

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

**NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING**

**SUBJECT: REPOSITORY ADVANCED
CONCEPTUAL DESIGN**

PRESENTER: DAN MCKENZIE

**PRESENTER'S TITLE
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**SALT LAKE CITY, UTAH
JULY 11-12, 1995**

Overview

- **Controlled Design Assumptions**
- **Repository Layout**
 - **Requirements and major features**
 - **Alternatives**
- **Retrievability**
 - **Requirements**
 - **Issues related to retrievability**

Repository Design Schedule

According to OCWRM program plan:

- **Complete conceptual design by March 1997**
- **Complete License Application design by September 2000**
- **Presently less than halfway through conceptual design**

Controlled Design Assumptions (CDA)

Controlled Design Assumptions (CDA)

- **Revised the Controlled Design Assumption Document in April 1995**
- **Reflects changes brought about by CRWMS Program Plan (December 1994)**
- **Document change summary:**
 - **Developed top-level functions and surface and subsurface sequences of operations**
 - **Restructured, revised, and expanded the concepts of operations compatible with the Functional Analysis**
 - **Simplified and integrated the process and format for generation and tracking of design assumptions**
 - **Revised, added, and withdrew assumptions**

Repository Layout

Repository Layout Design

- **Requirements governing the layout design include the following:**
 - **At least 200 m ground cover over underground facility**
 - **Preserve options for retrievability**
 - **Assist in keeping liquid water from contacting waste packages for the first 300 to 1000 years [TBV]**
 - **Orientation, geometry, layout, and depth of the underground facility contribute to the containment and isolation of radionuclides**

Repository Layout Design

(Continued)

- **Requirements:**
 - **Thermal and thermomechanical response of the host rock must be considered**
 - **Excavation methods should limit potential for creating preferential pathway for groundwater**
 - **Must maintain flexibility to allow adjustments to accommodate specific site conditions**
 - **Utilize as low as reasonably achievable (ALARA) radiological safety design approach**
 - **Separate the ventilation of emplacement and development operations**

Repository Layout Design

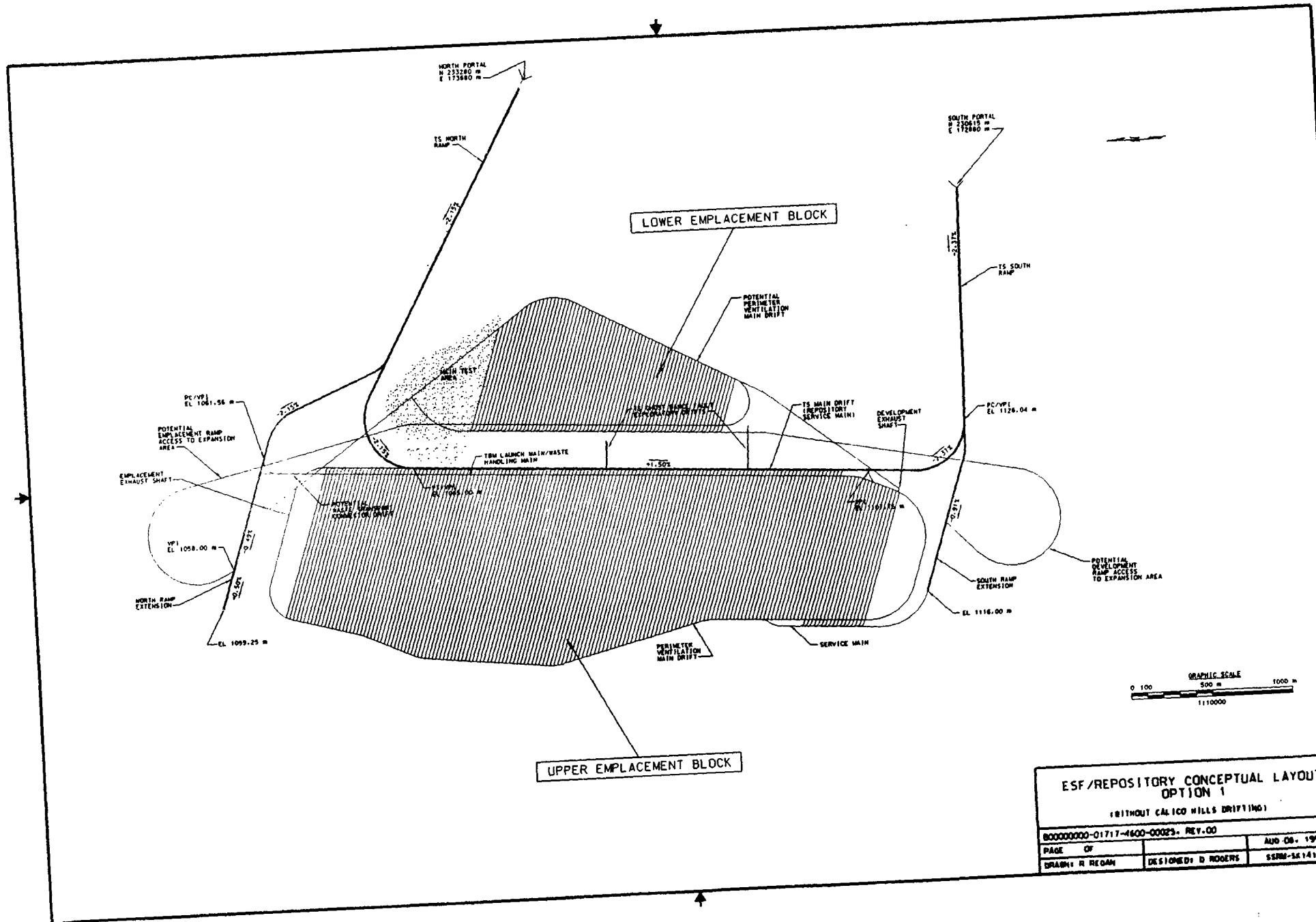
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- **Major assumptions and goals affecting layout design include**
 - **Implement MPC-based waste packages (e.g. transport, emplace)**
 - **Maintain thermal goals (e.g. maximum rock temperature of 200°C; maximum fuel cladding temperature of 350°C)**
 - **Meet licensing strategy (e.g. thermal loading)**
 - **Waste receipt rate**
 - **Avoid faults to extent practicable**

