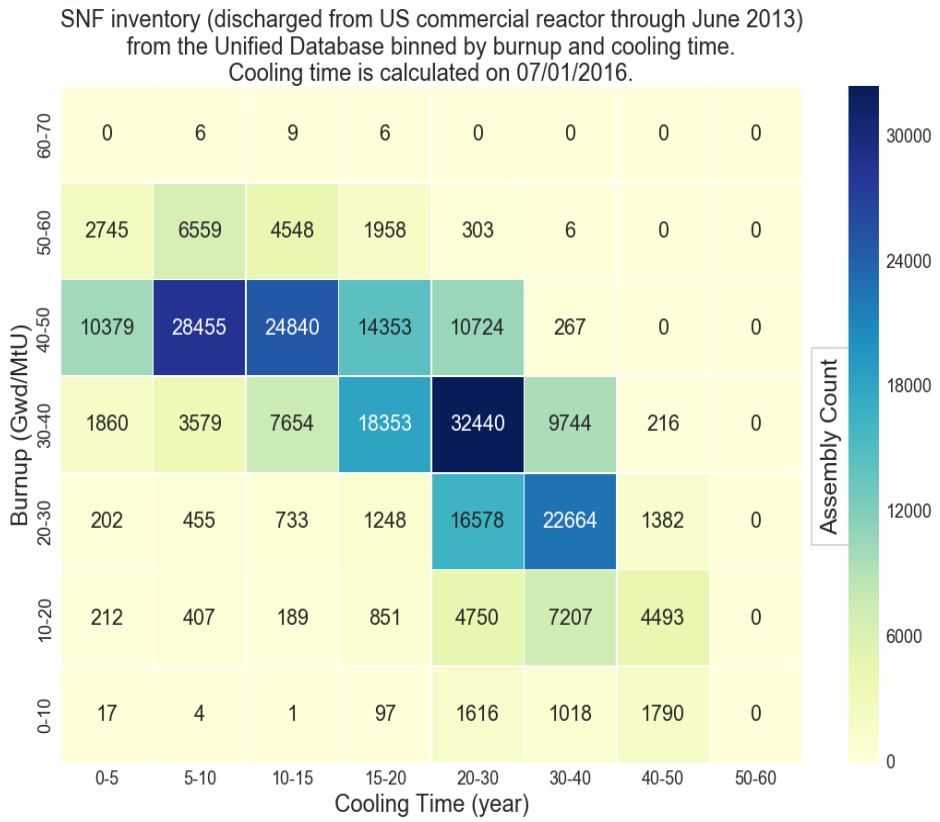
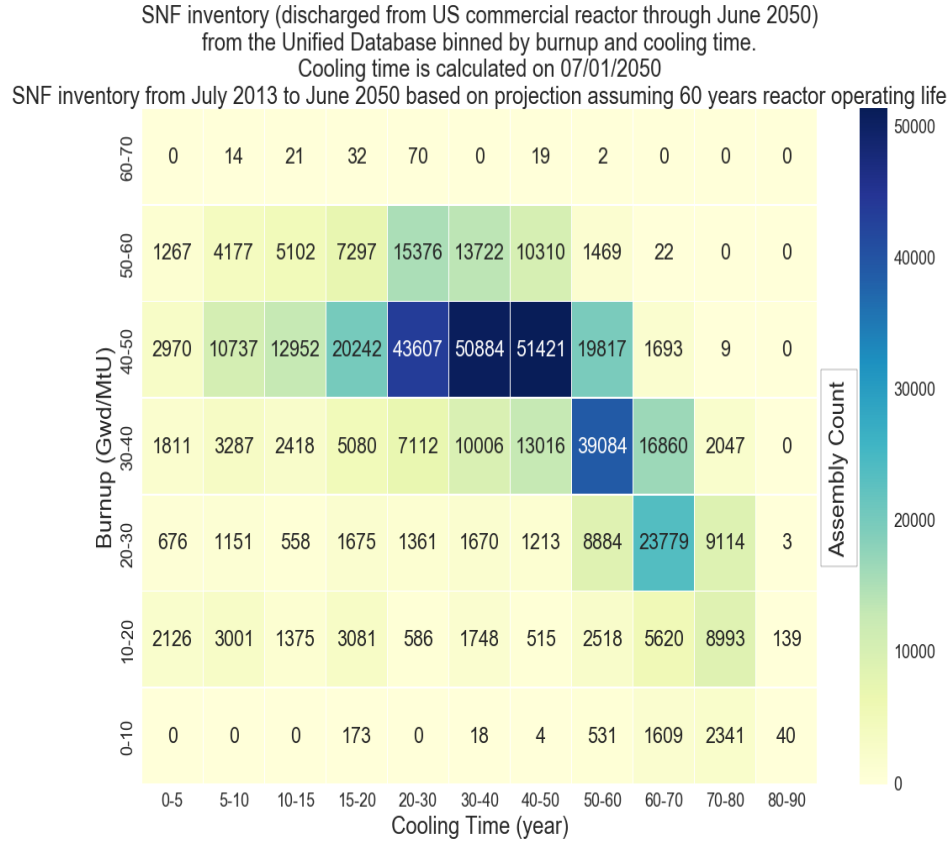


