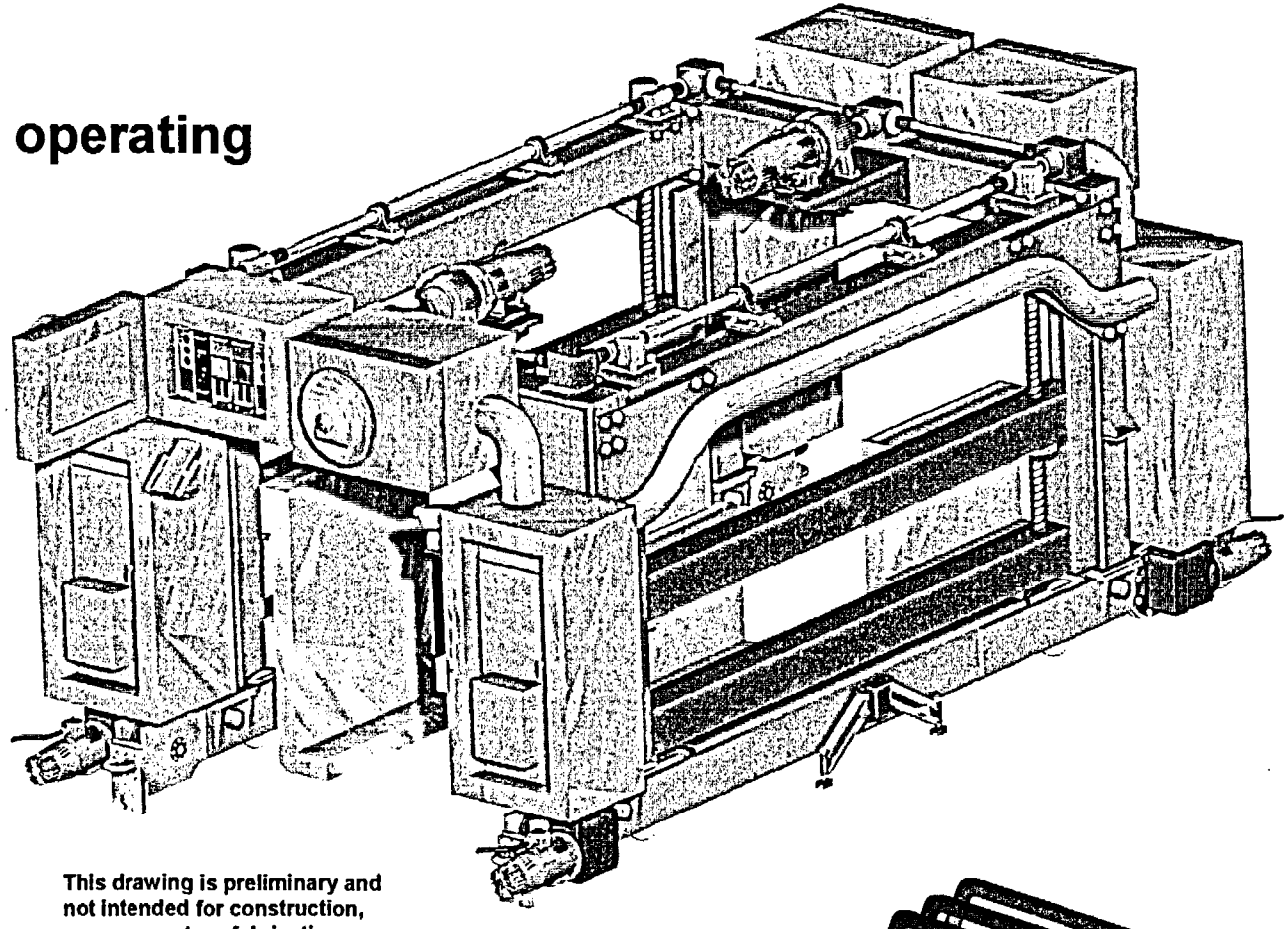
Emplacement Gantry

- Moves and emplaces waste packages on pallets within emplacement drift
- 40-60 tons weight
- 1.7 mph maximum operating speed
- Remote controlled



This drawing is preliminary and not intended for construction, procurement, or fabrication.

Subsurface Facility Preliminary Preclosure Safety Analysis and Classification Results

- There are no Category 1 or Category 2 event sequences in the subsurface facilities
- Structures, systems, and components that prevent Category 1 or Category 2 event sequences are important to safety
- The following structures, systems, and components are important to safety because they are credited with prevention:
  - Waste package
  - Waste package transporter
  - Emplacement gantry

Subsurface Facilities Preliminary Classification Results

- The following features are important to waste isolation because they are important to meeting 10 CFR 63.113 performance objectives
  - Subsurface facility
  - Drift inverts
  - Drip shields
  - Saturated zone (between repository and accessible environment)
  - Unsaturated zone (above and below the repository)
  - Waste packages
  - Commercial and naval spent nuclear fuel cladding
  - Waste form

Subsurface Facilities As Low As Is Reasonably Achievable and Worker Safety

- Unshielded waste packages are transported in a shielded transporter
- Drift turnouts are designed to reduce the dose rates in the access mains
- Emplacement drift ventilation control doors also provide personnel access control
- Differential pressure between emplacement and development areas

Waste Package

Waste Package Design Process

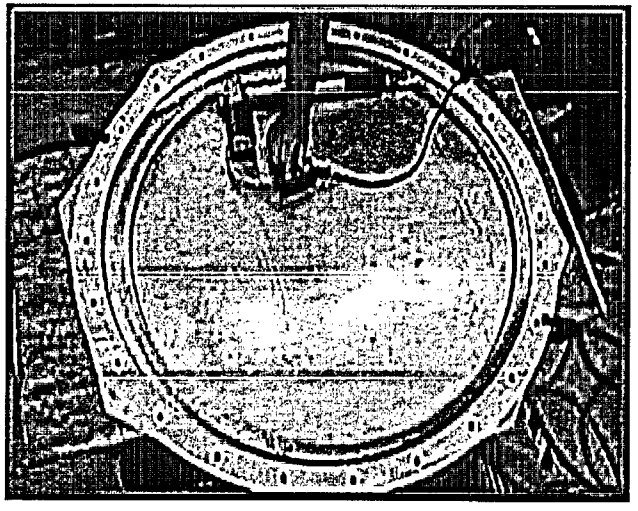
- **Design for preclosure**
  - **Waste package is designed such that breach is beyond Category 2 for postulated event sequences to support the Preclosure Safety Analysis**
  - **The following postulated event sequences will be evaluated:**
    - **Object falls onto the waste package**
    - **Waste package drops, dynamic events, swingdowns, tipovers, etc.**
    - **Vibratory ground motions**
    - **Parametric fires**
    - **Preclosure design-basis rock fall**

Waste Package Design Process
(Continued)

- **Analyze for postclosure**
  - **Analyze postulated events (drip shield installed) and provide information to support model abstractions for total system performance assessment, including assessment of corrosion potential**
    - **Damage from rock fall**
    - **Damage from vibratory ground motion**
    - **Weld flaw distribution**
    - **Waste package and weld area stress state**

Waste Package Mockups

- FY 2000 waste package mock-up (based on site recommendation design)
  - Fabricated a quarter-length test mock-up to investigate the feasibility of fabrication
  - Performed residual stress measurements before and after mock-up welding
  - Demonstrate machine welding and non-destructive evaluation techniques
  - Used in several development studies
- Spread ring mock-up
  - Mock-up of the single spread ring design and engagement tool was constructed
  - Operated successfully



Waste Package Development Studies

- Development studies serve several purposes:
  - Provide information and rationale for design and fabrication issues
  - Support analyses and model reports that are developed for total system performance assessment
- The following studies have been completed:
  - Weld Flaw Distribution
  - Induction Annealing
  - Laser Peening - Depth of Compressive Stress
  - Controlled Plasticity Burnishing - Depth of Compressive Stress
  - Residual Stress Measurement Analyses
  - Neutron Diffraction Analyses

Waste Package Development Studies
(Continued)

- **The following studies are planned or continue in FY 04**
  - **Weld Material and Base Material Variability Study**
  - **Laser Peening and Controlled Plasticity Burnishing Corrosion Study**
  - **Fracture Toughness Study**
  - **Welding Interpass Temperature Study**

Waste Package Prototype Program

- Prototyping is an integral part of design
- Prototyping will demonstrate the fabrication processes before manufacture of the production units
  - Ensures that waste packages can be manufactured as designed
- Prototypes will be used to:
  - Verify the closure processes and systems
  - Demonstrate waste package handling processes
  - Train operators for start-up and operations

