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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: REPOSITORY OPERATIONS: INTRODUCTION AND SUMMARY

PRESENTER: RICHARD D. SNELL

PRESENTER'S TITLE AND ORGANIZATION: OPERATIONS MANAGER, ENGINEERING & INTEGRATION
CRWMS MANAGEMENT AND OPERATING CONTRACTOR
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ARLINGTON, VA
OCTOBER 9-10, 1996

Repository Operations

- Overview of Mined Geologic Disposal System (MGDS)
  - Design approach and status
  - Major technical issues
- Retrievability issues
- Waste package physical characteristics
- Remote handling and maintenance (drift access)
- Drift stability and maintenance (long term)
- Repository thermal management

U.S. DEPARTMENT OF ENERGY
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NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: OVERVIEW OF MINED GEOLOGIC DISPOSAL SYSTEM (MGDS) OPERATIONS

PRESENTER: JACK N. BAILEY

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ARLINGTON, VA
OCTOBER 9-10, 1996

Overview of MGDS Operations

- **Design phases**
  - SCP-CD, ACD, VAD, LAD, Ongoing
- **Physical characteristics**
  - Repository size, layout, and waste forms
- **Operations**
  - Construction/container fabrication, surface and subsurface waste operations; caretaker, closure and decommissioning operations
- **Overview of key design issues**

Repository Design Phases

- ✔ Site Characterization Project Conceptual Design (1987)
  - Established feasibility based on shipment by truck and vertical borehole emplacement
- ✔ Advance Conceptual Design (March 1996)
  - Revised concept based on the use of multi-purpose canister
- Viability Assessment Design (FY98)
  - Revised concept that does not rely on multi-purpose canisters
  - Provides a consistent basis to support performance assessment, demonstrate feasibility, estimate costs, and develop a licensing plan
- License Application Design (FY02)
  - Provides NRC greater detail for safety systems and unprecedented designs
  - Reflects the latest scientific and performance assessment input
- Ongoing Design (FY02 to 2010)
  - Provides continuation of design to support construction packages, which is the bulk of the design effort

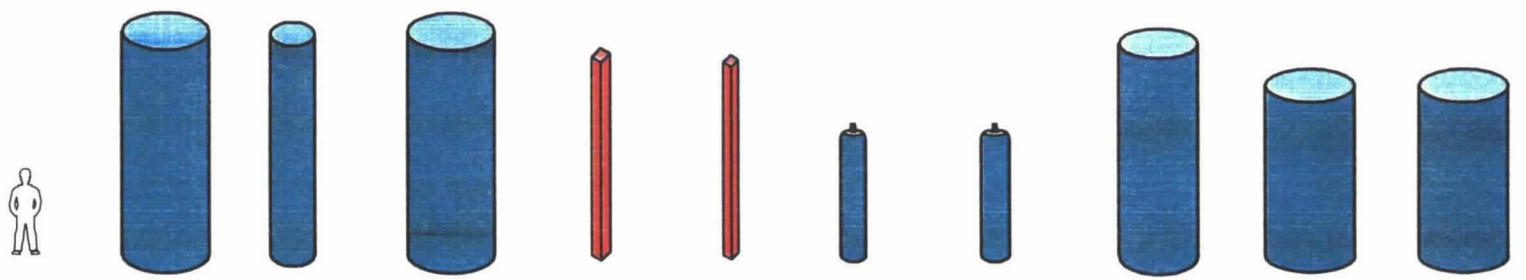
Viability Assessment (VA) Design
License Application (LA) Design

- One pass approach
- Advanced Conceptual Design (ACD) as point design
- Reference design for VA
  - Phase I
  - Phase II
- Design for LA
  - Phase II
  - Phase III

Repository Physical Characteristics

- **Disposal of 70,000 MTU**
  - In 11,000 5½- to 6-ft diameter containers
- **Horizontal emplacement in underground drifts**
  - 120 miles of 15- to 20-ft diameter tunnels and drifts
  - 840 acres of emplaced area
  - ⅛ to ¼ of a mile below the surface in welded tuff
- **Surface facilities**
  - 29 buildings for emplacement, excavation, and support
  - 800,000 ft^2 of floor space (~18 football fields)
- **Staffing:** 600 for surface and subsurface operations;
  300 for underground drift excavation

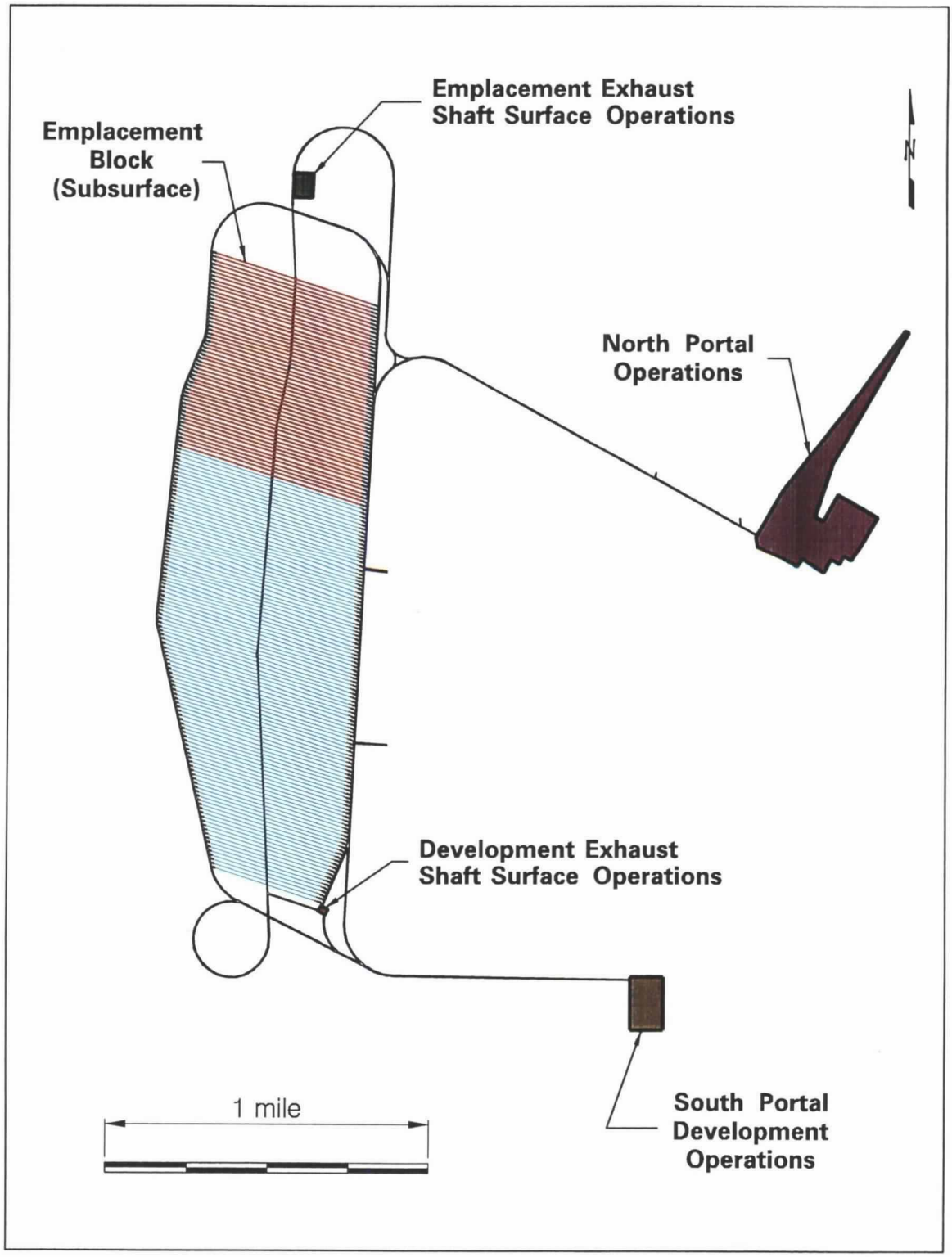
Representative Waste Form Data



	Rail Cask	Truck Cask	SNF Canister	PWR Assy	BWR Assy	DOE SNF	DHLW Canister	SNF DC	DHLW DC 5	DHLW DC 4
Loaded Weight (tons)	105	25	31	0.9	0.4	2.0	1.1	53	39	34
Peak Units per Year	420	140	460	4,900	8,300	103	800	370	160	200

