

UPDATE ON R&D FOR DISPOSAL OF DUAL PURPOSE CANISTERS

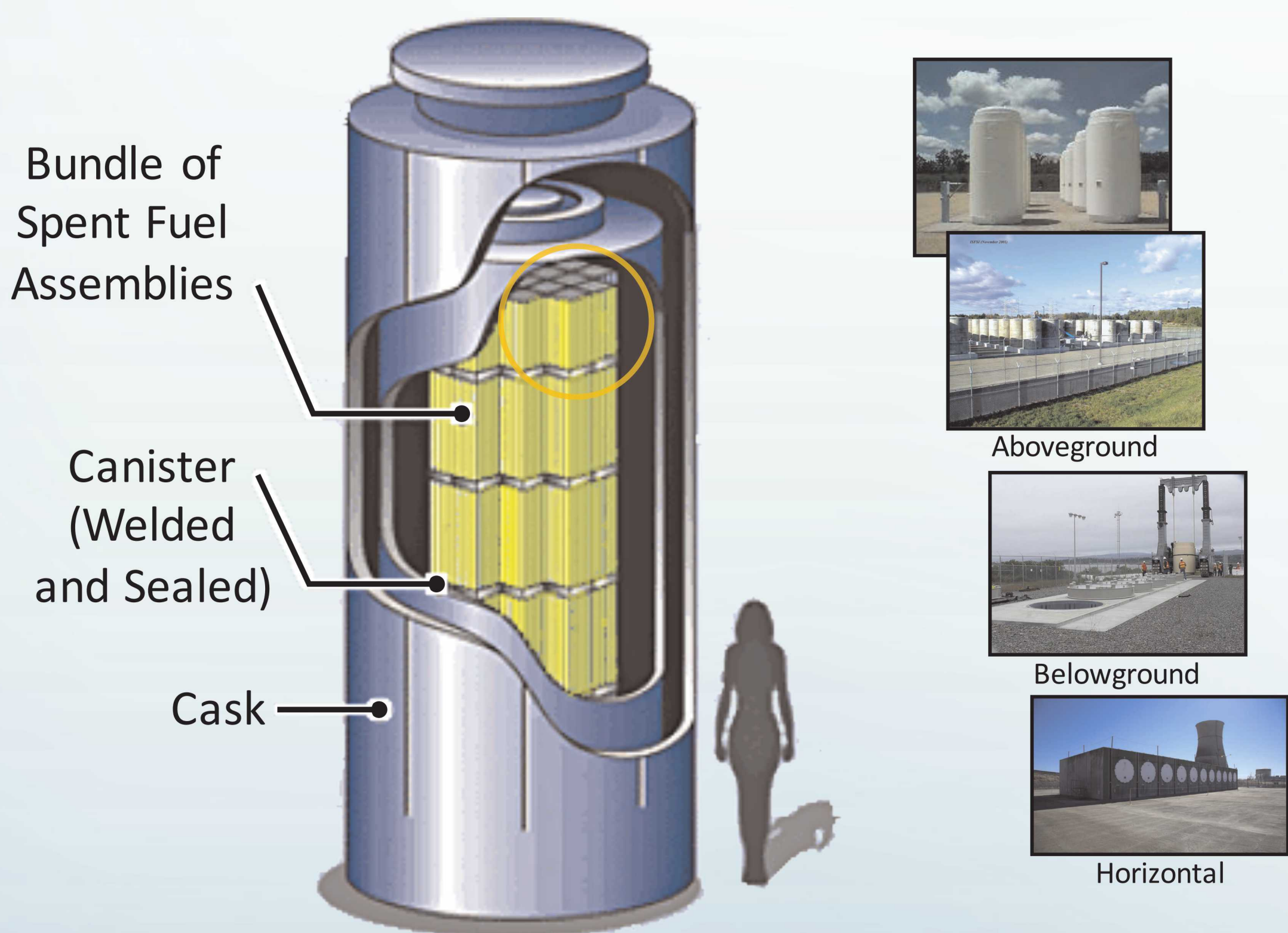
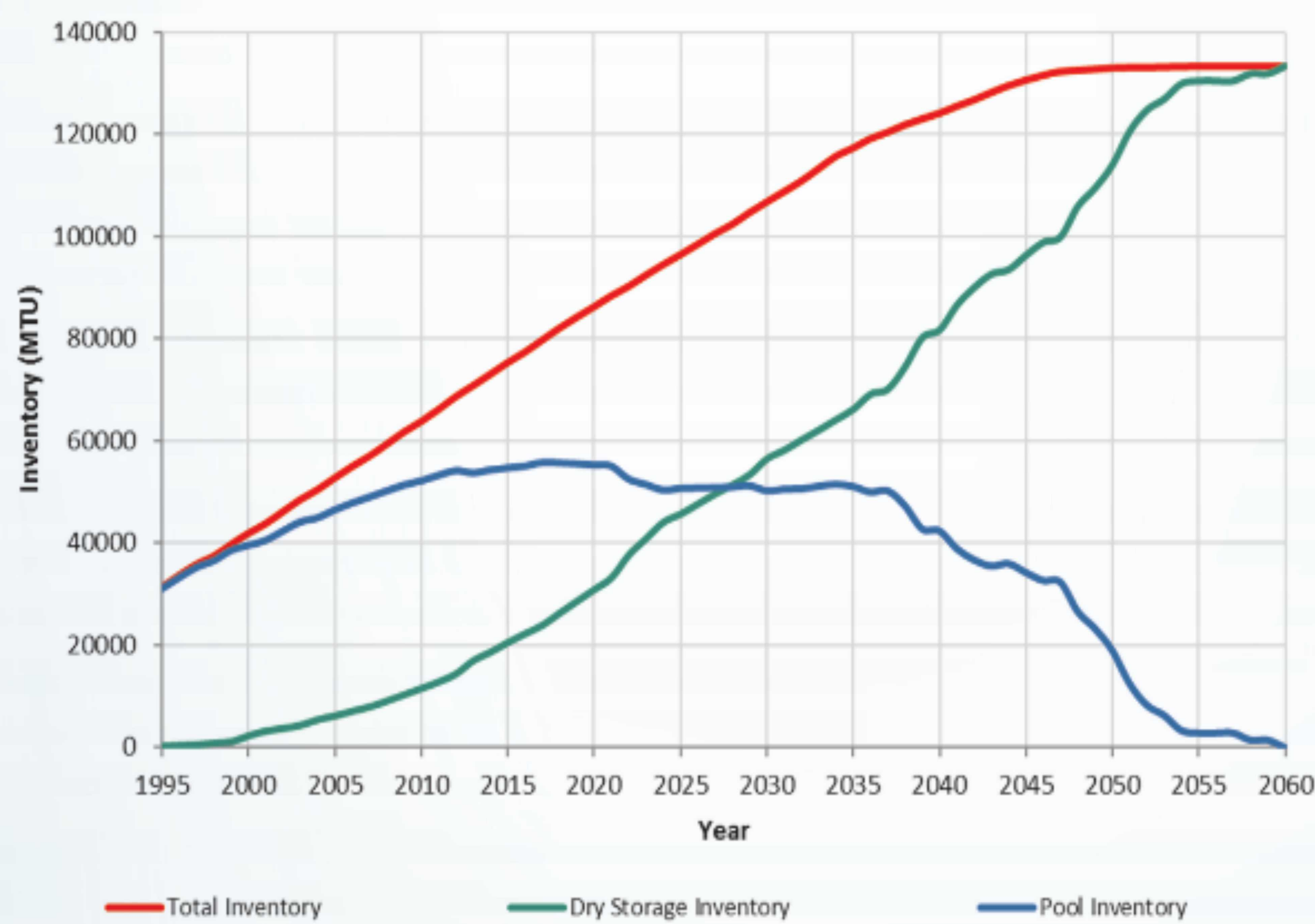
Ernest L. Hardin, Patrick V. Brady, Peter N. Swift and Evaristo J. Bonano // Sandia National Laboratories (SNL)