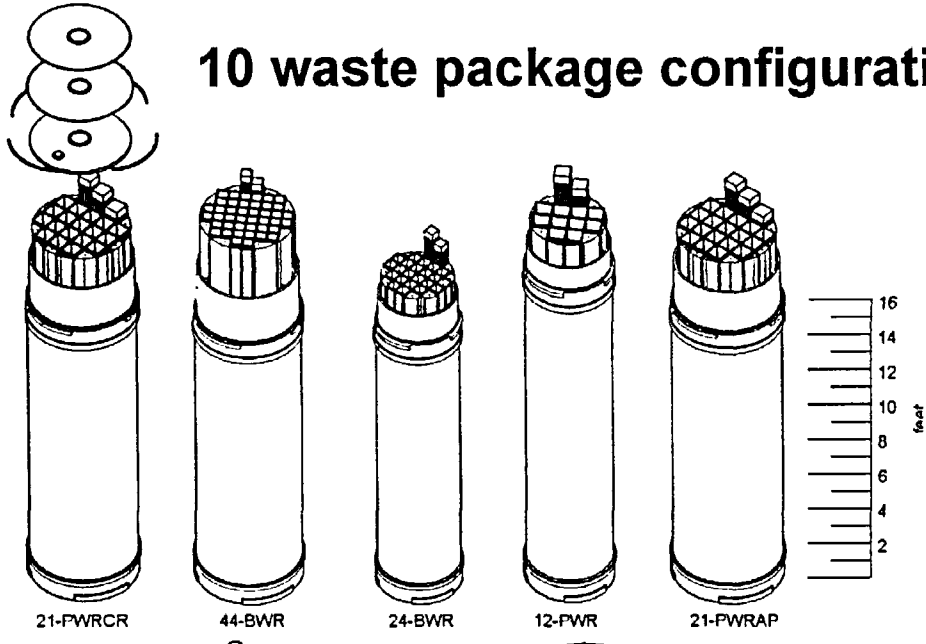
Waste Package Prototype Program

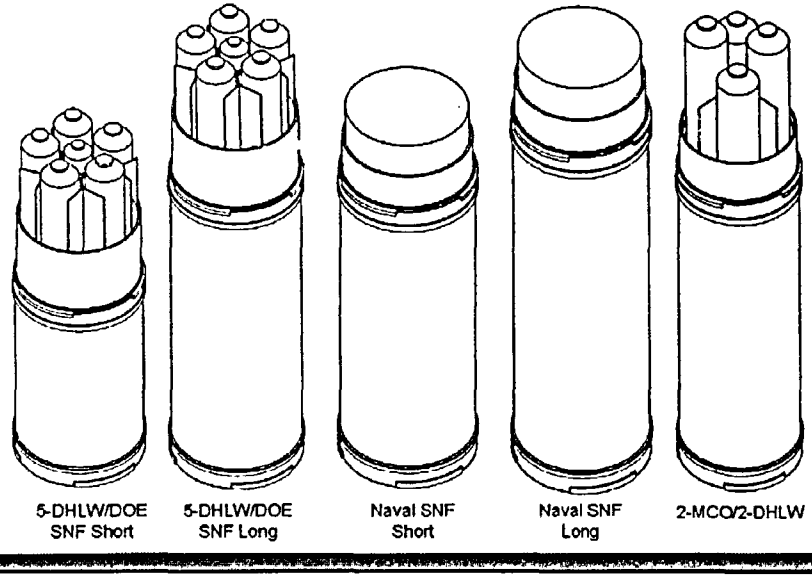
(Continued)

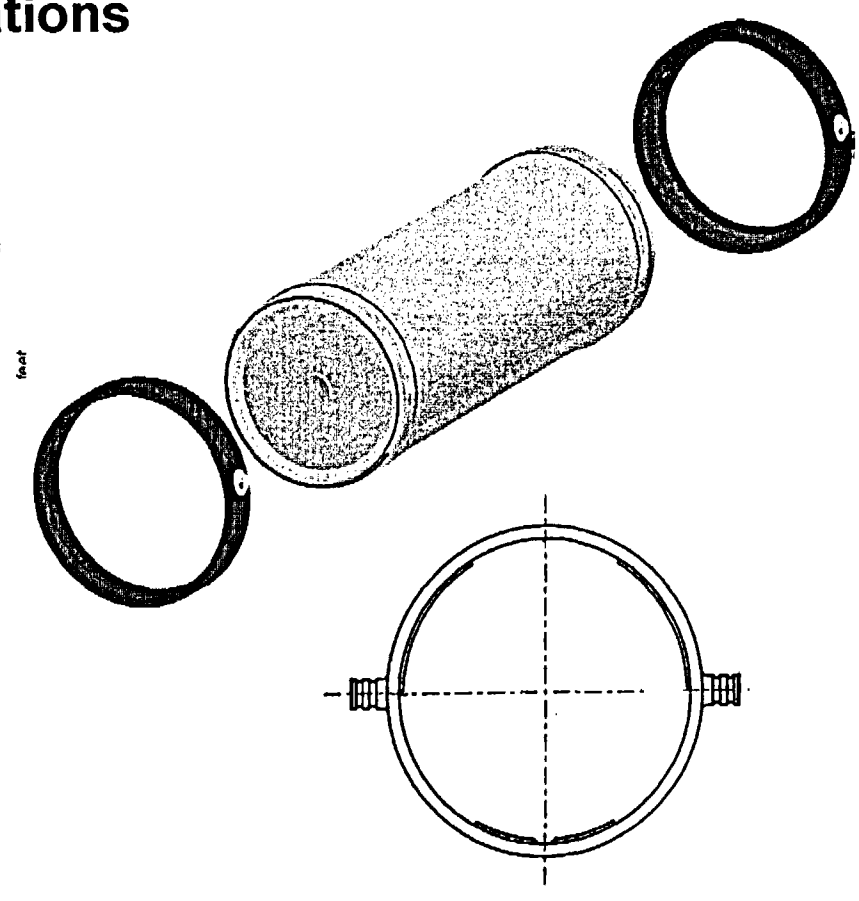
- 15 waste package prototypes have been planned, scheduled, and budgeted
- Prototypes will be produced over a six-year period from calendar year 2003 through 2008
- Request for proposal for the first waste package prototype procurement issued in July 2003
  - 21 element pressurized water reactor waste package with absorber plates, full scale, includes all internals
  - Manufactured in strict compliance with all current design requirements including application of the American Society of Mechanical Engineers Section III Code N-Stamp
- Award of fixed-price contract is expected by end of calendar year 2003

Waste Package Configurations

10 waste package configurations





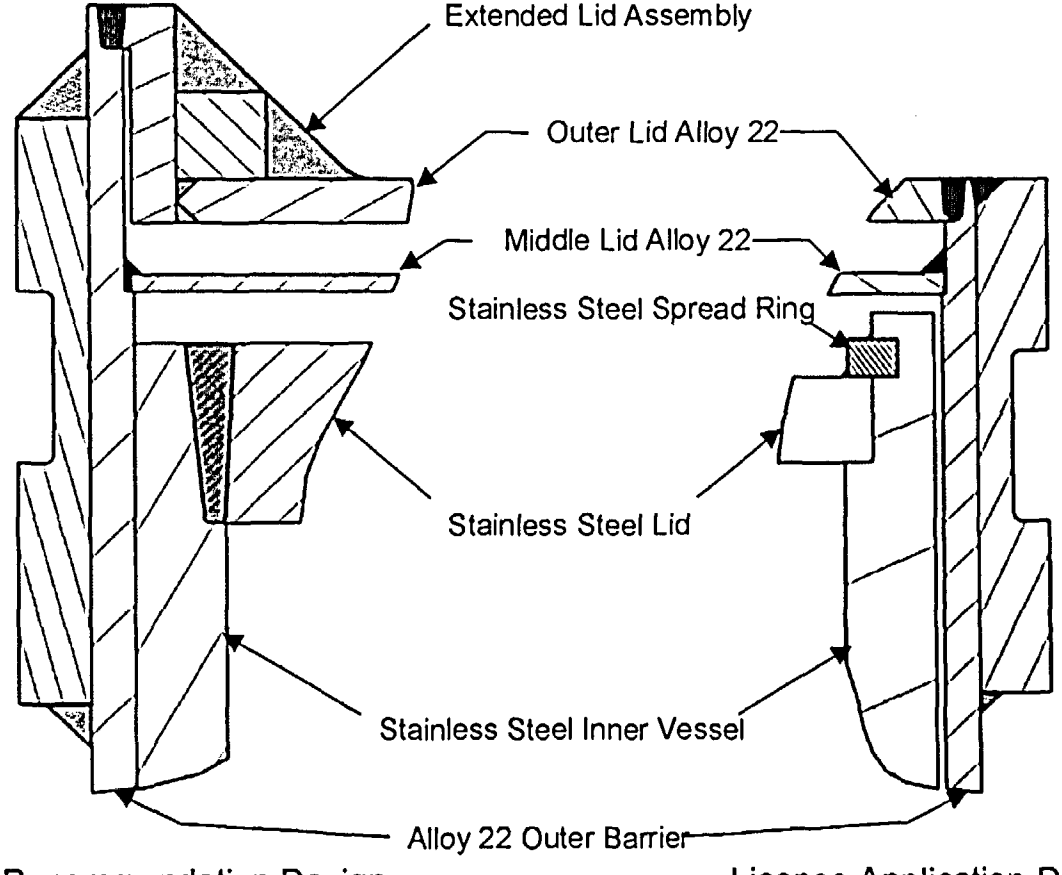


This drawing is preliminary and not intended for construction, procurement, or fabrication.

