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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
PANEL ON STRUCTURAL GEOLOGY & GEOENGINEERING

SUBJECT: YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT STATUS AND BUDGET

PRESENTER: CARL P. GERTZ

PRESENTER'S TITLE AND ORGANIZATION: PROJECT MANAGER
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
LAS VEGAS, NEVADA

PRESENTER'S TELEPHONE NUMBER: (702) 794-7900

ARLINGTON, VA
JANUARY 7-8 , 1992

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NWTRB: Fourth Report to Congress and the Secretary of Energy

"If the DOE is to meet its present schedule, substantial funding increases will be needed for ESF design and construction for fiscal year 1993 and the following years. Furthermore, if sufficient and predictable long-term funding is not provided for both ESF construction and the necessary site-characterization activities, Congress and the Secretary should anticipate slippages in the repository development schedule."

Executive Summary, p. xi

NWTRB: Fourth Report to Congress and the Secretary of Energy

(cont'd.)

"1. Because of the recent $30 million budget cut, the DOE has decided to postpone underground excavation. This will result in delays in characterizing the site and - should the site prove suitable - may delay the current schedule to license and operate a repository. Without substantial funding increases for ESF design and construction beginning in fiscal year 1993, Congress and the Secretary should anticipate a slippage of the key dates."

p. 15

To Demonstrate Federal Resolve DOE Needs Assistance

YES

- ☑ Litigation and/or legislation to obtain permits to continue field work
- ☑ Administration (OMB) and departmental (DOE) support to obtain adequate resources
- ☑ Congressional support of full funding

Without all three of the above, the repository program will become stalled

Presentation Topics

- Regulatory requirements
- Balanced site characterization program
- Site characterization costs and schedule
- Funding allocation considerations
  - Fixed vs. test and design costs
  - Traditional work breakdown structure (WBS)
- Funding impacts
- Ideas being discussed for YMP
- Conclusion

Regulatory Requirements

The Yucca Mountain Site Characterization Project is Driven by Regulatory Requirements

- **Key statutory**
  - NWPA
  - NWPAA
  - NEPA
  - Clean Air Act
  - MSHA
  - OSHA
  - RCRA
  - American Indian Religious Freedom Act
  - Historic Preservation Act
  - Nevada Revised Statutes

Regulatory Requirements

(cont'd.)

- Key regulatory
  - 10 CFR Part 60 (NRC)
  - 40 CFR Part 191 (EPA)
  - 10 CFR Part 960 (DOE)
  - 10 CFR Part 50, Appendix B (NRC)
  - 10 CFR Part 20 (NRC)
  - 30 CFR (MSHA)
  - 29 CFR (OSHA)
  - 40 CFR (Environmental)

Regulatory Requirements

(cont'd.)

- Key DOE Orders
  - DOE 4700.1 (Project Management System)
  - DOE 6430.1A (Design criteria)
  - DOE 5700.6C (QA)
  - DOE 5480.1A (ES&H)
  - DOE 5000.3A (Occurrence reporting)
- Other
  - Results of DOE ES&H Tiger Team investigations

Balanced
Site Characterization Program

The Yucca Mountain Site Characterization Project has a Balanced Site Characterization Program to Meet Requirements

- Published Site Characterization Plan in accordance with requirements of the NWPA and NRC
- Reviewed by public, external and oversight groups; comments received and responses generated
- NRC, EPA, USGS found the site characterization program to be adequate
- Detailed study plans prepared and reviewed by NRC
- Controls in place to revise characterization plans as needed

The Focus of the Yucca Mountain Site Characterization Program is to Investigate Site Suitability Concerns

- The Secretary of DOE, in his 1989 report to Congress, committed to an early evaluation of the suitability of theYucca Mountain site

- Key issues related to the suitability of the site involve
  - Unsaturated zone hydrology
  - Potential for impacts of volcanism on isolation
  - Potential for tectonic impacts on isolation
  - Potential repository horizon location

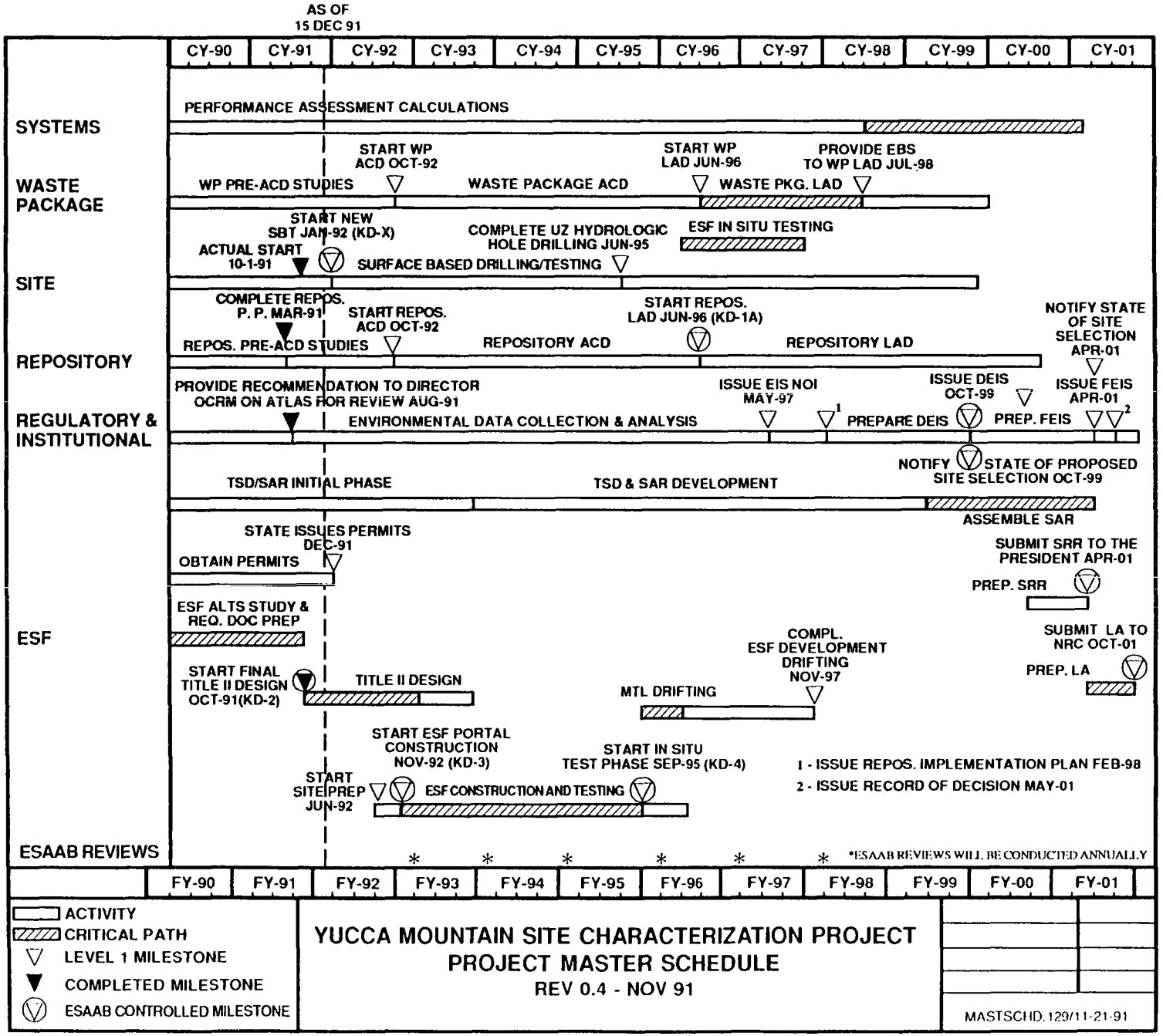
Investigations of Site Suitability Concerns

- The Secretary also noted that a timely and cost effective evaluation of the site will require both surface and underground tests, combined with continuing evaluation of the data as they are obtained

- Limited budgets and the need for the program to show demonstrable progress towards addressing scientific issues suggest that one course of action is to focus on surface-based testing
  - Surface-based test packages are discrete and costs are smaller
  - Impact of changing test program focus is less severe

Site Characterization Costs and Schedule

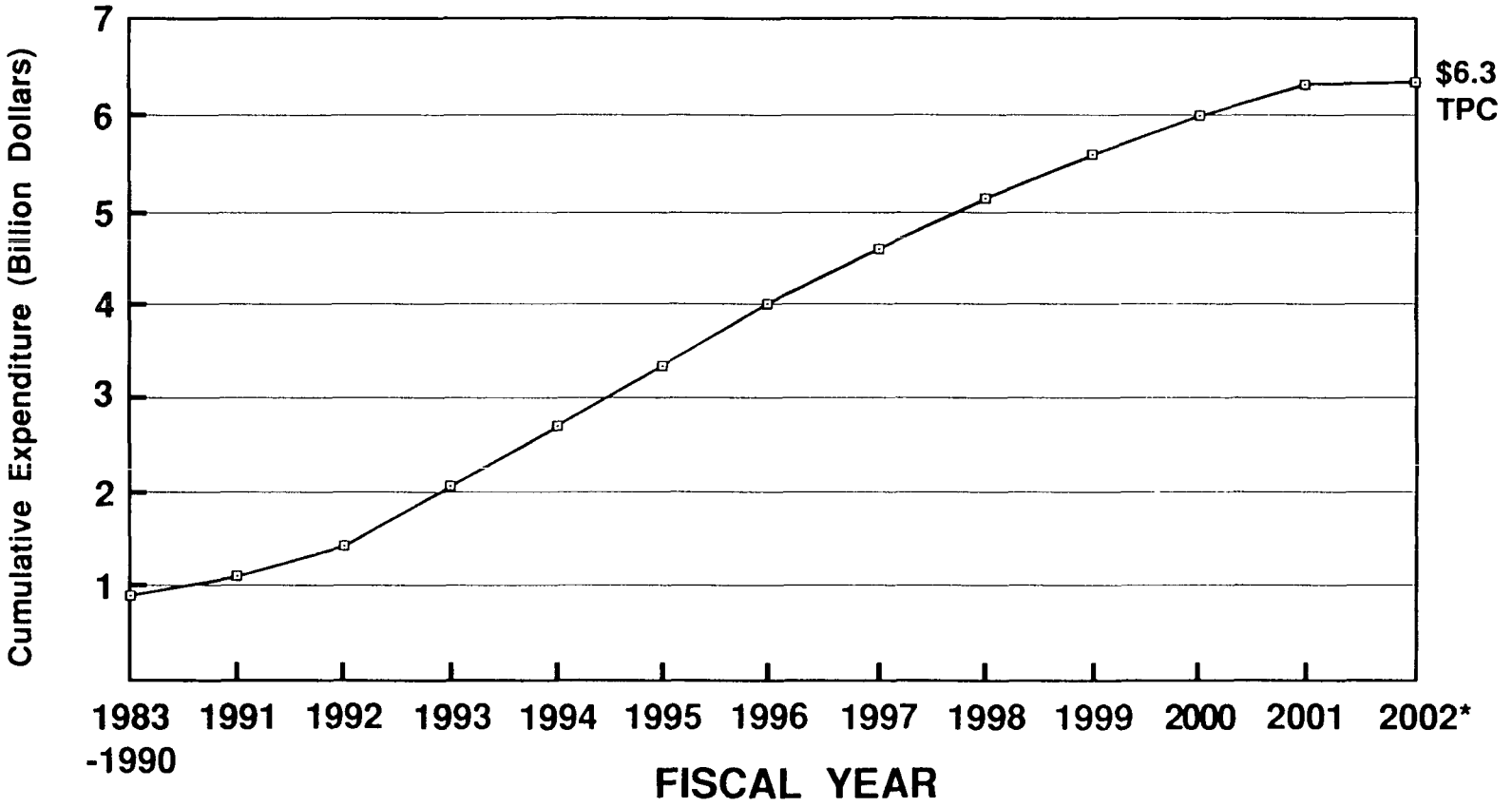
YMP Baseline Schedule (ESAAB Approved)



