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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: COMPATIBILITY OF MULTI-PURPOSE CANISTER/MULTI-PURPOSE UNIT WITH THERMAL SCENARIOS

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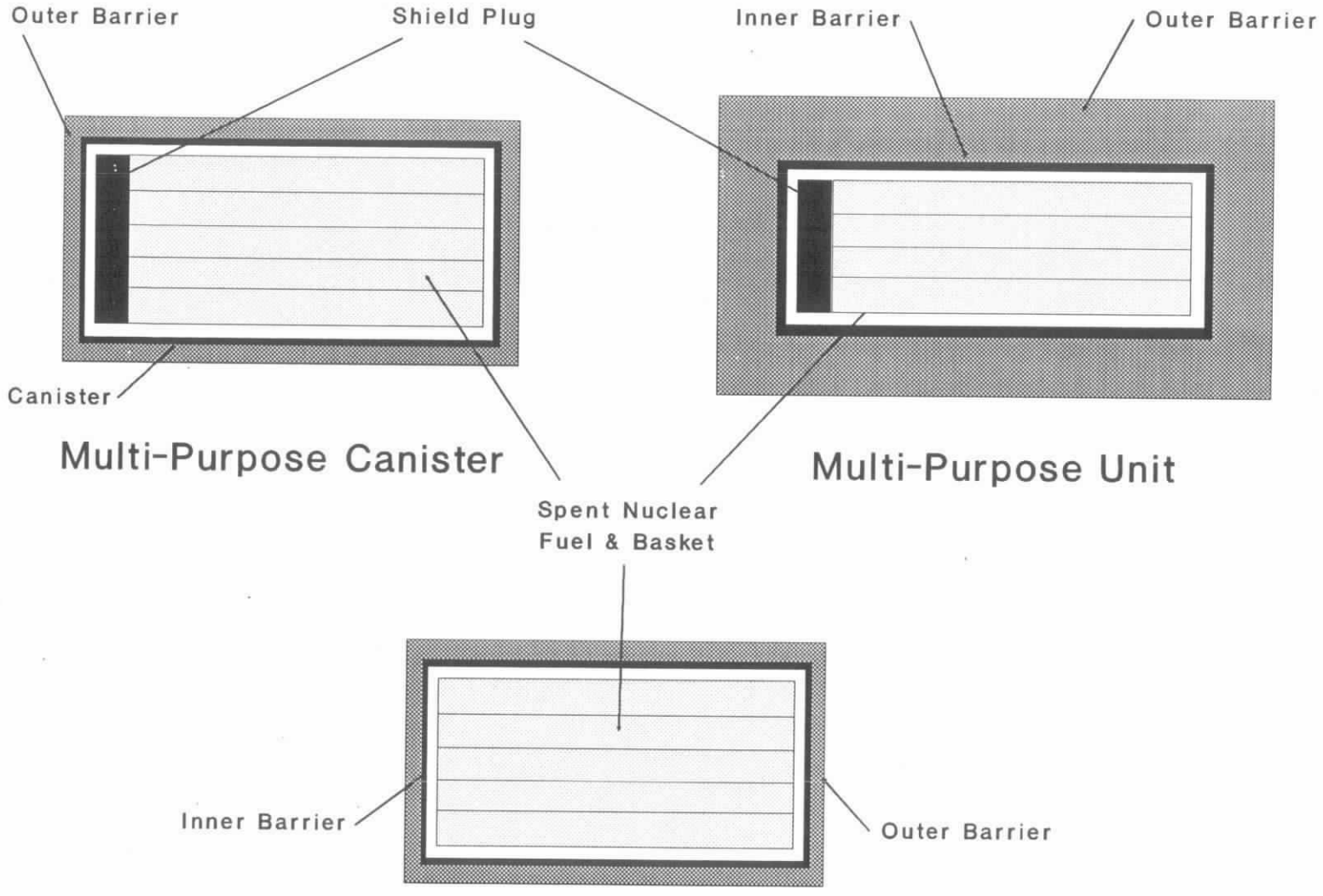
Outline