Waste Package Design Changes

- Recent design detail changes
  - Replaced the extended outer lid with a flat lid
  - Replaced induction annealing with either laser peening or low-plasticity burnishing as the outer lid closure weld stress mitigation technique
  - Changed the middle lid weld configuration from a full penetration weld to a fillet weld and delete the stress mitigation step
  - Reduced the stainless steel inner lid thickness from 3 to 4 inches to 2 inches and changed the closure method from a full penetration weld to a spread ring with seal welds
  - Replaced the split trunnion collar design with a one-piece twist-on design
  - Changed the gap between the inner vessel and outer corrosion barrier to accommodate differential thermal expansion

Waste Package Closure Details

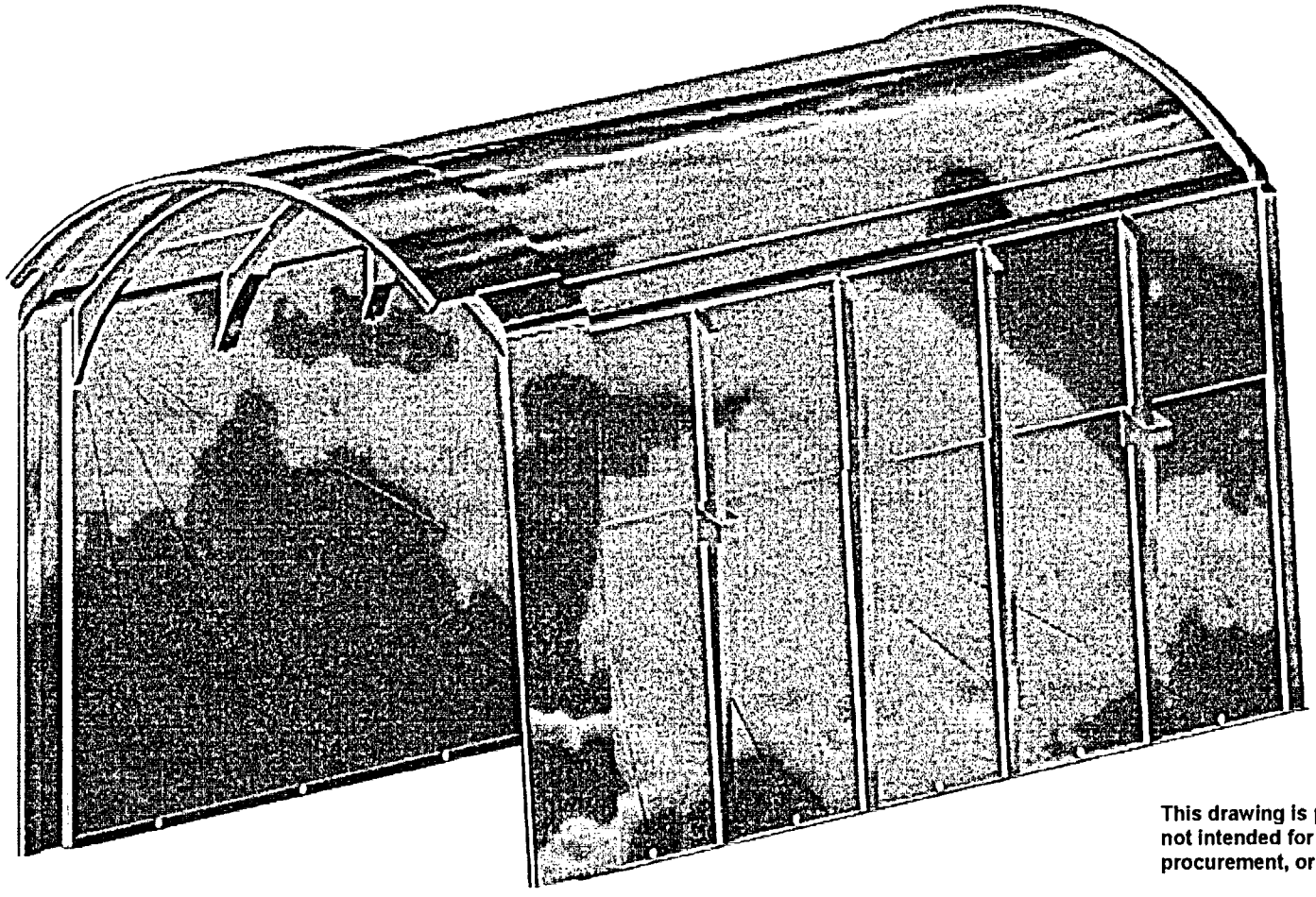


This drawing is preliminary and not intended for construction, procurement, or fabrication.

Drip Shield Design Process

- Analyze for postclosure
  - Analyze postulated events and provide information to support model abstractions for total system performance assessment
  - Postulated events include:
    - Rock fall
    - Vibratory ground motion

Drip Shield Illustration



This drawing is preliminary and not intended for construction, procurement, or fabrication.

Drip Shield Design Changes

- Potential drip shield design detail changes not yet adopted
  - Increased distance from drip shield to waste package to prevent drip shield contact with the waste package in the event of rock fall
  - Increased stiffness for bending loads and stresses along the bulkheads
  - Added longitudinal stiffener beams between the bulkheads along the axial direction, to provide additional strength for bending loads along axial length
  - Simplified handling and interlocking features
- Material selection remains unchanged

Waste Package Preliminary Preclosure Safety Analysis Results

- Preclosure safety considerations
  - The waste package design considers both Category 1 and Category 2 event sequences as defined by preclosure safety analysis
  - Waste package breach is therefore beyond Category 2

Waste Package Preliminary Classification Results

- The following structure, system, and component is important to safety:
  - Waste package
- The following features are important to waste isolation:
  - Waste package
  - Drip shield

Summary

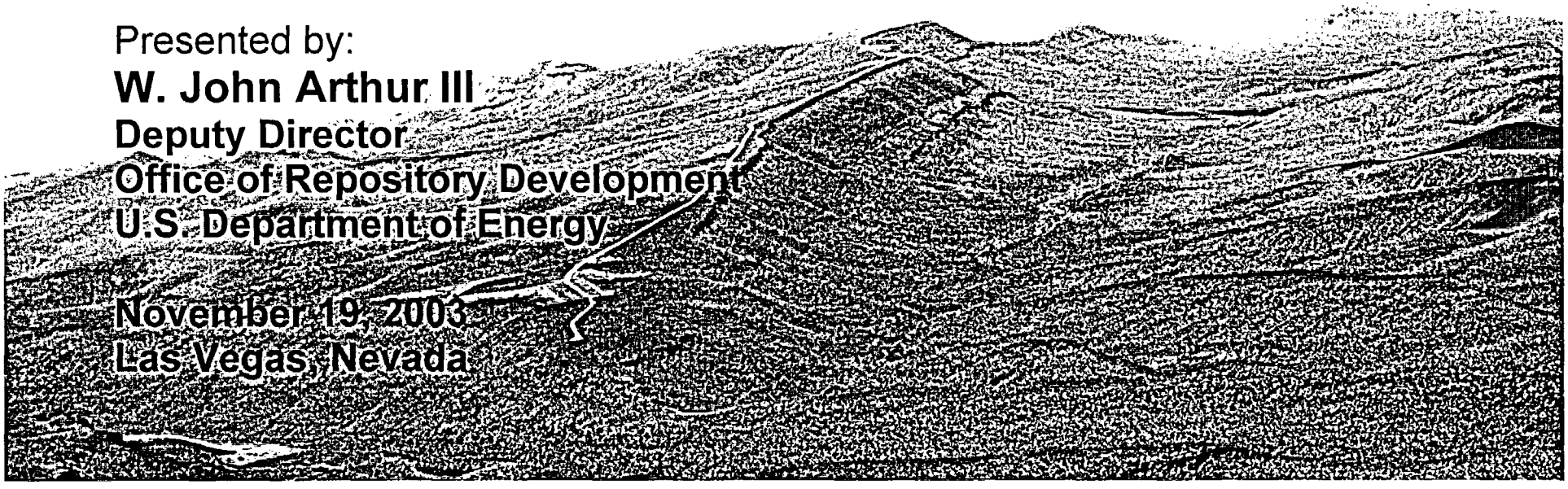
- Preliminary preclosure safety analysis indicated April 2003 design would be able to meet regulatory performance objectives
- Structures, systems, and components which are important to safety have been identified
- Engineered features which are important to waste isolation have been identified
- Complete design development to support License Application
- Preclosure safety analysis to be updated based upon final License Application design
- No new event sequences are anticipated, so ability of License Application design to meet regulatory performance objectives is expected

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

YUCCA MOUNTAIN PROJECT

Exhibits

Presented to:
Advisory Committee on Nuclear Waste



Presented by:
W. John Arthur III
Deputy Director
Office of Repository Development
U.S. Department of Energy

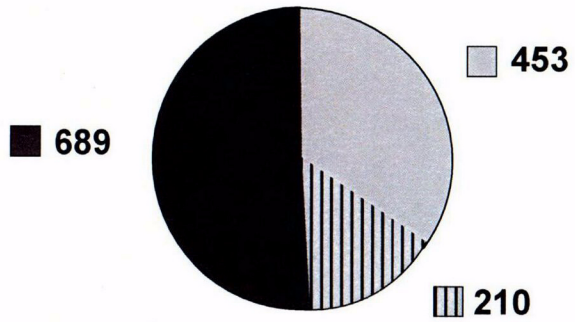
November 19, 2003
Las Vegas, Nevada

Management Assessment of Progress Towards License Application

COMPONENT (WEIGHT)	% COMPLETE (6/03)	%COMPLETE (10/03)
• KTI Agreements Addressed (10%)	50%	60%
• LA Document (20%)	5%	7%
• Preclosure Safety Assessment (10%)	14%	51%
• TSPA-LA (30%)	35%	63%
• Design (30%)	25%	40%
• TOTAL WEIGHTED % COMPLETE	25%	43%