Repository Layout Design

(Continued)

- **Major Features of the Layout Options:**
 - **Maintain ESF/GROA integration**
 - **Maintain design flexibility regarding thermal loading**
 - **Use an in-drift emplacement method**
 - **Use an integrated rail transportation system**
 - **Maximize use of tunnel boring machines**
 - **Minimize the number of main and secondary access drifts**
 - **Provide a common drainage point for all main drifts**

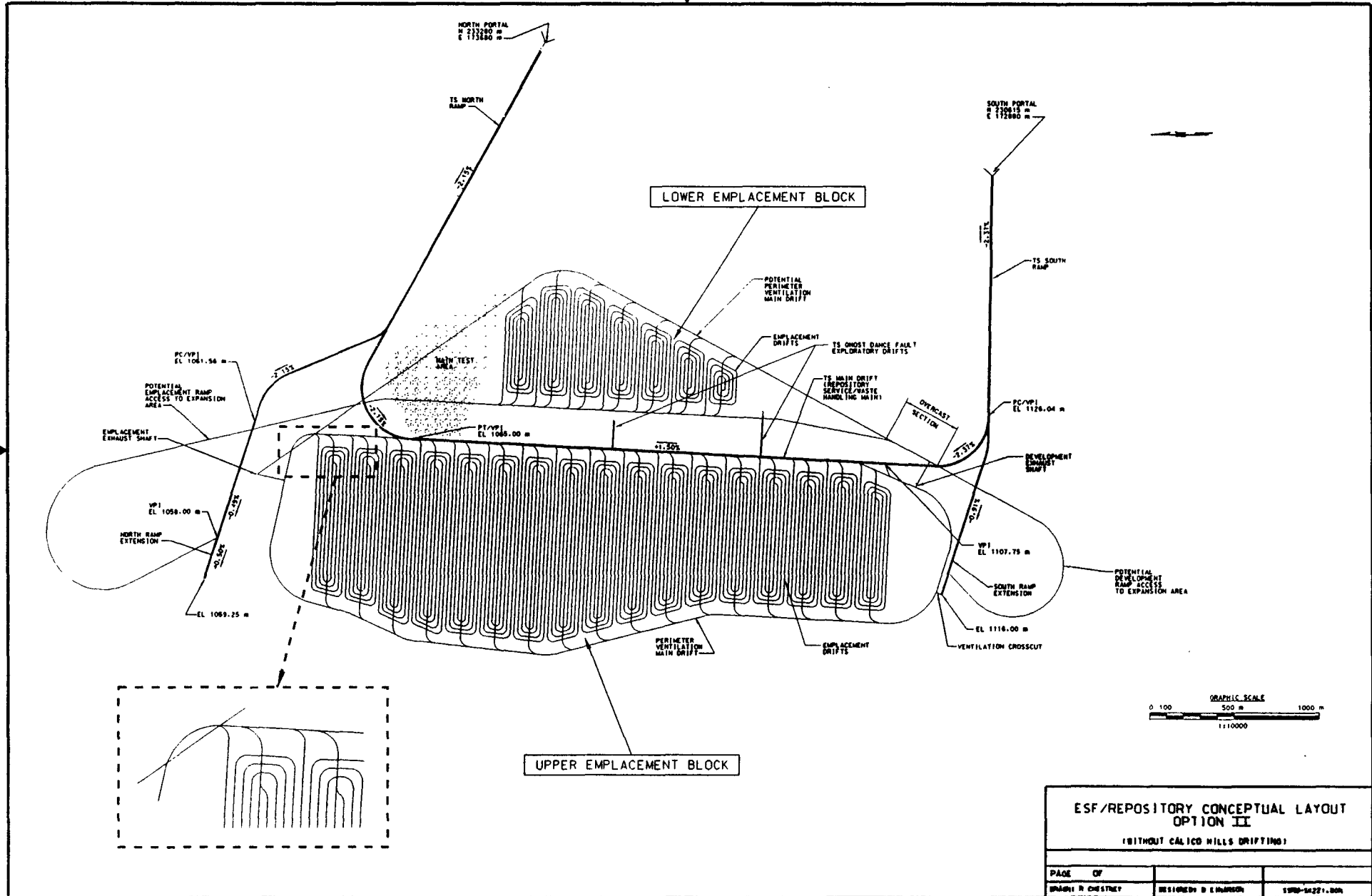


CONCEPTUAL

**ESF/REPOSITORY CONCEPTUAL LAYOUT
OPTION 1**
(WITHOUT CALICO HILLS DRIFTING)

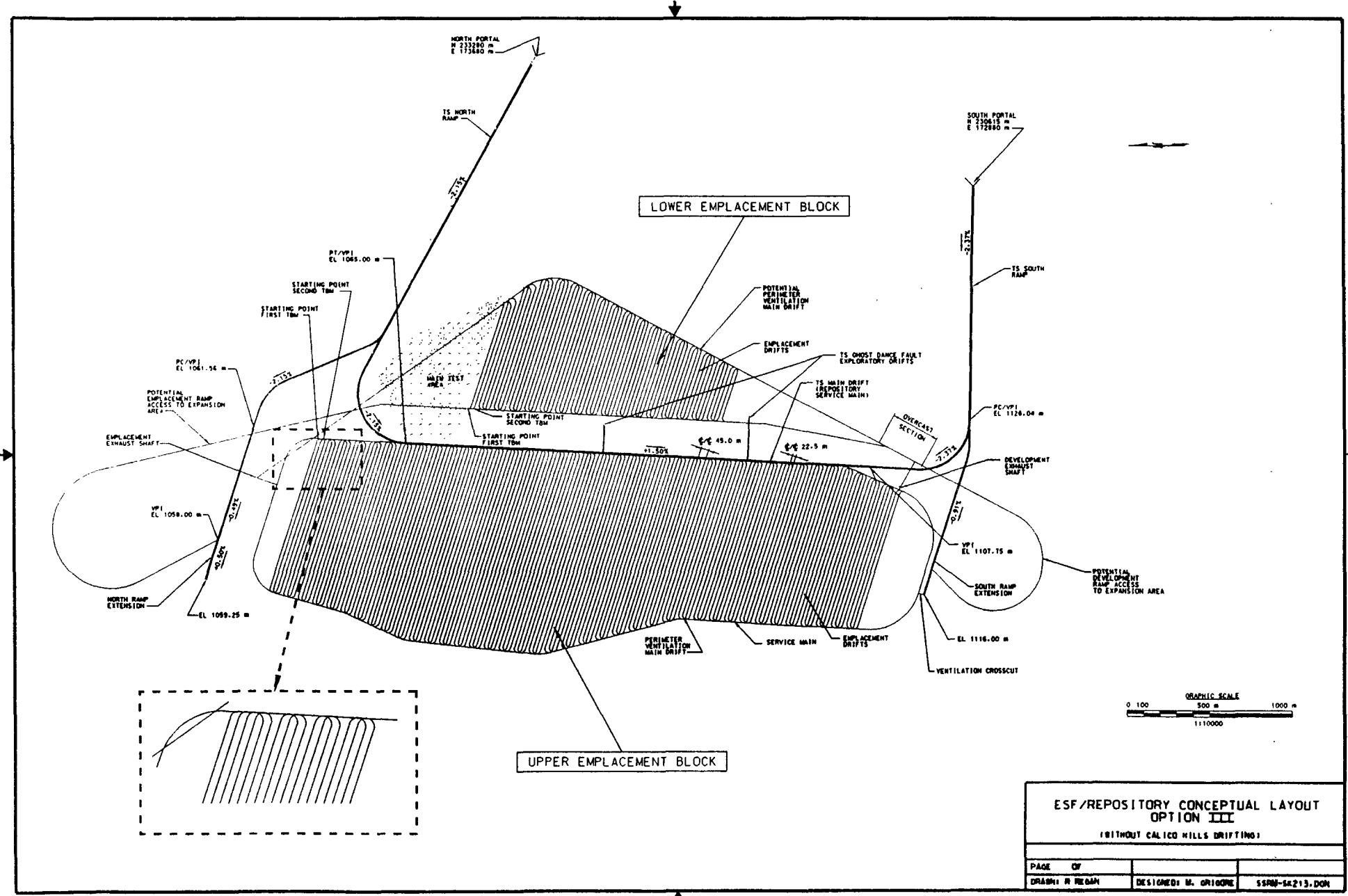
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DRAWN: R HEGAN	DESIGNED: D ROGERS	SSRM-SK141.DGN