The Unified Database provides a credible, controlled data source and key information for SNF management





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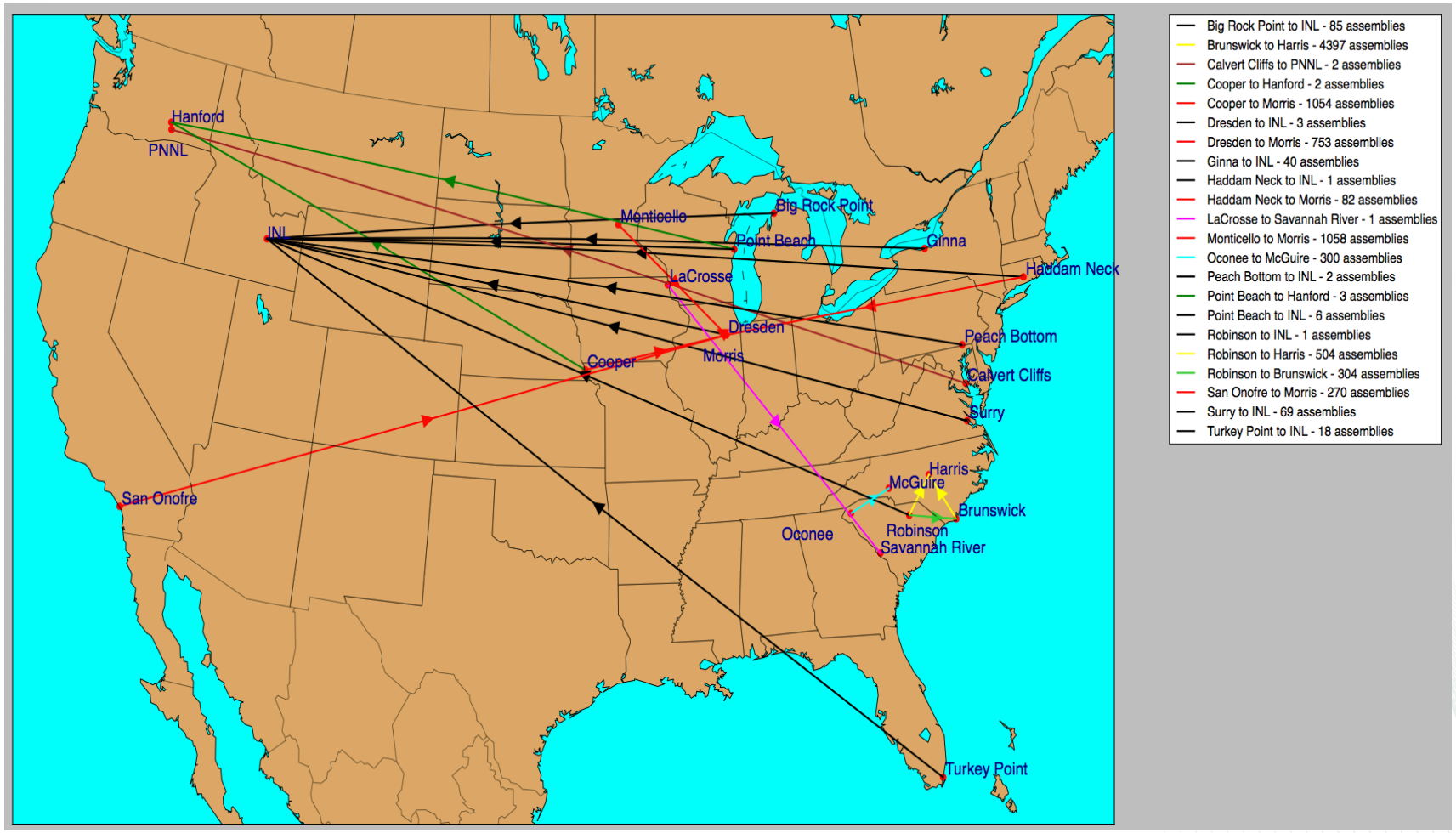
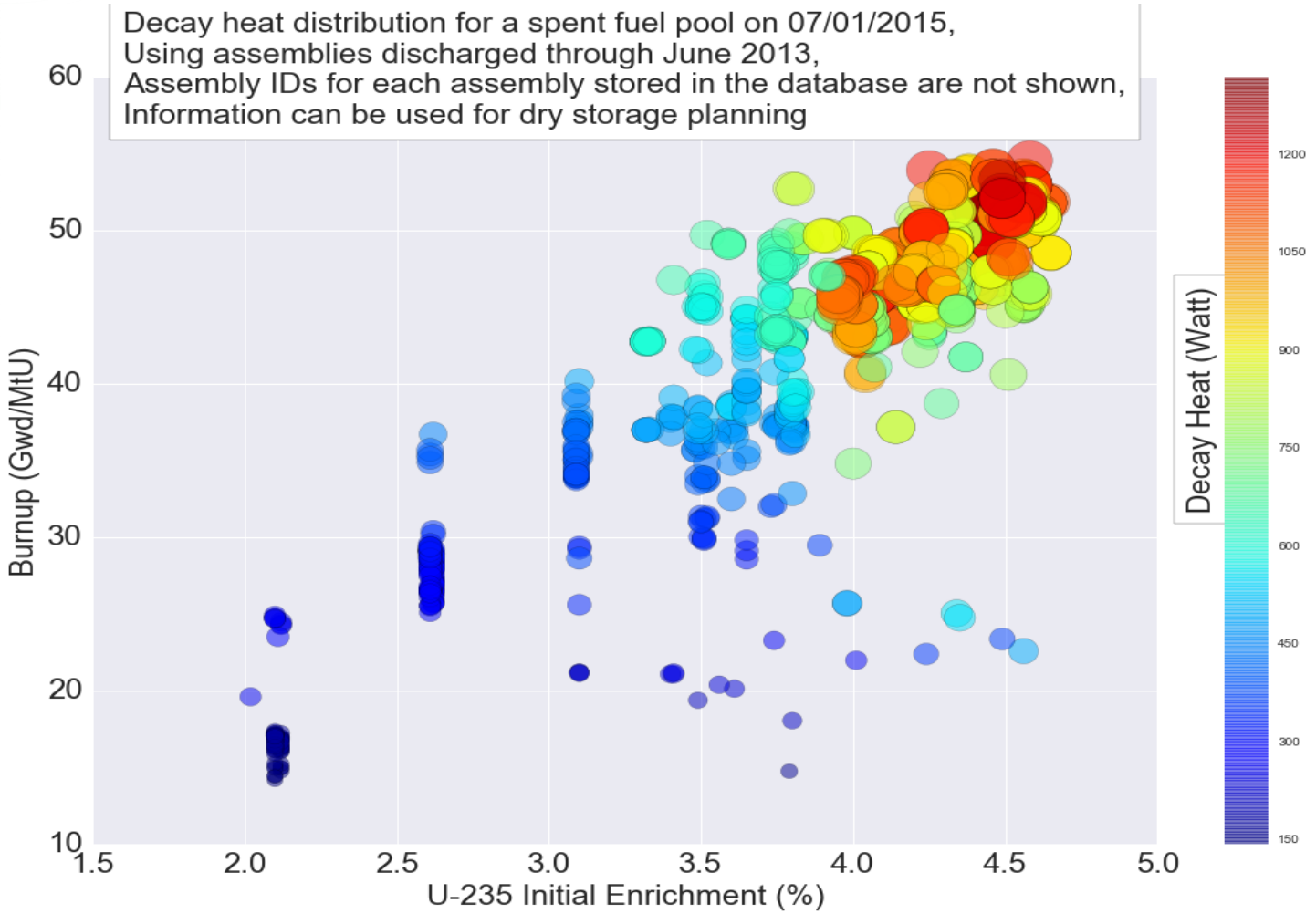
The Unified Database provides material movement history and proper material accountancy