Status of LA Data, Codes, and Models[1]

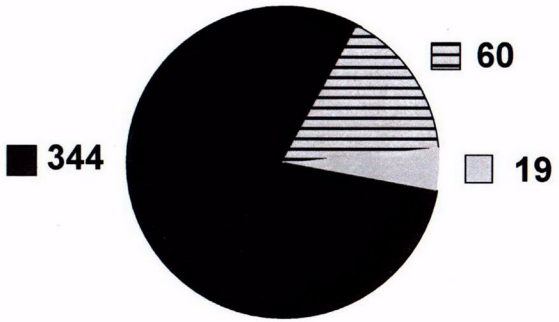
Data (Estimate)



Total Data Sets: 1,352

- Qualified: 689 (51%)
- Being Verified: 453 (34%)
- Being Developed: 210 (15%)

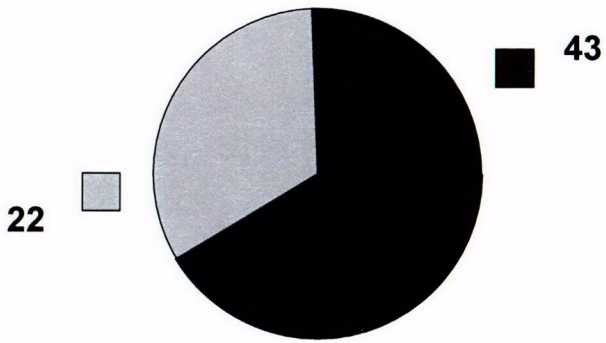
Codes (Estimate)



Total Codes: 423

- Qualified & Verified: 60 (14%)
- Qualified (Legacy/re-testing): 344 (81%)
- Developing/verifying: 19 (5%)

Model Reports [2]



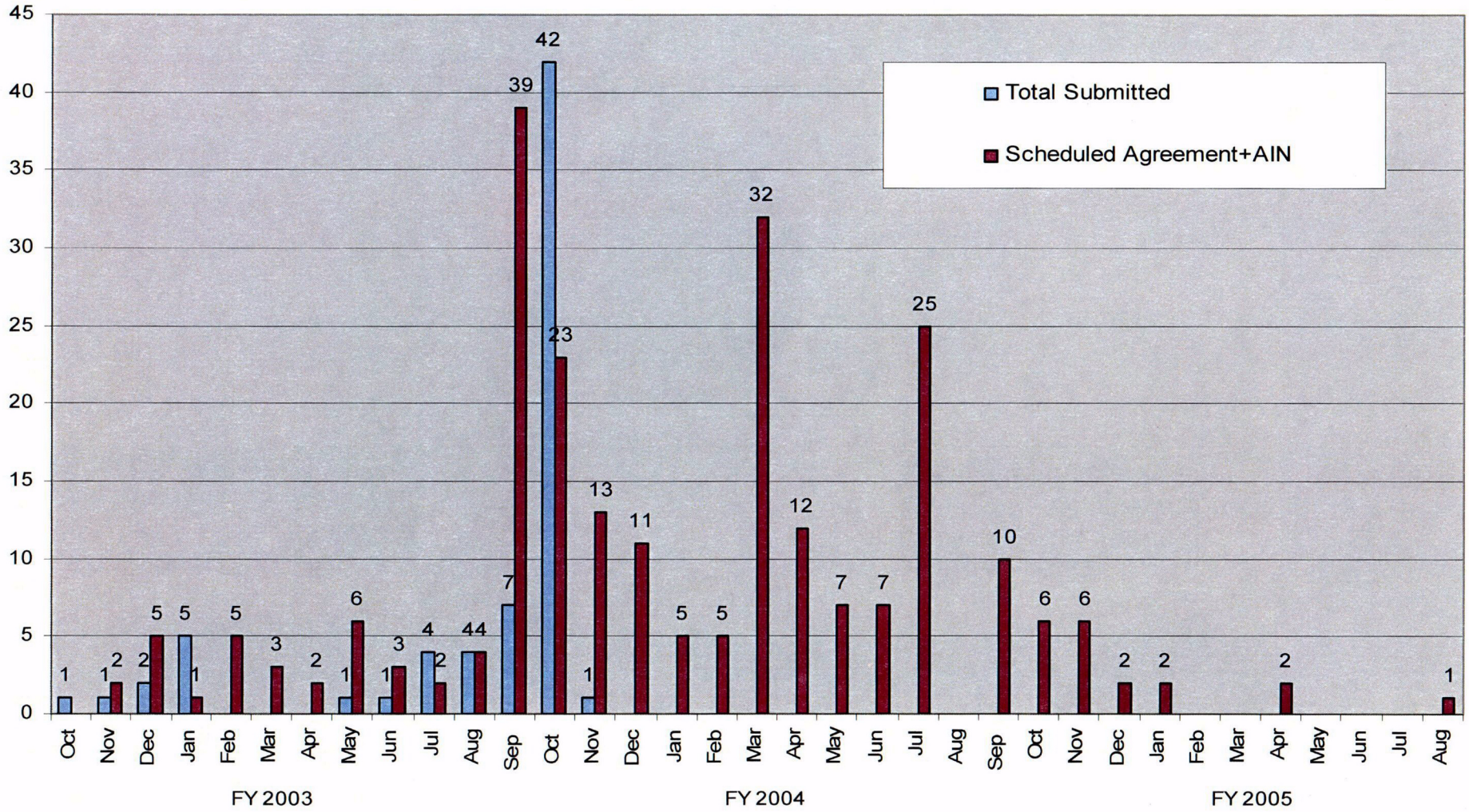
Total Model Reports Directly Supporting LA: 65

- Completed: 43 (66%)
- Being Developed: 22 (34%)

[1]Status of qualification activities for LA and completion of reports
[2]Model Reports may contain multiple models

C11

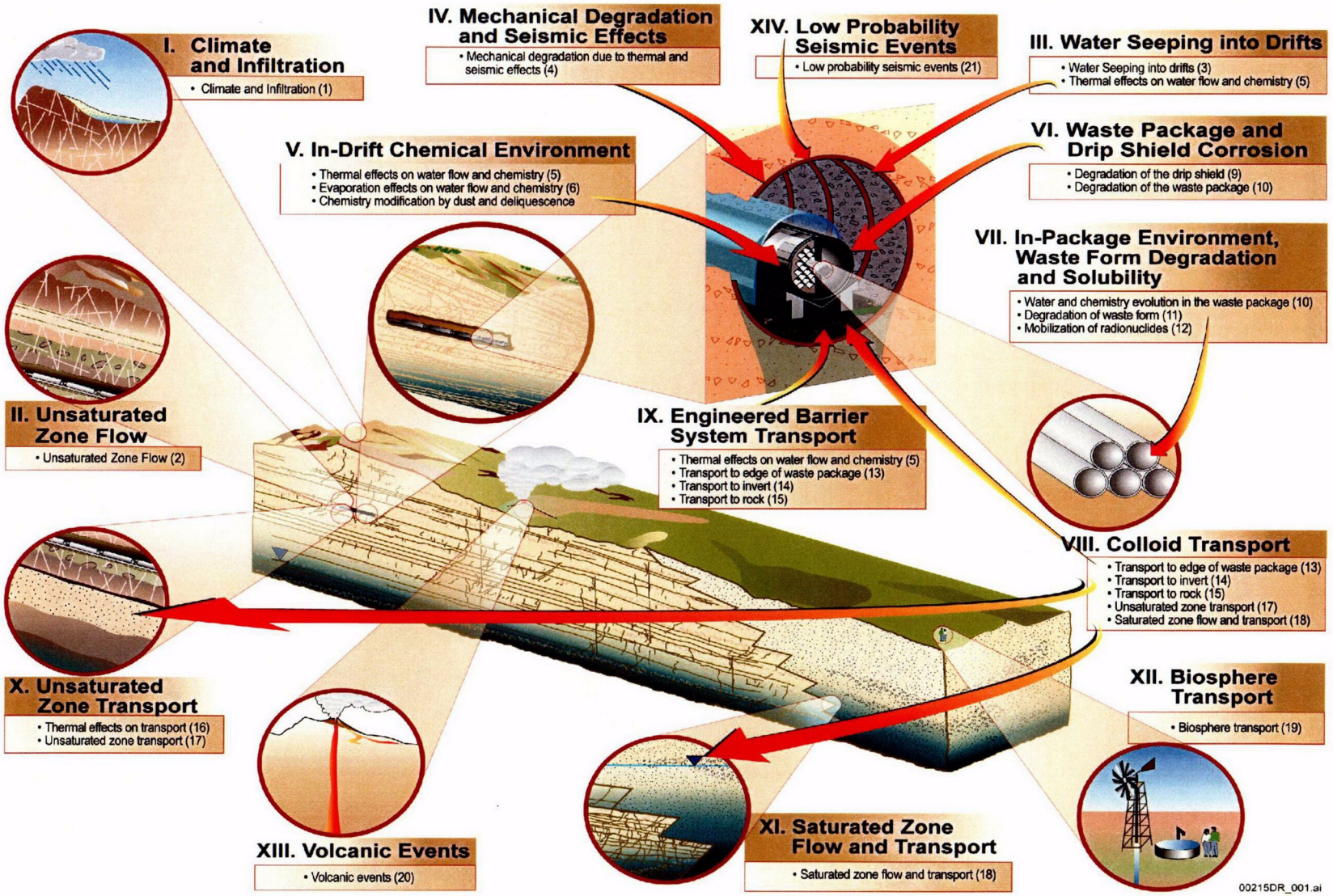
Scheduled KTI Submittals vs. Actual



C12

Integrated Technical Basis KTI Response Groups

(And Related Process Model Groups)

