

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

NUCLEAR WASTE TECHNICAL REVIEW BOARD

**SUBJECT: SYNTHESIS OF RESULTS
OF ESF EXPLORATION**

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Subsurface Exploration

- **How did we get here?**
- **What have we learned from the North Ramp and the North-South Main?**
- **Where do we go from here?**

How did we get here?

Original Plan

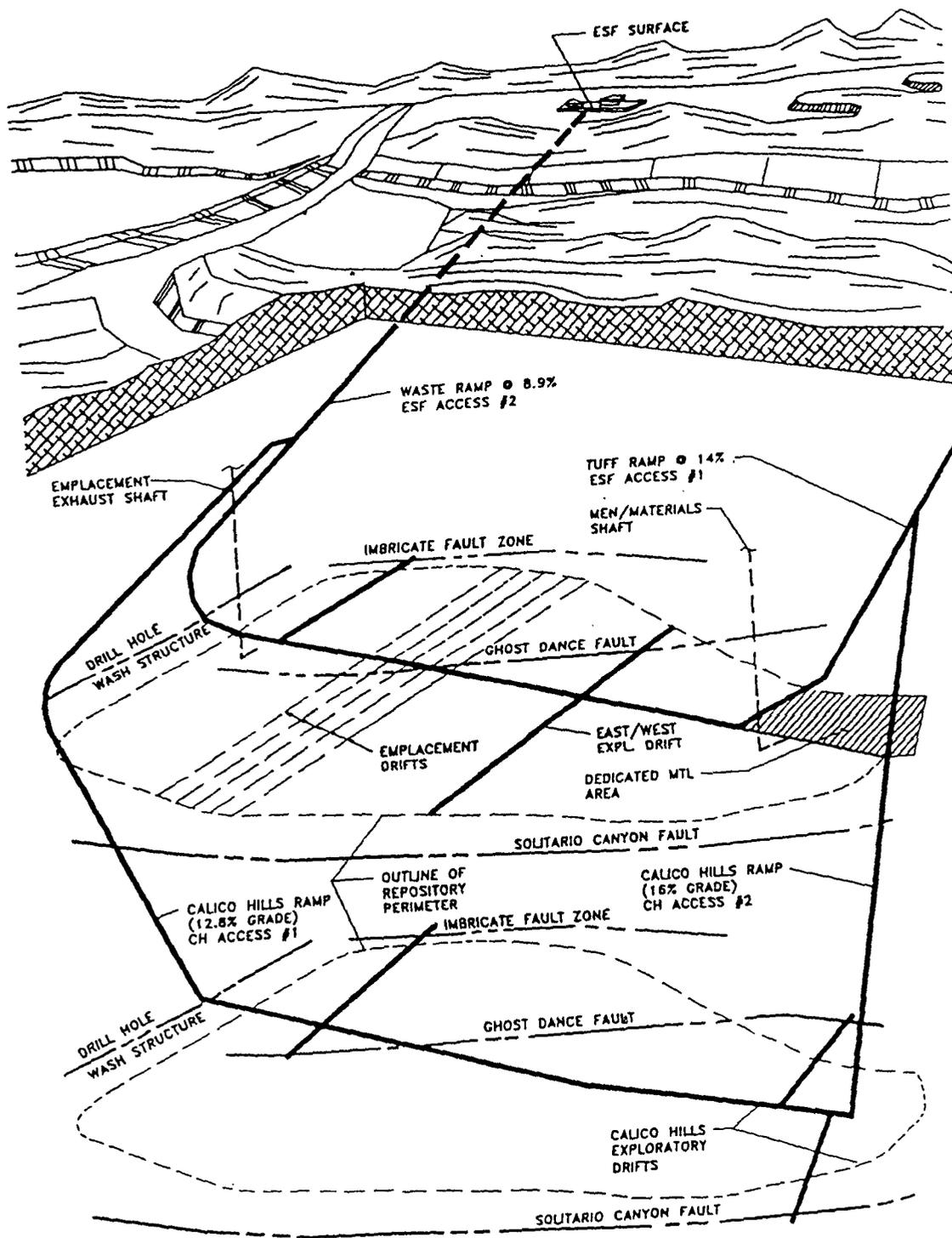
- **Two vertical shafts at the north end of the proposed repository block**
- **Lateral drifting at key horizons**
- **Proposed excavation method was drill and blast**