- Impacts of Multi-Purpose Canister (MPC) and Multi-Purpose Unit (MPU) on repository
- Impacts of repository requirements on MPC and MPU on system
- Impact of MPC and MPU size and weight
- Material selection impacts
- MPC and MPU thermal impacts on repository


Outer Barrier
Shield Plug
Canister
Multi-Purpose Canister
Inner Barrier
Outer Barrier
Multi-Purpose Unit
Spent Nuclear
Fuel & Basket
Inner Barrier
Outer Barrier
Multi-Barrier Waste Package

Multi-Purpose Canister (MPC) and Multi-Purpose Unit (MPU) Limits

- 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
- Repository thermal design goals
  - 350°C Cladding maximum temperature
  - 200°C one meter into rock maximum temperature

Multi-Purpose Canister and Multi-Purpose Unit Impacts on Repository

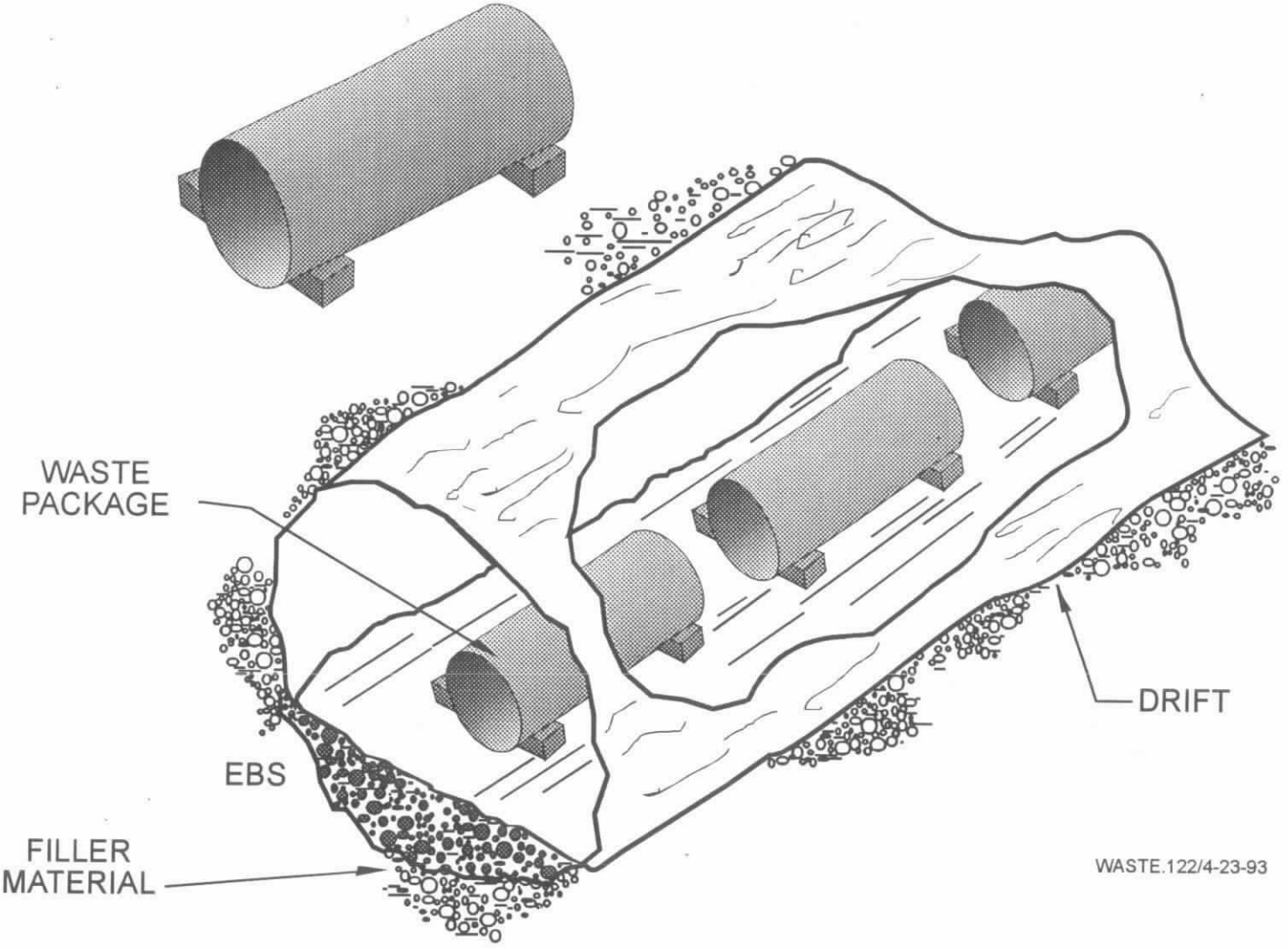
- Reduces individual fuel handlings
- Limits emplacement modes of waste package
- MPC/MPU are not specifically designed for disposal, alone
- MPU self-shielded, heavier
  - Title 10 CFR 71 shielding requirements dictate heavier shielding