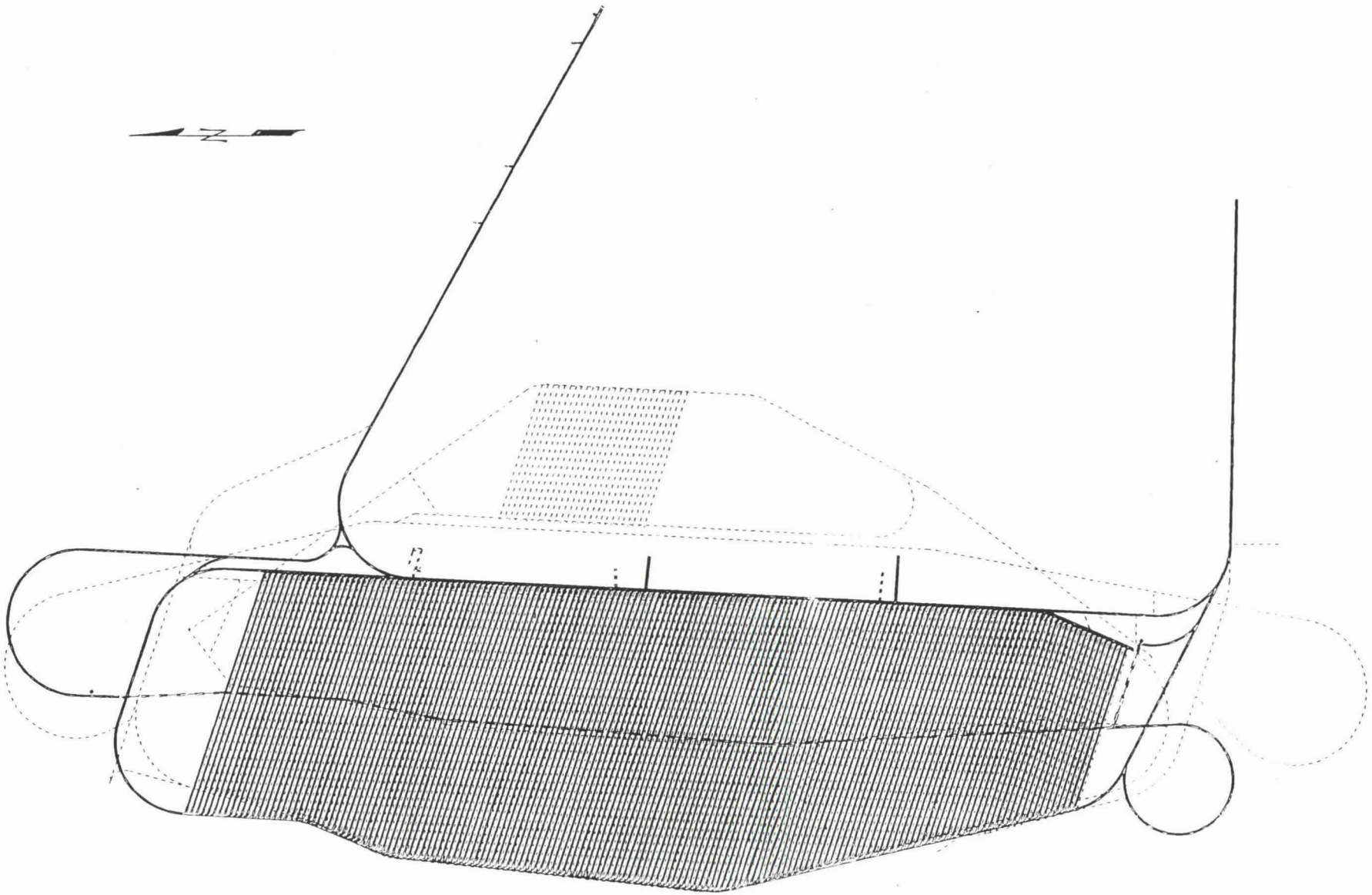
Key

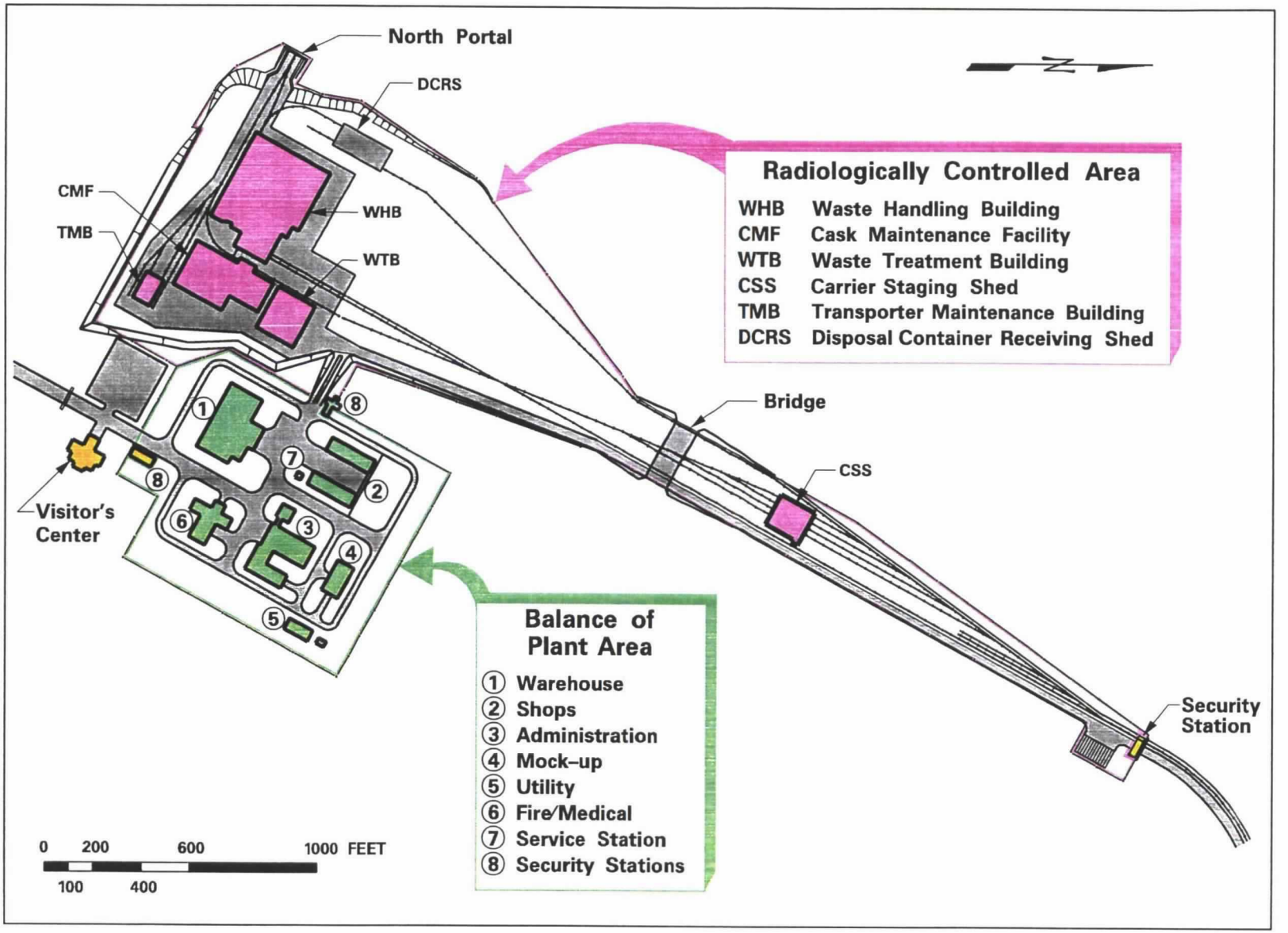
BWR	Boiling Water Reactor
DC	Disposal Container
DC 4	4 Pack
DC 5	5 Pack DOE Center
DHLW	Defense High Level Waste
PWR	Pressure Water Reactor
SNF	Spent Nuclear Fuel