Resource Plan

Yucca Mountain Site Characterization Project

Cost Baseline



TPC is Total Project Cost

*October 2001, Submittal of License Application

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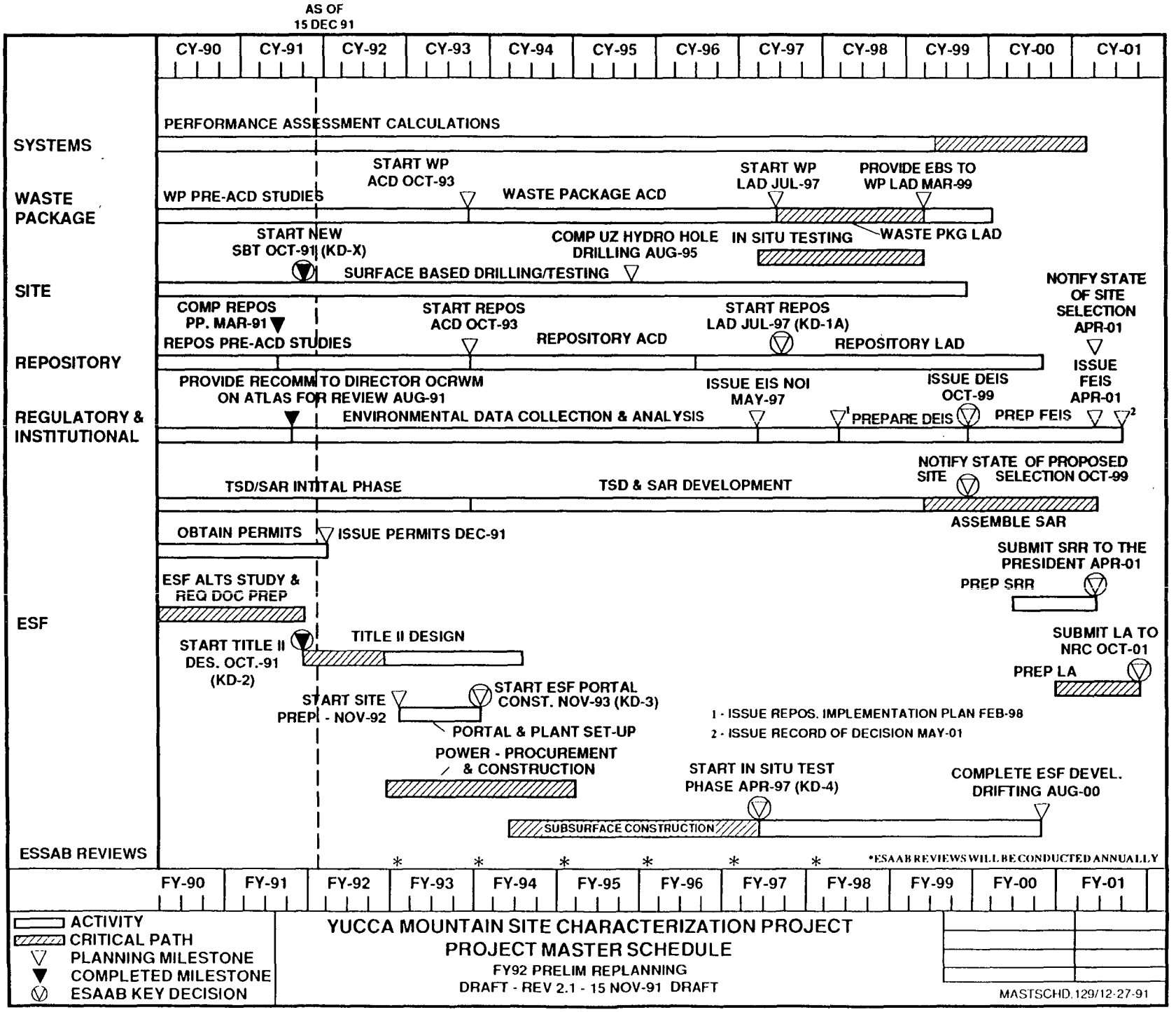
Current YMP Working Schedule



The Nature of the Yucca Mountain Site Characterization Project is Different from Typical DOE Programs

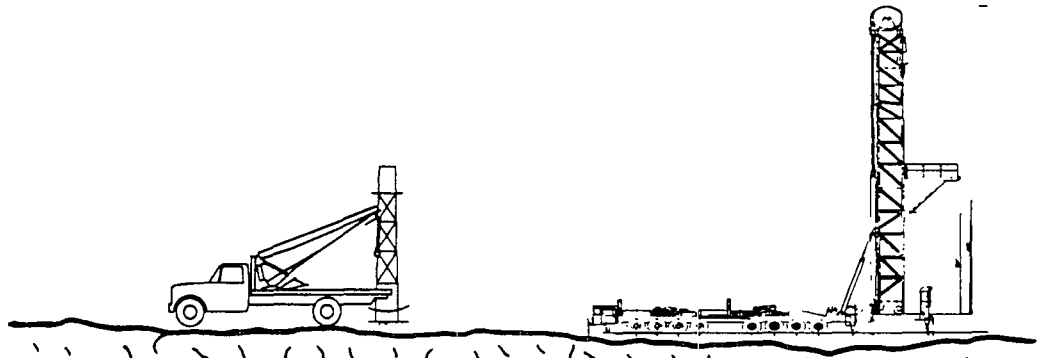
- There are necessary costs for performing work in the environment created by the NWPA
  - NRC compliance and licensing activities
  - Unprecedented 10,000 yr. compliance timeframe
  - Intensive public outreach activities
  - Interactions with oversight boards
  - State delays; permit and litigation expenses
  - Reactor construction control level Quality Assurance program during site characterization
  - Legislatively mandated socioeconomic and environmental monitoring
  - Grants to affected parties to participate in program
  - Multiple, diverse contractors to ensure scientific credibility

Funding Allocation Considerations

Two Ways to Look at Funding Allocations

- Allocations emphasizing characterization/design activities and fixed costs
  - Fixed costs examined in detail
- Allocations emphasizing project management accounting practices
  - Work Breakdown Structure (WBS)

Design And Test Program Based On Firm Foundation



$182 Million (includes carry over)

Discretionary

Drilling and trenching	$ 21
Non-surface-disturbing tests/studies	$ 23
Waste package, ESF, repository design	$ 16

Required

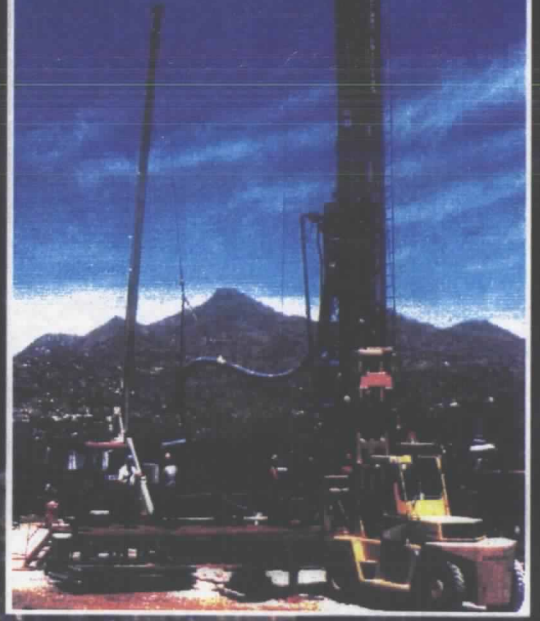
Support facilities and equipment	$ 16
Compliance and regulatory support	$ 76
Management and administration	$ 14
Financial and technical assistance	$ 16

ANALOGOUS COST SITUATIONS

Operating Nuclear Plant

< 10% personnel involved in directly operating the plant

Drilling in a Regulated Environment



- Signal network
- Track, roadbed and right-of-way
- Safety costs

Railroad Support Facilities/Infrastructure

Support Facilities and Equipment

• Sample Management Facility	$3.5 M
• Field Operations Center Support	6.6
• Information Resources Management	3.5
• Office Facilities	2.4
• Motor Pool	0.4
Total	$16.4 M

Compliance and Regulatory Support

• Quality Assurance	$12.5 M
• Systems Engineering	5.7
• Configuration Management	2.8
• Technical Data Base Management	3.3
• Performance Assessment	12.5
• Site Characterization Planning and Reporting	7.0
• NRC/NWTRB Interactions and Regulatory Review	3.8
• Environmental Compliance & Studies	8.6

Compliance and Regulatory Support

(cont'd.)

• Transportation (within Nevada)	$0.1 M
• Socioeconomics/PETT Support	1.2
• Public Outreach	2.3
• Land Acquisition	0.2
• Records Management	5.4
• Training	2.9
• Project Control	7.8
Total	$76.0 M

Management and Administration

• Participants' General Management	$6.4 M
• Administration Services	7.3
- Personnel	
- Contract Administration	
- Reprographics	
- Project Office Clerical Support	
- Mail Distribution	
Total	$13.7 M

Financial and Technical Assistance

• State and Local Governments	$9.0 M
• Payments-Equal-To-Taxes (PETT)	3.0
• University Funding	3.5
Total	$15.5 M

Testing and Design Activities are Funded After Required Fixed Costs

• **Total YMP FY92 Budget**	**$182 M**
- Sample Management Facility	-3.5
- Field Operations Center Support	-6.6
- Information Resources Management	-3.5
- Office Facilities	-2.4
- Motor Pool	-0.4
- Quality Assurance	-12.5
- Systems Engineering	-5.7
- Configuration Management	-2.8
- Technical Data Base Management	-3.3
- Performance Assessment	-12.5
- Site Characterization Planning and Reporting	-7.0
- NRC/NWTRB Interactions and Regulatory Review	-3.8
- Environmental Compliance & Studies	-8.6
- Transportation (within Nevada)	-0.1
- Socioeconomics/PETT Support	-1.2
- Public Outreach	-2.3
- Land Acquisition	-0.2
- Records Management	-5.4
- Training	-2.9
- Project Control	-7.8
- Participants' General Management	-6.4
- Administration Services	-7.3
- State and Local Governments	-9.0
- Payments-Equal-To-Taxes (PETT)	-3.0
- University Funding	-3.5
• **Available Funds for Testing and Design**	**$60 M**

Major Testing Activities

• Drilling and trenching	$21.0 M
• Non-surface-disturbing tests/studies	23.0
Total	$44.0 M

Major Design Activities

• Repository	$3.6 M
• Exploratory Studies Facility	6.7
• Waste Package	5.2
Total	$15.5 M

FY 1992 Priority YMP Activities Reflect Limited Funding

- Complete initial, early site suitability evaluation draft report; continue ongoing suitability evaluation
- Initiate and continue new surface-disturbing (drilling) site characterization activities including:
  - Park Service monitoring borehole
  - Unsaturated zone boreholes
  - Geologic investigation boreholes
  - Field trenching
  - Test pits
- Continue ongoing surface-based site characterization activities

FY 1992 Priority YMP Activities Reflect Limited Funding

(cont'd.)

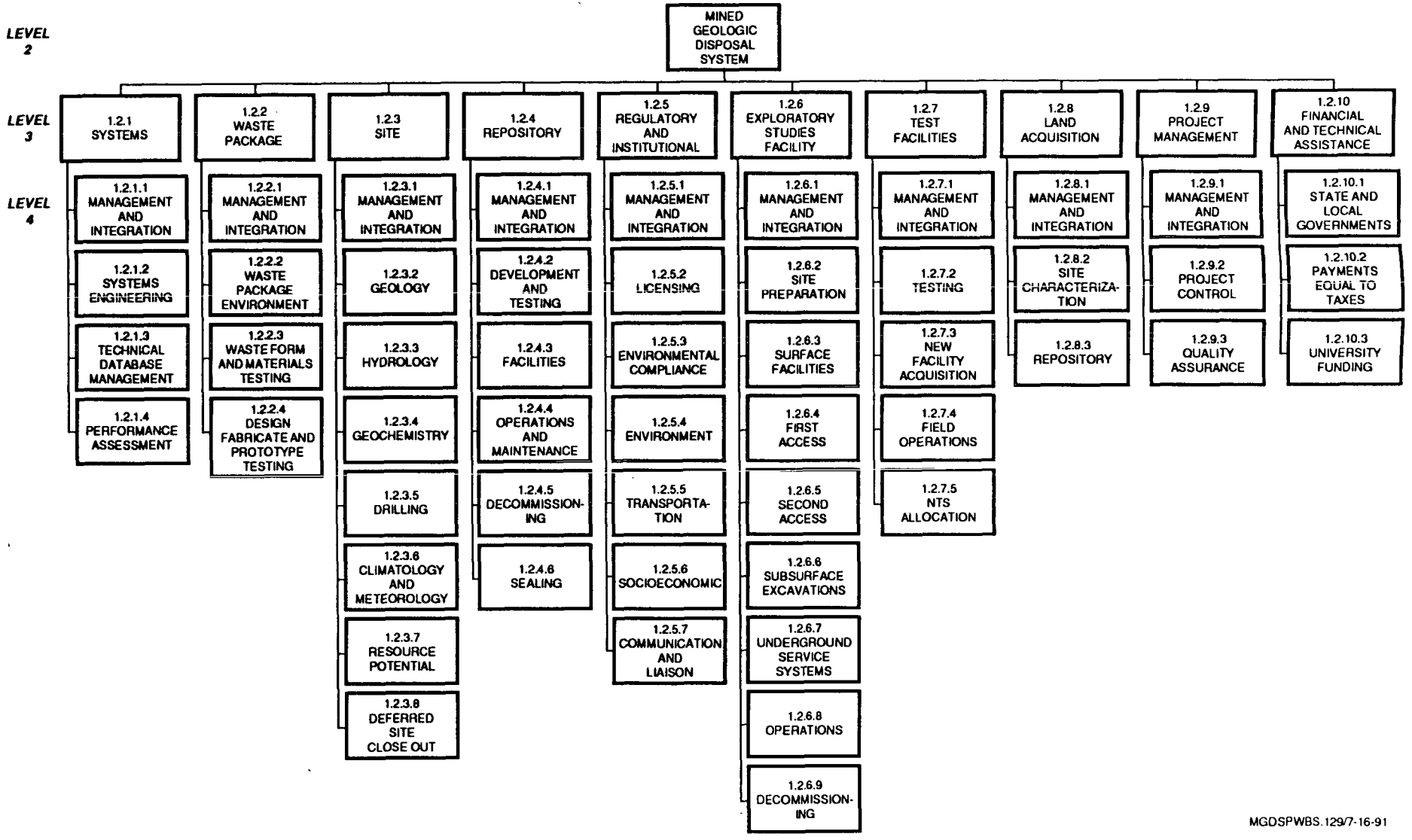
- Begin limited ESF Title II design in October 1991 (update repository design as appropriate)
- Quality Assurance program and planning
- Maintain a sound environmental program and provide support to field activities, as necessary
- Conduct performance assessment to support Project priorities/activities
- Continue to fully implement a YMP-wide cost/schedule planning and control system (PACS)

FY 1992 Priority YMP Activities Reflect Limited Funding

(cont'd.)