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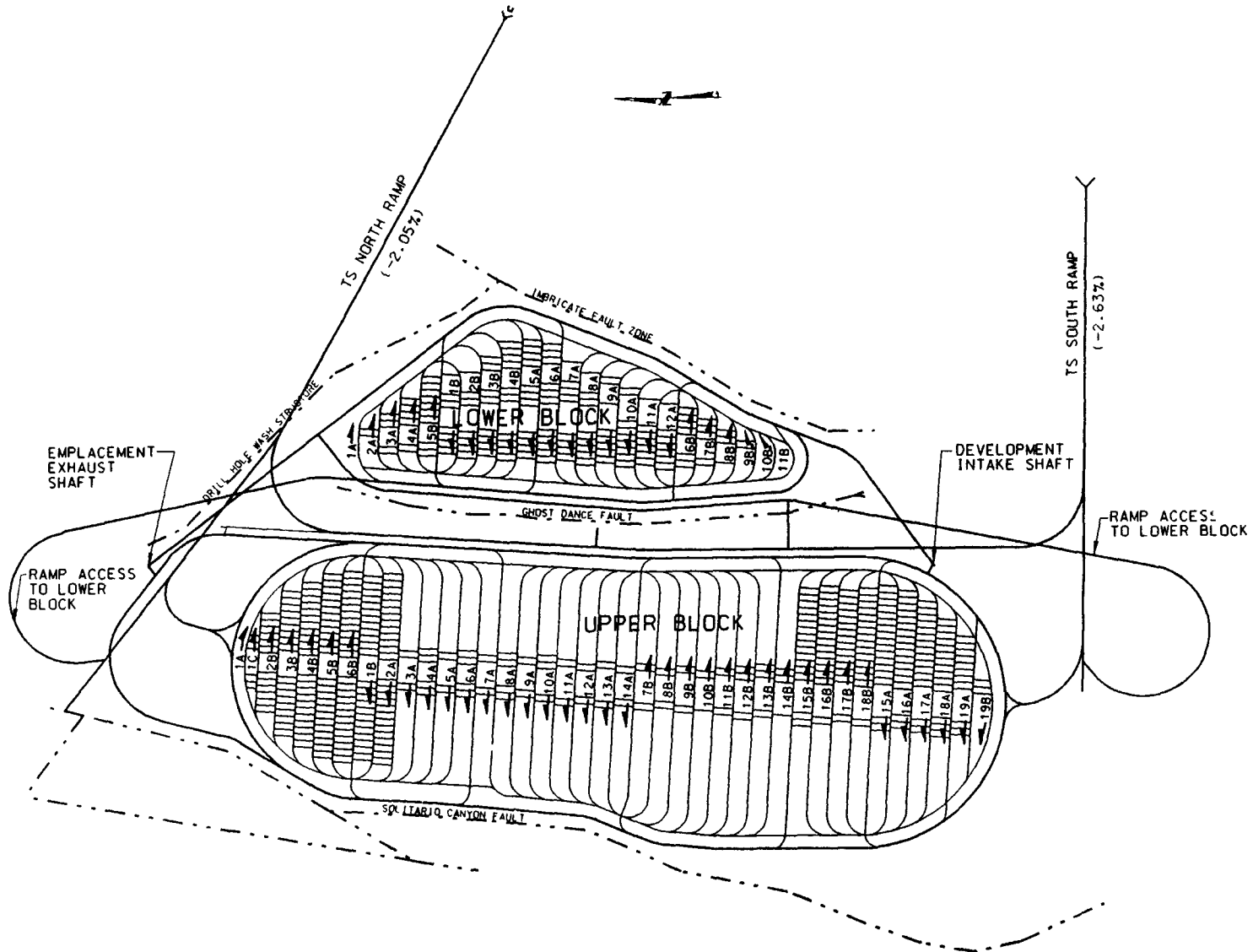
CONCEPTUAL