MGDS Operations Areas

Current vs ACD Repository Layouts

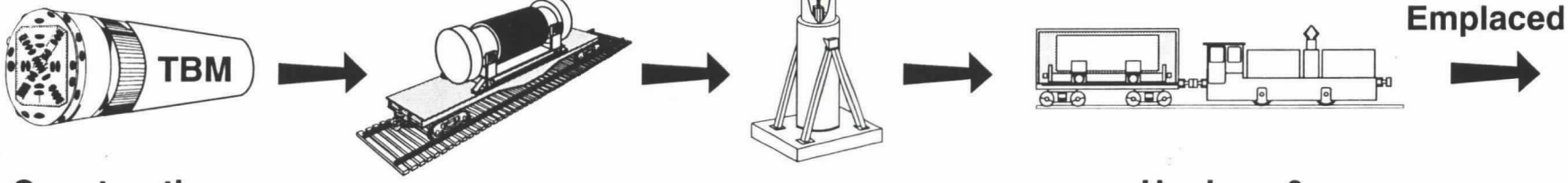




Repository North Portal Surface Facilities

/rep/reps/arch/dgn/sketch.dgn Sep. 26, 1996 08:13:49

Operations



Construction, Development & Disposal Container Fabrication

Receipt

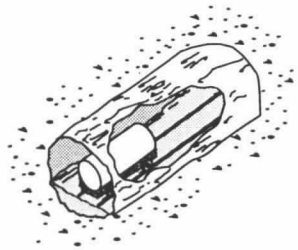
Packaging

Haulage & Emplacement

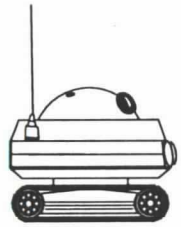
MGDSPHAZ.CDR.125/9-27-96

Operations (Continued)

From Haulage & Emplacement

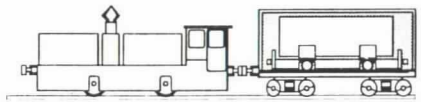


Waste Emplaced



Caretaker

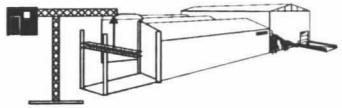
Closure & Decommissioning



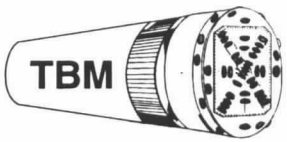
Retrieval

MGDSPHAZ.CDR.125/9-27-96

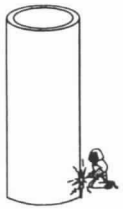
Potential Construction, Development & Disposal Container Fabrication Phasing



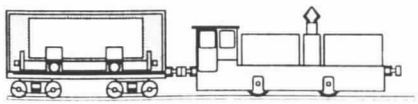
Surface Construction



Subsurface Development



Disposal Container Fabrication



Emplacement

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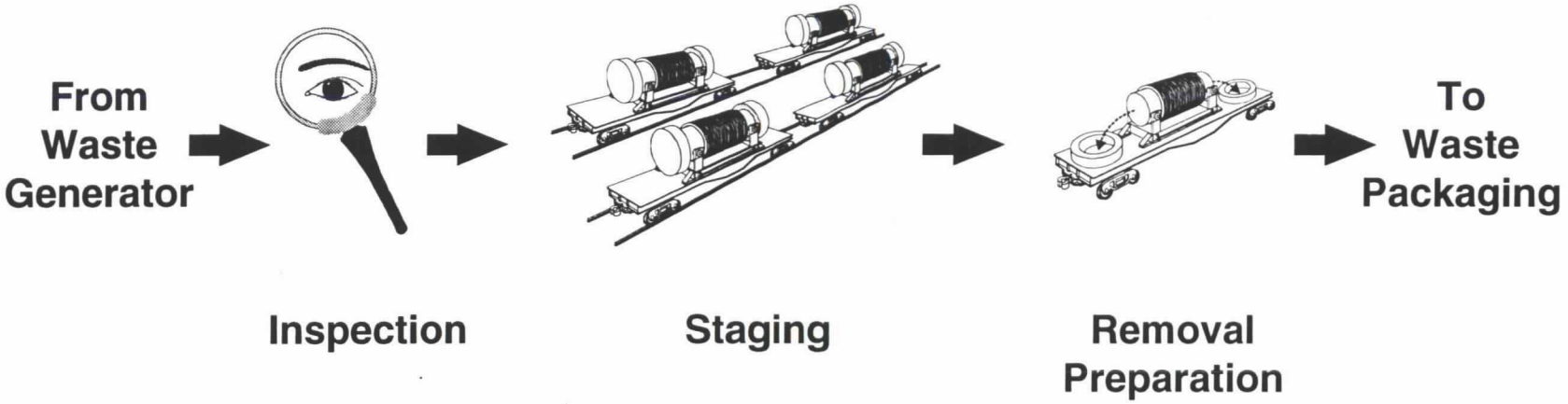
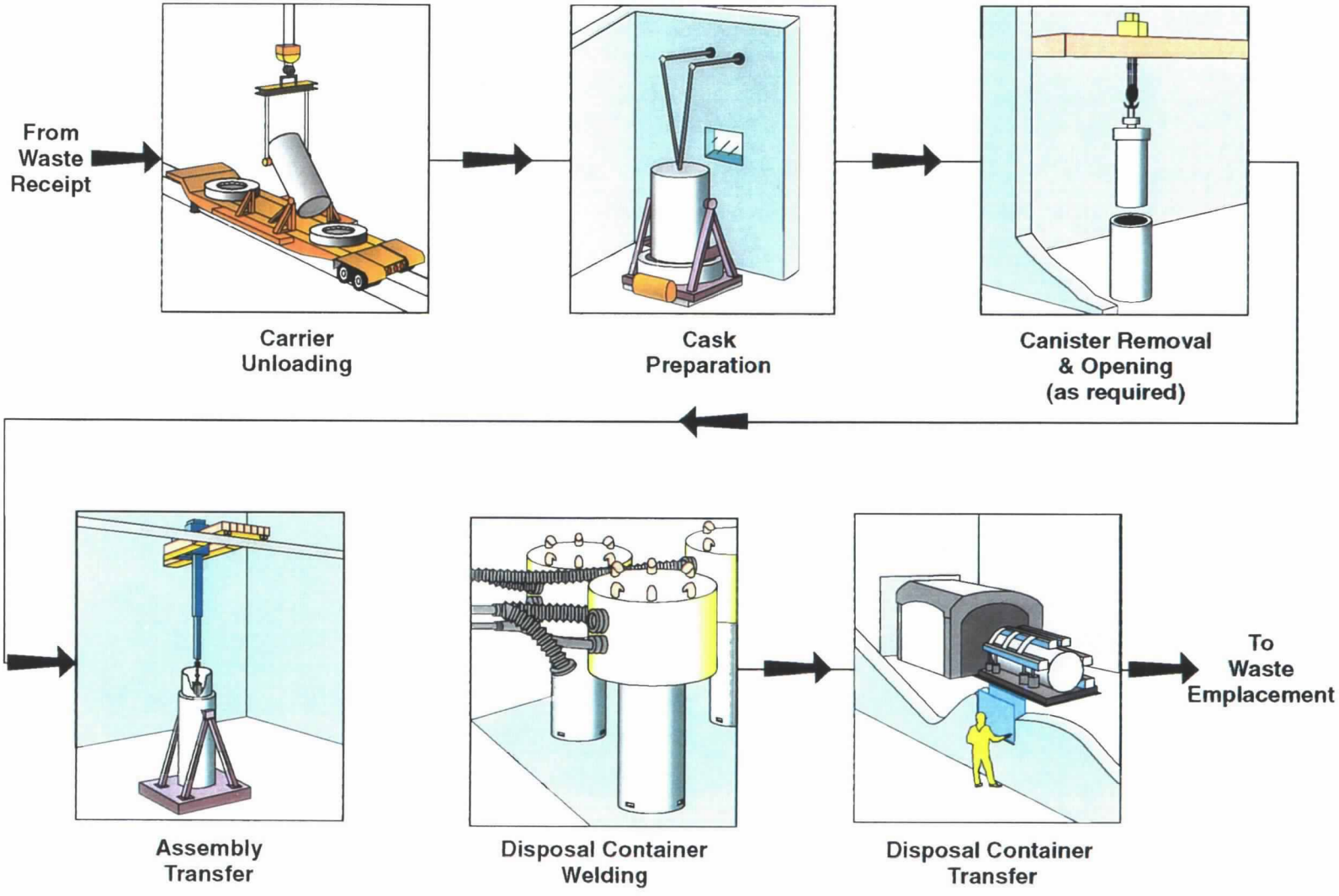
Waste Receipt Operations