- Conduct a minimal waste package/EBS/near-field environment/waste form characterization program
- Maintain Project roads, buildings, records centers, etc.
- Conduct institutional/outreach programs
- Transition M&O (TRW) into Project activities

YMP Work Breakdown Structure



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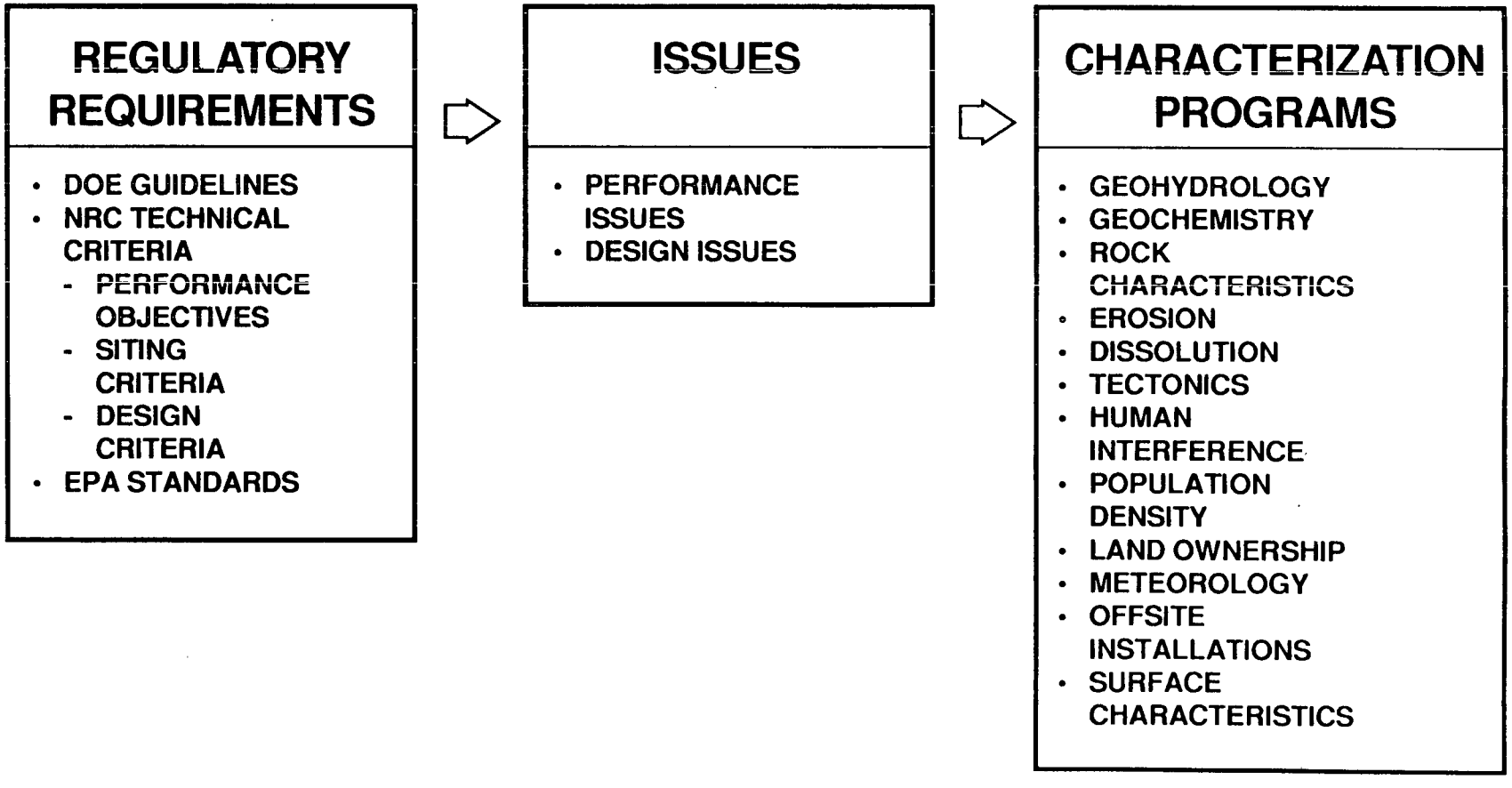
FY-92 Budget by 3rd Level WBS ($M)

1.2.1	Systems/PA/Technical Data	24.2
1.2.2	Waste Package/Near Field Environment	5.3
1.2.3	Site	49.0
1.2.4	Repository/ESF	3.5
1.2.5	Regulatory/ Institutional/Environmental	21.3
1.2.6	Exploratory Studies Facility	6.7
1.2.7	Test Facilities	6.7
1.2.8	Land Acquisition	0.2
1.2.9	Project Management	
	- Management	6.4
	- Administrative Services	23.0
	- Project Control	8.3
	- Quality Assurance	12.5
1.2.10	Financial & Technical Assistance	15.5
	Total	182.5

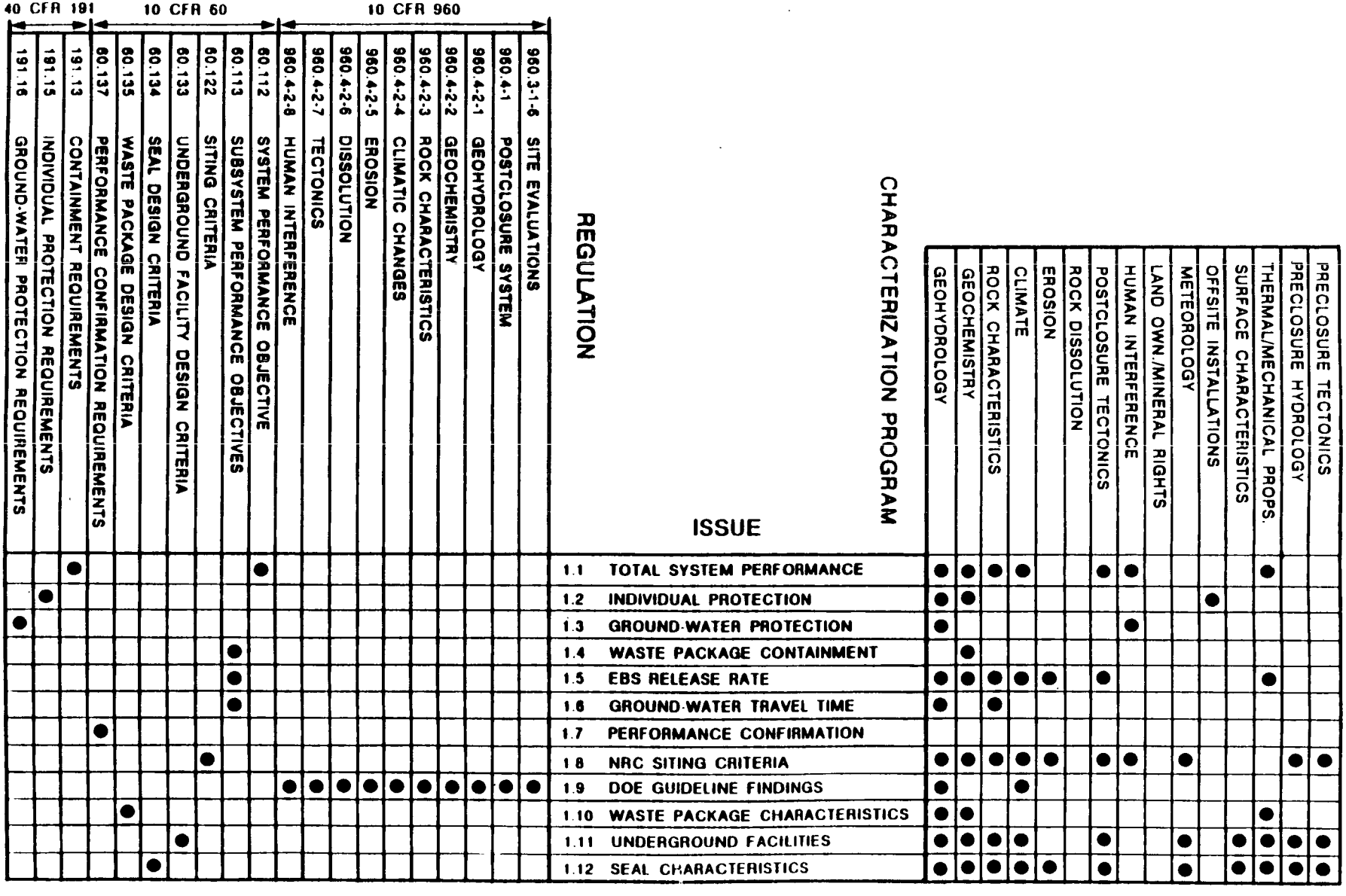
YBUDCG5P.125.NWTRB/1-7-92

Site

Site Characterization Programs are Derived from Technical Regulatory Requirements



Key Issue 1
(Postclosure Performance)



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Specific Requirements from NRC Place Significant Constraints

- 10 CFR 60.15 requires that characterization impacts be limited and that excavation be coordinated with repository design
- 10 CFR 60.21 requires evaluation of alternative repository design features in context of limiting impacts on the site
- SBT activities and ESF excavations must be included in such evaluations
- Because of these and other requirements, careful planning and evaluations are needed prior to testing or excavating

Principal Regulations Driving 1.2.3 Site Investigations

- Repositories for disposal of high-level radioactive waste; site characterization (Nuclear Waste Policy Act, Subtitle A)
- Review of site characterization activities (10 CFR 60.18)
- Construction records (10 CFR 60.72)
- Site characterization (10 CFR 60.15)
- Site Characterization Plan required (10 CFR 60.16)
- Content of license application (10 CFR 60.21)
- NRC-specified tests (10 CFR 60.74)
- Performance of the geologic repository operations area through permanent closure (10 CFR 60.111)

Principal Regulations Driving 1.2.3 Site Investigations

(cont'd.)

- Overall system performance objective for the geologic repository after permanent closure (10 CFR 60.112)
- Performance of particular barriers after permanent closure (10 CFR 60.113)
- Siting criteria (10 CFR 60.122)
- Scope of design criteria for the geologic repository operations area (10 CFR 60.130)
- General requirements for the performance confirmation program (10 CFR 60.137 and 60.140)
- Confirmation of geotechnical and design parameters (10 CFR 60.141)
- Quality Assurance program (10 CFR 60, Subpart G)

FY 1992 YMP Work Scope

1.2.3.1 Management and Integration ($7.6 M)

- Provide management and integration of site investigations
- Support the implementation of results from the Early Site Suitability Study, Surface Based Testing Prioritization (SBTP) and Calico Hills Risk Benefit (CHRB) studies, start of ESF design, non-surface-disturbing work, and study plan development
- Develop test planning and job packages for surface-based testing activities

FY 1992 YMP Work Scope

1.2.3.2 Geology ($10.0 M)

- Support structural and stratigraphic non-surface-disturbing work and ongoing studies in support of complex geologic studies and other issues
- Support continuing surface-disturbing activities at Midway Valley and Trench 14
- Support new surface-based testing activities for the design of the ESF
- Support development of the systematic drilling program and geostatistical evaluation of the site
- Continue development of Yucca Mountain seismic network
- Support issue resolution on calcite/silica and erosion

FY 1992 YMP Work Scope

1.2.3.3 Hydrology ($10.2 M)

- Continue ongoing surface hydrology studies including run-off and streamflow monitoring and debris monitoring
- Continue non-surface-disturbing monitoring of UZ infiltration. Expand precipitation monitoring network for UZ hydrology
- Continue ongoing monitoring of saturated zone hydrology
- Continue analysis & modeling of regional flow system
- Conduct fracture network modeling
- Continue groundwater geochemistry studies

FY 1992 YMP Work Scope

1.2.3.3 Hydrology (cont'd.)

- Continue gaseous phase flow studies
- Continue borehole instrumentation tests for new surface disturbing activities
- Support issue resolution on calcite-silica studies
- Continue drilling of neutron-access boreholes to support unsaturated zone hydrology studies

FY 1992 YMP Work Scope

1.2.3.4 Geochemistry ($4.0 M)

- Continue non-surface-disturbing work in radionuclide three-dimensional flow and transport code and modeling effort
- Perform UZ transport experiments for both advective and diffusion conditions related to migration and sorption
- Study solubility measurements for radionuclides
- Continue activities associated with radionuclide sorption tasks as delineated at the September Geochemistry Workshop co-sponsored by the Nuclear Waste Technical Review Board
- Continue computer code studies to determine effects of volcanism and tectonics on radionuclide transport

