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

# NUCLEAR WASTE TECHNICAL REVIEW BOARD
# FULL BOARD MEETING

## SUBJECT: THERMAL-LOADING TESTING NEEDS AND PLANS


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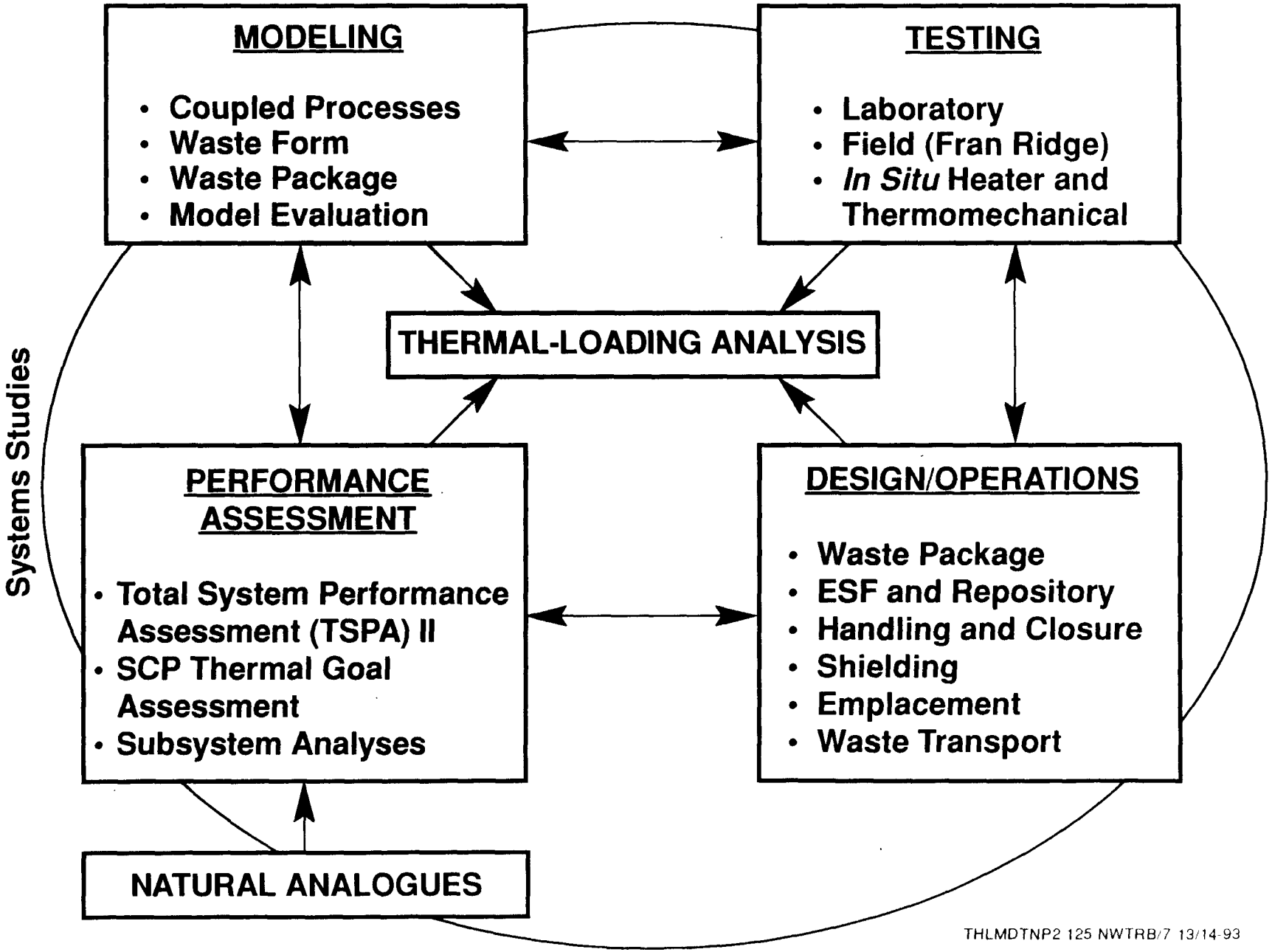
DENVER, COLORADO
JULY 13-14, 1993