Multi-Purpose Canister and Multi-Purpose Unit Impacts on Repository

(Continued)

- MPC with disposal overpack would become a large, drift-emplaced, multi-barrier waste package
- MPU similar to a medium-sized, drift-emplaced, multi-barrier, waste package
- MPC and MPU concepts thermal output relatively high

Drift-Emplaced Waste Package



Robust Waste Package, MPC and MPU Weight[1] Trends

	Multi-Barrier Waste Package	MPC With Disposal Overpack	MPC with Shielded Disposal Overpack[2]	MPU
21 PWR	56	78	150	180
12 PWR	38	59	112	139
10 CFR Part	60	60, 71	60,71	60, 71, 72

1 Weight in U.S. short tons
2 Meets Title 10 CFR Part 20 for radiation worker

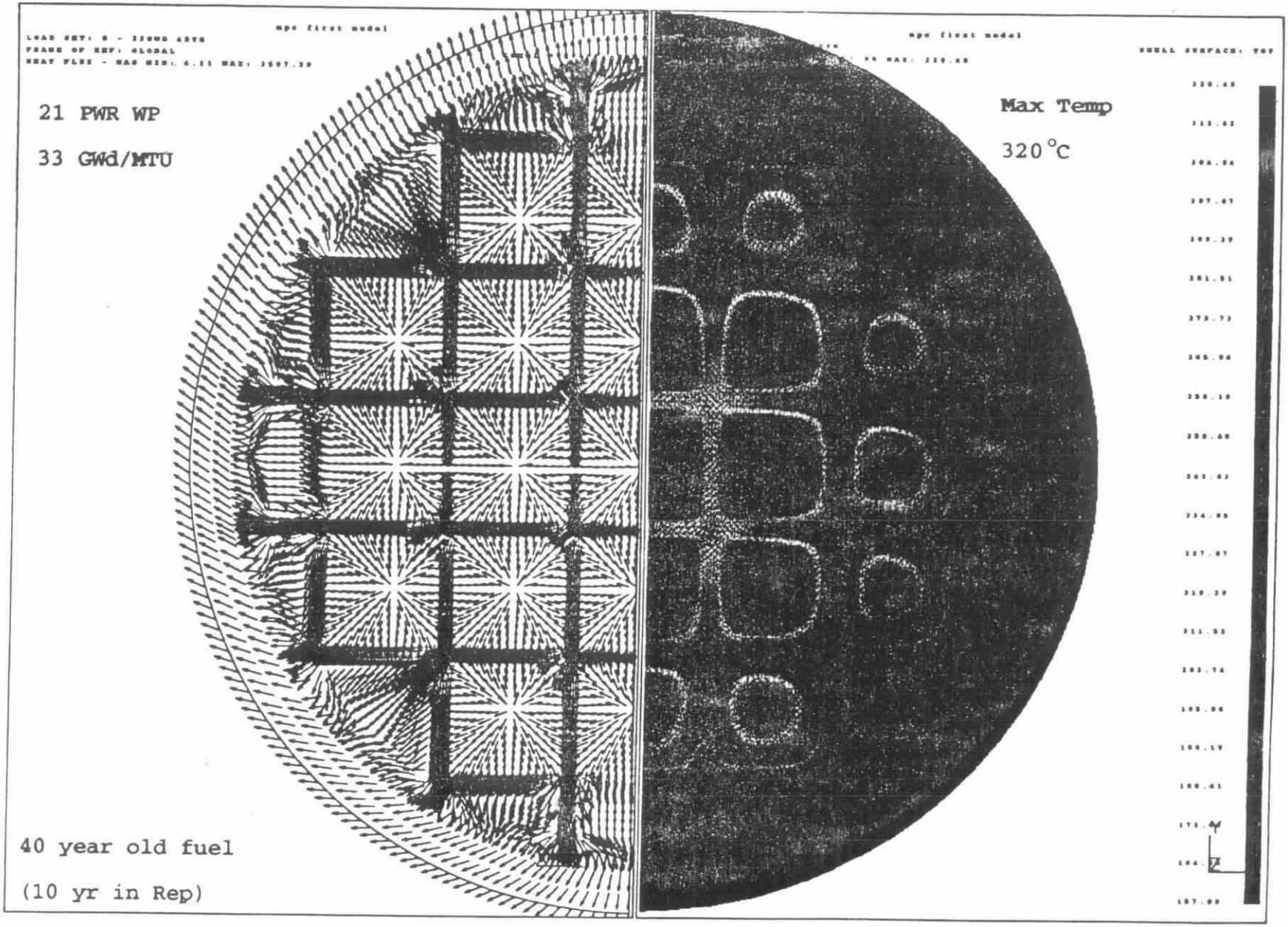
MPC Material Selection

Component	Primary	Alternate
MPC Shell	Alloy 825	Titanium Grade 12, Alloy C-4
Shield Plug	Iron Base Alloy (SS Sheathed or Nickel Plated)	Iron Base Alloy
SNF Basket (Structural)	316L Stainless Steel	Alloy 825 (if welded to shell, use same material as shell)
SNF (Criticality)	Boron Stainless Steel	Boron Aluminum Alloy
Filler Material	(May be Required)	
MPC Fill Gas	Argon	Helium