Waste Packaging Operations



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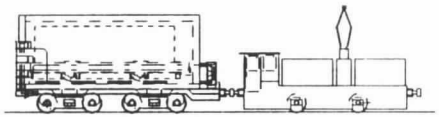
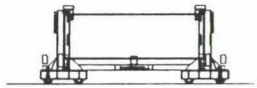
Waste Emplacement Operations

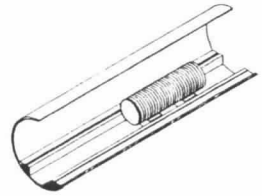
Underground Haulage



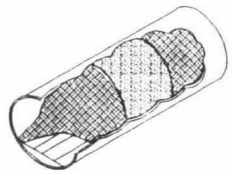
Emplacement



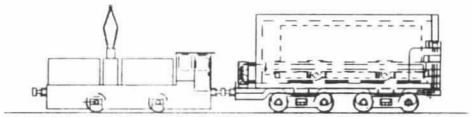
Monitoring and Performance Confirmation



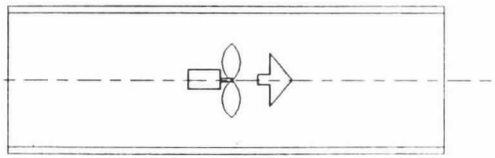
Sealing and Backfill



Retrieval



Ventilation



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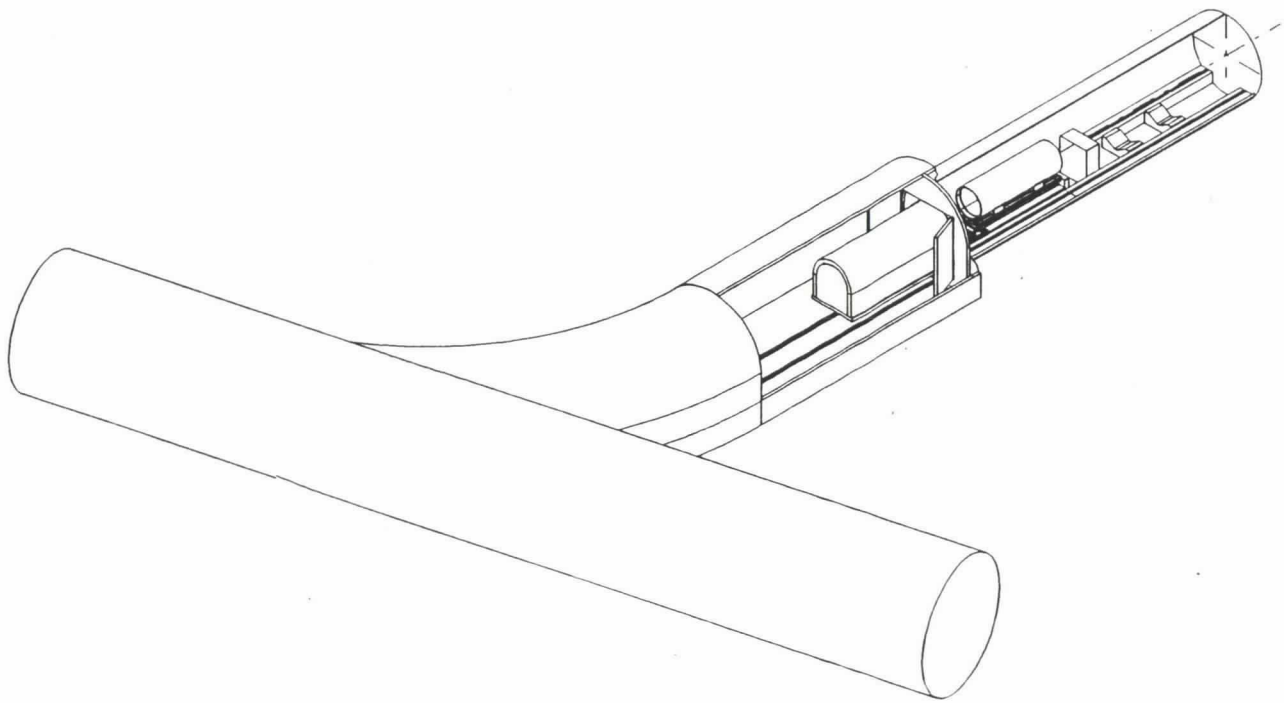
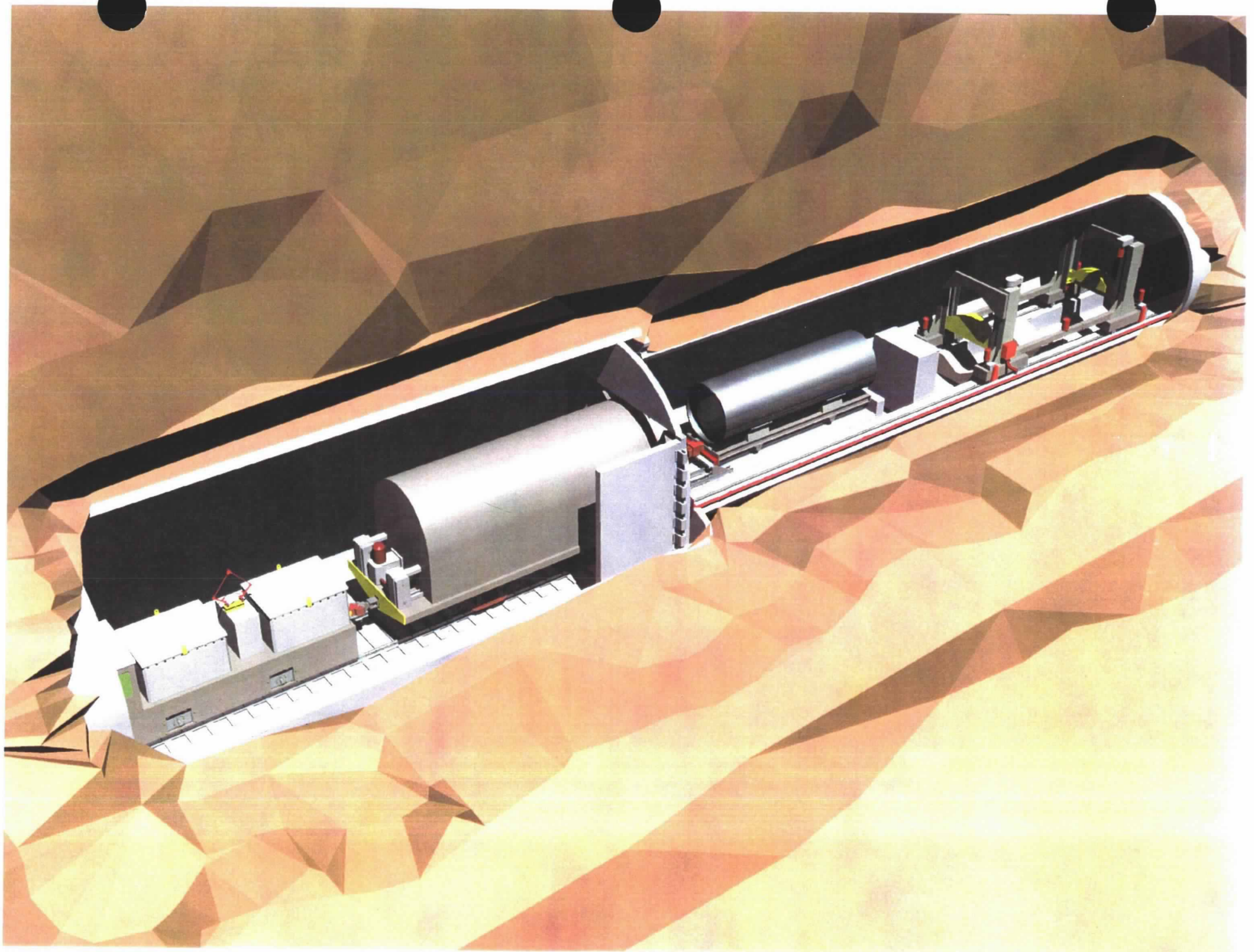
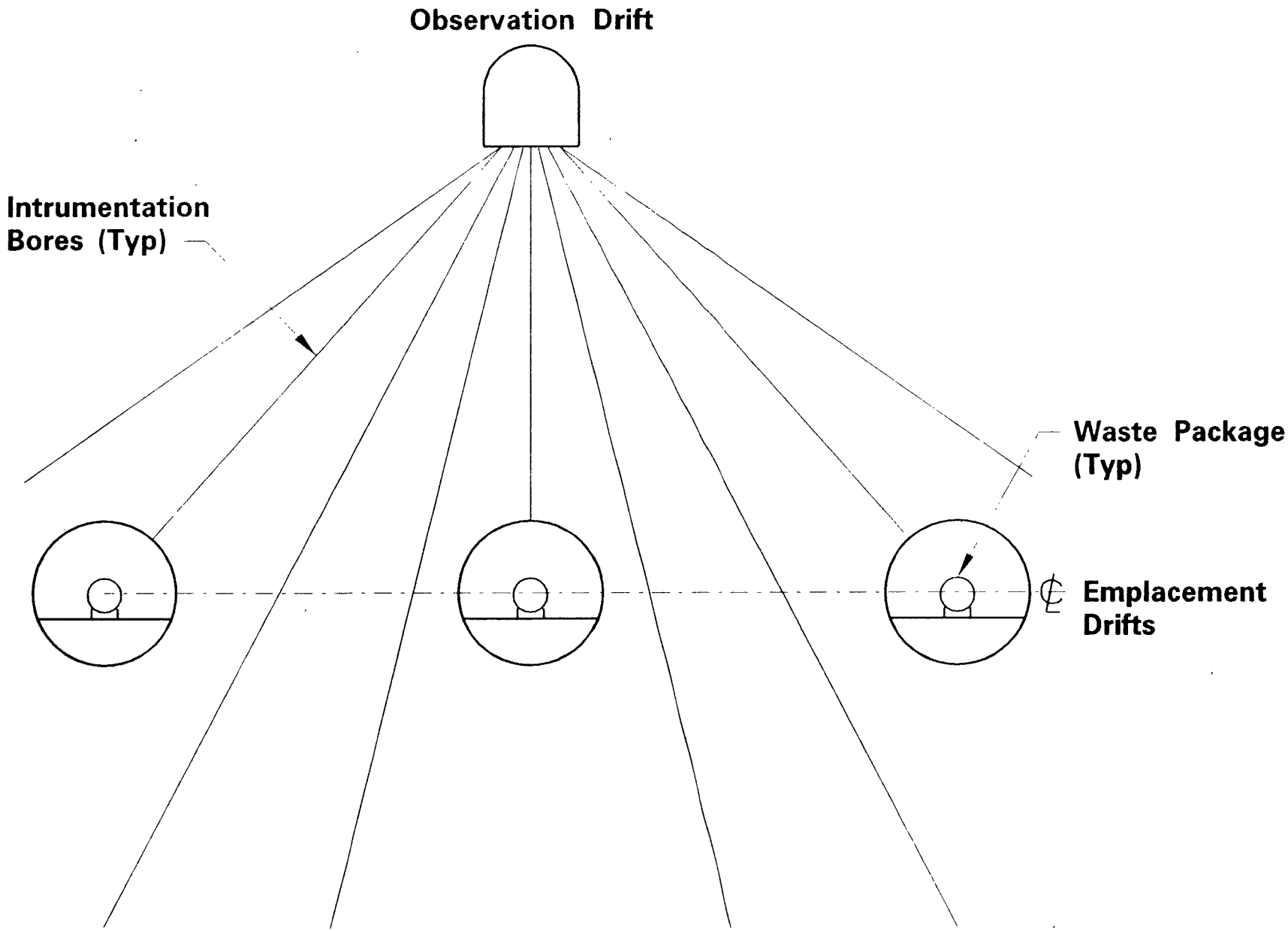
Transporter Unloading Waste Package