# Outline

- Technical elements of thermal loading
- Identification of activities relevant to thermal loading
- Evaluation of the analytical model
- Laboratory studies that support thermal loading
- Large block tests at Fran Ridge
- *In Situ* heater testing in Yucca Mountain
- *In Situ* thermomechanical testing in Yucca Mountain
- Analogue studies
- Summary

# Technical Elements of Thermal Loading

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# Identification Of Program Activities that Affect the Thermal-Loading Decision

- Thermal-loading task force identified activities for FY93 and beyond that could narrow the range of thermal loads

- Task force evaluated issues highlighted from the August 1992 thermal-loading decision process meeting:
  - Radionuclide Transport (Waste-form dissolution, liquid transport models, refluxing, C-14 release)
  - Corrosion
  - Performance Assessment
  - Operational Issues
  - Thermomechanical Effects

# Identification Of Program Activities that Affect the Thermal-Loading Decision

(Continued)

- Heater duration task force evaluated test requirements that would satisfactorily evaluate coupled processes in both *in situ* and prototypic locations
- Task force members included representatives from LLNL, SNL, LANL, and the M&O
- Activities identified modeling and testing needed to support a thermal loading decision

# Evaluation of the Analytical Model

- Task force established to evaluate applicability of Multi-phase hydrothermal codes
- Representatives from LANL, LBL, LLNL, SNL, USGS, and the M&O
- Objectives:
  - Compare code and model conceptualization with other models
  - Review differences in calculation results
  - Develop explanations and consensus
- Status:
  - M&O supplied reference input, including typical spent nuclear fuel characteristics and decay heat
  - LLNL provided code assumptions and user information
  - USGS provided geological data, which has been evaluated
  - Task force has reviewed calculational results

# Laboratory Studies that Support Thermal-Loading Decision

- Small block tests at LLNL evaluate
  - Fracture density and orientation
  - Rock density
  - Effective porosity
  - Moisture content
  - Saturated permeability
  - Submodel validation testing

- Rock thermomechanical evaluations at LLNL and SNL include
  - Development of block stability codes based on commercial computer codes
  - Determination of rock physical properties
  - Determination of rock strength, as a function of temperature

# Laboratory Studies that Support Thermal-Loading Decision

(Continued)

- Other laboratory studies include
  - Corrosion testing
  - Waste-form and C-14 release evaluations
  - Geochemical and mineralogical evaluations
  - Core flow-through integrated testing

# Large Block Tests at Fran Ridge

- **Major objectives:**
  - Evaluate coupled thermal, mechanical, hydrological, and geochemical processes in a large block of tuff
  - Compare pre-test and post-test code calculations
  - Provide an early evaluation of equipment and instrumentation that could be used in the *in situ* heater tests

- **Status:**
  - Study Plan revision underway
  - Scientific Investigation Plan written and reviewed
  - Rock outcropping selected and fracture mapping initiated
  - Job Package for site preparation initiated
  - Test-frame designed and bid process initiated