ESF Alternative Study

- **Driven by internal and external concerns that indicated a need to see more rock at various horizons with mechanical excavation**
- **ESFAS considered 38 options; preferred option was Option 30**

Option 30 Key Attributes

- **Mechanical excavation for a total linear footage of ~65,000 feet**
- **Excavation to two major stratigraphic levels**
- **Four major ramps**
- **Multiple testing alcoves**
- **NE/SW-oriented main drift at both major stratigraphic levels**
- **Testing focused on main drift on repository block, south ramp, and lower stratigraphic level**

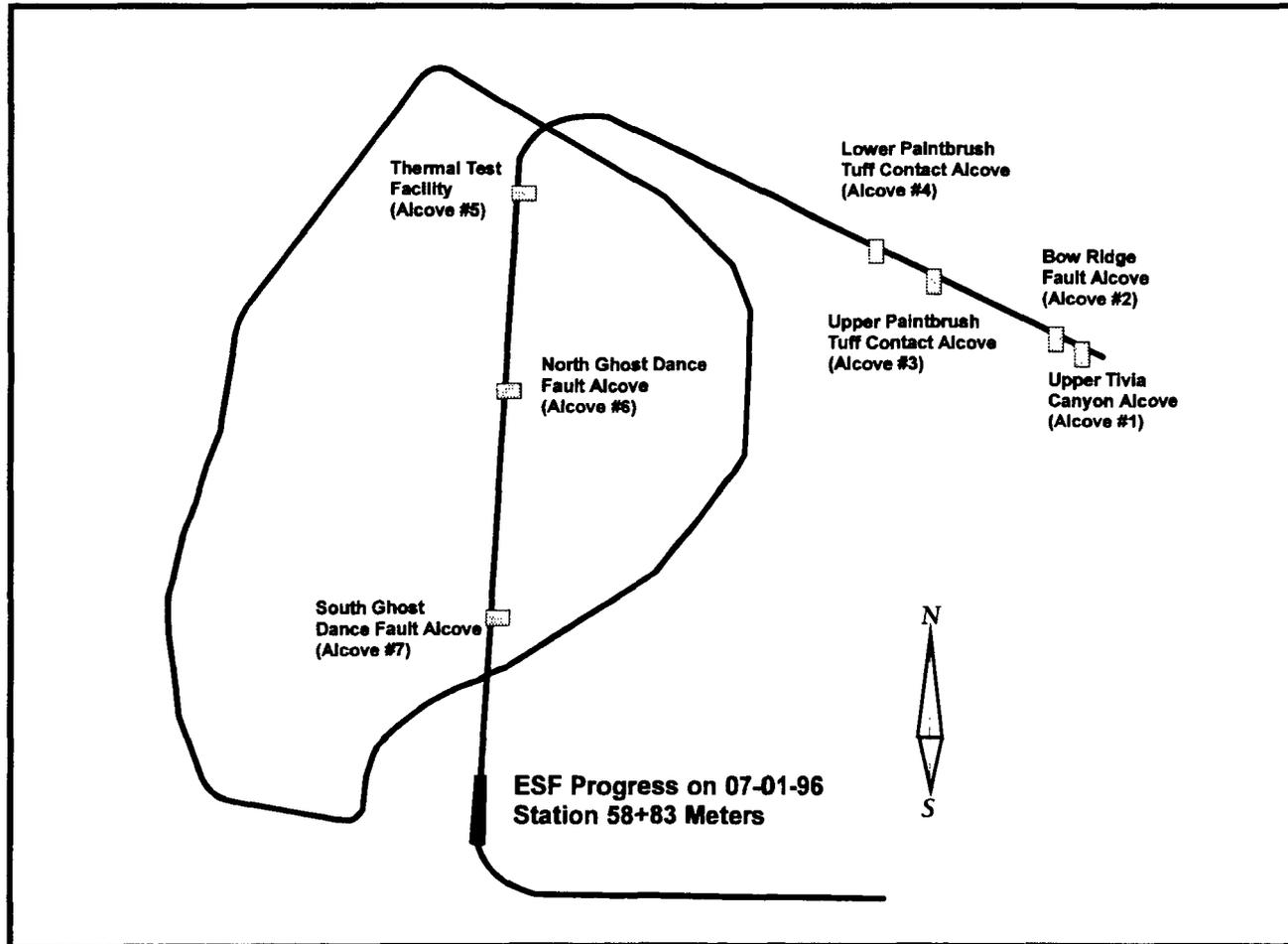


ESF ALTERNATIVES STUDY
 TASK NO. 4
 OPTION NO. B7
 ISOMETRIC SCENARIO #2
 DATE DEC 13 1990

Modification of ESF Option 30

- **Character and purpose of modifications**
 - Changes in drift grade, location, and extent of excavation
 - Reduce drift grade to permit access by rail
 - Avoid N/S main drift penetration of main trace of Ghost Dance Fault; design envisioned upper and lower repository blocks
 - Access and test Ghost Dance via alcoves
 - Maximize potential repository area; ESF could function as access to potential repository
- **Components**
 - North Ramp, N/S Main drift constructed parallel to Ghost Dance Fault, South Ramp
 - Alcoves (7 planned) constructed to test major features

ESF Configuration



What have we learned?

Subsurface Exploration

ESF: What We Have Learned

- **Offset along major faults and complexity of fault zones have been less than expected**
- **Fracturing within the potential repository host sequence is likely stratabound**
- **Free-draining fractures have not been observed**

Subsurface Exploration

ESF: What We Have Learned (Continued)

- **Rock quality has been better than predicted from borehole information**
- **Ground conditions range from category I to IV; category V ground conditions have not been encountered**
- **Ground conditions generally within the category II/III range for repository host sequence**
- **TBM excavation has proceeded with little delay due to adverse ground condition; constructibility has been demonstrated**
- **Tunnel stability and constructibility appear to be better in lithophysal and non-welded units**