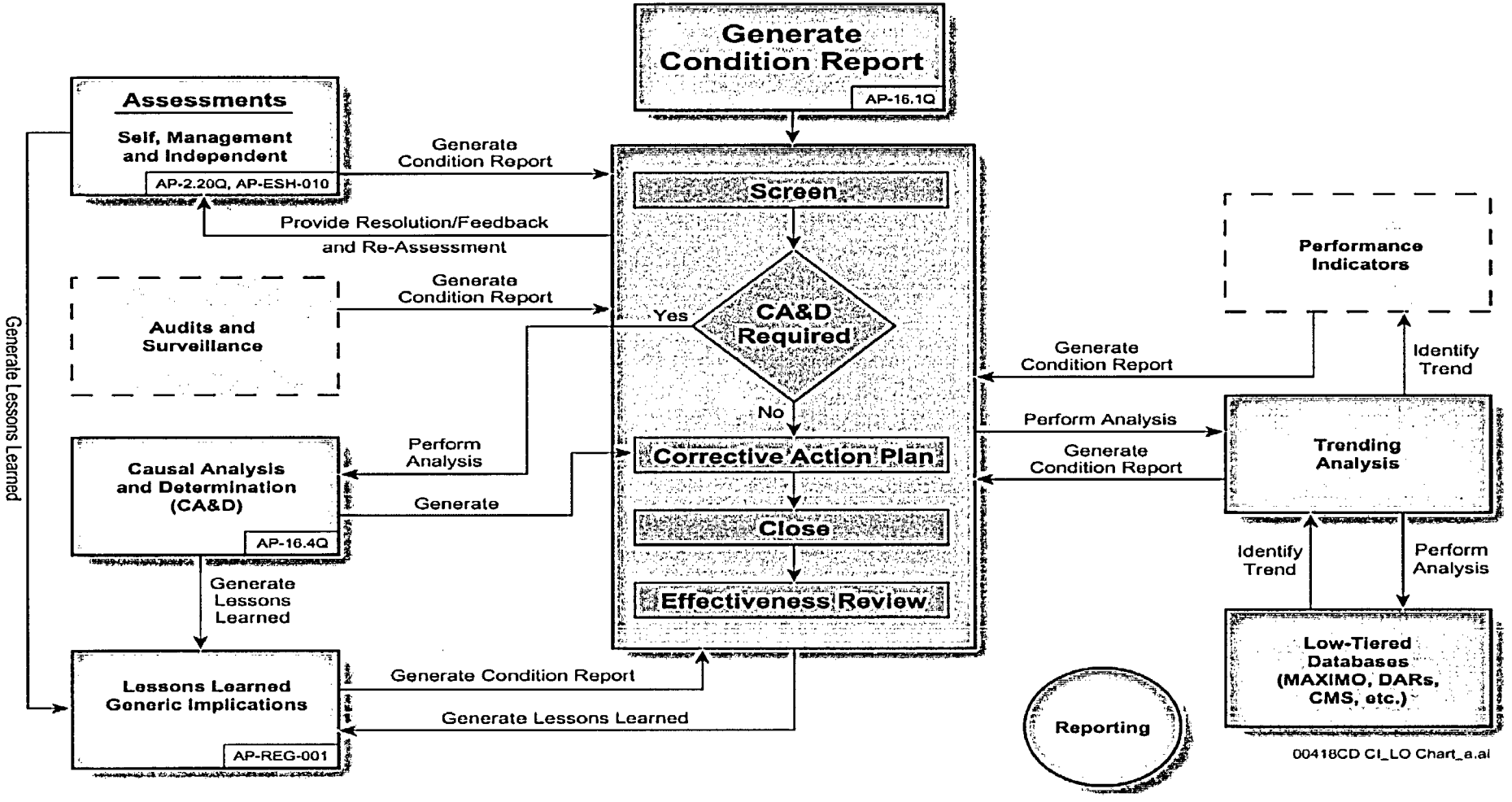


YUCCA MOUNTAIN PROJECT

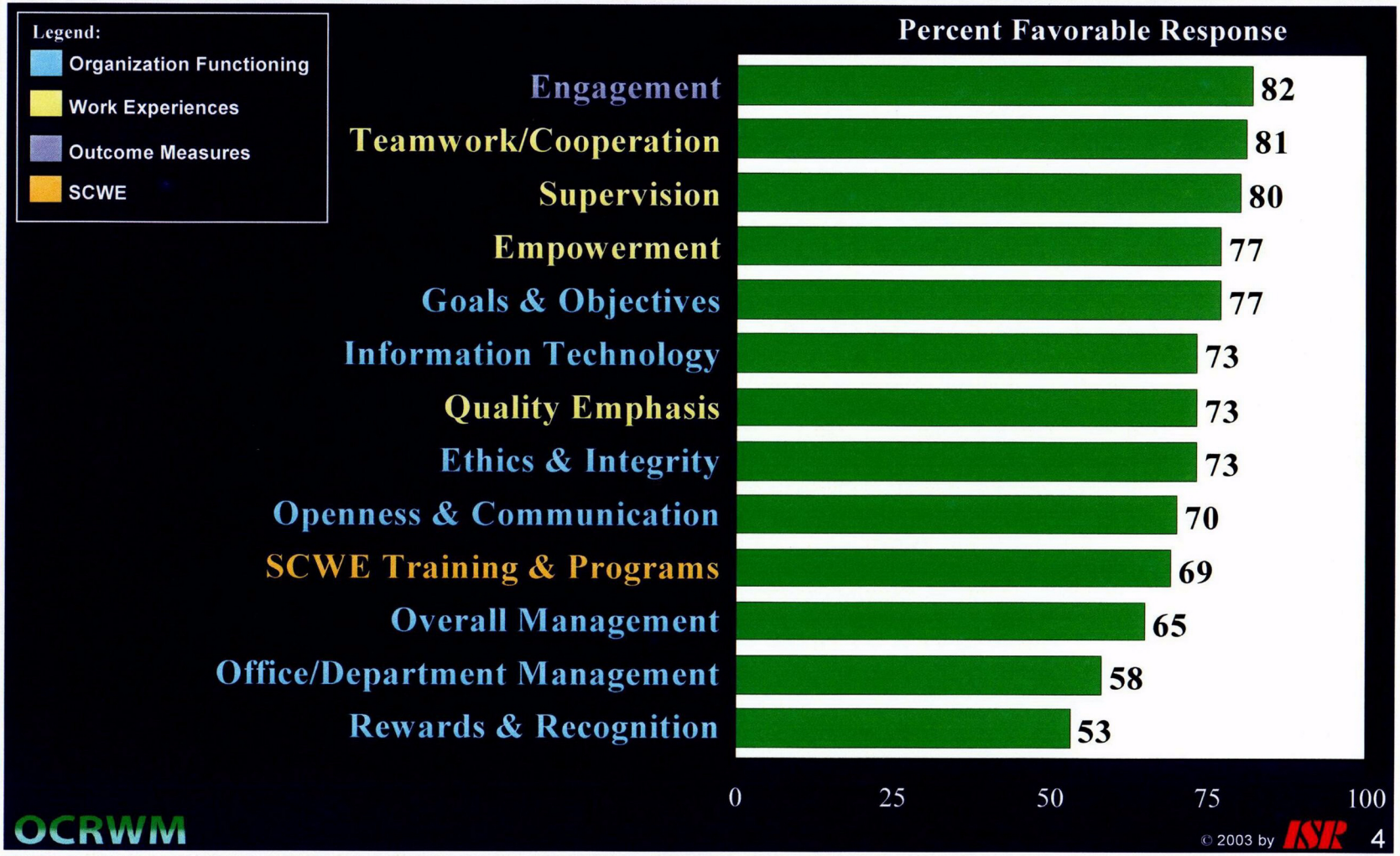
C13

Corrective Action Program - Process

Continuous Improvement Learning Organization



OCRWM 2003
Safety Conscious Work Environment Survey (N=1,492)



C14

Office of Civilian Radioactive Waste Management

OCRWM

2003 Safety Conscious Work Environment Survey

Administration: August 18 through September 5

Outgoing	Returned	Return Rate	Margin of Error
2,287	1,492	65%	+/- 1.5%

Results Summary

Strengths to Maintain:

- Emphasizing Quality
- Setting and Communicating Goals & Direction
- Encouraging Openness & Receptiveness to Input
- Building Trust and Maintaining Integrity
- Involving Employees in Decisions
- Keeping SCWE as a Priority
- Encouraging & Recognizing Team Work

