

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

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

**SUBJECT: WASTE PACKAGE
ENVIRONMENT THERMAL TESTING
UPDATE**

PRESENTER: DALE G. WILDER

**PRESENTER'S TITLE
AND ORGANIZATION: TECHNICAL AREA LEADER
LAWRENCE LIVERMORE NATIONAL LABORATORY
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**PRESENTER'S
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**LAS VEGAS, NEVADA
OCTOBER 19-20, 1993**

We are moving dirt

Test Strategy

Scale

Purpose

<p>Lab Scale Core - 1 ft. hours to days (some long-term)</p>	<p>Property Measurements Matrix Processes Single-Fracture Processes Limited Model Testing</p>
<p>Block Scale 1 ft. to 3-5 m.</p>	<p>Multiple-Fracture Processes Fracture Interconnectivity Phenomena Coupled Processes</p>

In Situ Heater Tests

<p>ESF Tests (up to few 100 ft.)</p>	<p>Site characterization <i>In Situ</i> Hydrothermal/Geochemical/ Geomechanical Responses</p>
<p>Large Scale</p>	<p>Scaling Effects, Natural Heterogeneity Impacts</p>
<p>Repository Scale Monitoring</p>	<p>Performance</p>

***In situ* Heater Tests Can Test Fundamental Hypotheses**

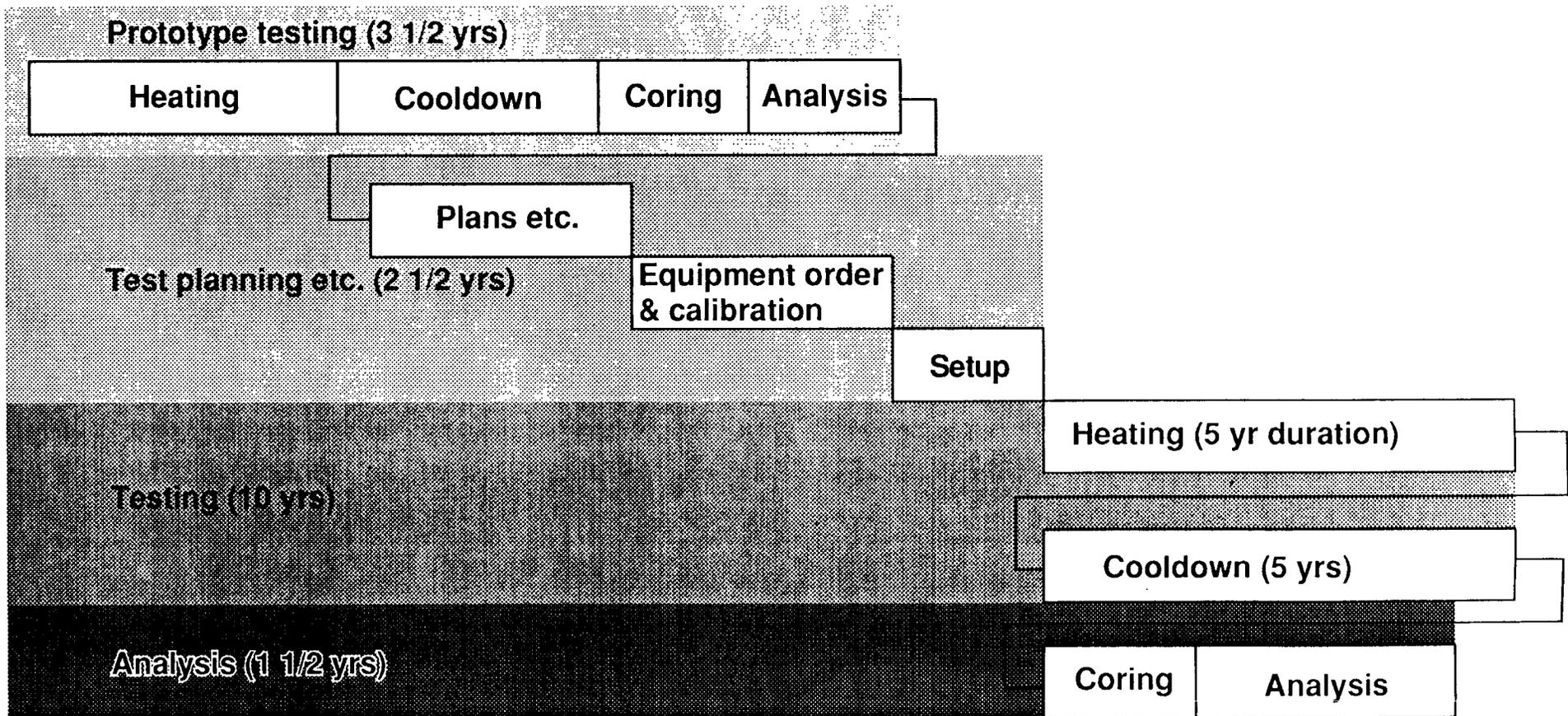
- (1) Conditions where heat conduction dominates heat flow**
- (2) Whether above-boiling temperatures remove all mobile liquid water**
- (3) Whether fracture density and connectivity are sufficient for rock dry-out**
- (4) Whether re-wetting significantly lags the end of boiling**
- (5) Conditions where large-scale, buoyant, gas-phase convection may dominate**