FY 1992 YMP Work Scope

1.2.3.5 Drilling ($14.2 M)

- Support ongoing non-surface-disturbing field work as defined by the participants
  - Support ongoing borehole monitoring
  - Workover on C-well complex
  - Maintenance of borehole instrumentation

- Perform A/E activities associated with new surface-disturbing field activities (environmental monitoring well JF-3, neutron-access boreholes, soil and rock properties studies at the ESF site, and saturated zone boreholes)

FY 1992 YMP Work Scope

1.2.3.5 Drilling (cont'd.)

- Operate the sample management facility to support core analysis
- Support drilling with LM-300 dry drilling/coring rig at Yucca Mountain
- Develop a drilling and geophysical logging support program and integration effort to aid in site characterization

FY 1992 YMP Work Scope

1.2.3.6 Climatology and Meteorology ($2.9 M)

- Continue to develop global climate model in support of performance assessment issues
- Continue to develop regional climate models in support of performance assessment issues
- Continue non-surface-disturbing work in Quaternary regional hydrology studies

FY 1992 Surface Disturbing Activities

Unsaturated Zone Infiltration (ODEX)
Natural Infiltration - 12 neutron boreholes 50 TO 200'
First borehole completed
Second borehole near completion

Other Field (Trenches, Test Pits)
Midway Valley, Trench 14
Quat. Faulting-Site Area on-site, Yucca Mountain
Quat. Faulting - Region, Bare Mountain
Paleoenvironment, Nevada Test Site
Volcanic Studies, Lathrop Wells

Environmental Monitoring
JF-3 Monitoring Well - 1 borehole 1,100'

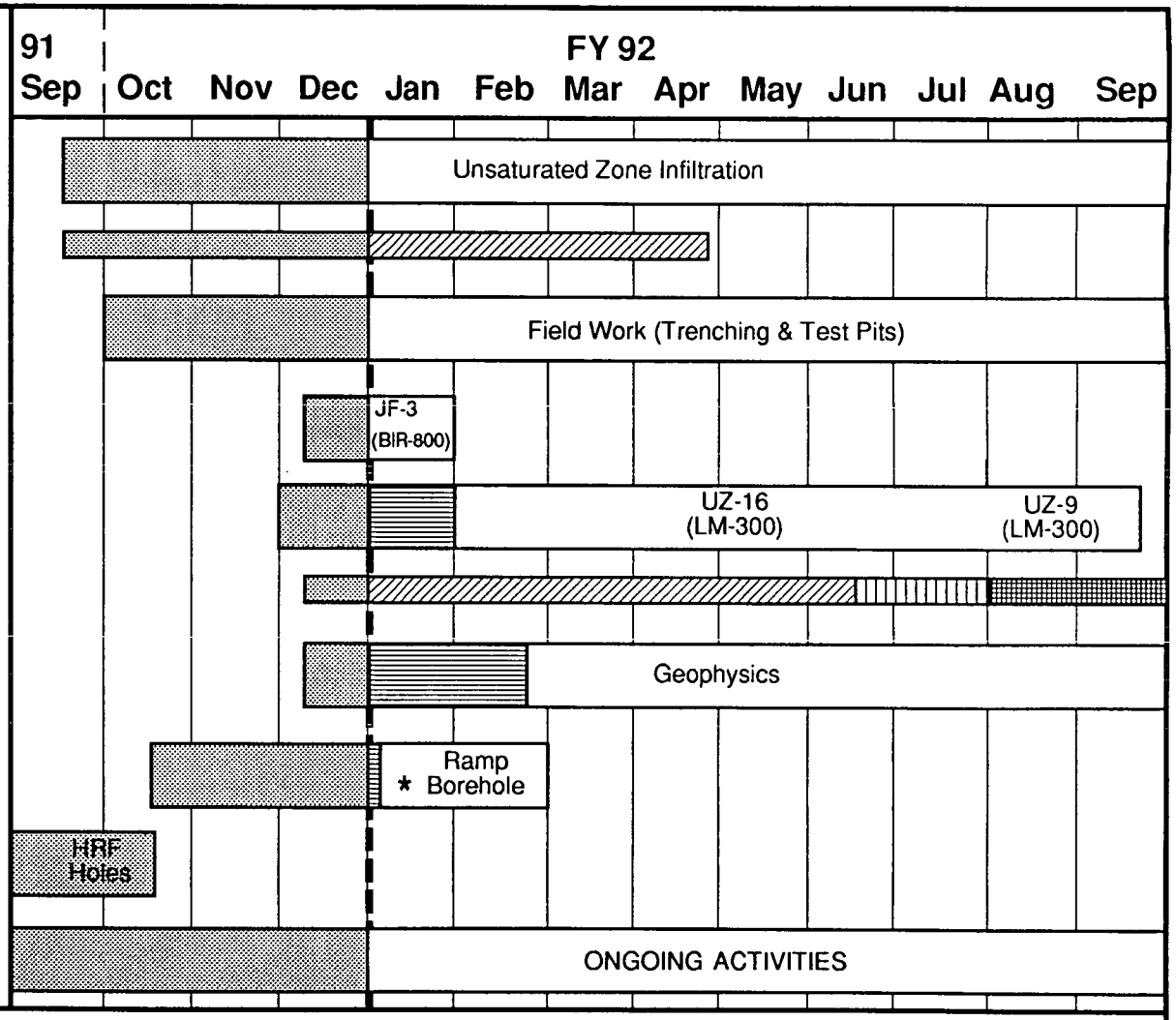
Unsaturated Zone Percolation
UZ-16 - 1 borehole 1,700'
UZ-9- 1 borehole approx. 2,000'

Rock Characteristics
Geophysical Program (prerequisite to Geologic hole drilling)

Soil and Rock Properties
North Portal Core Hole 150'

UZ Percolation
Hydrologic Research Facility - 3 Auger Holes 40'

Ongoing Activities
Lab Analysis
Field Monitoring
UZ and SZ Sampling
Geologic Mapping, Lab Analysis
Field Monitoring (Seismic, Climatology, etc.)



RIG WORK SCHEDULE

Status as of: 12/24/91

Work Complete

8 Hours/Day, 5 Days/Week

16 Hours/Day, 5 Days/Week

24 Hours/Day, 5 Days/Week

PREREQUISITE COMPLETION

* **SCHEDULE TBD**

SUDAFY9P.129/1-7-92/14

Exploratory Studies Facility

Principal Regulations Driving 1.2.6 Exploratory Studies Facility

- Repositories for disposal of high-level radioactive waste; site characterization (Nuclear Waste Policy Act, Subtitle A)
- Site characterization (10 CFR 60.15)
- Site Characterization Plan required (10 CFR 60.16)
- Content of License Application (10 CFR 60.21)
- Construction records (10 CFR 60.72)
- NRC-specified tests (10 CFR 60.74)
- Performance of the geologic repository operations area through permanent closure (10 CFR 60.111)

Principal Regulations Driving 1.2.6 Exploratory Studies Facility

(cont'd.)

- Overall system performance objective for the geologic repository after permanent closure (10 CFR 60.112)
- Performance of particular barriers after permanent closure (10 CFR 60.113)
- Scope of design criteria for the geologic repository operations area (10 CFR 60.130)
- General design criteria for the geologic repository operation area (10 CFR 60.131)
- Additional design criteria for the underground facility (10 CFR 60.133)

Principal Regulations Driving
1.2.6 Exploratory Studies Facility
(cont'd.)

- General requirements for performance confirmation (10 CFR 60.137 and 60.140)
- Confirmation of geotechnical and design paramenters (10 CFR 60.141)
- Design testing (10 CFR 60.142).
- Quality Assurance program (10 CFR 60, Subpart G)

FY 1992 YMP Work Scope

1.2.6.1 Management and Integration ($3.7 M)

- Provide management and integration of ESF activities
- Complete Title II ESF design requirements
- Support soils and rock study to obtain design data
- Finalize location of the first portal
- Finalize number of TBMs for use in ESF
- Complete operations plan
- Complete maintenance plan

FY 1992 YMP Work Scope

1.2.6.1 Management and Integration (cont'd.)

- Complete safety analysis report of designated items
- Complete value engineering plan
- Support performance assessment
- Support selected drilling of shallow holes at portal site
- Provide design support for portal mapping and test cutouts

FY 1992 YMP Work Scope

1.2.6.2 Site Preparation ($1.7 M)

- **Prepare the following site and road deliverables:**
  - **3 trade-off studies**
  - **17 drawings**
  - **10 specifications**
- **Prepare the following surface utilities and communications system deliverables:**
  - **2 trade-off studies**
  - **12 calculation packages**
  - **37 drawings**
  - **58 specifications**

FY 1992 YMP Work Scope

1.2.6.2 Site Preparation (cont'd.)

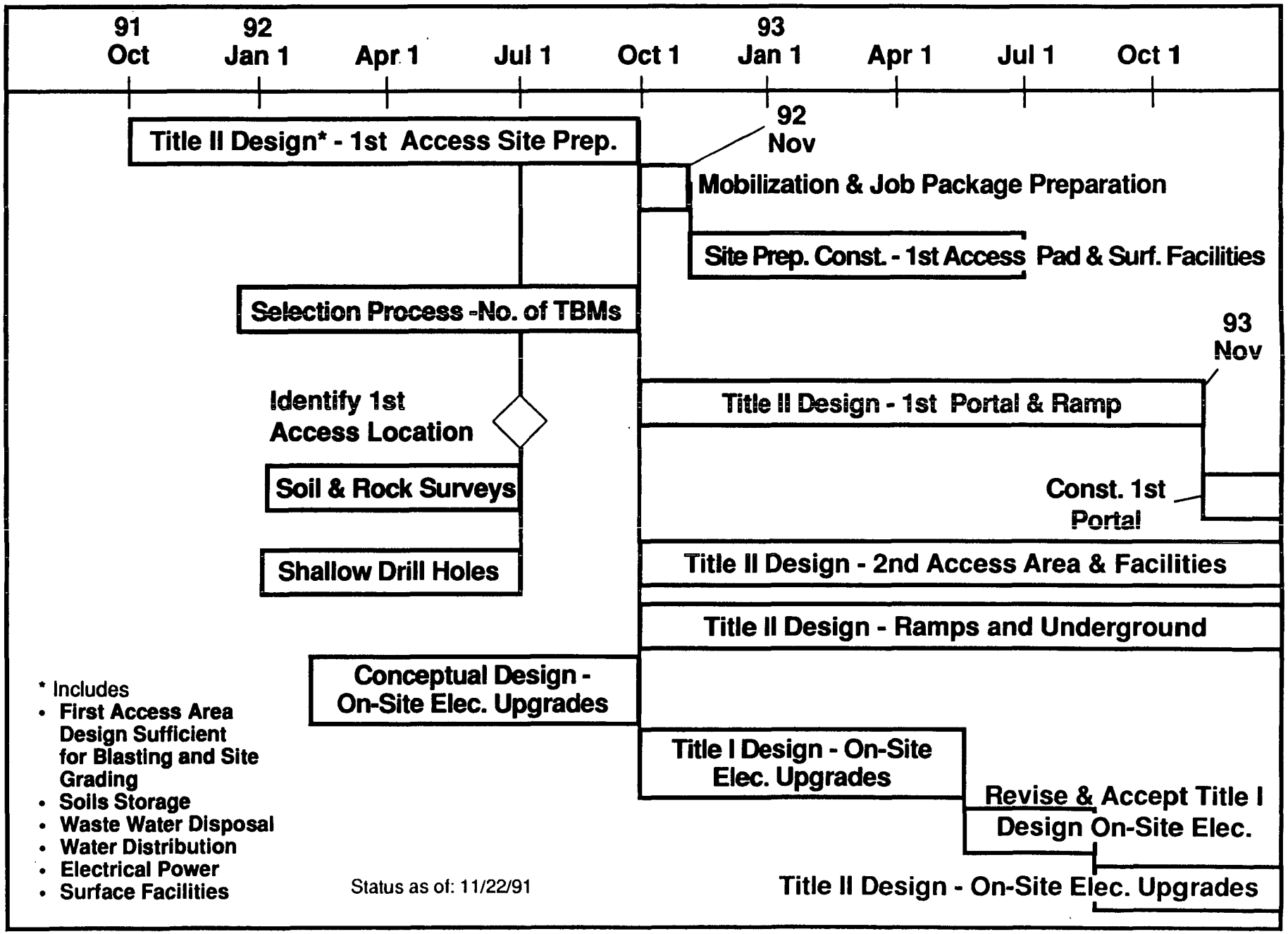
- Complete topsoil and subsoil storage design
- Complete design of first access waste water disposal system
- Complete design of first access potable and industrial water distribution
- Complete design of first access electrical substation envelope

FY 1992 YMP Work Scope

1.2.6.3 Surface Facilities ($1.2 M)

- Prepare surface and portal facilities deliverables:
  - 28 analyses and trade-off studies
  - 46 drawings
  - 42 specifications
- Complete portal highwall design sufficient for blasting
- Complete portal pad area design sufficient for blasting and site grading
- Complete design of first access facility layouts
- Complete design of first access building envelopes

