U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD ENGINEERED BARRIER SYSTEM AND TRANSPORTATION AND SYSTEMS JOINT PANEL MEETING

SUBJECT: EFFECT OF THE MULTIPLE-PURPOSE CANISTER ON THERMAL LOADING

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Mined Geologic Disposal System (MGDS) Multiple-Purpose Canister (MPC) Thermal-Loading Considerations

- MPC implications on thermal loading
- MPC design criteria related to thermal loading
- Thermal-loading decision strategy
  - Activities ongoing and planned
  - Schedule
- Decision risks

MPC Implications on Thermal Loading

Importance of Thermal Loading

- Affects
  - Magnitude and content of site characterization
  - Material selection and design of waste package
  - Repository design and operation
- All of which affects
  - Overall system performance and licensability

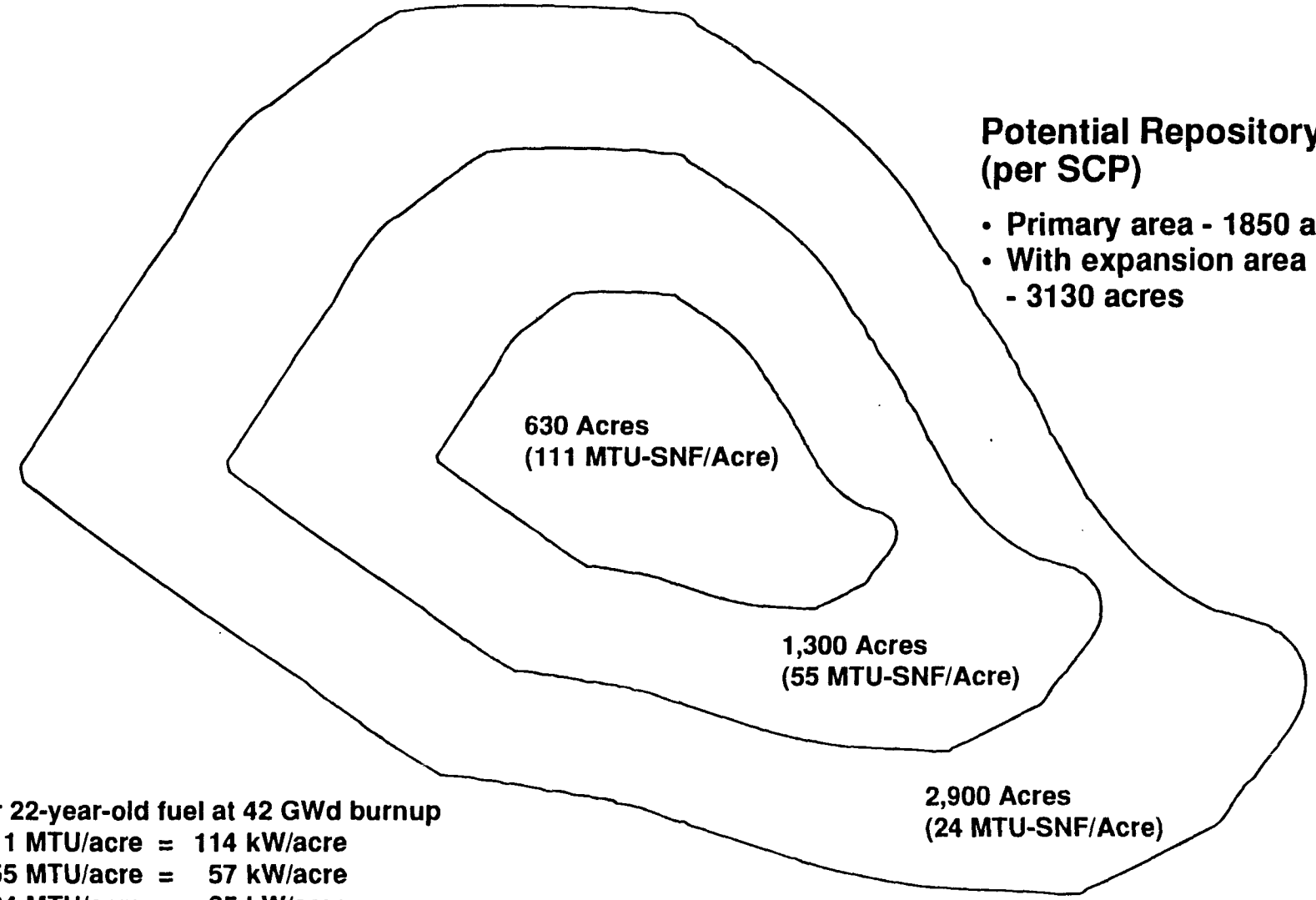
Factors Affecting Thermal Response Waste Package