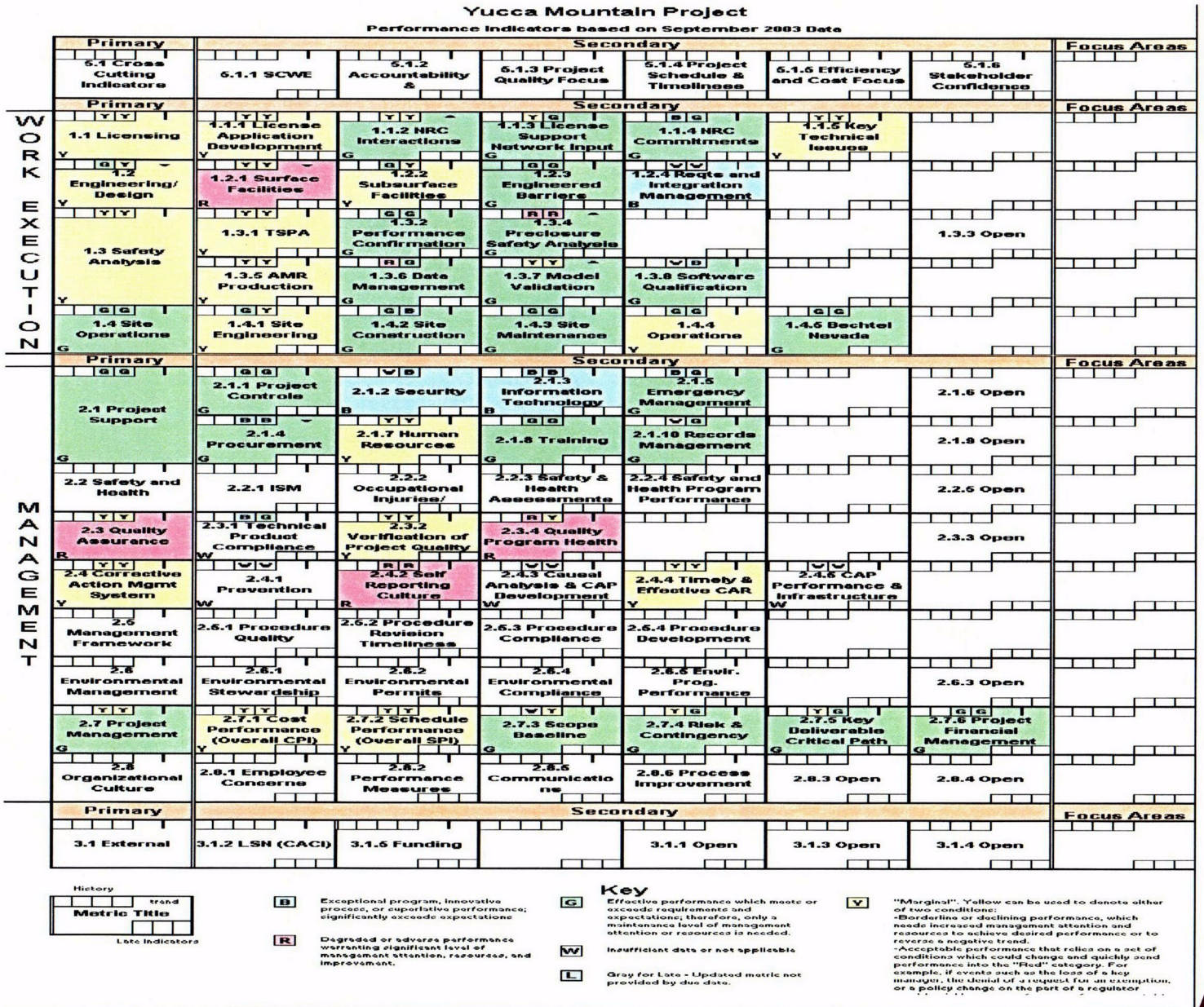
Areas for Improvement:

- Managing Change
  - Planning & Communication of Reorganizations
  - Setting Objectives and Priorities
  - Keeping Quality Focus
- Communicating Organizational Performance
- Ensure Sufficient Authority Levels
- Perceived Effectiveness of CAP

OCRWM

 20

Yucca Mountain Project Performance Indicators



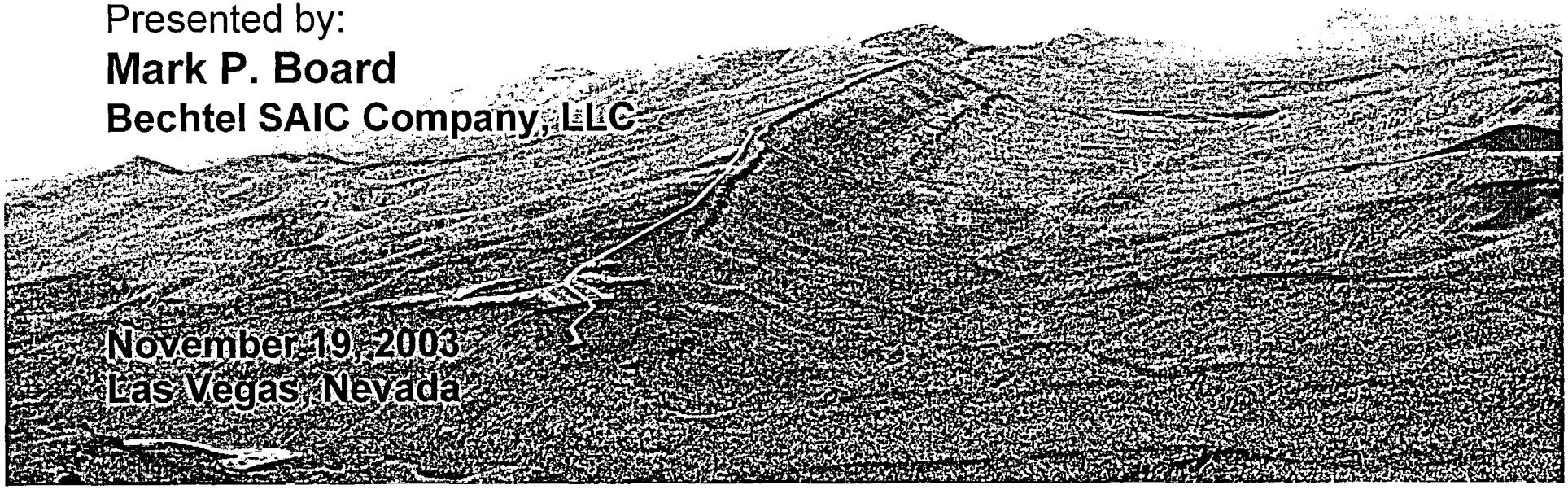
U.S. Department of Energy
Office of Civilian Radioactive Waste Management

YUCCA MOUNTAIN PROJECT

Mechanical Drift Degradation Analysis

Presented to:
Advisory Committee on Nuclear Waste

Presented by:
Mark P. Board
Bechtel SAIC Company, LLC

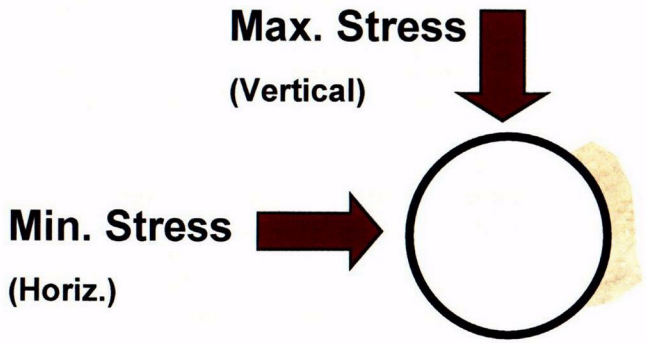


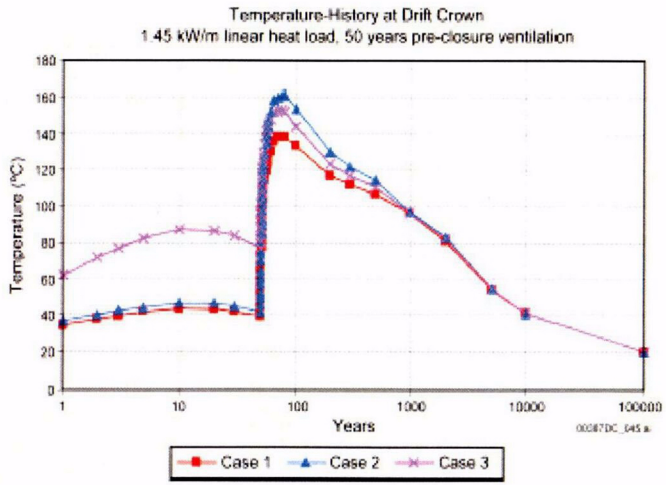
November 19, 2003
Las Vegas, Nevada

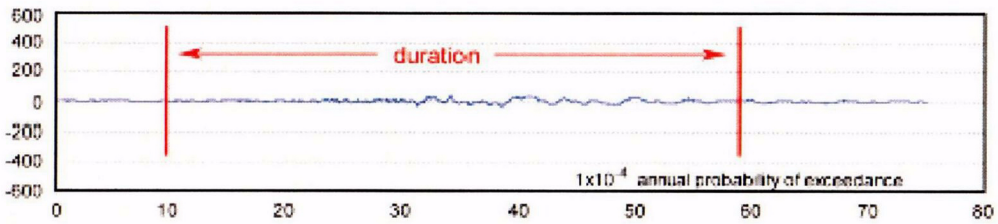
Outline

- Summarize general sources and mechanisms of mechanical degradation
- Review site geology and layout
- Review methodology for simulation and prediction of drift degradation
- Presentation of results of drift degradation to in situ, thermal, seismic and time-dependent loading
- Contrast results of DOE and NRC drift degradation results and approaches