UNF-ST&DARDS assembly-specific decay analysis can be used for dry storage planning



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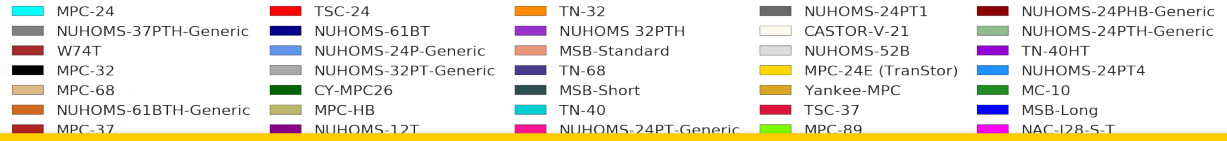
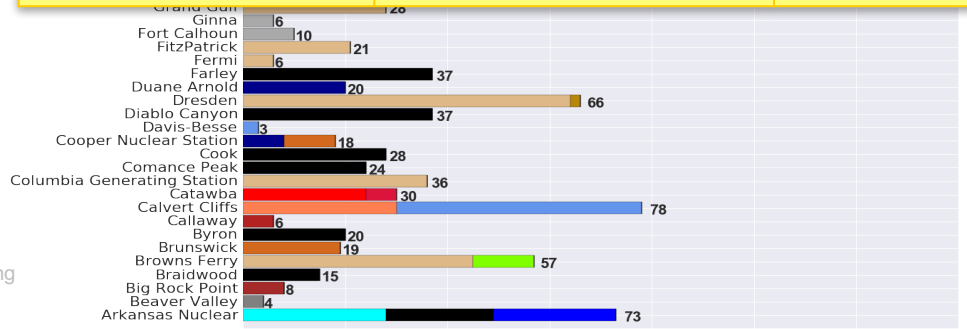
UNF-ST&DARDS cask specific information facilitates transportation planning



Canister	Transportation Cask	Length with Impact Limiter (in)	Diameter with Impact Limiter (in)	Loaded Weight (lb)
MPC-24, MPC-32, MPC-68	HI-STAR	307.5	128.0	272,622-279,893
NUHOMS-37PTH, NUHOMS-61BTH	MP197HB	271.25	126.0	303,600
CY-MPC, LACBWR	NAC-STC	273.7	128.0	241,664-254,589
W74T	TS125	342.4	143.5	285,000



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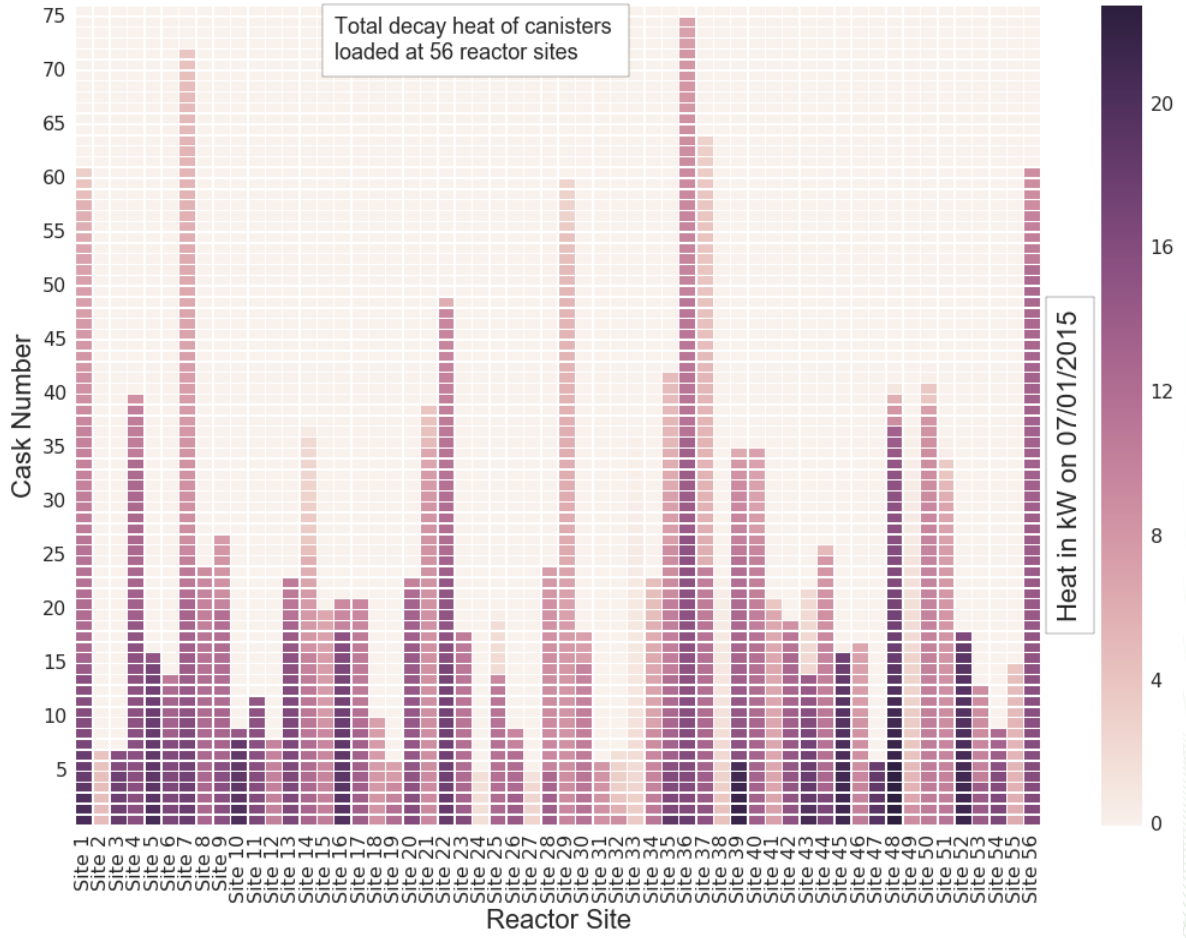
UNF-ST&DARDS can be used to determine when a loaded canister is transportable from a decay heat standpoint