- Repository thermal loading, area, mass loading (AML)/ area, power density (APD) (canister and drift spacing)
- Waste package size
  - Heat output per package
  - Waste package capacity
- Decay heat of spent nuclear fuel (SNF)
  - Time after discharge
  - Initial enrichment and burnup of SNF
- Materials of fabrication
- Design type
  - Flux trap
  - Burnup credit
- Drift size

Thermal Loadings

	Low T < boiling	Medium SCP - hot	High Extended hot
MPC with Disposal Canister	Small	Any	Any
Emplacement Mode	Any	Any	Drift or Large Horizontal Borehole
Emplaced Area	~2xSCP	SCP-1250 acres	~1/2xSCP

POTENTIAL REPOSITORY SIZE
(EMPLACEMENT OF 70,000 MTU)



Potential Repository Area (per SCP)

- Primary area - 1850 acres
- With expansion area - 3130 acres

For 22-year-old fuel at 42 GWd burnup
111 MTU/acre = 114 kW/acre
55 MTU/acre = 57 kW/acre
24 MTU/acre = 25 kW/acre

Implications of a Large MPC in a Below-Boiling Repository

Significant portions of the rock will be above boiling

- In the immediate vicinity of the large waste package because of its high heat-generation rate
- Reduces the overall effectiveness of the cold strategy

Significant potential for water reflux into the drift

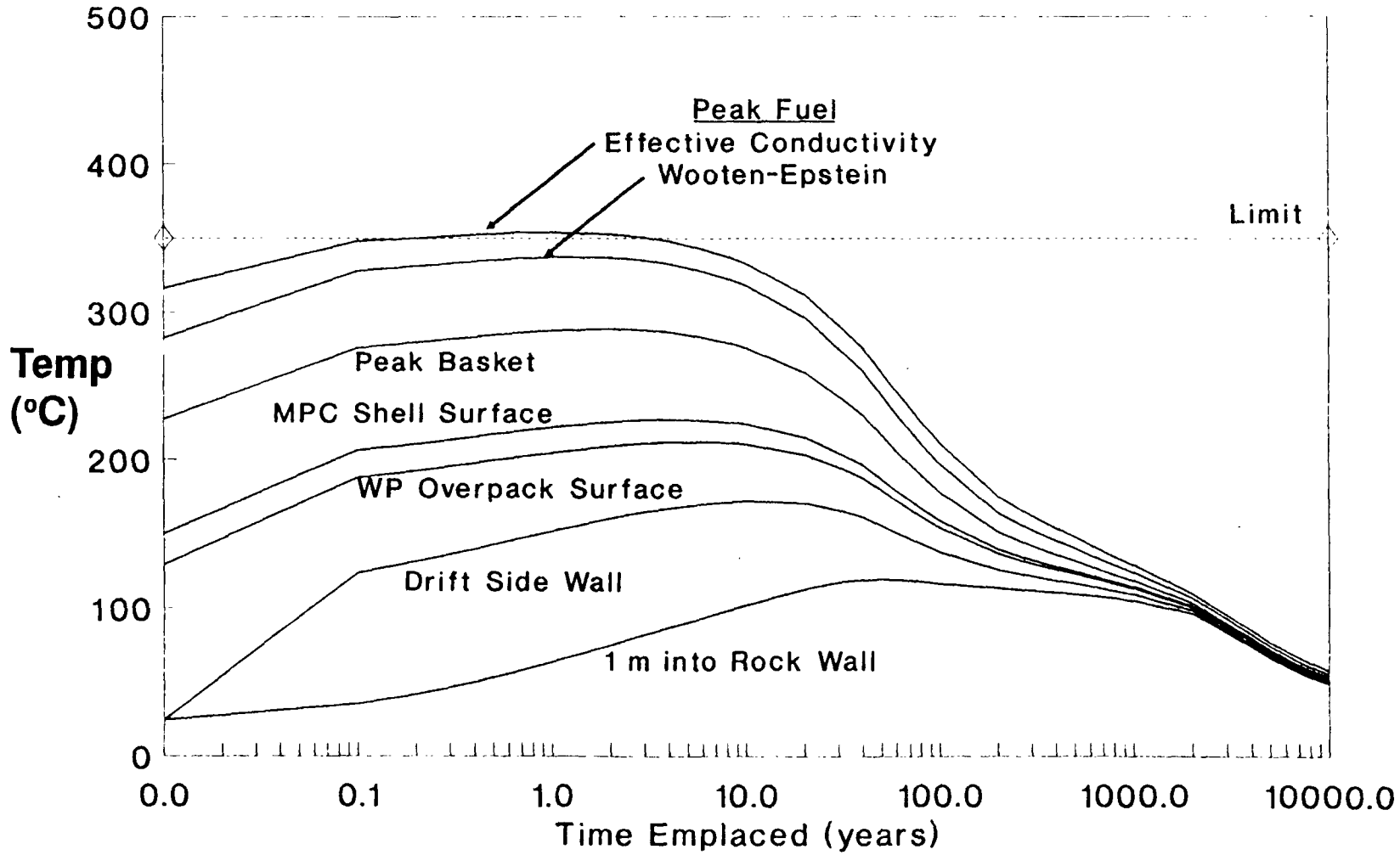
- Large waste packages/MPC require large spacing to achieve low thermal loading
- Large spacing between packages means large temperature variations along the drift
- Large temperature variations can drive persistent convection cells