PROPOSED ESF DESIGN/CONSTRUCTION ACTIVITIES FY 1992 & 1993



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Regulatory/Institutional/Environmental

Principal Regulations Driving 1.2.5 Regulatory and Institutional

- Benefits (Nuclear Waste Policy Amendments Act, Part C)
- Nuclear Waste Negotiator (Nuclear Waste Policy Amendments Act, Part C)
- Nuclear Waste Technical Review Board (Nuclear Waste Policy Amendments Act, Part E)
- Participation of States (Nuclear Waste Policy Act, Subtitle A)
- Consultation (Nuclear Waste Policy Act, Subtitle A)
- Completeness and accuracy of information (10 CFR 60.10)
- Content of license application (10 CFR 60.21)
- National Environmental Policy Act (NEPA)
- Clean Air Act
- Nevada Revised Statutes

FY 1992 YMP Work Scope

1.2.5.1 Management and Integration ($2.0 M)

- Provide management and integration of Regulatory and Institutional activities in support of site characterization activities

FY 1992 YMP Work Scope

1.2.5.2 Licensing ($7.6 M)

- Support technical and regulatory meetings with the NRC, NWTRB, ACNW, NAS, and others
- Conduct study plan reviews and approval
- Support issue resolution process
- Support the Site Suitability Study
- Prepare/issue two site characterization progress reports

Regulatory/Oversight Interactions

- FY 1991
  - NWTRB: 18 Meetings
  - NRC: 14 Meetings
  - ACNW: 22 Meetings
- FY 1992
  - Similar or increased level of interactions expected

FY 1992 YMP Work Scope

1.2.5.3 Environmental Compliance ($0.8 M)

- Prepare required annual reports (Programmatic Agreement, Environmental Protection Implementation Plan)
- Continue support for obtaining permits, and regulatory approvals and compliance
- Prepare EMMP Progress Reports
- Implement hazardous waste management program
- Implement Project Waste Minimization Plan
- Maintain Environmental Regulatory Compliance Tracking Systems
- Develop and implement environmental oversight and surveillance program
- Support YMP activities to ensure compliance with reclamation requirements

FY 1992 YMP Work Scope

1.2.5.4 Environment ($7.7 M)

- Conduct required archeological, terrestrial ecosystem and radiological preactivity surveys
- Conduct desert tortoise studies to ensure compliance with the FWS biological opinion
- Perform reclamation and topsoil stabilization studies
- Prepare, update and implement Environmental Field Activity Plan (EFAP) for terrestrial ecosystems
- Collect small mammals for radiological program and monitor effects of site characterization activities on animal and plant populations
- Collect far-field radiological samples

FY 1992 YMP Work Scope

1.2.5.4 Environment (cont'd.)

- Prepare and issue 5-year summary of meteorological conditions
- Maintain Meteorological Monitoring Plan, Meteorological Study Plan, Scientific Investigation Implementation Plan (SIIP) and associated technical implementing procedures
- Begin data analyses associated with meteorological and air quality monitoring
- Maintain Environmental Field Activity Plan and SIIP for air quality and associated technical implementing procedures
- Continue air quality particulate and criteria pollutant monitoring
- Prepare topical reports for documentation of data collection and analyses

FY 1992 YMP Work Scope

1.2.5.4 Environment (cont'd.)

- Provide support to locations of population centers relative to wind patterns
- Maintain radiological field programs, provide radiological monitoring and protection activities including general health physics support
- Continue consultations with National Park Service (NPS) for Water Monitoring Program
- Support interactions with Native American official tribal representatives
- Continue NPS consultations and technical interactions for planning and data gathering efforts

FY 1992 YMP Work Scope

1.2.5.4 Environment (cont'd.)

- Implement environmental water resources network design for quantity and quality, and continue data collection
- Compile preliminary data base of existing water information for use in ongoing assessments
- Design and implement pump testing and monitoring program for newly proposed well JF-3
- Prepare monitoring reports per EFAP requirements
- Maintain Environmental Field Activity Plan for Cultural Resources: Native American component
- Implement the Reclamation Implementation Plan
- Maintain Reclamation Feasibility Plan

FY 1992 YMP Work Scope

1.2.5.4 Environment (cont'd.)

- Implement archaeological data recovery and mitigation strategies
- Monitor known historical and archaeological properties
- Maintain artifact inventory, storage, and records management to conform to Federal requirement 36 CFR 79, (9/90)
- Develop, review, and implement archeological data recovery and mitigation strategies

FY 1992 YMP Work Scope

1.2.5.5 Transportation ($0.1 M)

- Identify public concerns about the transportation of HLW to the potential repository at Yucca Mountain and respond to requests for support on transportation issues
- Facilitate local government participation through public outreach programs

1.2.5.6 Socioeconomics ($1.2 M)

- Conduct Socioeconomic Monitoring Program
- Continue development/update of socioeconomic profiles
- Continue support to PETT Program
- Continue support to the Radiological Monitoring Program

FY 1992 YMP Work Scope

1.2.5.7 Communication and Liaison ($2.4 M)

- Provide support for State of Nevada interactions
- Operate YMP Information Offices (Beatty, Las Vegas)
- Support YMP update meetings, presentations, and exhibits
- Support YMP tours
  - Monthly open houses of Yucca Mountain (spring and summer)
  - VIP tours as requested
  - Special request tours
- Continue Speakers' Bureau, Exhibit Program, Education Program, work on developing information products

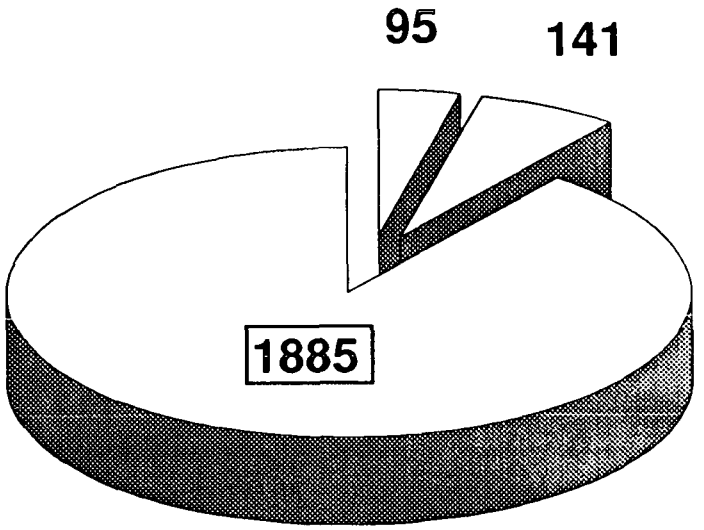
Informal Surveys Revealed 89% of Recent Public Tour Attendees Believe that DOE Should Study Yucca Mountain

- **After Tours:**

  89% Study Yucca Mountain

  7% Undecided

  4% Do Not Conduct Studies



- **Before Tours:**

  776 were undecided or opposed to studies. After tours, 621 or 80% changed their opinion positively.

As of 12-10-91

YMPIE5P.GERTZ/12-10-91

Funding Impacts

Why is Project Emphasizing SBT in the Near-Term?

- **Funding inadequate to sustain the ESF Program**
  - **Even if design were completed in FY92, construction would have to be deferred**
- **SBT provides more program continuity**
- **Congress and utility industry are concerned about insufficient visible progress toward addressing technical issues**
- **Failure to demonstrate such progress may further reduce support for continued funding**

Why is Project Emphasizing SBT in the Near-Term?

(cont'd.)

- Diversion of funds to ESF could delay acquisition of surface data for about two years
- No visible progress for two years could be detrimental to the continued support from numerous constituencies

Implications for Future Funding Requirements

- YMP has an approved cost baseline for gathering the data needed to
  - Determine site suitability
  - Prepare License Application
- YMP cost baseline verified within 4% by independent cost estimating team
- Reductions in funding will delay scheduled activities
- Early favorable findings could result in reduced work scope, budgets, and schedule

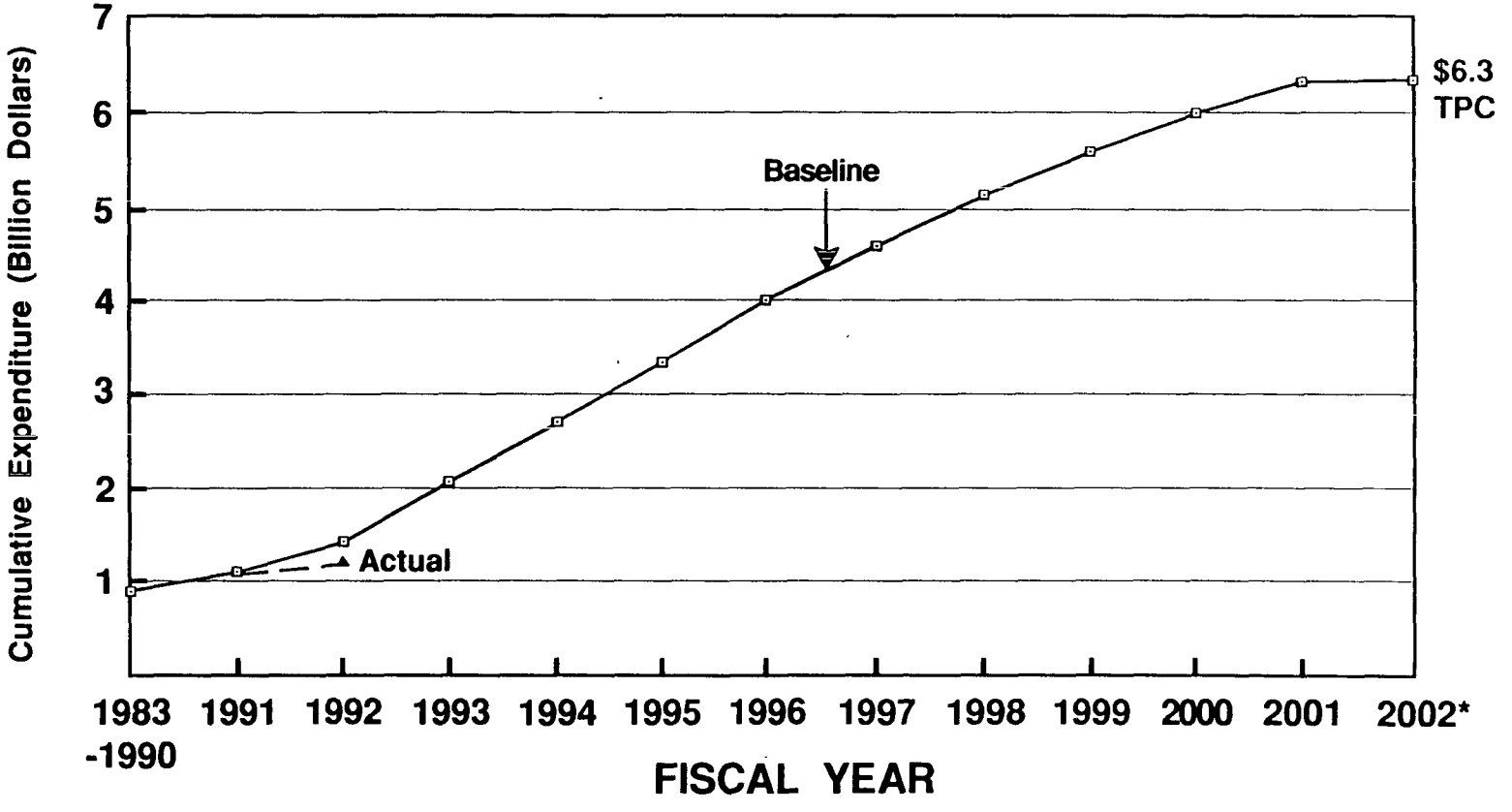
General Funding Impacts

- Level funding at $200 M
  - Significant schedule delay
- Increased funding
  - Majority will go to ESF
  - Waste package development and repository design will be expanded
  - Minor growth in support activities
- Decreased funding
  - Further defer ESF, waste package, and repository activities
  - Reduce SBT activities significantly
  - Begin reduction in support activities

What Would Happen if the Funding Were Significantly Diminished?