The large block test will provide valuable information pertaining to all five hypotheses tests, particularly to hypotheses 2, 3, and 4

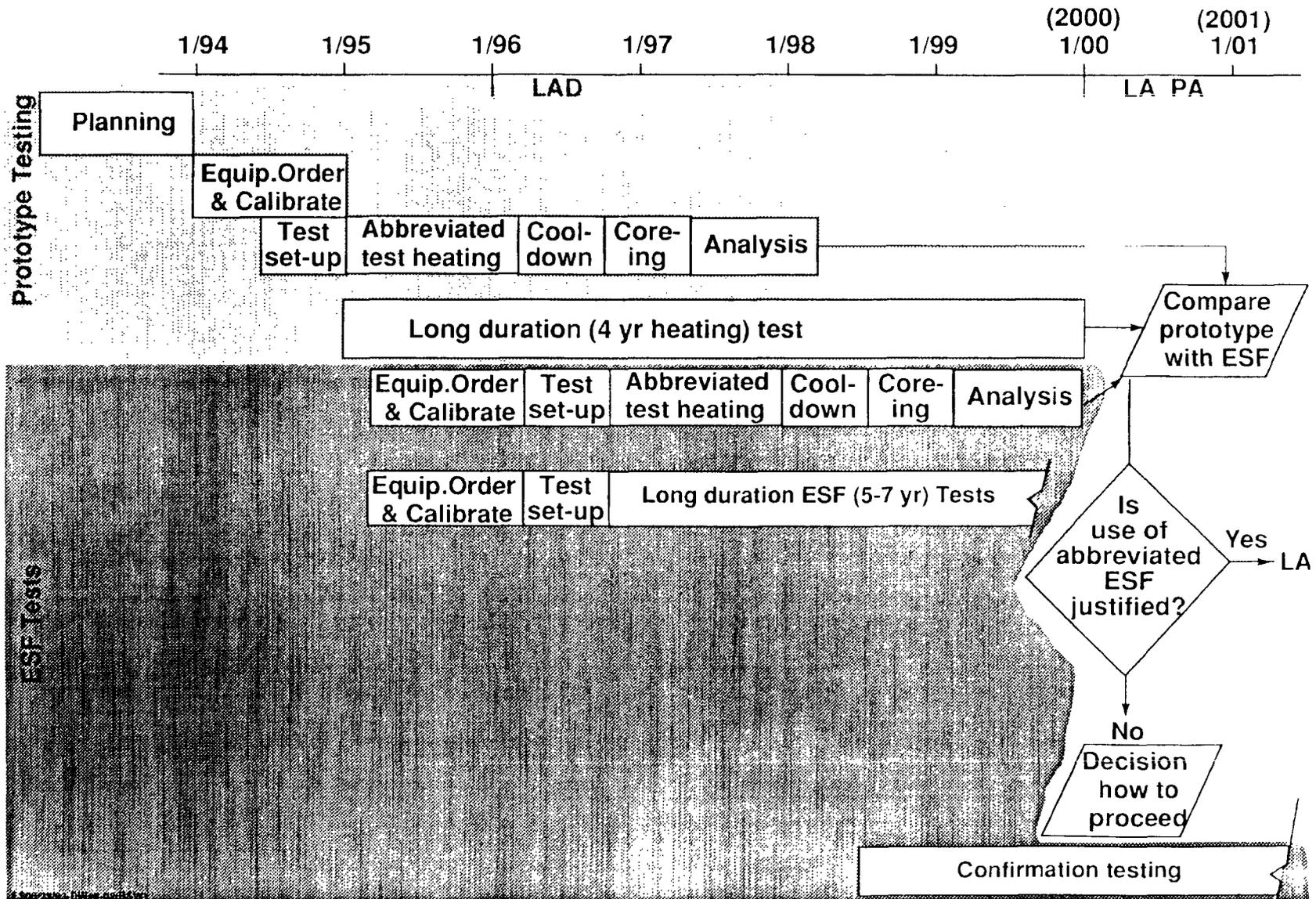
Criteria for Design of Waste Package Environment Tests