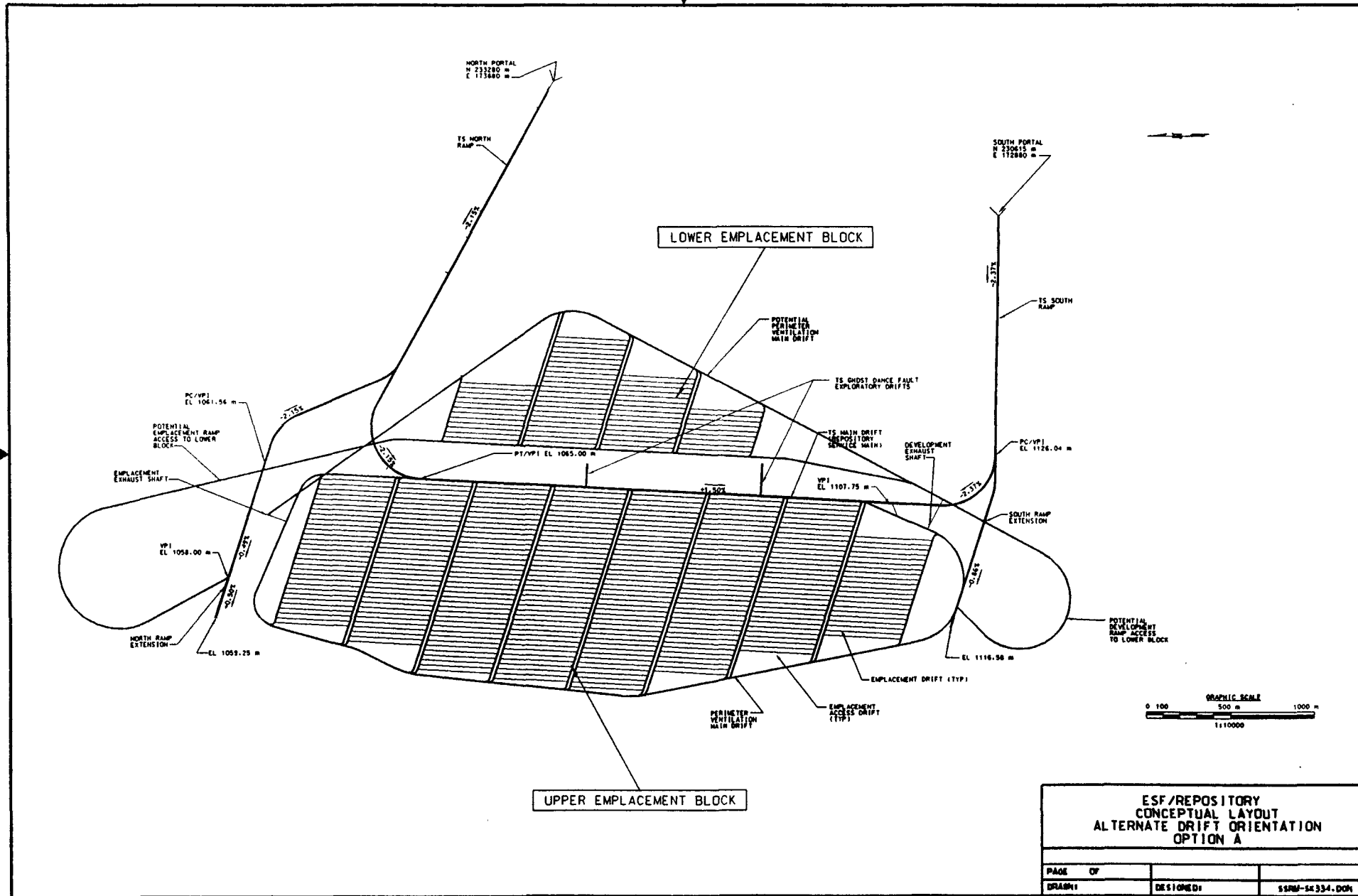
ESF/REPOSITORY CONCEPTUAL LAYOUT OPTION II		
(WITHOUT CALICO HILLS DRIFTING)		
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BRANDT R. CHESTNEY	DESIGNED: D. E. HANSON	SPB-54221.DGN



CONCEPTUAL

ESF/REPOSITORY CONCEPTUAL LAYOUT OPTION III (WITHOUT CALICO HILLS DRIFTING)		
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DRAWN: R. REGAN	DESIGNED: M. ORIGONE	SSRN-54213.DGN