The growing inventory of spent nuclear fuel from U.S. commercial nuclear reactors in dry storage dual-purpose canisters (DPCs) at both operating and decommissioned power plants has necessitated the need to explore the possibility of directly disposing of these canisters even though they were neither designed nor licensed as disposal canisters.

LOCATION OF SPENT NUCLEAR FUEL IN THE USA

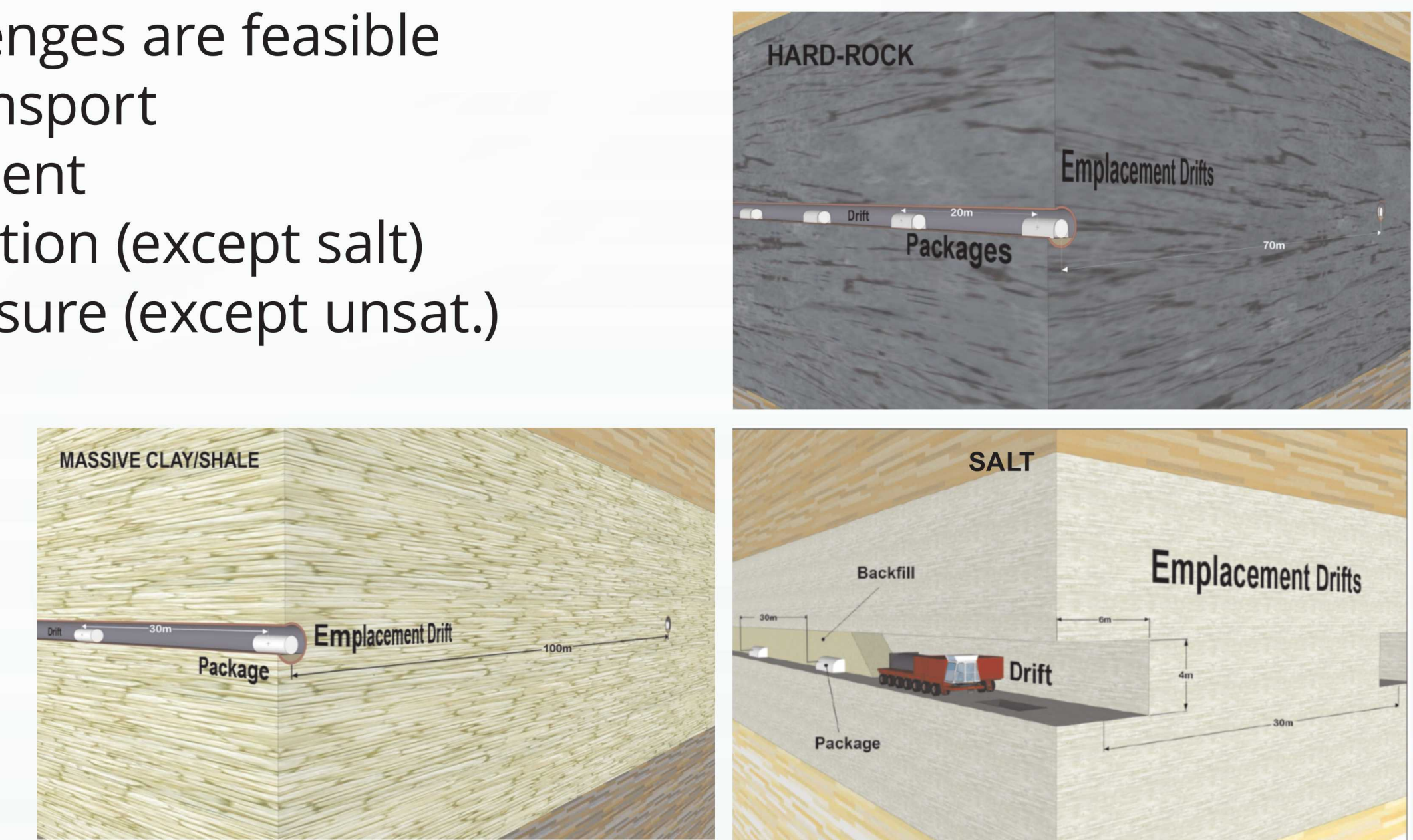


At present, there are ~40,000 MT of SNF stored in over 2,700 DPCs at Independent Fuel Storage Facilities located at both operating and decommissioned nuclear power plants across the U.S.