Sources of Mechanical Degradation



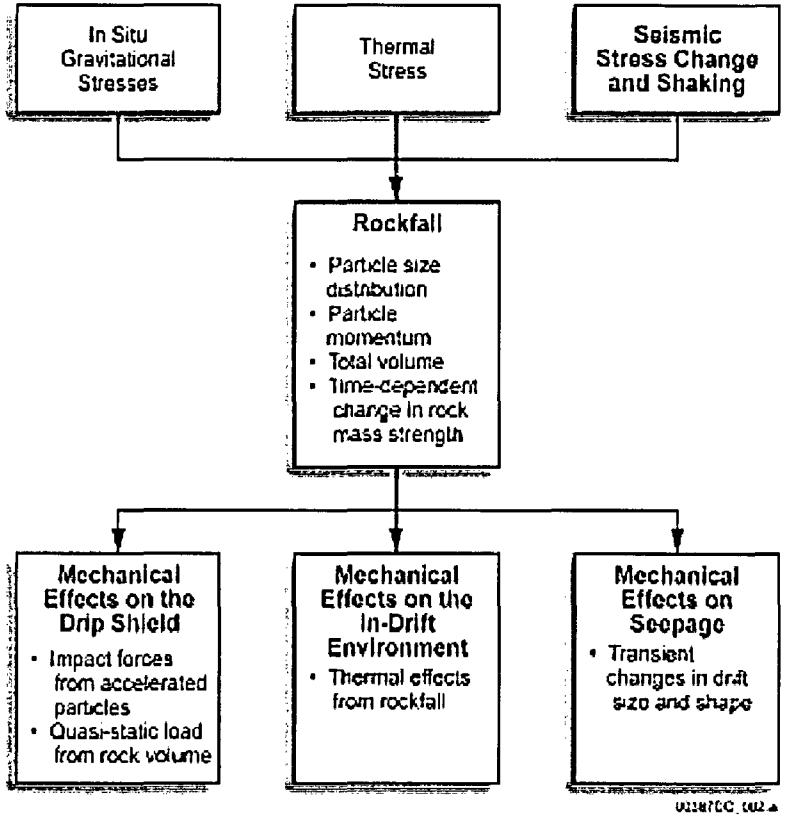




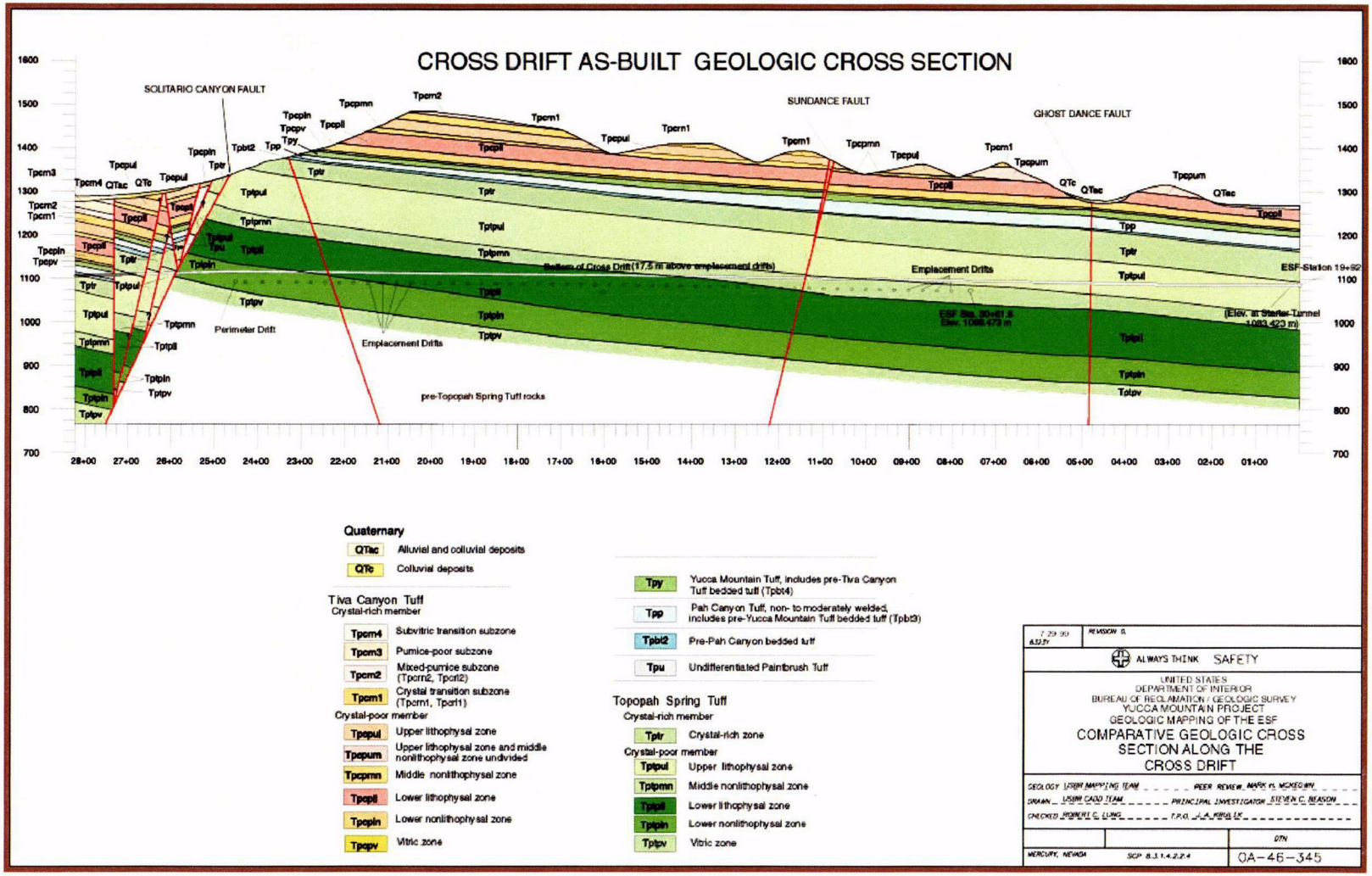
- **Mechanical degradation is damage or yield induced in the rock mass surrounding drifts as a result of applied stresses or time-dependent mechanical effects**
- **Three primary sources of stress change**
  - **In situ gravitational stress**
  - **Thermal loading**
  - **Seismic load**

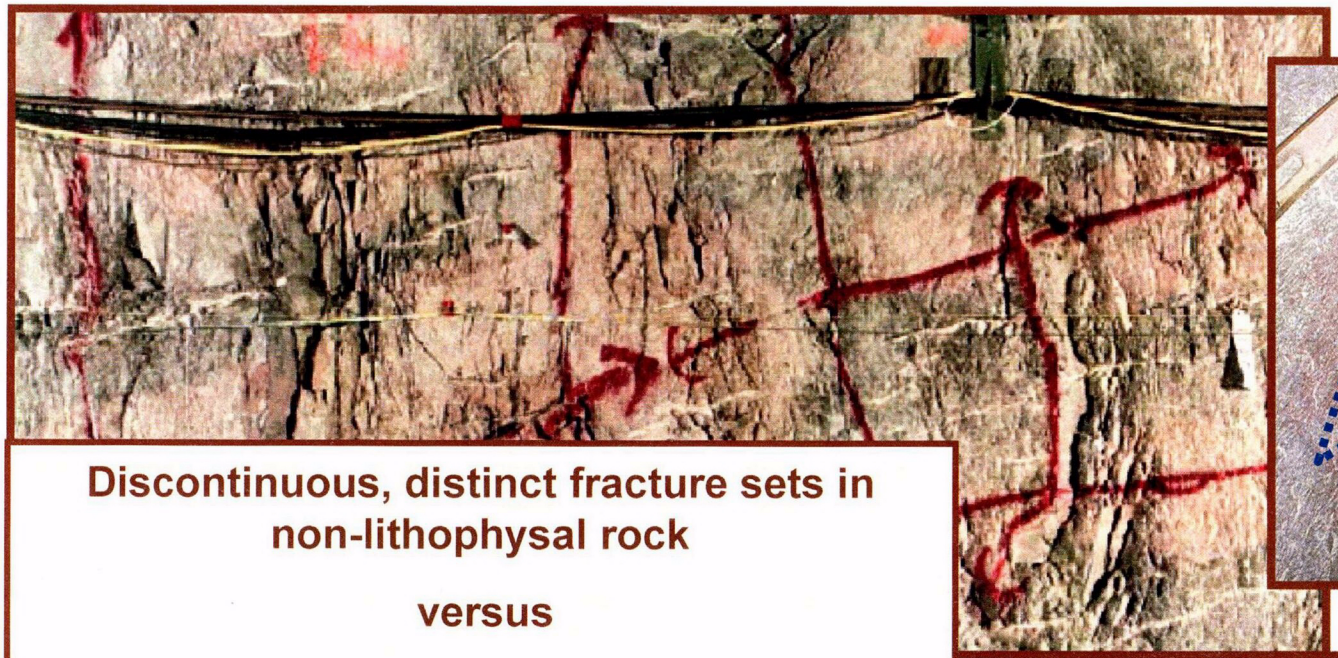
Use of Rockfall in Performance Assessment