Factors Affecting Thermal Response of Disposal Device

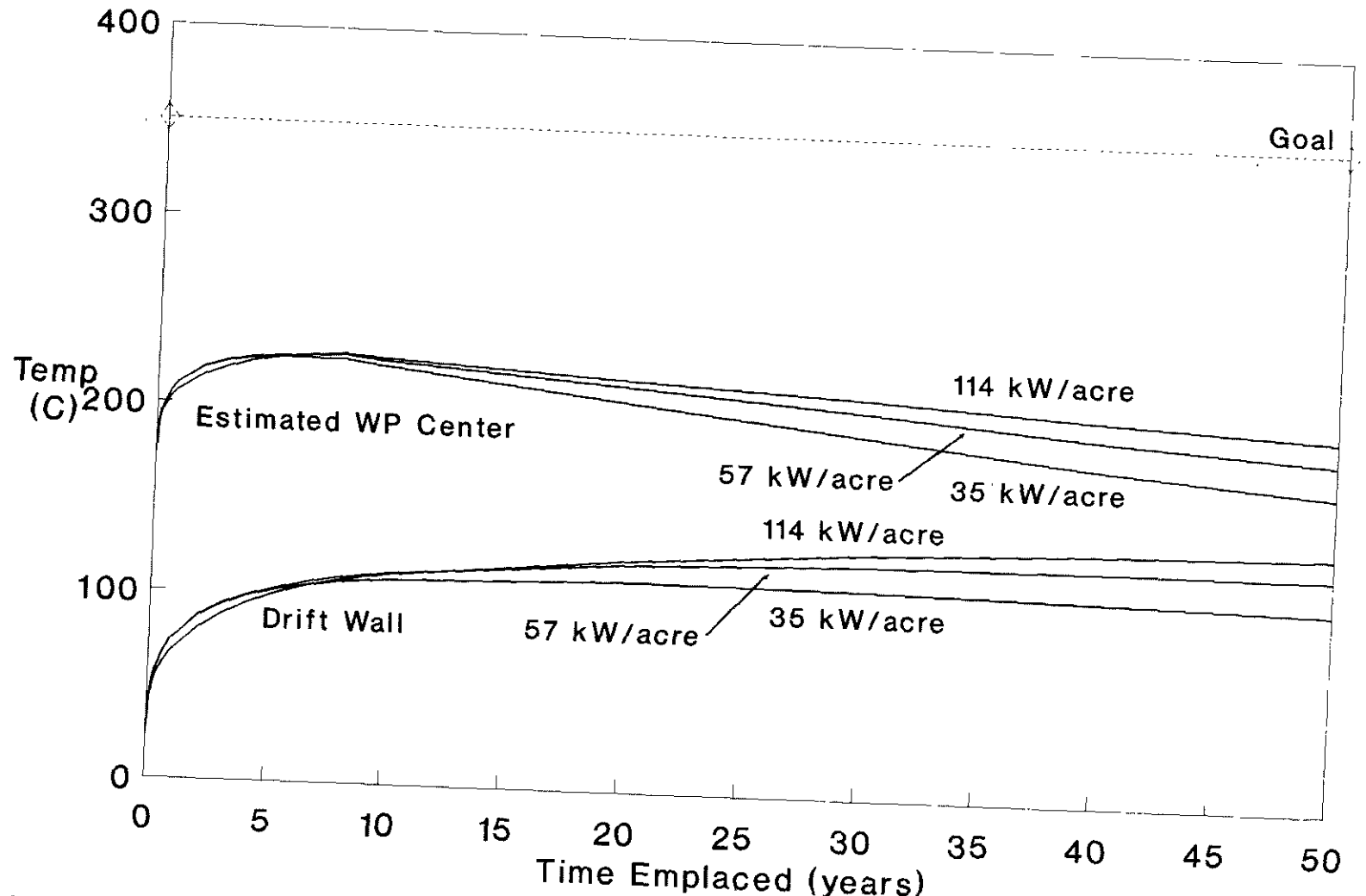
- Repository thermal loading, areal mass loading (AML)/areal power density (APD)
- Drift size
- Canister and drift spacing
- Decay heat of spent nuclear fuel (SNF)
  - Time after discharge
  - Initial enrichment and burnup of SNF
  - Amount of SNF
- Materials of fabrication
- Design type
  - Flux trap
  - Burnup credit