- **Schedule goal is to initiate thermal testing in mid-1994**

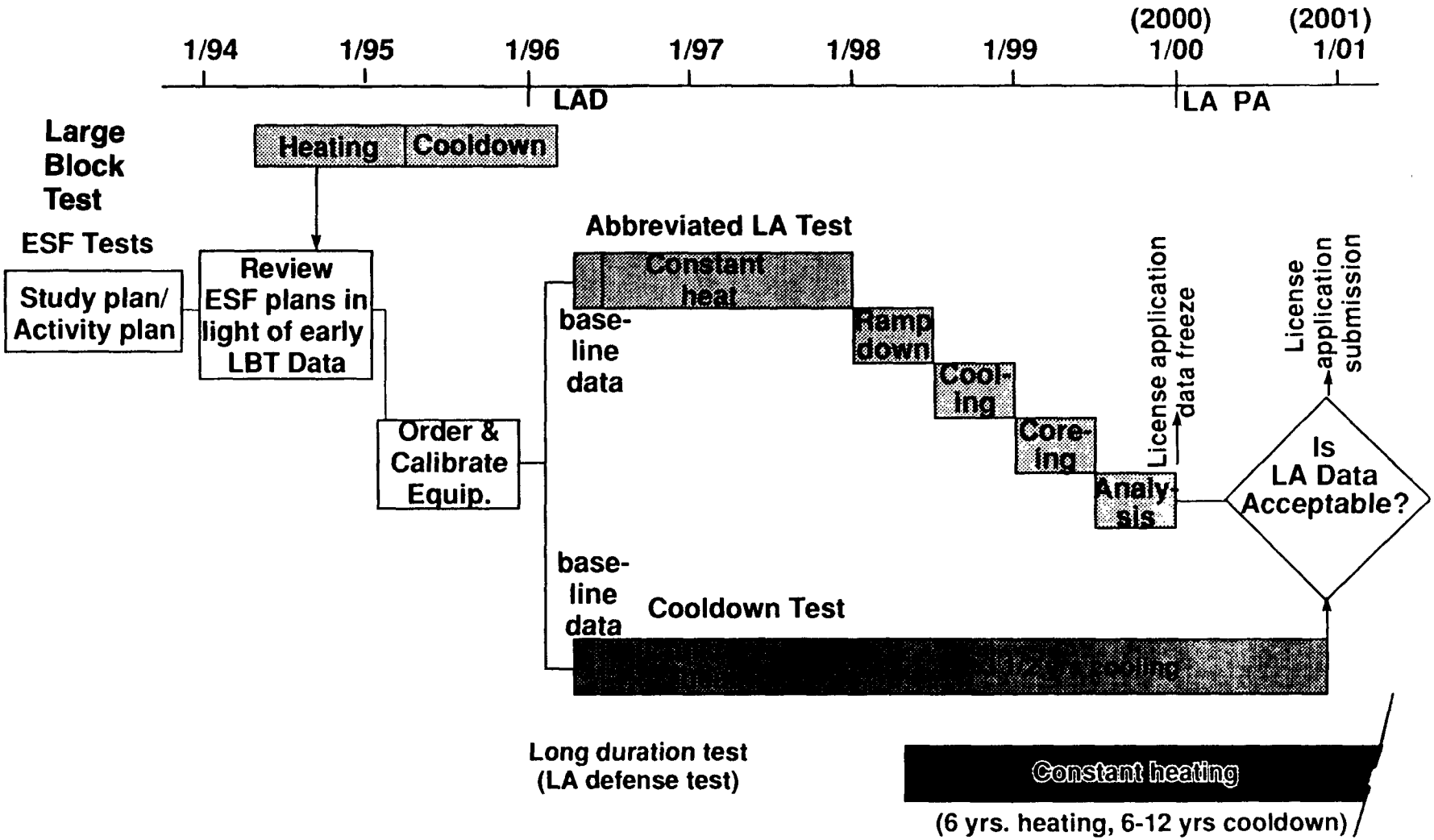
# *In Situ* Heater Testing in Yucca Mountain

- **Major objectives:**
  - Characterize response of Yucca Mountain to emplacement heat
  - Evaluate coupled thermal/mechanical/hydrological/geochemical processes in Yucca Mountain
  - Compare pre-test and post-test code calculations
  - Confirm analytical models

- **Status:**
  - Study plan written and internal review underway
  - Scoping calculations being performed to determine heater output and expected rock dryout volume
  - Test planning provides both short-term and long-term tests to confirm model predictions

- **Schedule goal is to begin abbreviated heater test in June 1996**

# Heater Tests

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# *In Situ* Thermomechanical Testing in Yucca Mountain

- **Major objectives:**
  - Determine rock-mass response to thermal load
  - Determine stability of rock openings under thermal gradients
- **Status:**
  - Study plans written and approved
  - Scoping calculations being performed to determine heater output and expected rock response
- **Schedule goal is to begin thermomechanical test in late 1996**

# Use of New Zealand Natural Analogues in the Thermal-Loading Decision Process

- **Major objectives:**
  - Evaluate "real" sites with active hydrogeochemical processes
  - Evaluate codes and models by comparing simulations to natural occurrences
  - Evaluate performance of various man-made materials

- **Status:**
  - Agreement in place to study the New Zealand Taupo Volcanic Zone geothermal fields
  - Design of studies/experiments underway