- Assembly-specific decay heat calculated within UNF-ST&DARDS can be used to determine when a loaded canister can be transported
- Decay heat is also used to determine
  - Internal component temperature including cladding temperature
  - Canister surface temperature



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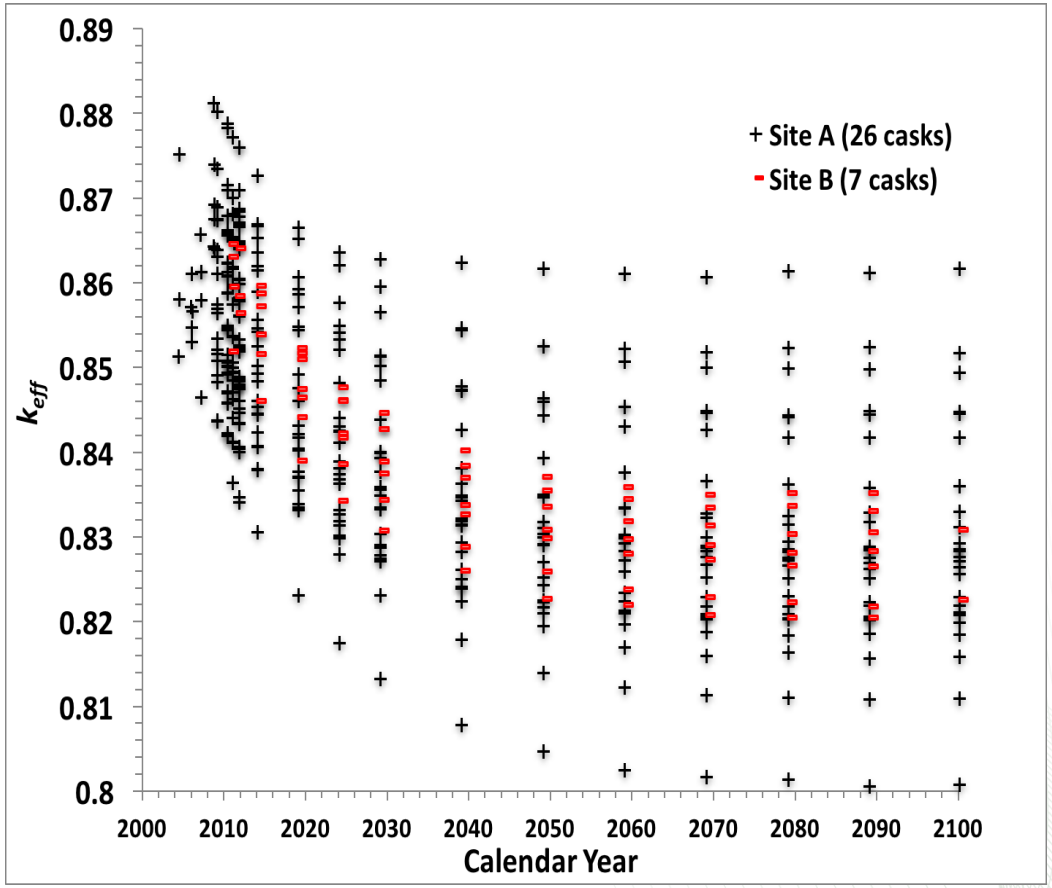
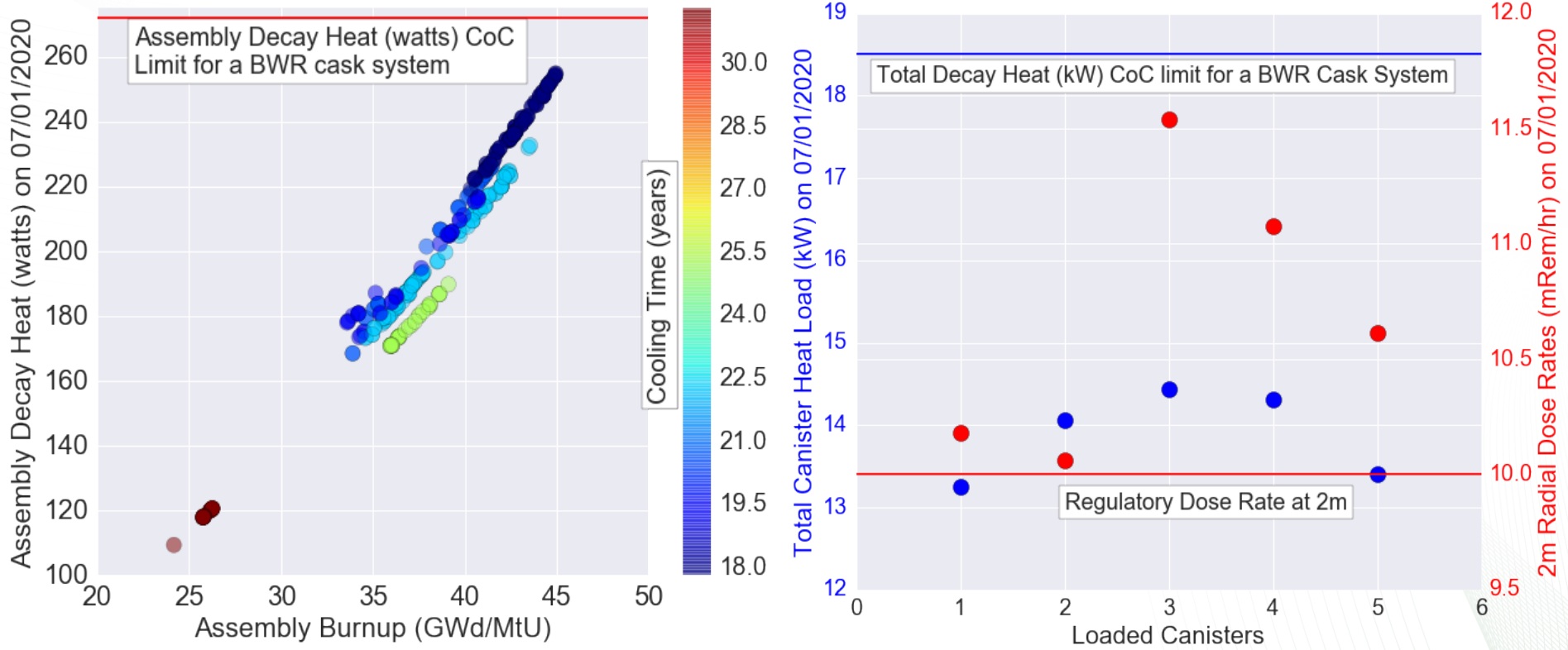
UNF-ST&DARDS can be used to determine whether a loaded canister is transportable from a criticality standpoint

- SNF loaded following the storage COCs may not be transportable
- However, loaded canisters generally possess excess and uncredited criticality margins (difference between licensing and as-loaded)
  - As-loaded analysis can be used for license amendment and integrating storage and transportation analysis approaches