Performance Confirmation



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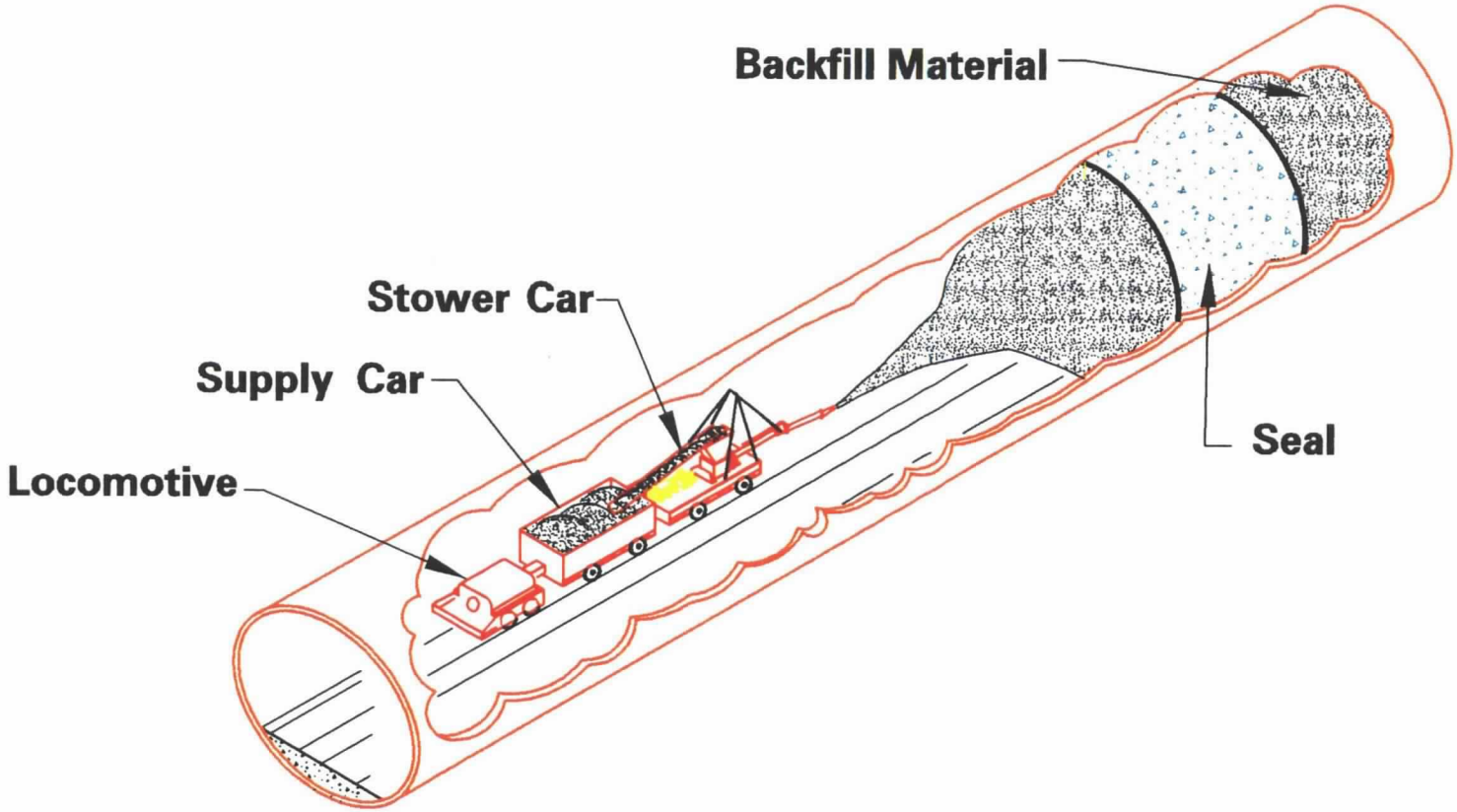
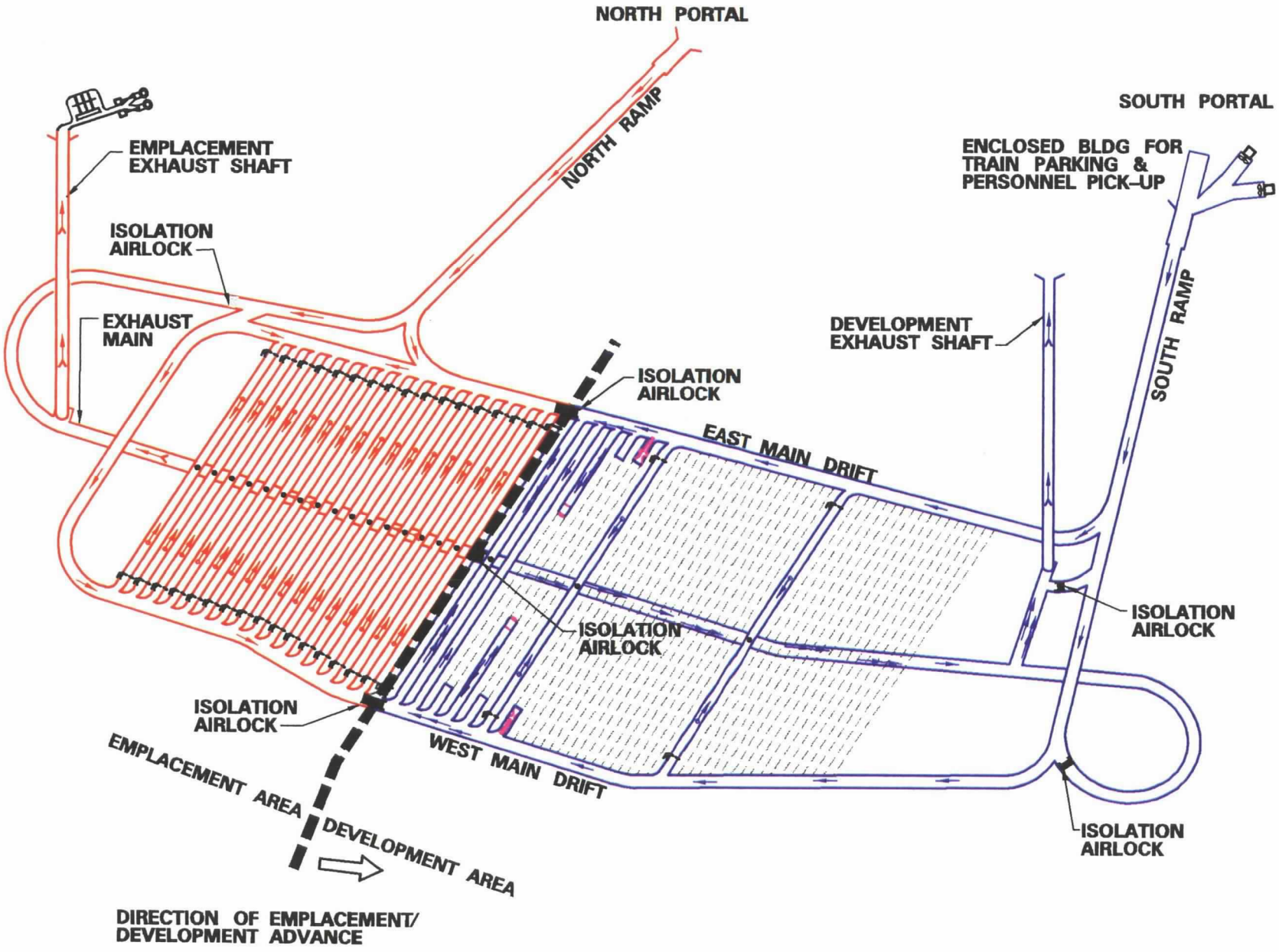
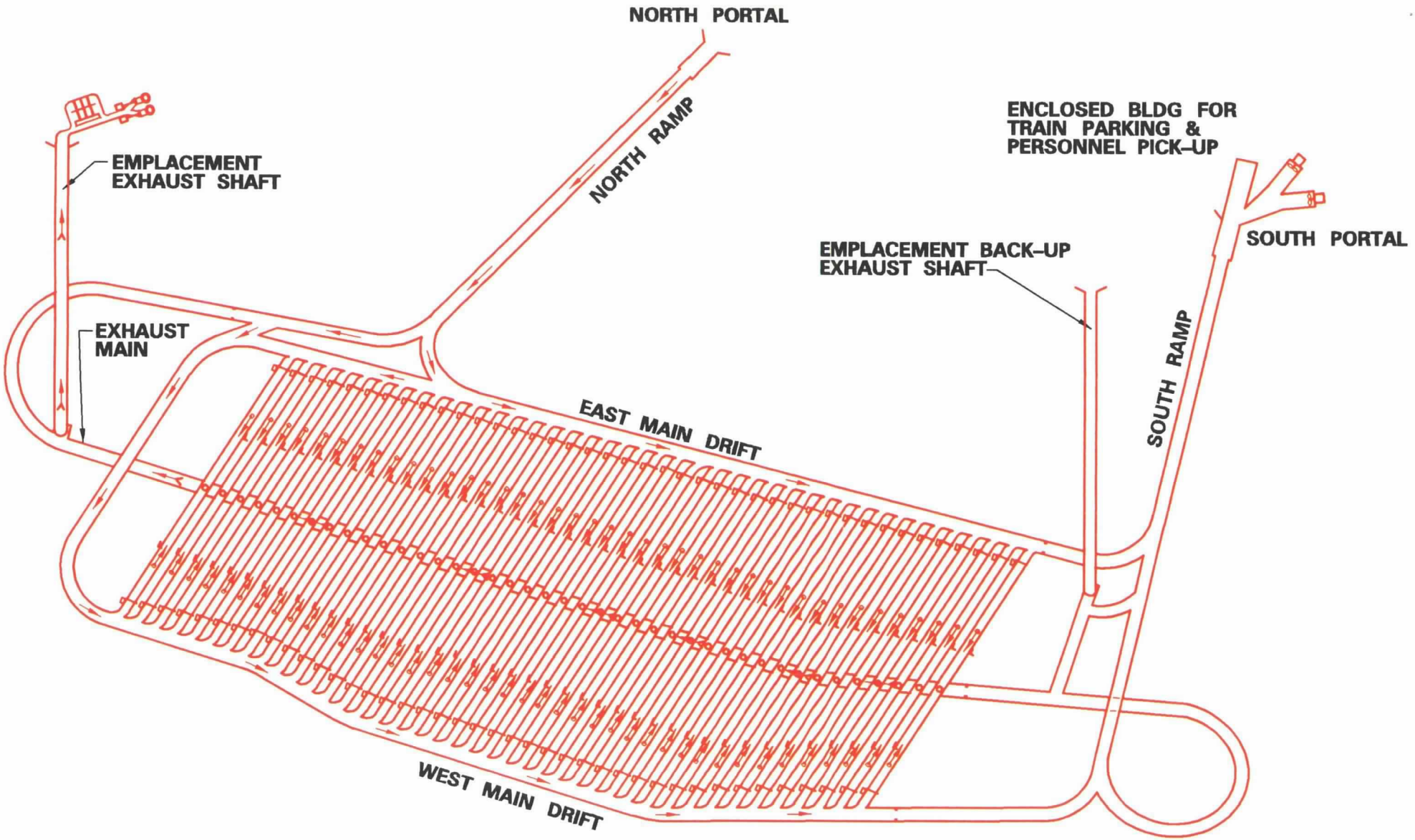
Backfilling at Closure



