THERMAL MANAGEMENT OBJECTIVE

- Evaluate system operational alternatives with potential to:
  - Increase thermal flexibility
  - Increase operational efficiency
- Provide input for overall thermal strategy development
INTEGRATED THERMAL MANAGEMENT ACROSS SYSTEM ELEMENTS

UTILITIES

Waste Selection

REDUCE TOTAL HEAT LOAD
REPOSITORY OPERATIONAL OPTIONS

STORAGE
Aging

REPOSITORY(s)

Emplacement Pre-closure operations

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Effect of Selection Strategies

- Delay pickup of hottest packages
  - provide maximum on-site aging of fuel
  - examples illustrate bounds (OFF, YFF5)

- Approach must recognize institutional constraints to pickup strategies
Example of Effect in a Simple Model
OFF Pickup

MPC RFP assembly heat limit for transportation (730 watts)

10930 PWR assemblies over limit

Assembly heat at pickup (watts)
Example of Effect in a Simple Model
YFF(>5 yrs) Pickup

Number of assemblies

MPC RFP
assembly
transportation
heat limit
(730 watts)

38074 PWR assemblies exceed limit most greatly exceed it

Assembly heat at pickup (watts)

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Example of Effect in a Simple Model
YFF(>10 yrs) Pickup

MPC RFP
assembly transportation
heat limit
(730 watts)

33659 PWR assemblies exceed limit
Further Evaluation In Simple Model
Delay Emplacement of Hottest Packages

- MPC only
- OFF pickup
- No MRS
  (ship direct)
- Casks derated
  as required for
  shipment

Maximum Allowed Heat Output at Emplacement
(kilowatts per Multi-Purpose Canister)

Average Storage (years)

Number of Cask-years
(of storage at repository)

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Waste Package Spacing Example

- Equalize heat-load/unit-length among all packages that are spaced in the interior
Potential Effect Of Removing Water Vapor During Ventilation -- Latent Heat Removal

- Turnover air in waste-drifts through ventilation
  - remove water vapor flowing from rock

- Use negative pressure in emplacement-drifts to direct vapor flow from rock
Factors Can Reduce Repository Horizon Heat-loads Increasing Emplacement Flexibility

- Possible Sources of Design Margin
  - Avoid picking up hotter than OFF spent fuel (~1.25)
  - Age hottest fuel prior to emplacement (~1.12)
  - Higher thermal load near edge of repository (~1.12)
  - Remove warm moist air during operations (~1.05-1.25)

- Combined factors allow more flexible design

\[(1.25 \times 1.12) \times (1.12 \times 1.25) \approx 2\]
SUMMARY

- Options are applicable for all potential repository thermal loads
- Preliminary analyses suggest overall strategy may benefit from combination of
  - Waste acceptance from utilities
  - Aging hotter SNF prior to emplacement
  - Emplacement spacing
  - Ventilation
- Need to be careful; these are preliminary scoping studies
- Thermal management options must take into account institutional framework