MPC Design Criteria Related to Thermal Loading

MPC Design Criteria Related to Thermal Loading

- **Must meet the repository Title 10 CFR Part 60 performance requirements**
  - 10 CFR 60.133 (i) performance under thermal loads
  - 10 CFR 60.113 (a) (ii) (A) substantially complete containment for 300-1,000 years
- **Maximum temperature goals**
  - 350°C fuel element cladding
  - 200°C one meter into rock
- **Criticality**
- **Subsurface operations**
  - Operability, weight constraints
  - 50°C in access drifts during emplacement period
  - Radiation shielding

Temperature in Repository
21PWR MPC, 25 ft. Drift, 57 kW/acre



10-year-old fuel, 40 GWd/MTU burnup

Thermal-Loading Decision Strategy

Decision Strategy for Thermal Loading

- **Goal:** Develop a Civilian Radioactive Waste Disposal System (CRWDS) in which all system elements contribute to meeting applicable regulatory requirements
  - Mined Geologic Disposal System (MGDS) (pre-closure and post-closure)
  - Monitored Retrievable Storage (MRS) and transportation
- **Strategy:** Enhance the performance of the CRWDS by appropriate use of the repository waste heat

Thermal-Loading Decision

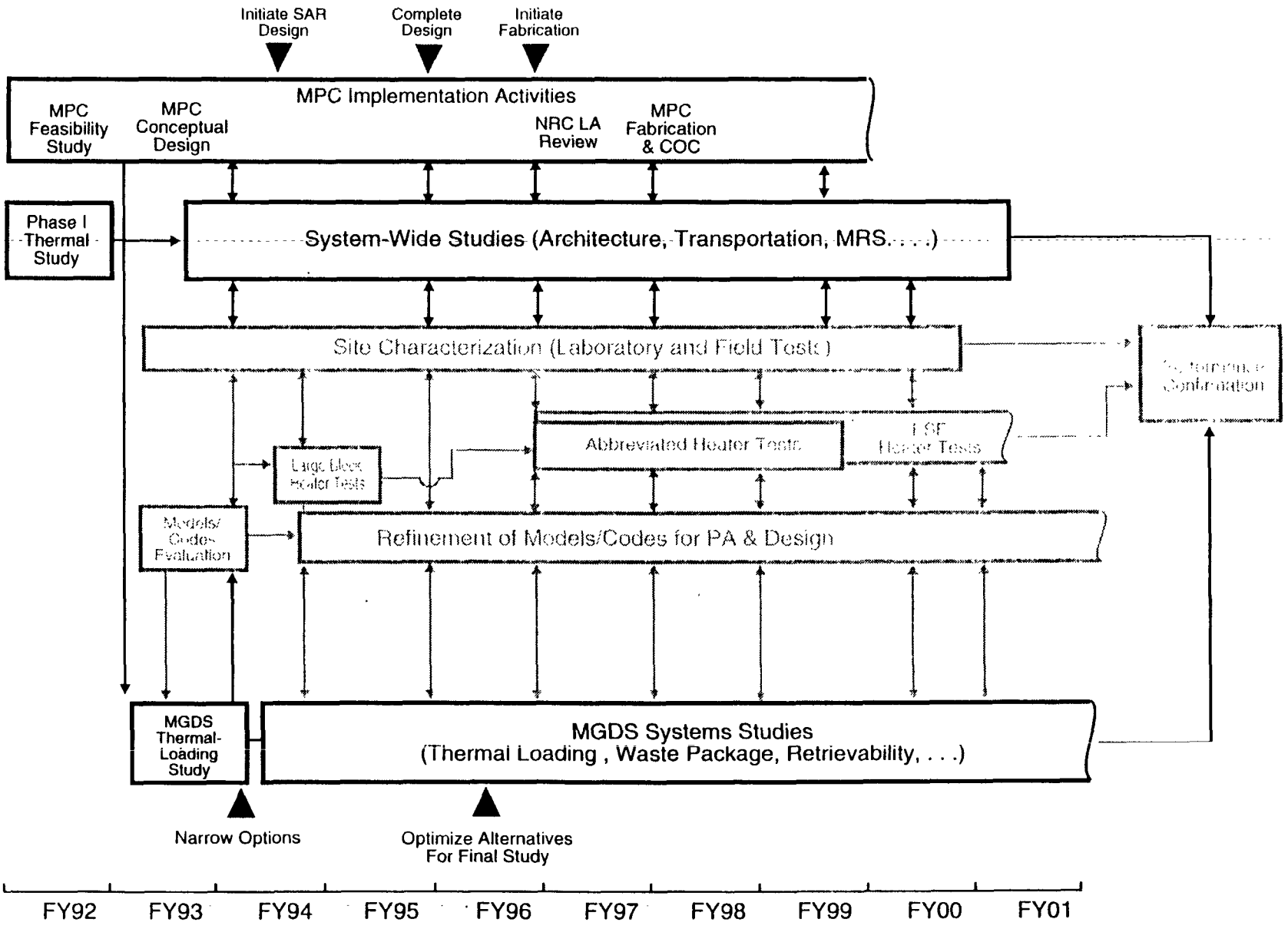
Requires Integration of

- Site characterization
- Design
- Performance Assessment
- MPC studies

Through

- Thermal-loading study
- Modeling and code development
- Laboratory and field testing
- Performance calculations
- MPC design studies

Thermal-Loading Interactions



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Decision Risks

Large MPC Capacity Considerations for MGDS

- Waste Package Design Goal: no loading requirements beyond maximum acceptable assembly heat defined by design-basis fuel

- If MPC loading can be managed with selection/blending, then higher capacity MPCs can be accommodated in repository emplacement
  - Fuel age requirements/differential loading

    or
  - Leaving center assembly spaces open (derating)

- Thermal strategy

Decision Risks

- The program recognizes that proceeding with MPC has some risk
  - MPC is less flexible if local boiling is to be minimized
  - Thermal-loading decision will probably not be made until 1997-1999
  - Some early MPCs may end up dual-purpose
- The thermal-loading decision will be based on scientific evidence expected in the 1997-1999 time frame
  - Dependent on subsurface test data
  - By that time, only about 100 to 200 MPCs probably will have been constructed