- Technical progress delayed
  - Early site suitability determination delayed
  - License Application delayed
- Loss of key scientific contributors
  - Scientific consensus will be weakened
- Work discontinued if sufficient funds were not available to comply with Federal and State laws
- Potential loss of NRC acceptance of Participants' QA programs due to lack of continued implementation

$200-300 M Per Year Will Not Support A License Application By 2001



TPC is Total Project Cost
*October 2001, Submittal of License Application

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Ideas Being Discussed for the Yucca Mountain Project

Concepts

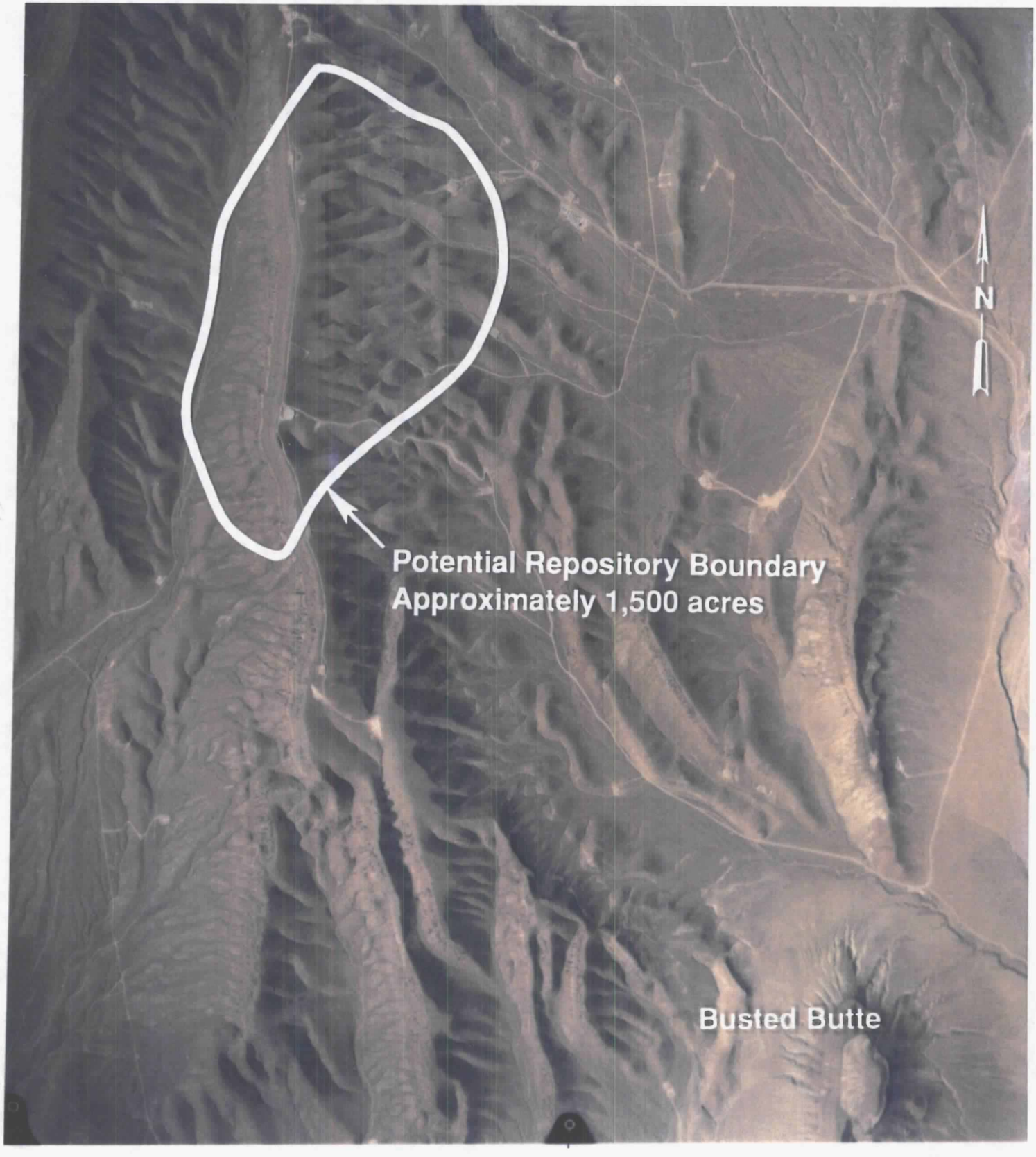
- Prototype test & engineering development facility
- Early exploratory pilot program
- Emphasize full ESF scope
- Sequenced ESF approach

Programmatic Concerns for Concepts

- Consistency with existing program commitments
- Compliance with 10 CFR 60.21 requirements for evaluation of the impacts of alternatives
- Consistency with existing land access agreements
- Consistency with environmental monitoring program baselines and permits
- Increased total costs
  - Interface with or replacement of existing test programs
- Design control concerns - ties to ESFAS

Prototype Test & Engineering Development Facility

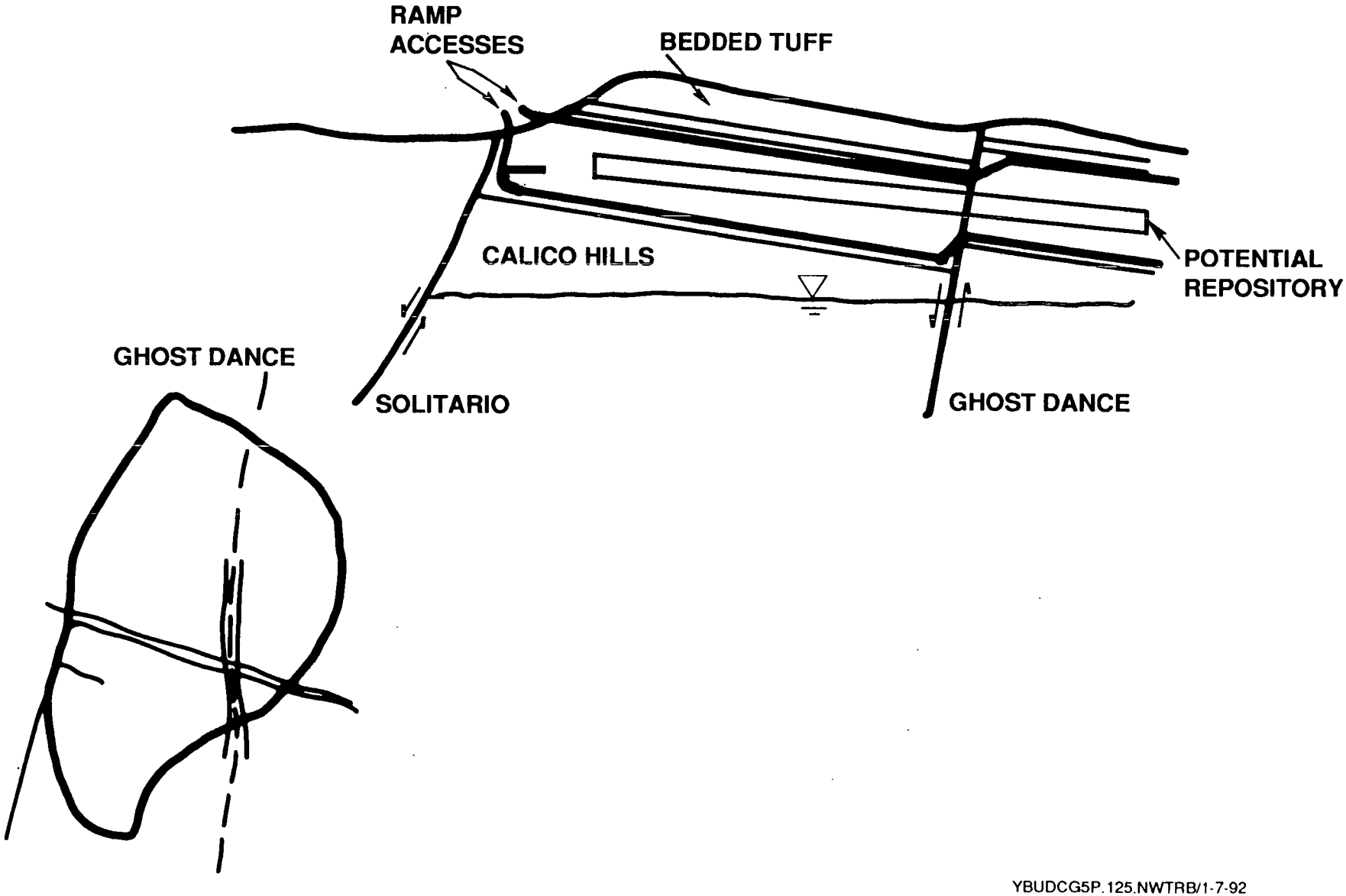
- Multipurpose underground laboratory, prototype testing, and visitor orientation facility at Busted Butte
- Outside the potential repository block
- Geologic conditions similar to potential repository horizon (densely welded, devitrified tuff)
- Data obtained would complement data later obtained in ESF


N
Potential Repository Boundary
Approximately 1,500 acres
Busted Butte

Early Exploratory Pilot Program

- Early access via small diameter tunnels:
  - Below contact of bedded tuff and upper Topopah Spring
  - Above contact of lower Topopah Spring and Calico Hills
  - Ghost Dance fault
  - Other north-south structures within the repository block

Specifics of Concept

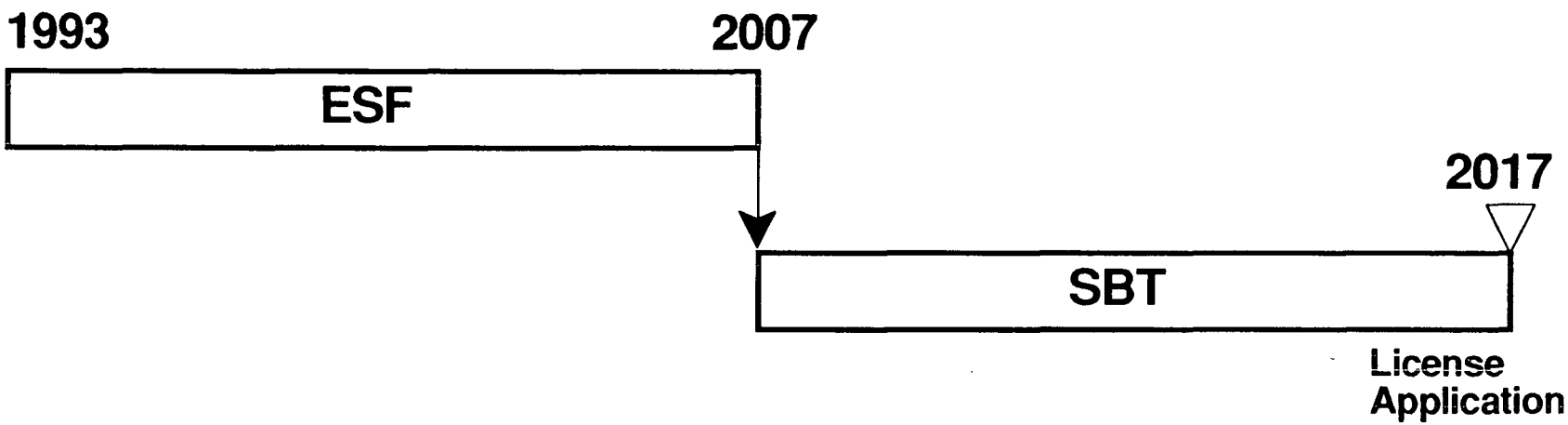


Emphasize Full ESF Scope Early ESF Construction

- Assumptions
  - Level YMP funding at $200 M/yr
  - Level ESF funding at $70 M/yr
  - Level SBT funding at $70 M/yr after ESF complete

- Potential Consequences
  - Approximately 14 years to complete the $979 M ESF scope of work
  - SBT activities postponed until completion of ESF
  - Approximately 10 years to complete the $690 M SBT scope of work