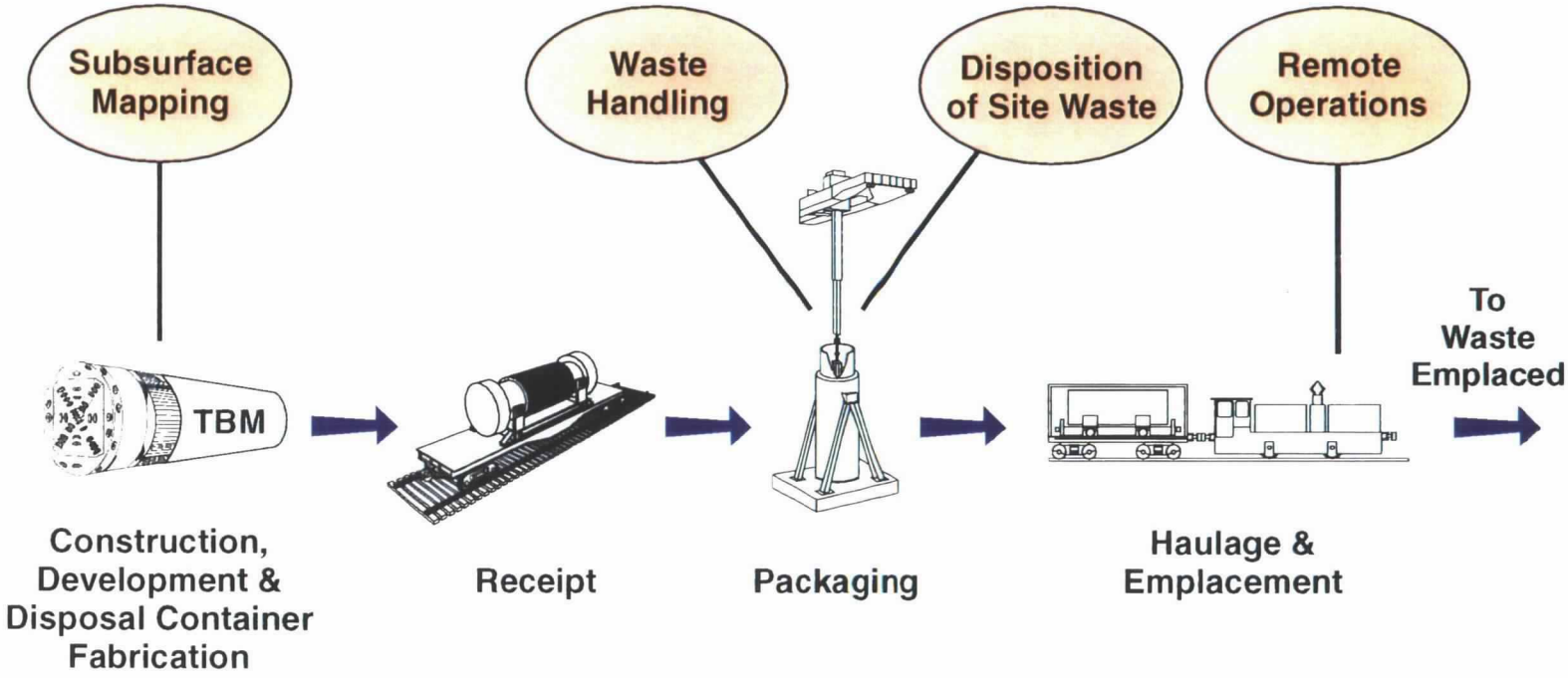
Ventilation – Mid Emplacement / Development