- **Volume of the dry-out zone**
 - G-Tunnel ~0.75 m
 - Small percentage of fractures responsible for majority of flow
- **Peak rock temperatures**
 - Above 200 degrees can have phase transition
- **Velocity of dry-out front**
 - Lab tests of up to one-year duration required
- **Size and duration of condensate zone**
- **Time rate of change of temperature**

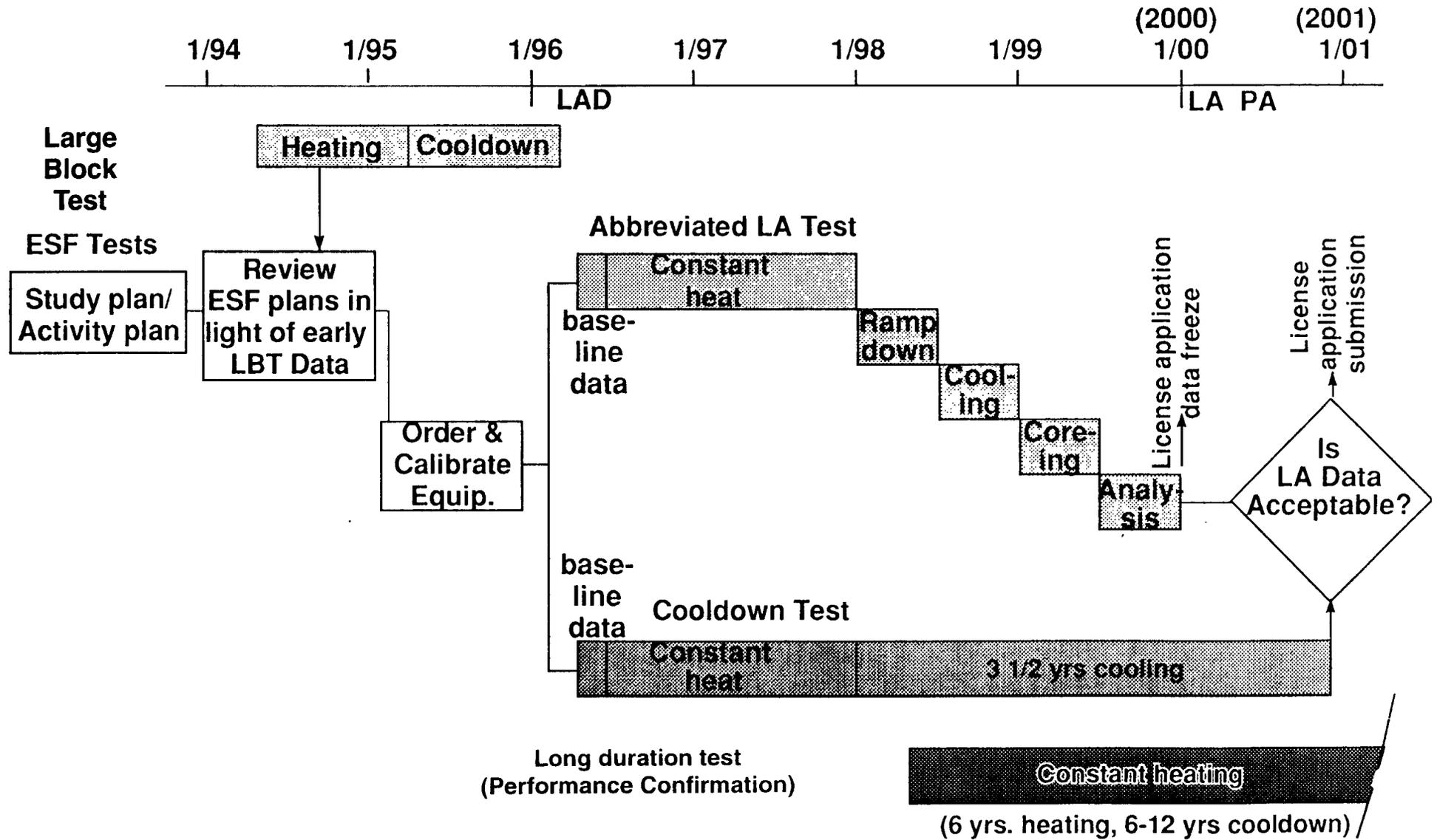
Ideal Strategy



Strategy with Off-Block Prototype Testing



Strategy Using Large Block Test



Issues Requiring Testing Before ESF Testing

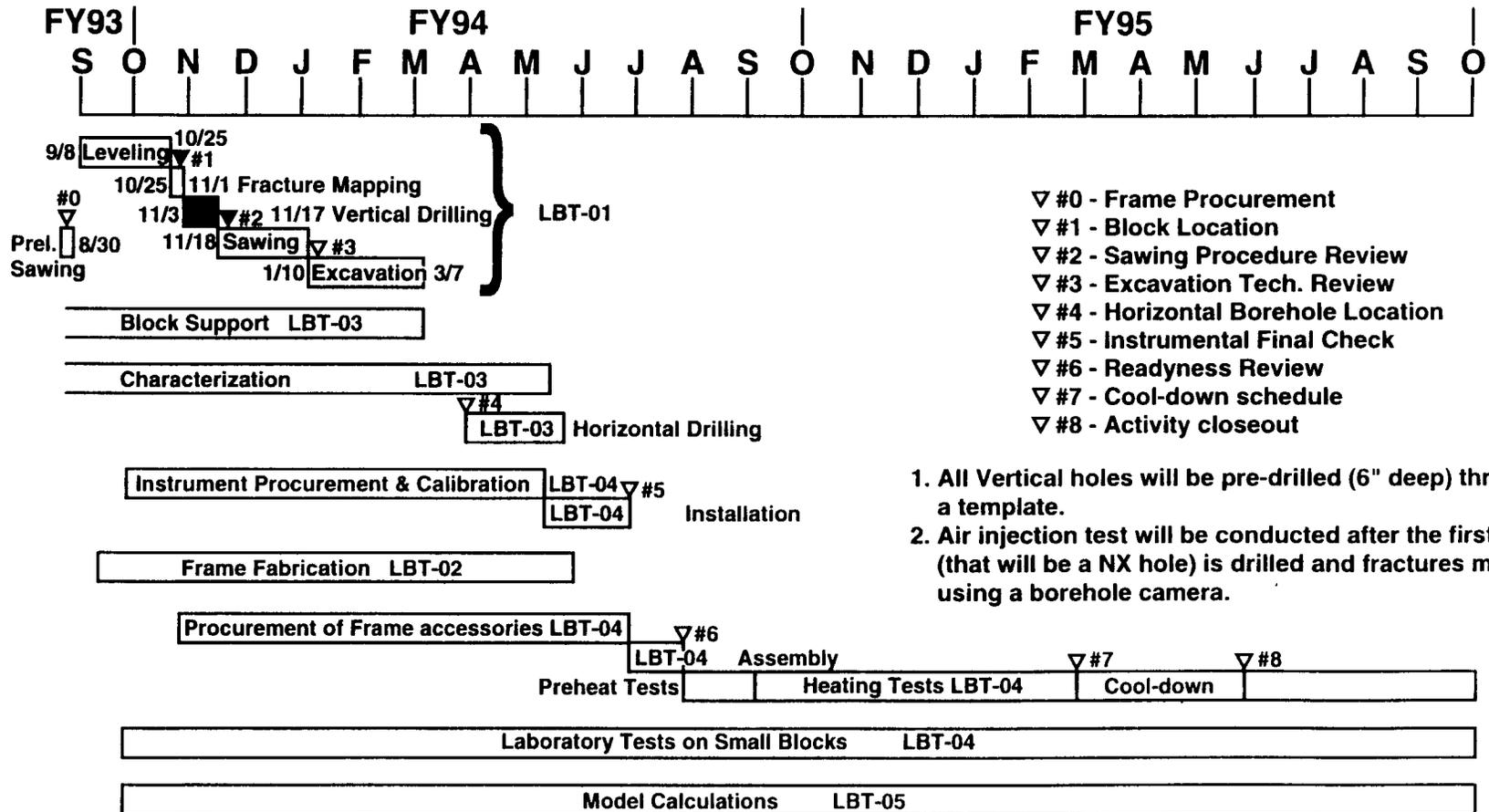
- **Validation test independent of those used for characterization (property values, etc.) data, and developing or testing models**