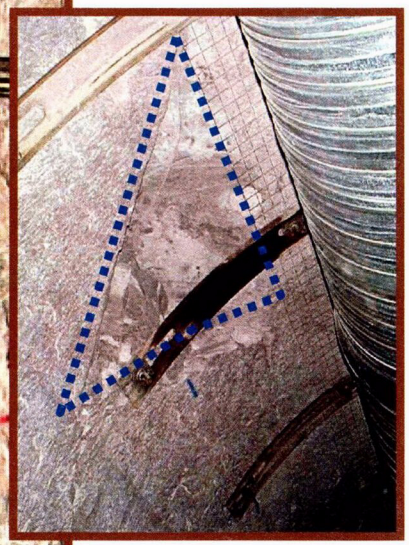
- **Rockfall has three potential areas of performance impact:**
  - **Mechanical effects - waste package in preclosure safety assessment, and drip shield in postclosure performance assessment**
  - **In-drift environment - thermal effects of rockfall**
  - **Seepage - change in drift size and shape, rockfall in drift**



Site Conditions
East-West Geologic Cross Section



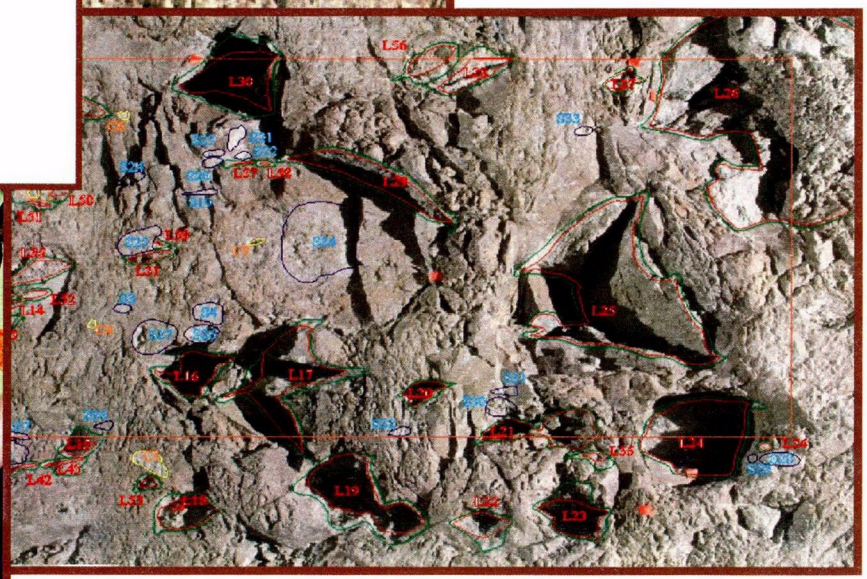




Discontinuous, distinct fracture sets in non-lithophysal rock

versus

short, ubiquitous fractures with irregular cavities in lithophysal rock

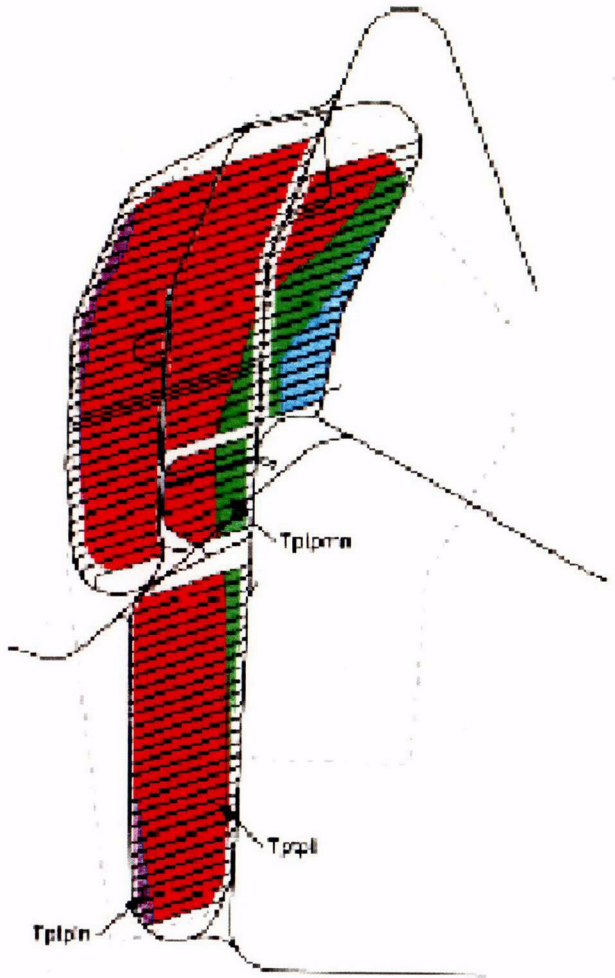


YUCCA MOUNTAIN PROJECT

C18

Repository Rock Units

- **70,000 metric tons of heavy metal baseline emplacement**
  - **3 percent lower non-lithophysal**
  - **80.3 percent lower lithophysal**
  - **12.4 percent middle non-lithophysal**
  - **4.4 percent upper lithophysal**



Upper Lith

Middle Non-Lith

Lower Lith

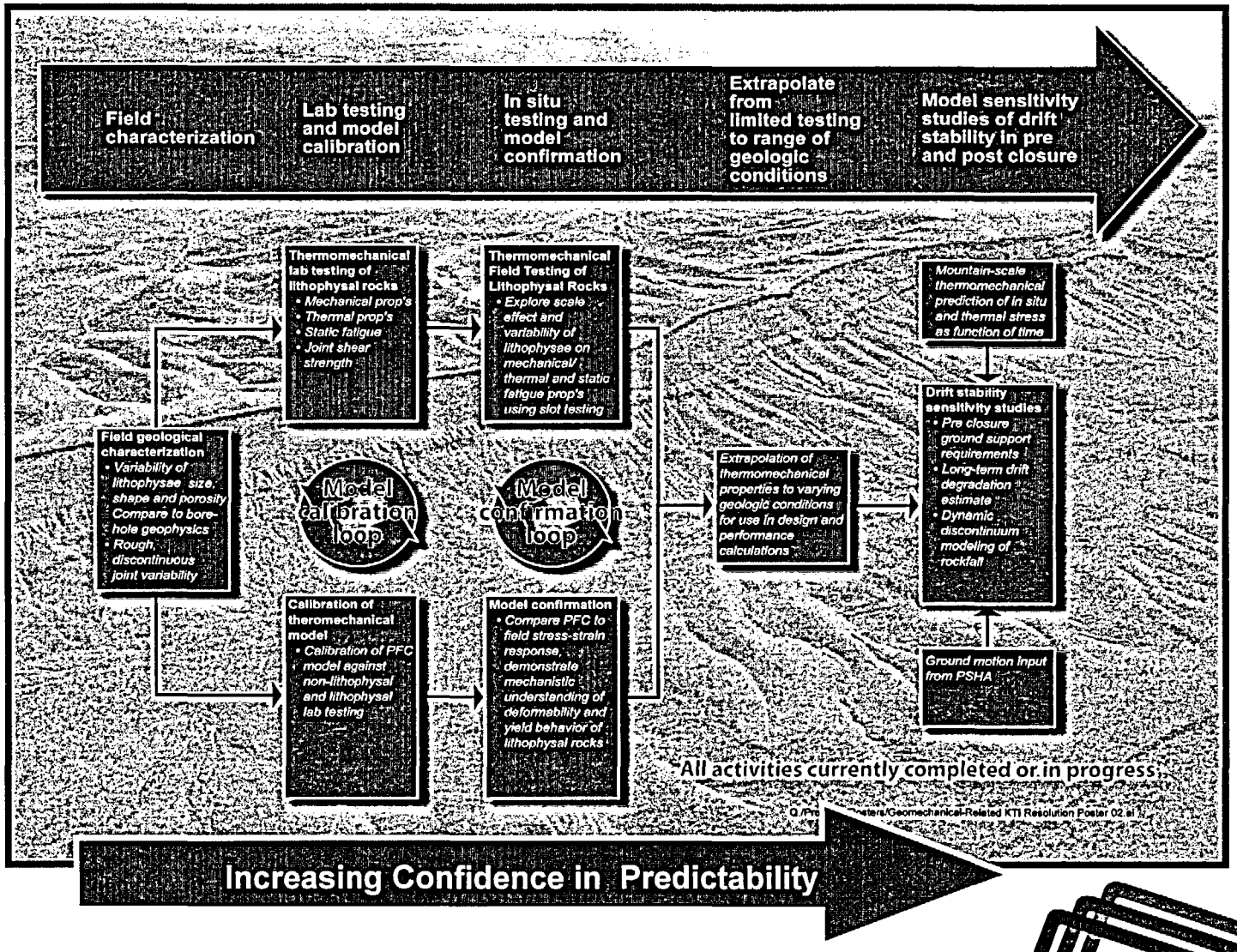
Lower Non-Lith

C19

Observations in Existing Tunnels

- Exploratory Studies Facility (25' diameter) and Enhanced Characterization of the Repository Block (16') developed through all proposed repository host rock units
- Excavations 5-7 years old
- Light ground support (friction bolts and wire mesh in roof - typically no support in walls)
- No observed rockfall in tunnels (minor spalling in Drift Scale Test during thermal overdrive testing)
- Deformation measurements show excavations in equilibrium

Geomechanical Performance Assessment and Design Strategy



Geotechnical Rock Mass Properties - Non-Lithophysal Rock

- Development of stochastic model of fracturing using FracMan program
- Determination of shear properties of joints from direct shear testing and in situ geotechnical mapping