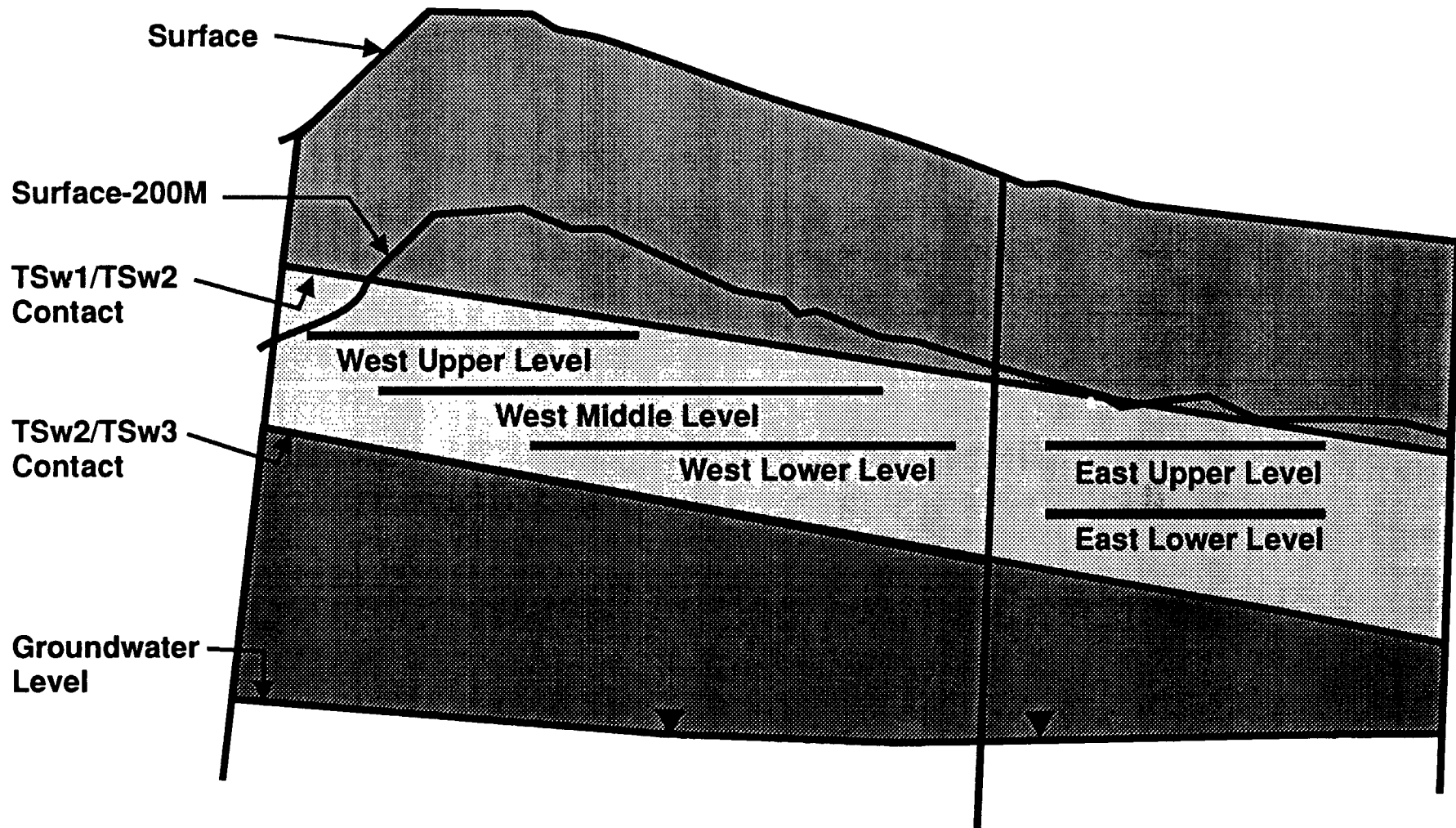




CONCEPTUAL

ESF/REPOSITORY CONCEPTUAL LAYOUT ALTERNATE DRIFT ORIENTATION OPTION A		
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Multi-Level Repository Layout
East - West Section at N 233,400
(Repository Levels 50m apart;
2:1 Vertical Exaggeration)

Repository Layout Design

(Continued)

- **Major issues related to layout:**
 - **Thermal loading**
 - **Geologic structures (joint orientation, faults)**
 - **Construction and operability issues (equipment, remote handling, backfill, retrievability)**