Developing and testing require “tweaking knobs” in the models to understand physics. Validation test design relies on scoping calculations; therefore, the physics must be appropriate prior to testing

- **Early decisions based on model predictions (e.g., thermal loading, MPC, emplacement strategy) require that processes important to the outcomes be incorporated into models. The models have not been demonstrated adequately**
- **ESF test planning**
 - **Confidence in models used for planning of ESF tests**
 - **Instrument and technique evaluation prior to ESF test**
 - **Evaluation of scaling effects**

Large Block Test at Fran Ridge

(photo)



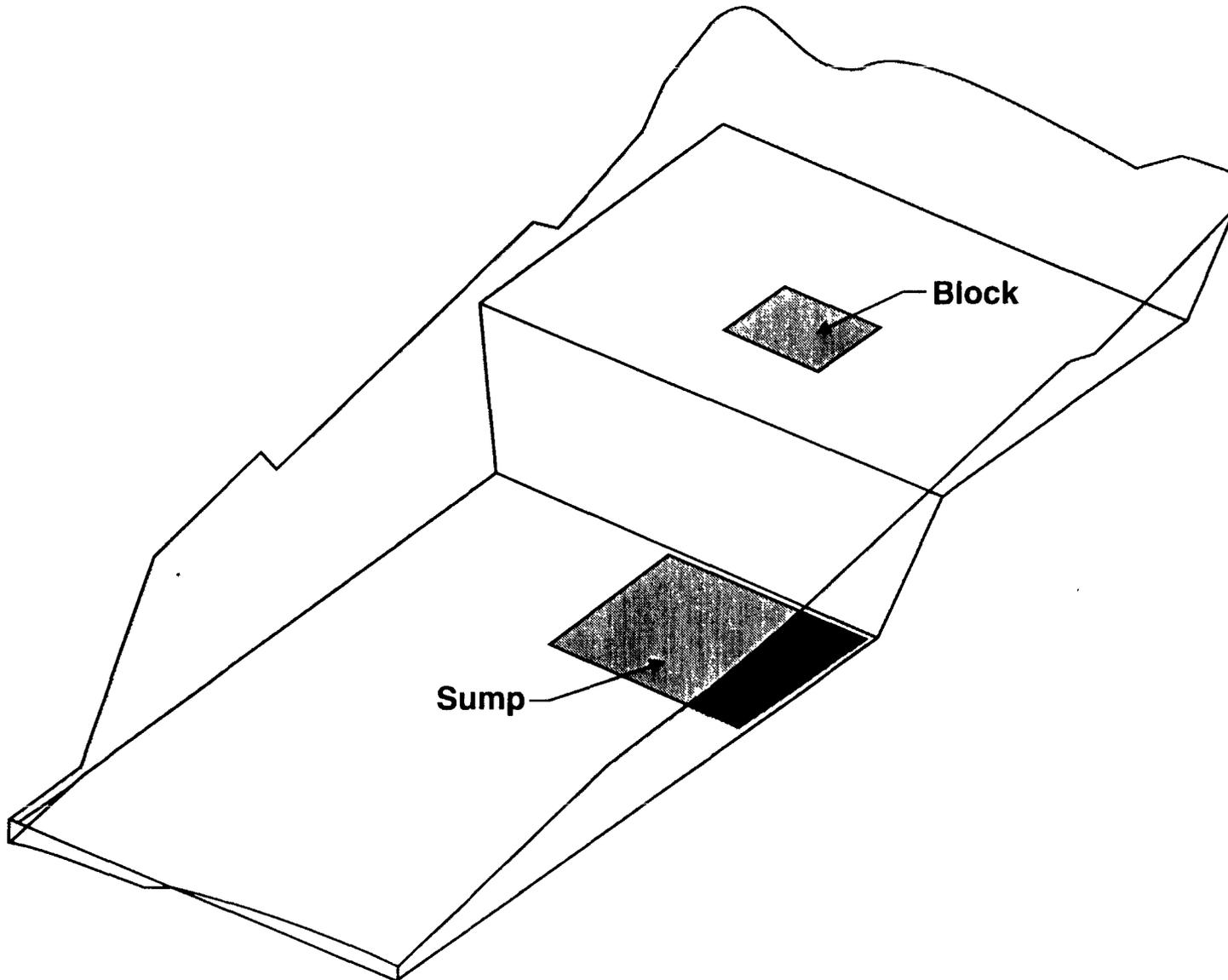
- ▽ #0 - Frame Procurement
- ▽ #1 - Block Location
- ▽ #2 - Sawing Procedure Review
- ▽ #3 - Excavation Tech. Review
- ▽ #4 - Horizontal Borehole Location
- ▽ #5 - Instrumental Final Check
- ▽ #6 - Readiness Review
- ▽ #7 - Cool-down schedule
- ▽ #8 - Activity closeout