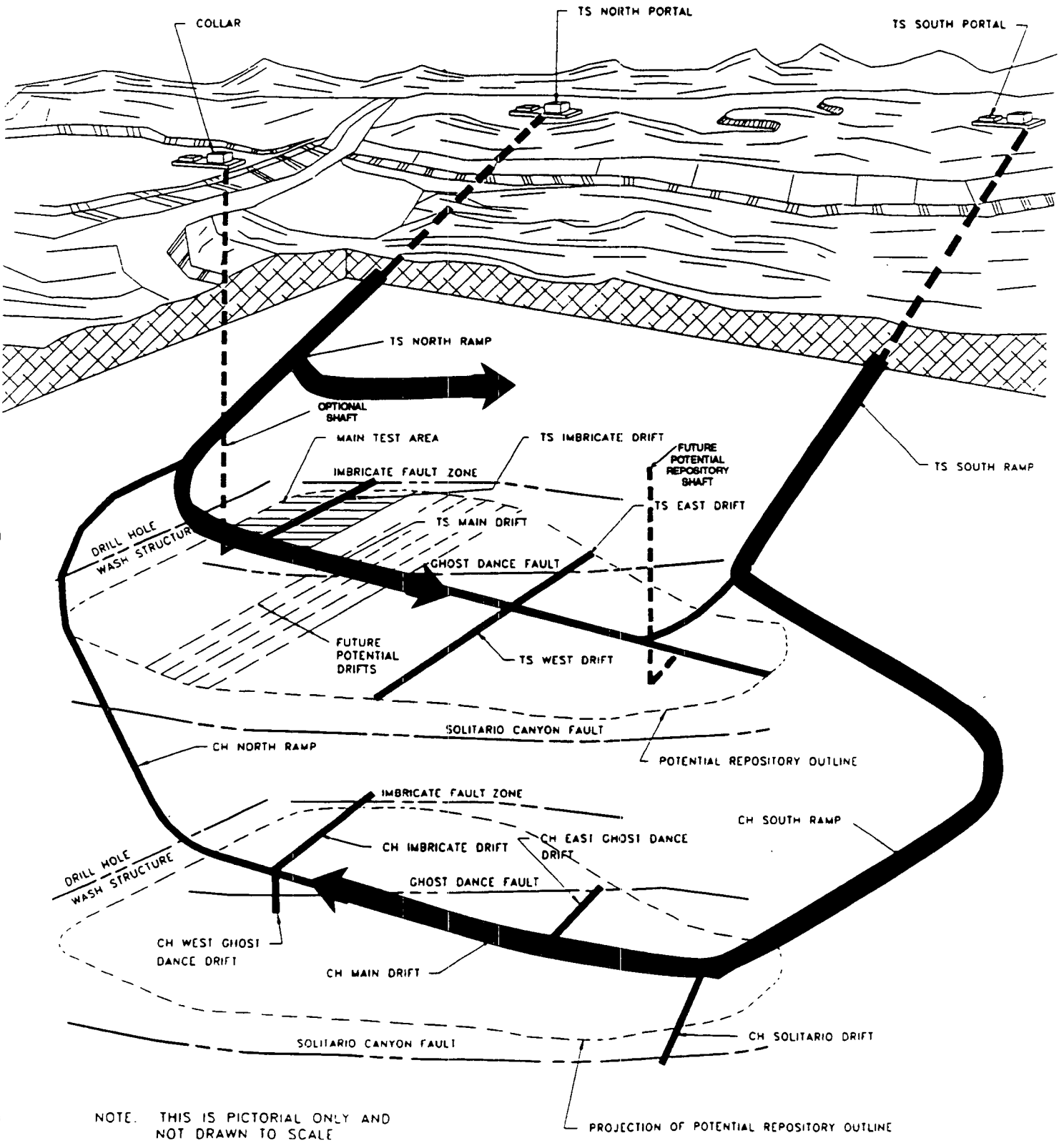
Phased ESF/SBT Schedule



Sequenced ESF Approach

- Sequenced construction has always been a part of Project's planning process
- DOE also examining sequence recommended by NWTRB
- Ghost Dance fault early target of exploration
  - Above potential repository horizon
  - Topopah Spring
  - Calico Hills
- North ramp in form of a "J" down to Topopah Spring
- South ramp in form of a "J" down to Calico Hills
- Upper drift from north ramp above potential repository horizon

ESF CONFIGURATION



NOTE. THIS IS PICTORIAL ONLY AND NOT DRAWN TO SCALE

RERGBV5P.125.NWTRB/9-18/19-91

Conclusion

Conclusion

- Present funding level not sufficient to implement a comprehensive site characterization program (i.e., surface and underground testing)
- If present funding trends continue, the date for submittal of a license application could be delayed
- DOE will continue to evaluate options (actively looking at sequenced ESF approach)

Additional Information Material

Additional Information Material

- Remaining activities by WBS number
- Selected FY91 accomplishments

Remaining Activities by WBS Numbers

Principal Regulations Driving 1.2.1 Systems

- Site characterization (10 CFR 60.15)
- Reporting, record keeping and application requirements (10 CFR 60.8)
- Review of site characterization activities (10 CFR 60.18)
- Construction records (10 CFR 60.72)
- Content of License Application (10 CFR 60.21)
- NRC-specified tests (10 CFR 60.74)
- Performance of the geologic repository operations area through permanent closure (10 CFR 60.111)
- Overall system performance objective for the geologic repository after permanent closure (10 CFR 60.112)

Principal Regulations Driving 1.2.1 Systems

(cont'd.)

- Performance of particular barriers after permanent closure (10 CFR 60.113)
- Siting criteria (10 CFR 60.122)
- Scope of design criteria for the geologic repository operations area (10 CFR 60.130)
- Additional design criteria for the underground facility (10 CFR 60.133)
- Design of seals for shafts and boreholes (10 CFR 60.134)
- Criteria for the waste package and its components (10 CFR 60.135)

Principal Regulations Driving 1.2.1 Systems

(cont'd.)

- General requirements for the performance confirmation program (10 CFR 60.137 and 60.140)
- Confirmation of geotechnical and design parameters (10 CFR 60.141)
- Quality Assurance program (10 CFR 60, Subpart G)

FY 1992 YMP Work Scope

1.2.1.1 Management and Integration ($3.5 M)

- Provide overall management and integration of the systems engineering and performance assessment activities
- Provide YMP support to the OCRWM Management Systems Improvement Strategy
- Issue revision to Q-List, YMP Requirements List, and Quality Activities list to support site characterization and ESF design activities
- Support the Quality Review Board
- Revise and implement QA grading process

FY 1992 YMP Work Scope

1.2.1.2 Systems Engineering ($5.2 M)

- Implement YMP SEMP
- Maintain YMP baseline
- Provide YMP interface control and configuration management to support the design and field activities
- Revise YMP requirements documents (SR, SD, RDR, ESFDR)
- Provide support to waste management system total system life cycle cost estimate
- Develop and maintain YMP plans and procedures
- Conduct field change control activities

FY 1992 YMP Work Scope

1.2.1.3 Technical Data Base Management ($3.3 M)

- Develop TDB Handbook
- Develop TDB parameter dictionary
- Issue TDB quarterly report and technical data catalog (quarterly)
- Provide input to the Technical Data Base including the SEPDB and GIS in support of site characterization
- Identify technical data that is not in the automated technical data trading system and begin entry of that data
- Expand the Reference Information Base (RIB) to support performance assessment and major YMP initiatives

FY 1992 YMP Work Scope

1.2.1.4 Performance Assessment ($12.5 M)

- Continue developing PA methodology
- Continue developing long-term performance assessment model and code development
- Continue model validation & code verification
- Manage and support PA in preparation of PA planning documents in accordance with QAPD/ QARD with particular attention to software QA and SIP documents
- Support near-term activities requiring iterative PA capabilities
  - ESF task force
  - Site characterization issue resolution
  - Test prioritization
  - Early site suitability evaluation
  - Natural analog studies

Principal Regulations Driving 1.2.2 Waste Package

- Research and development on disposal of high-level radioactive waste; waste package (Nuclear Waste Policy Act, Title II)
- Contents of Site Characterization Plan (10 CFR 60.17)
- Performance of particular barriers after permanent closure (10 CFR 60.113)
- Content of License Application (10 CFR 60.21)
- Criteria for the waste package and its components (10 CFR 60.135)
- Monitoring and testing waste packages (10 CFR 60.143)
- Quality Assurance program (10 CFR 60, Subpart G)

FY 1992 YMP Work Scope

1.2.2.1 Management and Integration ($0.8 M)

- Provide waste package management and integration
- Complete transition of M&I responsibility to NWMS - M&O
- Maintain the Waste Package Plan

FY 1992 YMP Work Scope

1.2.2.2 Waste Package Environment ($1.2 M)

- Complete the Preliminary Near-Field Environment Report (NFER)
- Complete study plans for chemistry/mineralogy, hydrology, and mechanical attributes of the waste package environment
- Continue development of hydrothermal code, VTOUGH, and initiate testing to support validation

FY 1992 YMP Work Scope

1.2.2.3 Waste Form and Materials Testing ($2.5 M)

- Complete the preliminary Waste Form Characterization Report (WFCR)
- Maintain hot cell capability for spent fuel characterization by the Materials Characterization Center (MCC) and for spent fuel oxidation and dissolution testing at PNL
- Continue flow-through dissolution testing on unirradiated UO_2 at LLNL and initiate dissolution testing on spent fuel at PNL
- Issue the SCP-CD Container Materials Selection Report
- Continue ongoing testing and modeling of HLW glass at ANL

FY 1992 YMP Work Scope

1.2.2.4 Design, Fabrication, and Prototype Testing ($0.7 M)

- Finalize methodology and criteria for selecting EBS/waste package design concepts for Advanced Conceptual Design (ACD)
- Perform development and evaluation of alternative concepts and prepare summary report
- Issue report on Yucca Mountain Engineered Barrier System Concepts Workshop (June 18-20, 1991) to discuss extended-life performance concepts and their technical feasibility

Principal Regulations Driving 1.2.4 Repository

- Content of License Application (10 CFR 60.21)
- Inspections (10 CFR 60.75)
- Performance of the geologic repository operations area through permanent closure (10 CFR 60.111)
- Overall system performance objective for the geologic repository after permanent closure (10 CFR 60.112)
- Scope of design criteria for the geologic repository operations area (10 CFR 60.130)
- General design criteria for the geologic repository operations area (10 CFR 60.131)
- Additional design criteria for surface facilities in the geologic repository operations area (10 CFR 60.132)

Principal Regulations Driving 1.2.4 Repository

(cont'd.)

- Additional design criteria for the underground facility (10 CFR 60.133)
- Design of seals for shafts and boreholes (10 CFR 60.134)
- General requirements for performance confirmation (10 CFR 60.137)
- Quality Assurance program (10 CFR 60, Subpart G)

FY 1992 YMP Work Scope

1.2.4.1 Management and Integration ($0.5 M)

- Provide management and integration of repository design, testing, and development
- Complete transition of M&I responsibility to NWMS-M&O

FY 1992 YMP Work Scope

1.2.4.2 Development and Testing ($2.4 M)

- Develop thermal mechanical properties estimate for ESF Title II design and RIB, analyze geologic structures & conditions related to major faults and in situ stress states, lab joint test, data analysis - determine thermomechanical properties, analysis of field experiments results
- Provide models & code development & validation to support draft design, preclosure, experimental designs, thermo-mechanical, mechanical, and structural investigations
- Provide analytical support for ESF studies & ESF Title II design related to future repository components
- Provide repository interface drawings to support ESF and SBT designs

FY 1992 YMP Work Scope

1.2.4.6 Sealing ($0.7 M)

- Issue draft report on available seals technology, define requirements & strategy, compile/evaluate information & prepare seals report

- Prepare seals degradation models, develop test concepts & requirements, scope development of laboratory analysis & procedures

Principal Regulations Driving 1.2.7 Test Facilities

- Research and development on disposal of high-level radioactive waste (Nuclear Waste Policy Act, Title II)
- NRC-specified tests (10 CFR 60.74)
- Monitoring and testing waste packages (10 CFR 60.143)
- General requirements for the performance confirmation program (10 CFR 60.137 and 60.140)
- Confirmation of geotechnical and design parameters (10 CFR 60.141)

FY 1992 YMP Work Scope

1.2.7.1 Management and Integration ($0.4 M)

- Provide management and integration of field management support activities
- Establish a fully functional field management system consistent with upper-level requirements
- Develop an Area 25 Master Plan for the central facilities needed for site characterization
- Establish an Area 25 construction coordination function
- Continue developing design criteria for Area-25 central facilities
- Support the development of health and safety program and implementation of DOE Order 5000.3A

FY 1992 YMP Work Scope

1.2.7.3 New Facility Acquisition ($1.4 M)

- Continue power study and produce conceptual design report
- Study MX aggregate piles for stability

FY 1992 YMP Work Scope

1.2.7.4 Field Operations ($4.4 M)

- Support YMPO site and special tours
- Operate and maintain existing Area 25 facilities (90 square miles, 10 buildings)
- Support the Field Operations Center at YMPO and YMSO
- Provide direct services for field activities
  - Health and safety
  - Food service
  - Fire protection
  - Transportation

FY 1992 YMP Work Scope

1.2.7.4 Field Operations (cont'd.)

- **Provide direct support to field participants**
  - Warehousing, storage yard, repair shops
  - Landfill/road system
  - Utilities, electrical, sewer, water
  - Radio telephones

- **Provide field engineering services including materials testing, field surveying, non-destructive examinations**

Principal Regulations Driving 1.2.8 Land Acquisition

- Controlled area (10 CFR 60.2)
- Restricted area (10 CFR 60.2)
- Requirements for ownership and control of interests in land (10 CFR 60.121)

FY 1992 YMP Work Scope

1.2.8.2 Land Acquisition - Site Characterization ($0.2 M)

- Review participant requests for site access
- Coordinate with BLM and DOI for compliance with land withdrawal
- Coordinate with BLM for compliance with right-of-way reservations
- Conduct mineral evaluation of drilling core

Principal Regulations Driving 1.2.9 Project Management

- Repositories for disposal of high-level radioactive waste (Nuclear Waste Policy Act, Subtitle A)
- Employee protection (10 CFR 60.9)
- Records and reports (10 CFR 60.71)
- Reports of deficiencies (10 CFR 60.73)
- Quality Assurance program (10 CFR 60, Subpart G)
- Training and certification (10 CFR 60, Subpart H)

FY 1992 YMP Work Scope

1.2.9.1 Administrative Services ($29.4 M)

- Provide project management at participants' offices
- Integrate project management, administrative services, information resources management, training, project control and QA activities
- Provide administrative services to include technical writing, graphics, reproduction, photographic, contract management, procurement, and office services
- Provide for facilities rent and telephone service
- Operate YMPO technical library
- Support Nevada Operations Office logistics and coordination office

FY 1992 YMP Work Scope

1.2.9.1 Administrative Services (cont'd.)

- Operate and maintain motor pool fleet
- Provide security services
- Provide computer support services
- Operate Central Records Facility
- Operate local Document Control and Records Centers
- Provide centralized YMP training

FY 1992 YMP Work Scope

1.2.9.2 Project Control ($8.3 M)

- Develop and operate YMP summary-level Planning and Control System (PACS)
- Develop YMP-level budget and schedule
- Develop annual YMP funding request
- Develop and operate participants' cost and schedule systems
- Provide financial analysis and funding control
- Provide progress and performance reports

FY 1992 YMP Work Scope

1.2.9.3 Quality Assurance ($12.5 M)

- Develop and maintain QA programs
- Implement QA grading process for items and activities prior to initiation of associated work
- Perform internal and external QA audits and surveillances to verify implementation of QA programs
- Provide quality engineering services, including technical document reviews, technical investigations and root cause determinations
- Track audit findings, nonconformances, corrective actions and deficiencies, and perform trend analyses
- Provide quality control inspection
- Implement OCRWM quality concerns program

Selected FY91 Accomplishments

HYDROLOGIC INVESTIGATIONS PROGRAM HIGHLIGHTS 1991

Characterization of the Meteorology for Regional Hydrology

- Lightning detection, system installed to monitor and record lightning activity affecting Yucca Mountain area. Lightning strikes being correlated with precipitation.