Subsurface Exploration

ESF: What We Have Learned (Continued)

- **Air permeability testing in North Ramp Alcoves demonstrate that welded, non-welded, and fault zones are characterized by bulk permeabilities measured in darcies to tens of darcies; higher than expected from core measurements**
- **Indications of high permeabilities to air from ESF alcove air-k testing results agree with pneumatic testing in borehole UZ-7a; borehole located on Ghost Dance Fault; no delay in atmospheric pressure pulse to 750' depths; fault acts to “short circuit” pneumatic system**

Subsurface Exploration

ESF: What We Have Learned (Continued)

- Fracture fill age determination improved from earlier borehole and ESF sampling; permitted by refined sampling techniques in ESF
- Age of fracture fill material indicate very slow rates of deposition
- Feature (fault/fracture) related sampling resulted in identification of young “bomb pulse” ^{36}Cl

Subsurface Exploration

ESF: What We Have Learned (Continued)

- **Fast pathways exist**

- **UZ-16: presence of bomb pulse tritium in Calico Hills unit, depth exceeding 1400'**
- **UZ-14: carbon dated young waters (less than 500 yrs) in Calico Hills unit, depth exceeding 1400'**
- **^{36}Cl at numerous locations in the ESF**
- **^{99}Tc at Bow Ridge Fault in ESF**

Where do we go from here?

Current Plan

- **Complete N/S Main Drift in FY96**
- **Complete South Ramp in middle FY97**
- **Continue mapping, sampling, testing, analyses, and report development on drift and alcove investigations**
- **Complete construction, initiate tests, FY96/97**
 - **Thermal Test Alcove**
 - **North Ghost Dance Fault Alcove**
 - **South Ghost Dance Fault Alcove**

Conclusions

- **Project will continue with planned program of testing and observation in the ESF**
- **Results of ESF testing and observation will be evaluated and integrated into design, process models, and performance assessment activities**
- **Additional underground excavation has been considered in out-year planning**
- **A place-holder for additional underground excavation is present in the long-range plan**
 - **design of excavations in FY98**
 - **excavation and testing starting in FY99**