1. All Vertical holes will be pre-drilled (6" deep) through a template.
2. Air injection test will be conducted after the first hole (that will be a NX hole) is drilled and fractures mapped using a borehole camera.

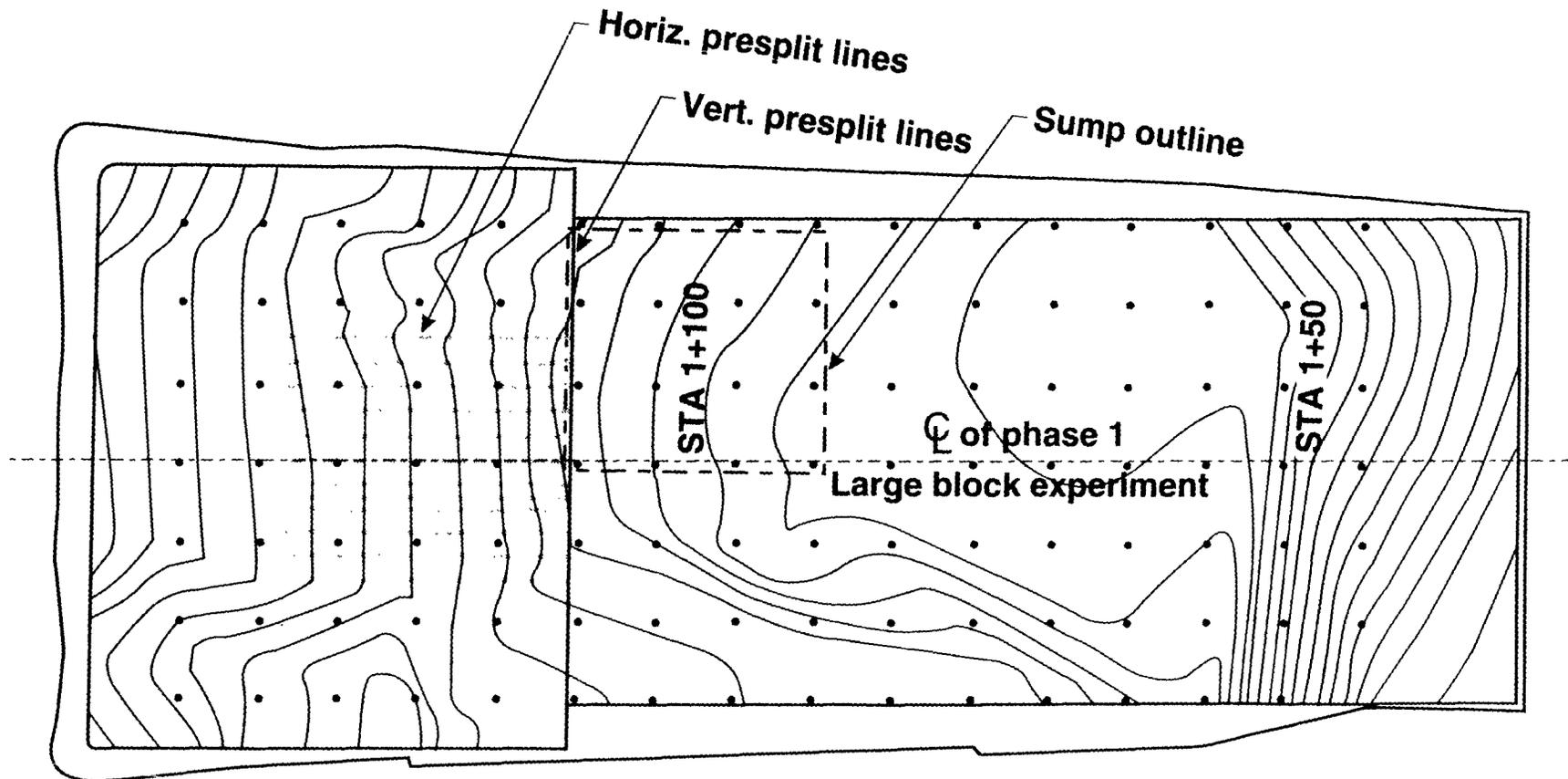
Large Block Test Status

- **Planning offsite**
- **Excavation started**
- **Drilling and testing mid-October**
- **Cutting planned for mid-November**
- **Planning documents progressing**
- **Test-frame contract awarded**