- Satellite ground station installed providing links with geostationary and polar orbiting weather satellites. Coverage includes all of North America.

- Precipitation network now includes 93 plastic collection gages and 13 automated tipping-bucket gages.

Characterization of Runoff and Streamflow

- Surface-water monitoring network enhanced by adding four additional monitoring sites and installing ALERT radio-telemetry systems at several sites. ALERT Provides real-time runoff information at these gages. Surface-water network now includes 9 continuous gages and 13 peak-flow sites.

Characterization of the Regional Ground-Water Flow System

- Three mining-company drilled geologic exploration boreholes; in western Amargosa Valley were converted to deep piezometers Borehole data and logs are being analyzed.

- Data were collected at two wildcat wells drilled in the Amargosa Desert.

Regional Hydrologic System Synthesis and Modeling

- Model simulations were performed to predict the effects of ground-water withdrawals from well J-13 on the flow system of Yucca Mountain and vicinity, in preparation for water-permit hearing .

- Conceptual models were developed and papers presented on the effects of a wetter climate and increased recharge on the groun-water flow system at Yucca Mountain.

Characterization of Unsaturated-Zone Infiltration

- Neutron-access borehole drilling started in September 1991 on the northeastern edge of the potential repository in WT-2 wash.

- Intensive study of a 1984 infiltration event in Pagany Wash continued. Two-dimensional numerical modeling of neutron-hole moisture profiles suggested presence of law-permeability layers in the alluvium, which were confirmed by subsequent field observations.

- Approximately 550 small diameter core samples were collected from outcrops to provide hydrologic and physical properties data.

Characterization of Percolation in the Unsaturated-Zone-Surface-Base Study

- Drilled and instrumented three shallow, prototype, UZ instrumentation holes at the HRF. Downhole sensors include thermocouple psychrometers, thermistors, and pressure transducers. Testing of sensor characteristics, and downhole recalibration procedures began.

- Conducted prototype air-permeability testing of an 8-inch diameter hole at Apache Leap test site using the UZ hydrochemistry, straddle-packer gas-sampling system.

- Prototype cross-hole air-permeability testing at Apache Leap site showed good correlations of permeability and porosity between test gases and injection rates. All downhole prototype equipment functioned well.

- Construction of the 8-inch diameter, straddle-packer system for air-permeability testing of existing deep UZ borholes at Yucca Mountain was completed.

Characterization of Percolation in the Unsaturated Zone-ESF Study

- Laboratory tests were conducted on small block samples for fracture coatings and rock matrix. Prototype air-permeability tests were conducted on a large clock sample providing information for packer design and locations of conducting fractures.

- Work progressed on two sets of experiments for the prototype ESF percolation test: water imbibition on small welded and nonwelded cores and large block ponding.

Characterization of Gaseous-Phase Movement and in the Unsaturated Zone

- Gas samples were collected for geochemical analysis from eight zones in well USW UZ-6, nine zones in USW UZ-6's, and one zone each in USW UZ-N93, -N94, and -N95.

Hydrochemical Characterization of the Unsaturated Zone

- Gas samples were collected from well USW UZ-1 and from Apache Leap, degassed, measured, and sent in to be analyzed for Carbon 14 and 13/12. Data have been tabulated and analyzed.

Site Unsaturated-Zone Modeling and Synthesis

- All relevant information to be used in the development of a preliminary site-scale UZ flow model for Yucca Mountain was collected and stored in a computerized data-base maker and a management system at LBL. Meetings were held with SNL to exchange information and integrate present and future data into the site model.

Characterization of the Site Saturated-Zone Ground-Water Flow System

- Monthly water-level measurements were made in 17 wells and quarterly measurements in 3 wells. Hourly data were collected from 19 zones in 12 wells.

- Six satellite data-collection platforms at wells were operational and transmitting data to Denver every four hours.

- A new type of transducer was tested, installed, and appears to have reduced the equipment failure rate.

- Construction of two 3-zone packer strings for c-holes hydraulic and tracer testing neared completion. Limit tests were conducted on packers by the manufacturer and low-pressure tests were conducted on transducers.

Saturated-Zone Hydrologic System Synthesis and Modeling

- The LBL 3-D fracture network flow and transport code, TRINET, has been tested, verified, and improved. Sensitivity analysis was performed.

Characterization of the Quaternary Regional Hydrology and Future Regional Hydrology Due to Climate Change

- Surficial samples were collected from 6 dry playas in New Mexico, 6 in Nevada, and 19 in California for the ongoing evaluation of past discharge areas.

- Regional data for a 3′ x 3′ area are being compiled for 3-D ground-water modeling of future climatic and tectonic conditions. GIS digital files have been compiled for Nevada geology, regional and large-scale faults, surface hydrology, springs, well locations, and water quality from existing data bases. Site specific data includes soils of Nye County, vegetation of Funeral Mountains, and surficial geology of Bare Mountain - Big Dune area.

Characterization of Flood Potential of the Yucca Mountain Site

- Probable maximum flood magnitudes have been calculated for clear water in washes near proposed surface facilities at Yucca Mountain. Discharges are being adjusted for sediment antrainment and flood inundation maps are being prepared.

BUREAU OF RECLAMATION TECHNICAL HIGHLIGHTS

Soil and Rock Properties for Exploratory Studies Facility Design

- Completed Study plan
- Modified Site Characterization Plan
- Completed Quality Assurance Grading Reports.
- Completed Criteria Letter containing exploration programs for North and South Ramps.
- Completed site selection reports on: (1) North Ramp alignment, (2) three South Ramp alignments, and (3) five shaft locations.
- Cerified USBR Geotechnical Testing Laboratory.
- Site selection report on six North Ramp Alignments in preparation.

Characterization of Unsaturated Zone Hydrochemistry

- Completed fabricating and testing high-pressure (120,000 psi lateral) test vessel to extract pore gas and water from tuffaceous rock. Began constructing a second vessel) for production testing.

Characterization of Percolation in the Unsaturated Zone, Surface-Based and ESF Studies.

- Continued building vertical-borehole packer equipment to support both Unsaturated Zone (UZ) and saturated-zone hydrology activities.

Characterization of Flood Recurrence Intervals and Levels at Potential Locations of Surface Facilities

- Began certifying flood-hydrology and laboratory-testing software for compliance to project requirements.

PROJECT MANAGEMENT AND QUALITY ASSURANCE

Project Control (Supported by SAIC/Golden)

- 187 SCP Activity Level Schedules, consisting of over 3,000 activities, were developed and resource loaded for PACS. Seventy of these schedules were active and statused during FY 1991.

- The USGS PACS database was used as a basis for developing Project-wide participant work stations for electronic transfer of PACS input. The USGS (SAIC/Golden) has been instrumental in development and testing of the work stations.

Records (SAIC/Golden)

- Local Records Center processed and transmitted to the Project's Central Records Facility More than 53,000 pages and maintains another 377 ongoing packages for later submittal.

- LRC consistently operated at better than 99% on the Project's performance achievement scales.

Training (SAIC/Golden)

- The training program has trained more than 325 USGS participants and tracked over 20,000 training assignments.

- USGS training database software has gained the attention of other participants, several of whom are converting it to use at their locations.

Quality Assurance (Supported by SAIC/Golden and USBR)

- A fully qualified Personnel Qualification Program was implemented that meets both the project requirements and the Privacy Act provisions. All YMP-USGS personnel conducting quality affecting work are verified as being qualified to conduct their assigned tasks.

- DOE audit 92-01 of USGS QA Program identified no deficiencies in the areas of organization, personnel qualification and training, QA program implementation and verification.

- USGS has conducted 23 audits, 15 surveillances, and 16 vendor evaluation, permitting the closure of 100 deficiency documents.

- The first NRC audit participants occurred at the USGS. The audit verified the USGS QA Program has adequate procedural controls in place and that program implementation is effective.

- Grading of all 32 funded USGS-YMP technical activities have been completed, and approved by the Quality Review Board.

- The USGS Software QA program is tracking over 300 software pieces, with 88 being brought in this year.

- YMP-USGS technical and QA personnel actively supported the YMPO sponsored workshops on QA.

- Completed the DOE review and verification cycle for 10 of 16 priority hydrologic study plans of which nine have DOE approval and are at the NRC.

GEOLOGIC STUDIES PROGRAM HIGHLIGHTS

USGS Reorganization

- Reorganization of the USGS-YMP program was completed with the transfer of geologic activities from Geologic Division to the Geologic Studies Program within the Water Resources Division. This consolidation will facilitate management, increase responsiveness to DOE's needs, and improve integration between the geologic and hydrologic investigations.

- In addition to a core group of about 25 people in the Geologic Studies Program, several top scientists in the Geologic Division will work under memoranda of agreement, and several scientists from the State of Nevada will work under cooperative agreement contracts.

- Members of the Geologic Studies Program wrote or contributed to 9 papers presented at the 1991 national meeting of the Geologic Society of America in San Diego in October.

Rock Characteristics Program

- Geologic maps showing prospects and mines in the vicinty of Yucca Mountain and mineral resources for a large part of southern Nevada volcanic fields have been completed.

- Reports concerning the geochemistry of fresh and altered tuffs at Yucca Mountain were published in proceedings of the American Nuclear Society and Materials Research Society. These reports establish approaches for study of cores from future geologic drill holes.

- Reports on physical properties of tuffs at Yucca Mountain and on geophysical logs for drill holes were completed. These will guide geophysical borehole logging in future drill holes.

- On the basis of isotopic studies of drill core from UE25A1, GSP and LANL scientists are collaborating to evaluate a depth-dependent strontium isotopic variation within the densely welded Topopah Springs. If confirmed by detailed analyses of USW G4 core, the technique could be used as a precise stratigraphic indicator which would be invaluable during development of the ESF.

- Samples of the Tram, Calico Hills, Bullfrog, and Topopah Spring units were collected from outcrops that have never been below the water table. These samples will be the basis for assessing the geochemical and isotopic effects of rock-water interaction in rock units below the proposed repository horizon.

- Information on hydrocarbons in the vicinity of Yucca Mountain has been compiled and a report has been submitted for review.

Climate Program

- The Trench 14 issue is ready for closure. Large and diverse data sets generated by GSP and LANL scientists prove conclusively that the calcite and silica deposits at Trench 14 were not deposited from upwelling ground water. This conclusion has been presented at several scientific meetings and is now published in Science magazine.

- Combined stable and radiogenic isotopic systems in calcite fracture fillings are being used to establish paleo-water table elevations; preliminary results were presented at the national GSA meeting in San Diego.

- A report describing the control of temperature and water chemistry on particular ostracode taxa was published. These systematic environmental controls will allow use of fossil ostracodes in evaluating paleohydrologic conditions.

- Rock varnish dating and geomorphologic studies have provided data for a project position paper which will close the erosion issue.

- Two key study plans have been completed which will allow acceleration of the climate program activities.

Tectonics Program

- Specifications for contracting seismic lines; and potential field surveys across Crater Flat and Yucca Mountain, and up Yucca Wash have been completed. Results of these geophysical surveys will be used to assist in the siting of drill hole G-5.

- Field work was completed and preliminary strip maps of the Paintbrush, Windy Wash, Solitario Canyon, and Fatigue Wash faults were prepared.

- GSP has developed a transition plan for the transfer of the seismic network from the USGS at Golden to the University of Nevada at Reno.

- Photogeologic analysis of Yucca Mountain and detailed structural data on the Paintbrush, Stagecoach Road, and Windy Wash faults show that all major Quaternary faults at Yucca Mountain demonstrate a component of left-lateral slip and that several major fault systems are interconnected.

- Feildwork on the Paintbrush Canyon fault indicates that the integrated rate of Quaternary movement on the fault that will most heavily influence design of the potential repository and and the ESF is 0.007-0.01 mm/year.

- An ambitious trenching program for FY 92 includes new trenches on the Paintbrush Canyon and Solitario Canyon faults, and a 1 km-long trench in Midway Valley to support the ESF design, work.

- A photogrammatric method has been developed to calculate the volume of material eroded off Yucca mountain during high intensity storms. The method will be demonstrated at AGU meeting on December 9, 1991.

- A compilation map of the geology between Yucca Mountain and Death Valley has been completed at a 1:250,000 scale. The map is now being drafted for formal review.