Retrievability

Regulatory Basis of Retrievability

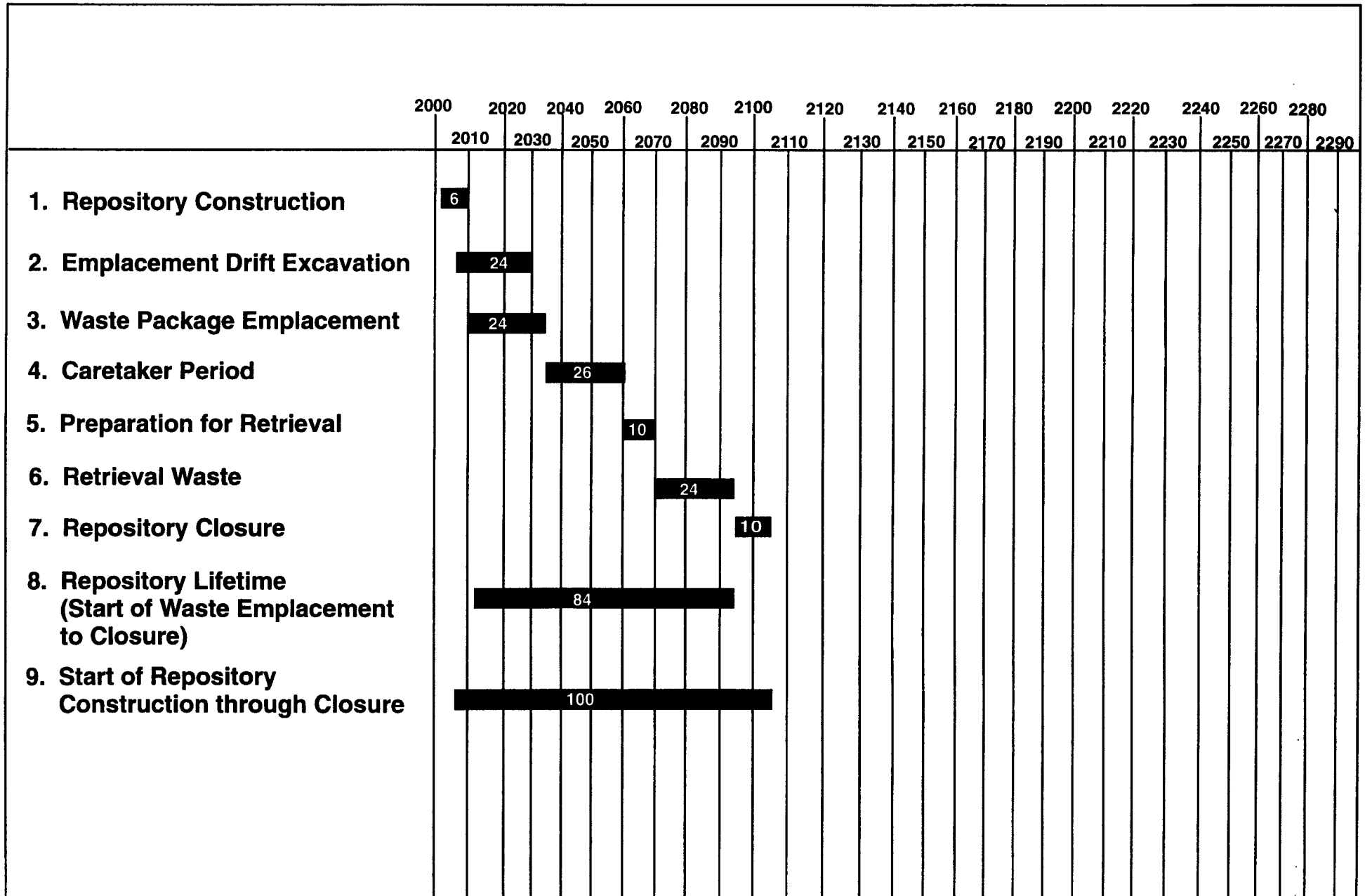
- **10 CFR 60.111 (b) Retrievability of Waste (1) The geologic repository operations area shall be designed to preserve the option of waste retrieval throughout the period during which wastes are being emplaced and, thereafter, until the completion of a performance confirmation program and Commission review of the information obtained from such a program.**
- **10 CFR 60.133(2)(c) Retrieval of Waste. The underground facility shall be designed to permit retrieval of waste in accordance with the performance objectives of 60.111**

Regulatory Basis of Retrievability

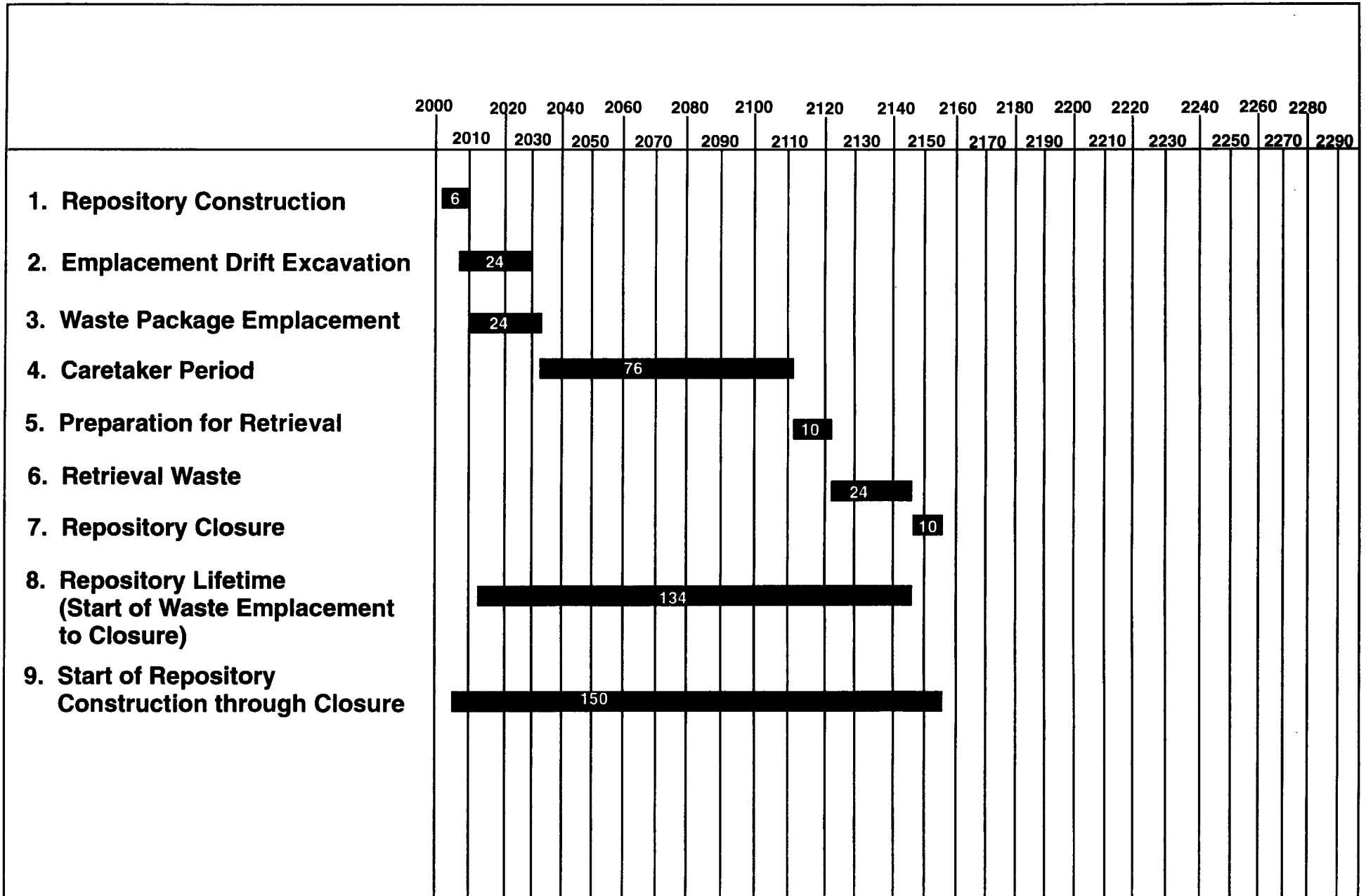
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- The regulation defines reasonable schedule:
 - 10 CFR 60.111 (b)(3)...a reasonable schedule for retrieval is one that would permit retrieval in about the same time as that devoted to construction of the geologic repository operation area and the emplacement of wastes.
- NRC explained (Federal Register, June 21, 1983) that "...retrievability does not imply ready or easy access...[the NRC] recognizes that any retrieval operation would be an unusual event, and may be an involved and expensive operation. The idea is that it should not be made impossible or impractical...if necessary to protect public health and safety."