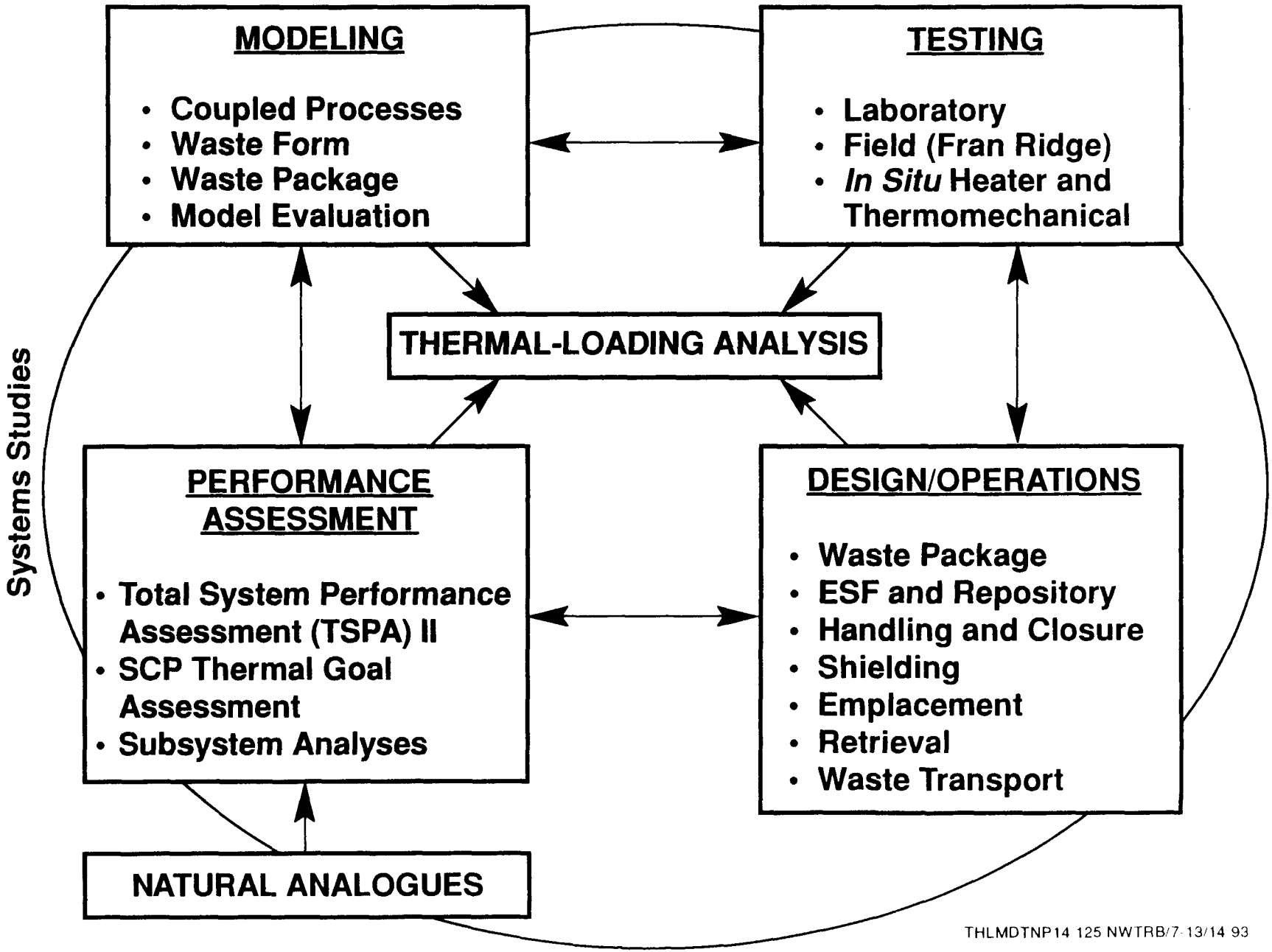
- **Schedule goal is to initiate phase one this year, which deals with observations of mineral assemblages and predicted analyses**

# Use of Other Natural Analogues in the Thermal-Loading Decision Process

- Use of other geothermal systems as natural analogues
  - Several systems have been studied

- Use of Yucca Mountain (YM) as a natural analogue
  - Hydrothermal system existed at YM about 11 million years ago
  - Topopah Spring member alteration may be appropriate analogue
  - Outcrop evaluation planned

# Technical Elements of Thermal Loading

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