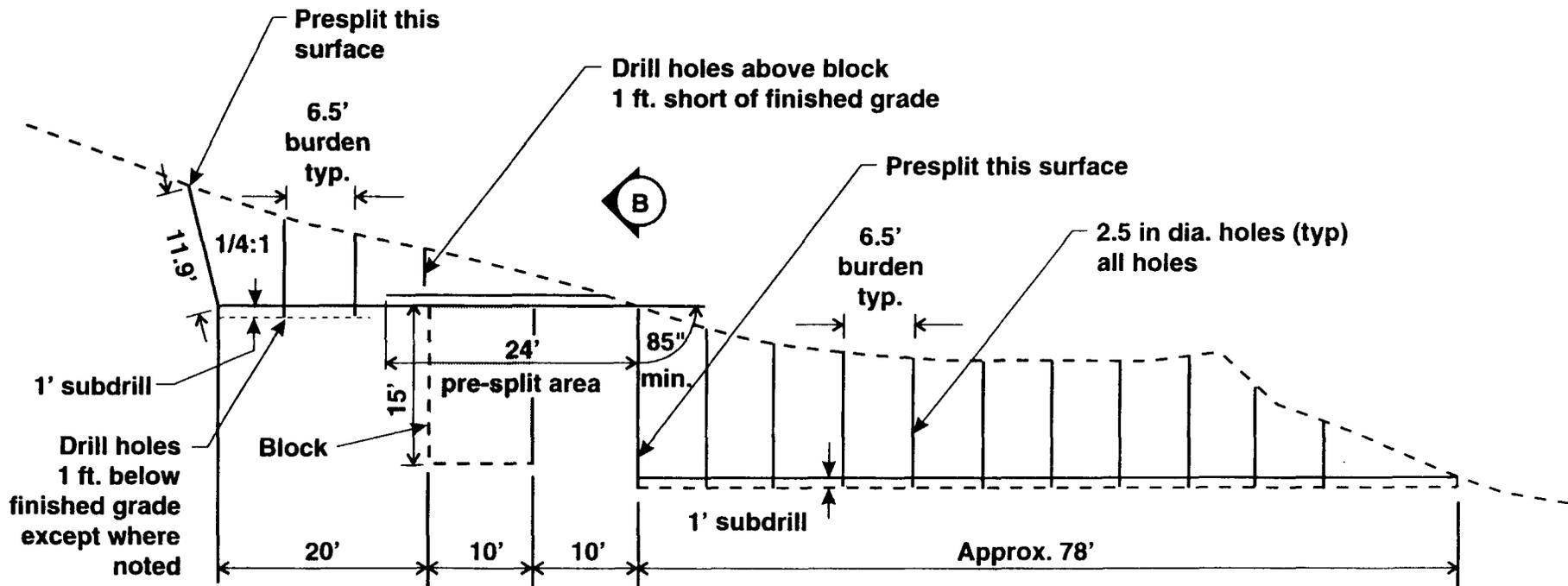
Benching for Large Block Test



Excavation Plan Large Block Test



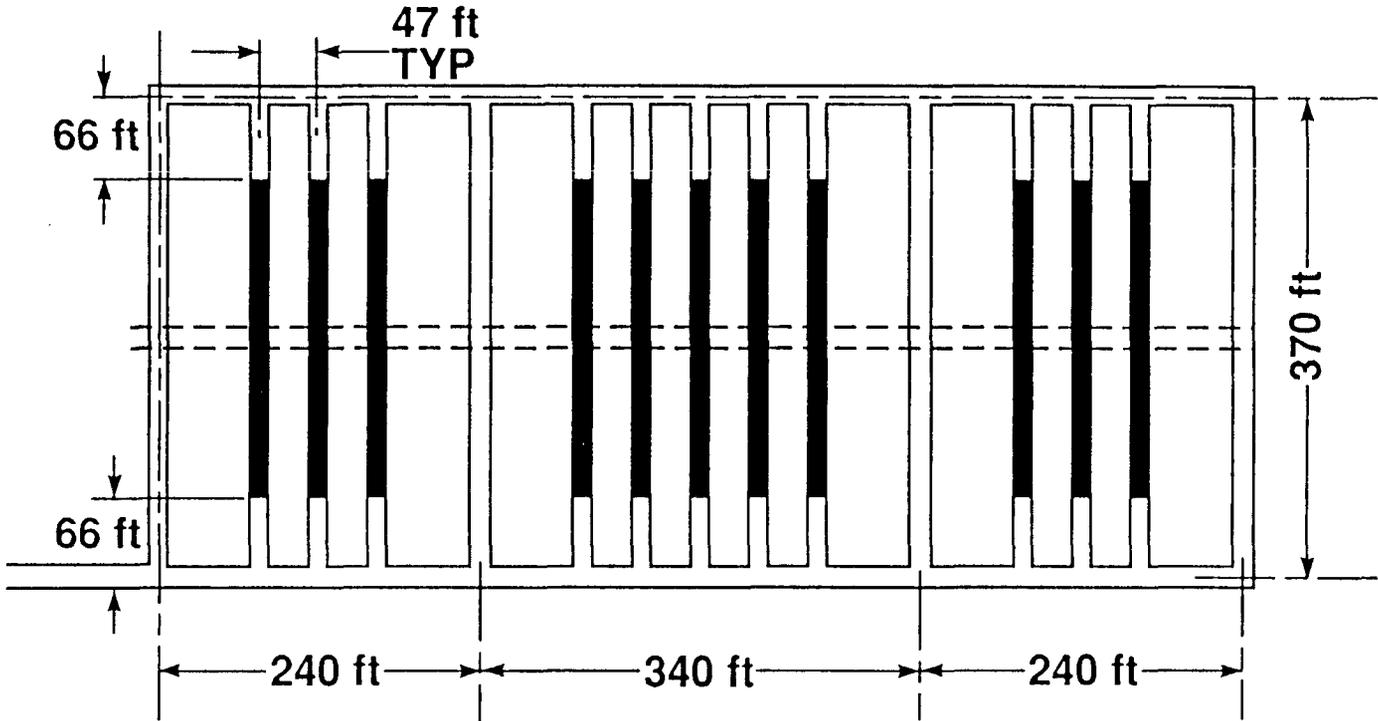