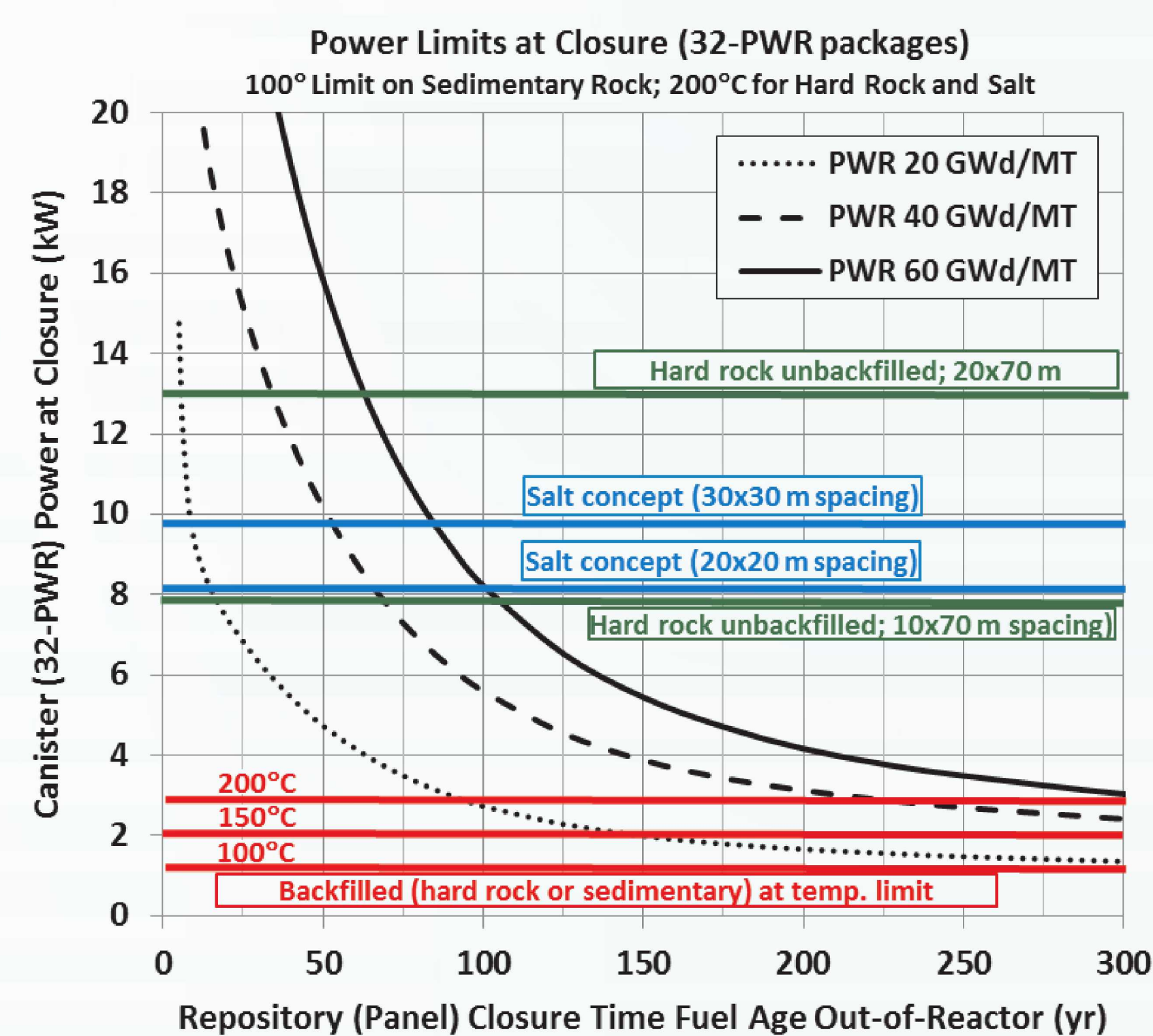
DPC DIRECT DISPOSAL CONCEPTS: REPOSITORY ENGINEERING

- Engineering challenges are feasible
- Shaft or ramp transport
- In-drift emplacement
- Repository ventilation (except salt)
- Backfill before closure (except unsat.)
- Degradation of Al-based materials in ground water → Postclosure criticality control problem