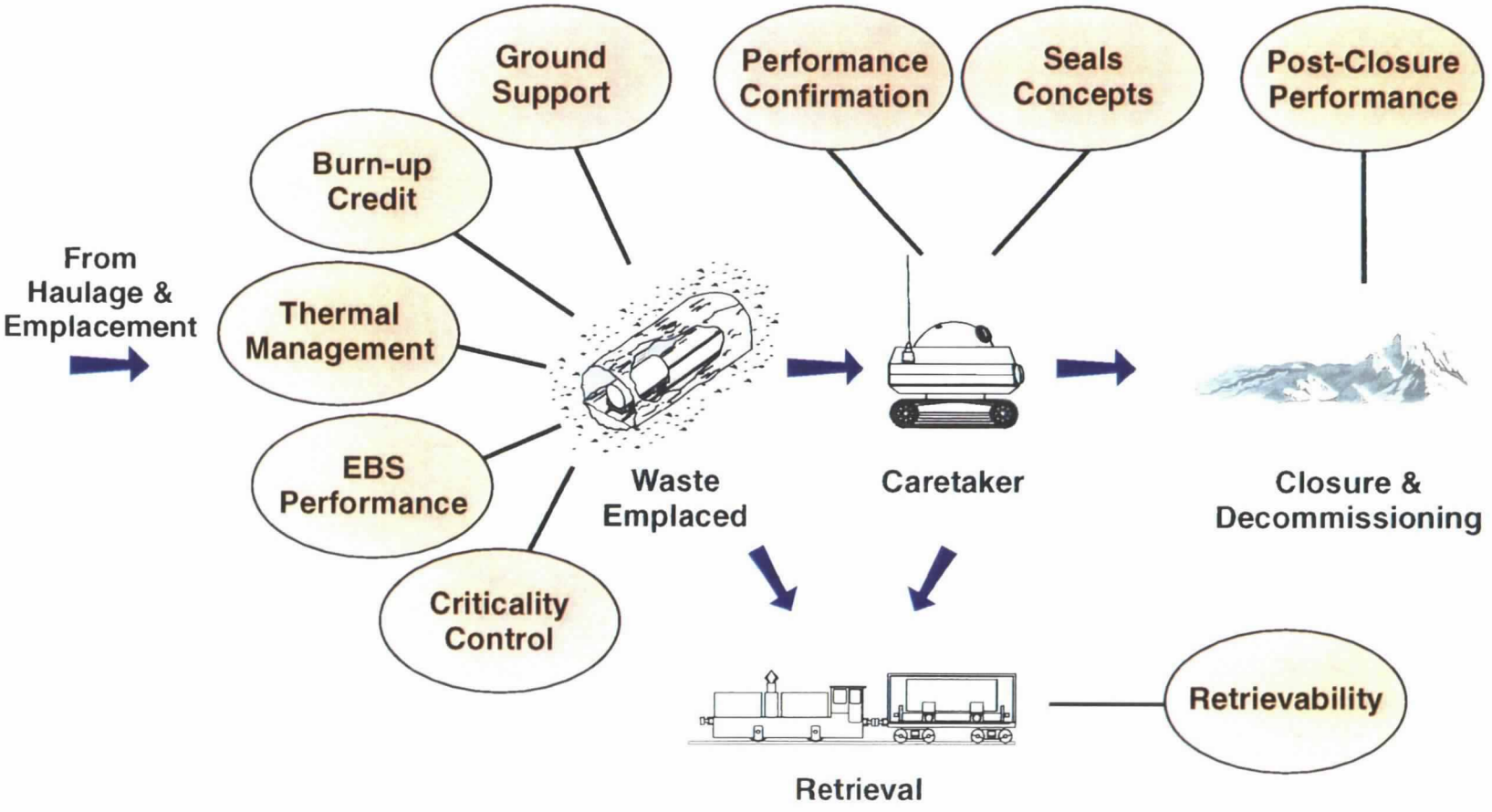
Ventilation – Caretaker Phase



Overview of Key Design Issues



Overview of Key Design Issues (Continued)



MGDSPHAZ CDR 125/9-27-96

Issue: Subsurface Mapping

- **Description**
  - The extent and nature of geologic mapping of emplacement drift wall surfaces required for performance confirmation requirements
- **Impacts**
  - Selection of ground control system and it's installation
- **Resolution process**
  - Working with site characterization, performance assessment, licensing, and design groups to determine mapping requirements
  - Maintaining ground support options and designs to meet mapping requirements

Issue: Waste Handling

- **Description**
  - Production-scale dry packaging of spent fuel assemblies is unprecedented (over 11,000 annually)
- **Impacts**
  - Handling approach (e.g., wet or dry) impacts licensing, facility cost, secondary waste generation, and NEPA data
- **Resolution process**
  - Complete study to select an approach early in FY97
  - Incorporate results in the VA design
  - Expand the design detail during LA design to support licensing

Issue: Disposition of Site Waste

- **Description**
  - Disposal location (e.g., on site or off site) has not been identified for the large volume of site-generated radioactive low-level waste
- **Impacts**
  - Selection of on-site disposal would require a licensed low-level waste disposal facility
  - MGDS cost and NEPA data would be impacted
- **Resolution process**
  - Conduct a study in FY97 to recommend a disposal strategy
  - Reflect the study results in the VA

Issue: Remote Operations

- **Description**
  - Application of remote handling operations in an underground repository environment including high radiation and temperature
- **Impacts**
  - Handling of waste packages underground, including emplacement and retrieval
  - Performance confirmation monitoring
- **Resolution process**
  - Extensive review of applicable technology, including mining and other underground operations
  - Preliminary design of communication and power supply systems for waste handling equipment operation by VA
  - Addressing the issues related to high temperature during performance confirmation by VA

Issue: Criticality Control

- **Description**
  - Current disposal criticality regulation, 10 CFR 60.131(b)(7), is worded deterministically
  - Criticalities are not permitted during isolation operations unless at least two unlikely independent and concurrent or sequential changes have occurred in conditions essential to nuclear criticality safety
- **Impacts**
  - Based on time frames, the reasonable approach for postclosure disposal criticality control is probabilistic (risk-based)
  - Waste package design, loading
- **Resolution process**
  - Provide suggested word changes to NRC
  - Ongoing discussions with the NRC (next to occur October 29, 1996)
  - Proceeding with development of risk based approach

Issue: Engineered Barrier System Performance

- **Description**
  - Use of backfill, drip shield, and invert material additives to enhance post-closure performance of the repository
- **Impacts**
  - Invert design (additives, material placement)
  - Method of placing backfill material to meet performance requirements
- **Resolution process**
  - Study on enhancement of the Engineered Barrier System made recommendation for no backfill (however, are keeping the option open) or invert additives; VA design is following these recommendations

Issue: Thermal Management

- **Description**
  - Determine the effect of thermal loading and other thermal management techniques on overall MGDS performance
  - Select thermal loading and other thermal management techniques to attain acceptable performance with reasonable assurance and at a reasonable cost
- **Impacts**
  - Size, shape, and layout of the repository
  - Ground control system
  - Performance confirmation design instrumentation and control
- **Resolution process**
  - Thermal loading system studies provided recommendation and thermal goals that are being followed in VA design
  - Work on selected issues will continue during and after VA design, including the effects of higher percolation flux

Issue: Burn-up Credit

- **Description**
  - Burn-up credit is the process of accounting for the reduced reactivity of spent fuel compared to fresh fuel
  - NRC has not approved methodologies for burn-up credit for away-from-reactor applications
- **Impacts**
  - Without burn-up credit, waste packages would be limited to a few assemblies, thus resulting in significantly more packages and a larger emplaced area
- **Resolution process**
  - Disposal Criticality Analysis Technical Report (September 1996) describes the approach being used
  - Ongoing discussions with the NRC

Issue: Ground Support

- **Description**
  - Compatibility of ground support system with the Engineered Barrier System performance of the repository and performance confirmation requirement
  - Long design life and emplacement drift environment
- **Impacts**
  - Emplacement drift ground control system
  - Repository layout
  - Retrievability
  - EBS performance concerns
- **Resolution process**
  - Issue of material of construction being worked with Performance Assessment (PA) for compatibility with waste isolation
  - Design focused on the most promising support system(s) to meet long life, performance confirmation needs, and drift environment

Issue: Performance Confirmation

- **Description**
  - Design requirements for site-specific design implementation are in the development stage
  - Monitoring and data collection approach remain to be developed
  - Technology for monitoring instrumentation may have to be developed in some cases
- **Impacts**
  - Repository layout to provide access to emplacement drifts
  - Instruments for high radiation and temperature environment
  - Surface facilities design and operation related to extent and frequency of waste package inspection
- **Resolution process**
  - Preliminary requirements have been developed by performance confirmation concepts study
  - Further development of requirements is planned for FY97
  - Developing layout concepts for providing access for performance confirmation
  - Developing concepts for instrumentation and control systems for monitoring

Issue: Retrievability

- **Description**
  - Strategy for retrieval has not been developed fully
  - Credible off-normal retrieval scenarios and the method to mitigate them are under development
- **Impacts**
  - Emplacement mode, emplacement and retrieval equipment, ground support system, repository layout, ventilation system, and surface facilities
- **Resolution process**
  - Engineering study developed initial strategy for retrieval and preliminary off-normal scenarios for retrieval
  - Design basis events analysis is being performed to develop credible events and scenarios
  - Preliminary design of equipment and concepts are being performed for off-normal scenario

Issue: Seals Concepts

- **Description**
  - Material for seals will have to be developed to meet the requirements for long-term performance
- **Impacts**
  - Seal locations and types
  - Equipment and method for seal and backfill placement
- **Resolution process**
  - Utilize available performance requirement developed to date for seals
  - Review seal material testing information from past work and adapt to the current repository design to demonstrate viability

Issue: Post-Closure Performance

- **Description**
  - Established standard
  - Define performance allocation
- **Impacts**
  - Need for change to design
- **Resolution process**
  - Integration of science, performance assessment, and engineering

Follow-on Presentations