Cross Section of Excavation Plan



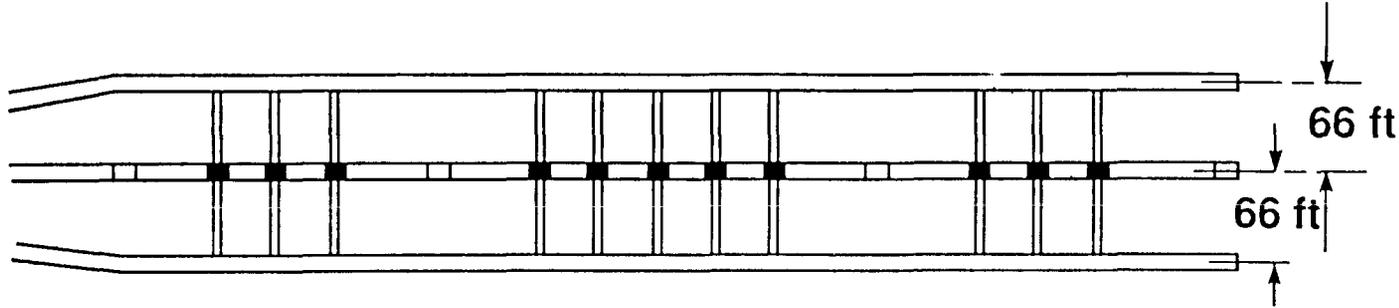
Photo

Videotape

Layout of ESF Tests



Plan



Cross Section