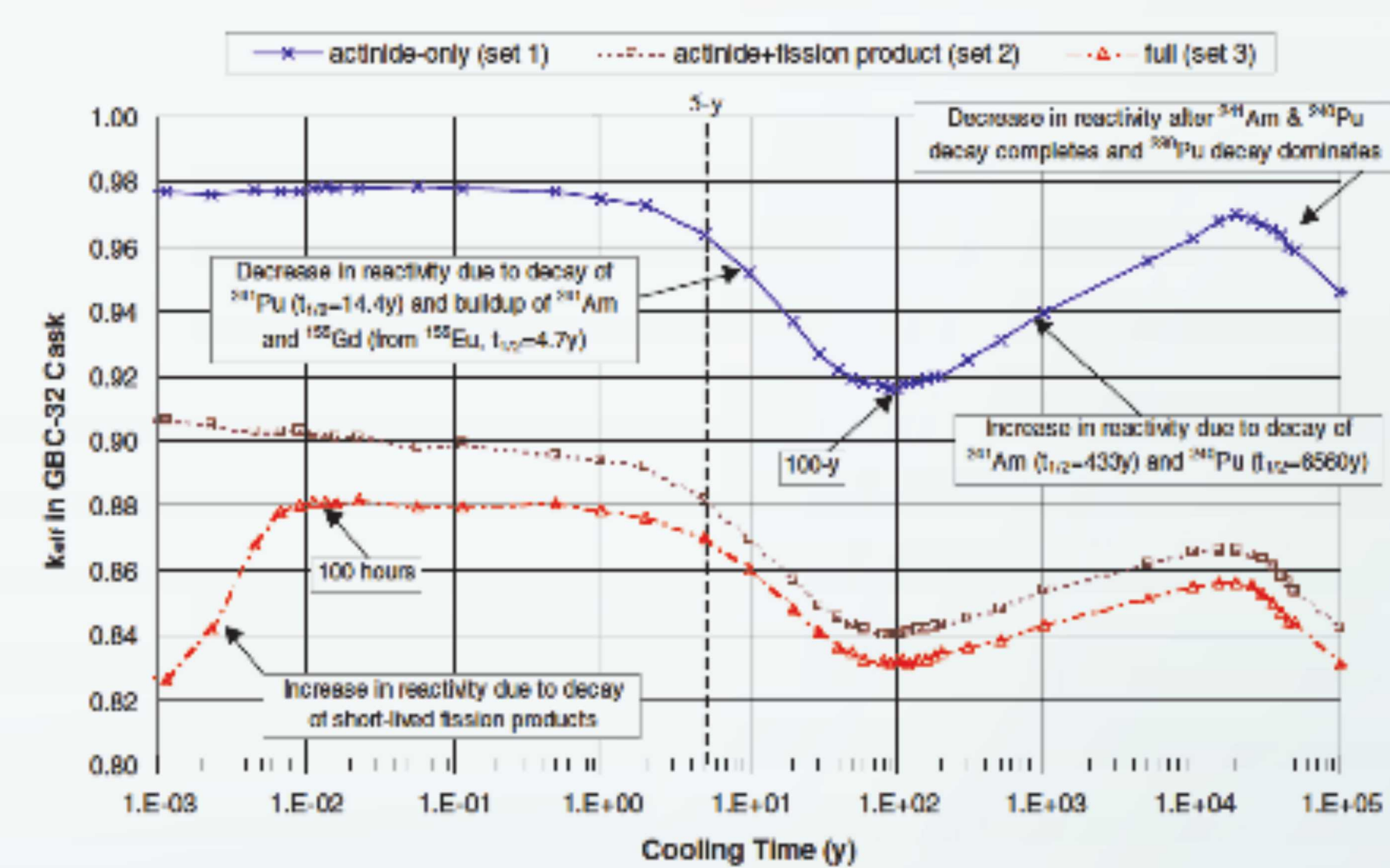
THERMAL MANAGEMENT

Cooling time needed before repository closure to meet waste package surface temperature constraints for a hypothetical waste package containing 32 PWR assemblies, shown for low, medium and high burnup fuel in various repository design concepts.



SPENT FUEL DISPOSAL: POSTCLOSURE NUCLEAR CRITICALITY CONTROL

- Disposal Environment
- Groundwater availability
 - Chloride in groundwater
- Moderator Exclusion
- Overpack integrity
- Moderator Displacement
- Fillers
 - Impervious DPC fillers
- Add Neutron Absorbers
- Fillers (e.g., B₄C loaded)
 - Disposal control rods
- Criticality Analysis Methodology
- Burnup credit, as-loaded, stylized degradation cases
 - Peak reactivity occurs at ~25,000 years



k_{eff} vs. time
Generic burnup credit 32-PWR cask
PWR fuel (4% enriched, 40 GW-d/MT burnup)
Wagner and Parks 2001 (NUREG/CR-6781, Fig. 3)

FY 18-19 PLANNED ACTIVITIES

PLANNED ACTIVITIES

- Technical/Programmatic Solutions for Direct Disposal of SNF in DPCs
- Probabilistic Post-Closure DPC Criticality Consequence Analysis
- DPC Filler and Neutron Absorber Degradation R&D
- Multi-Physics Simulation of DPC Criticality

EXPECTED OUTCOMES

- DPC disposition alternatives, R&D and resource needs
- Generic (non-site specific) preliminary PRA
- Preliminary multi-physics coupled models
 - Model benchmarks
- Feasibility of thermal-setting phosphate cement as filler