UNF-ST&DARDS can be used to determine when a loaded canister is transportable from a shielding standpoint



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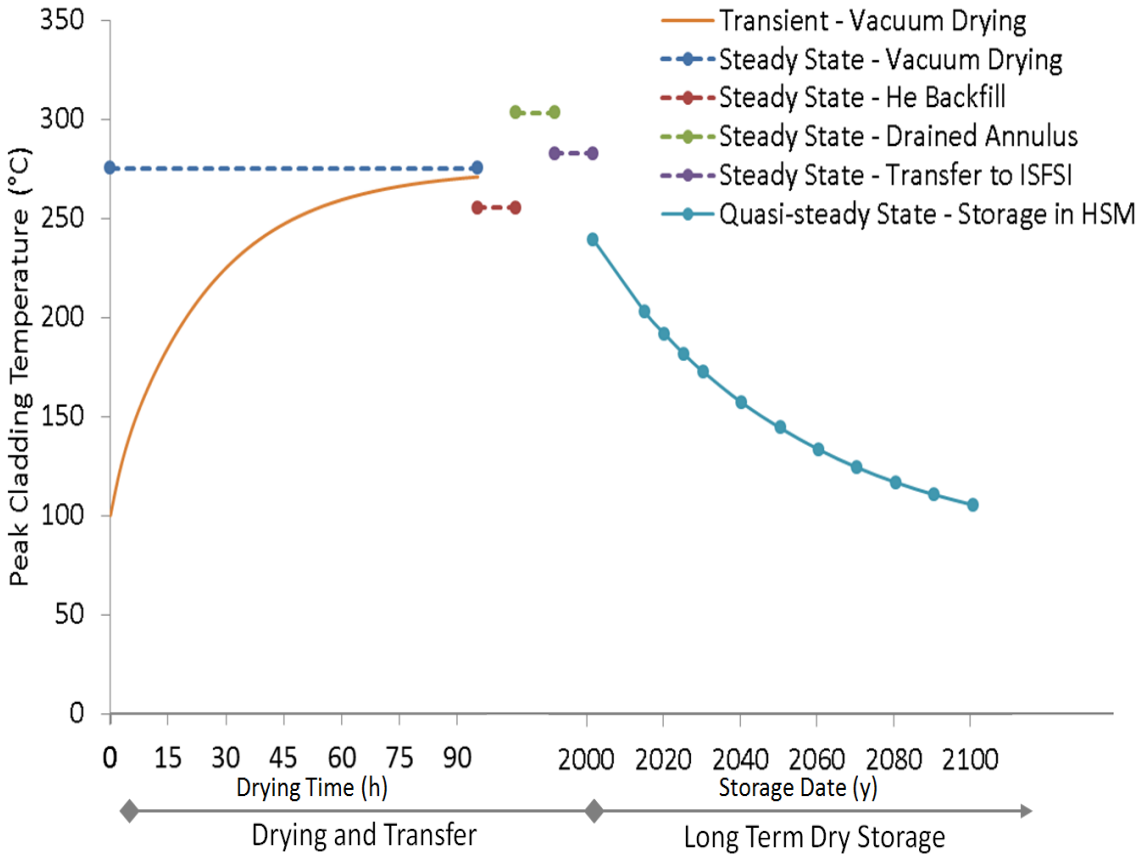
UNF-ST&DARDS can be used to answer concerns related to fuel structural integrity after extended storage

- UNF-ST&DARDS includes the capability to assess temperature changes during drying, transfer, and long term dry storage of SNF
- Temperature-dependent phenomena include
  - cladding creep
  - hydride reorientation
  - ductile-to-brittle transition
  - potential stress corrosion cracking of canisters



Conclusion: UNF-ST&DARDS provides the foundation of an integrated SNF management system

- UNF-ST&DARDS is a comprehensive, integrated data and analysis system
- UNF-ST&DARDS is being developed to support the design, licensing, safety, security, and eventual disposal of SNF systems
  - Ready access to characteristics of all the SNF assemblies enables informed decisions relative to system design, safety, security, fuel cycle options, and disposition
  - Realistic cask-specific safety margin can be used to offset uncertainties associated with continued fuel integrity and direct disposal
  - Ready access to various SNF related data helps to prioritize R&D on the most important issues
  - Proper characterization of systems supports aging management and planning for interim storage and associated transportation and disposal
  - Preserves the SNF information for decades during which SNF related issues will be addressed (**Knowledge Management**)