Thermal Color Photo



Effect of Thermal Loading

12 PWR, 25 ft Drift

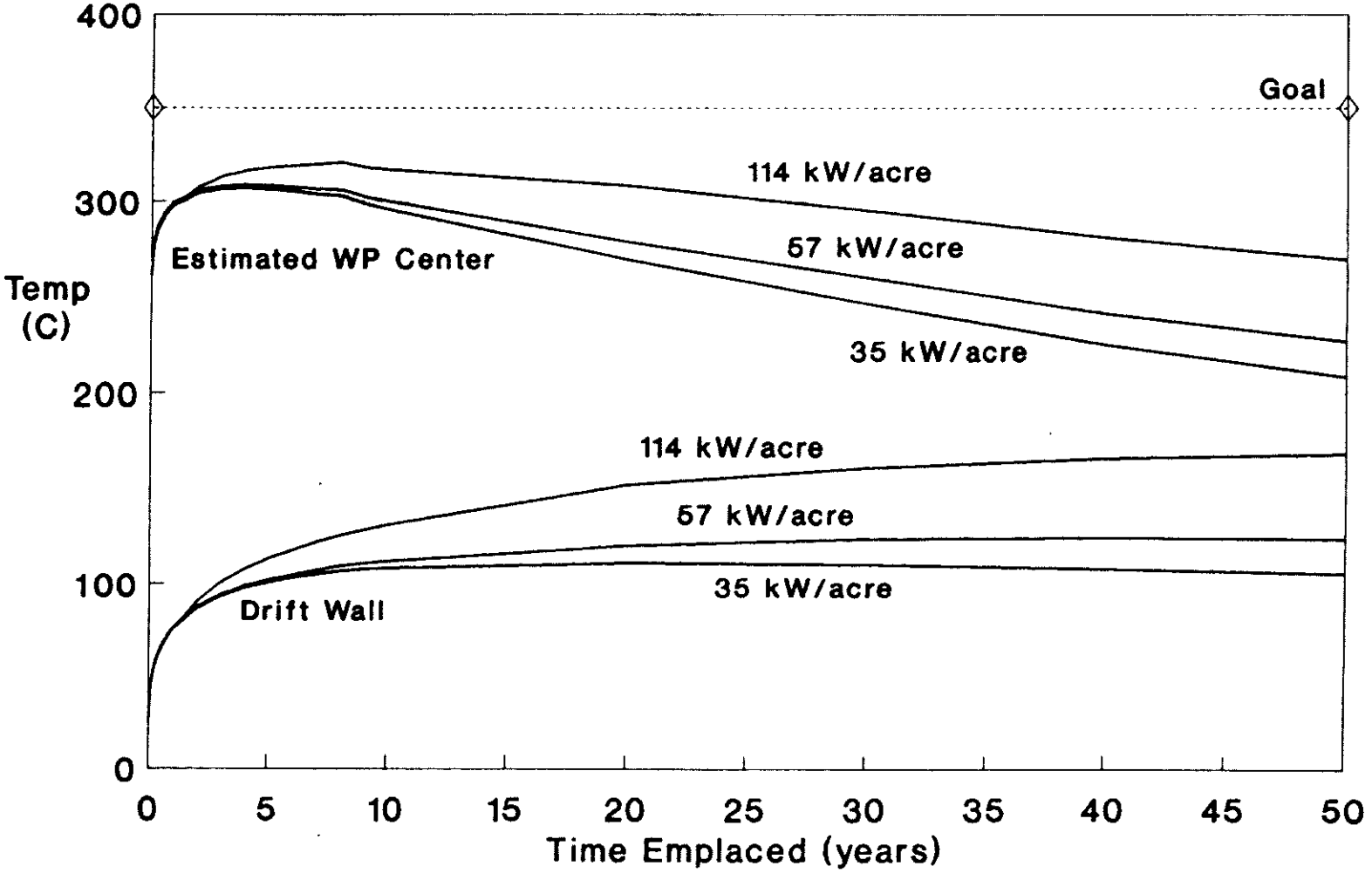


22 year old fuel, 42.2 GWd/MTU burnup

Constant 9.0 m WP spacing

Effect of Thermal Loading

21 PWR, 25 ft Drift

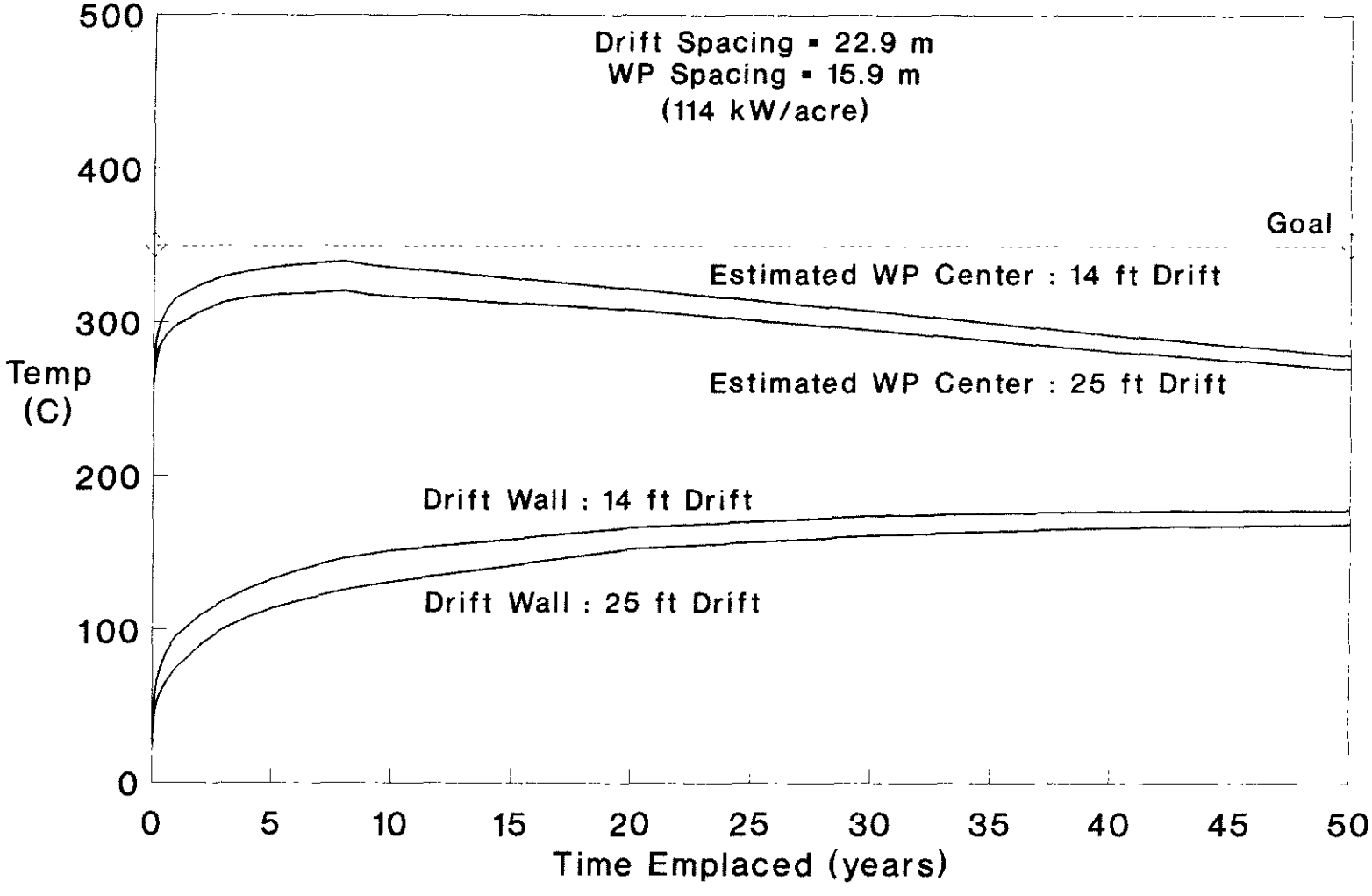


22 year old fuel, 42.2 GWd/MTU burnup

Constant 15.9 m WP spacing

Effect of Drift Diameter

21 PWR, 100 MTU/acre



22 year old fuel, 42.2 GWd/MTU burnup

Thermal Impacts

- Thermal response of engineered barrier system/disposal container is directly dependent on repository thermal load
- Spent nuclear fuel aging will not affect long-term engineered barrier system temperatures at a given areal mass loading
- Spent nuclear fuel aging at a given areal power density will raise repository temperatures

What if MPC/MPU Designs are Found Not to be Compatible with Repository Needs?

- Repackage waste at repository and/or redesign MPCs/MPUs
  - About 150 MPCs or MPUs of the 11,000 to 25,000 total MPCs/MPUs will be purchased by the anticipated time of the repository thermal loading decision

Conclusions

- If MPCs/MPUs are implemented
  - Larger capacity MPCs and MPUs are compatible with "hot" or "extended hot" repository thermal load ranges
  - Handling system(s) and transporter(s) will need to carry heavier loads
  - MPCs/MPUs tend to require drift emplacement