50-Year Retrievability Schedule



100-Year Retrievability Schedule



Retrievability Issue

- **Retrievability Issue 2.4:**
 - **Can the repository be designed, constructed, operated, closed, and decommissioned so the option of waste retrieval will be preserved as required by 10 CFR 60.111 ?**
- **SCP describes the tie of this issue to the principal Design Issue 4.4, Preclosure Design and Technical Feasibility**

Approach to Resolving the Retrievability Issue

Approach to resolve waste retrievability issue:

- Evaluate regulatory requirements, existing site data, designs and analyses**
- Determine functions and processes that must be performed to preserve the retrieval option**
- Establish performance measures and goals (design criteria)**
- Identify normal and credible abnormal conditions**
- Develop reference design, operating plans, analyses and demonstrations**
- Conduct compliance analysis**

Retrieval Functions

Retrieval functions will include the following:

- **Provide access to the emplacement drift**
- **Remove waste package from emplacement drift**
- **Transfer waste package to surface handling facilities**
- **Further handle and process retrieved waste**

Performance Goals and Measures

Examples of Provide Access function:

<u>Activity</u>	<u>Performance Measures</u>	<u>Tentative Goals</u>
Design and construct drifts to be usable throughout the retrievability period for normal and credible abnormal conditions	Time during which the drifts and accesses will remain usable	> 134 years
Develop rock support concepts that will ensure maintainability	Amount of spall Frequency of maintenance	TBD TBD
Monitor drifts and accesses to determine maintenance needs	Localized rock and rock support displacements	Monitor displacement > TBD

Normal Conditions for Retrieval Operations

Expected normal conditions in the accesses and drifts are characterized by the following:

- Rock temperatures in the drift**
- Condition of the openings**
- Radiation environment**

Off-Normal Retrieval Conditions

- **SCP-Conceptual Design Report (SNL, 1987) identified the following processes and events**
 - **Tectonics (seismic, faulting)**
 - **Variability in rock characteristics**
 - **Human error**
 - **Aging and corrosion of equipment and facilities**
 - **Radiolysis (borehole liner, waste package)**

Potential for Off-Normal Conditions for Retrieval

- **Examples of off-normal conditions:**
 - **Rock temperature exceeding predicted level**
 - **Waste package buried or lodged in the drift by rockfall**
 - **Flooding of the emplacement area**
 - **Emplacement car derailed**
 - **Retrieval equipment failed**
 - **Radiation level higher than expected**
 - **Drift blocked off**

Ongoing Retrievability Design Activities

- **Design approaches include**
 - **Locate and orient emplacement drifts for optimum stability with respect to joints, stress field, rock qualities**
 - **Perform stability analyses of heating and cooling phases**
 - **Develop ground support system for long-term durability**
 - **Provide access to inspect and provide necessary maintenance**
 - **Develop equipment concepts to remotely recover from accidents (equipment failure, rockfall)**
 - **Develop layouts for ease of maintenance and recovery from accidents**

Summary

- **CDA has been updated and augmented**
- **Regulatory and programmatic issues govern the layouts and require maintaining flexibility**
- **Layout options are being evaluated: few are rejected; none selected yet**
- **Retrievability is a requirement and an integral part of the design**
 - **As a major design issue, retrievability options and issues are being investigated**