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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: SITE INVESTIGATIONS FOR THE REVISED PROGRAM

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AUSTIN, TEXAS
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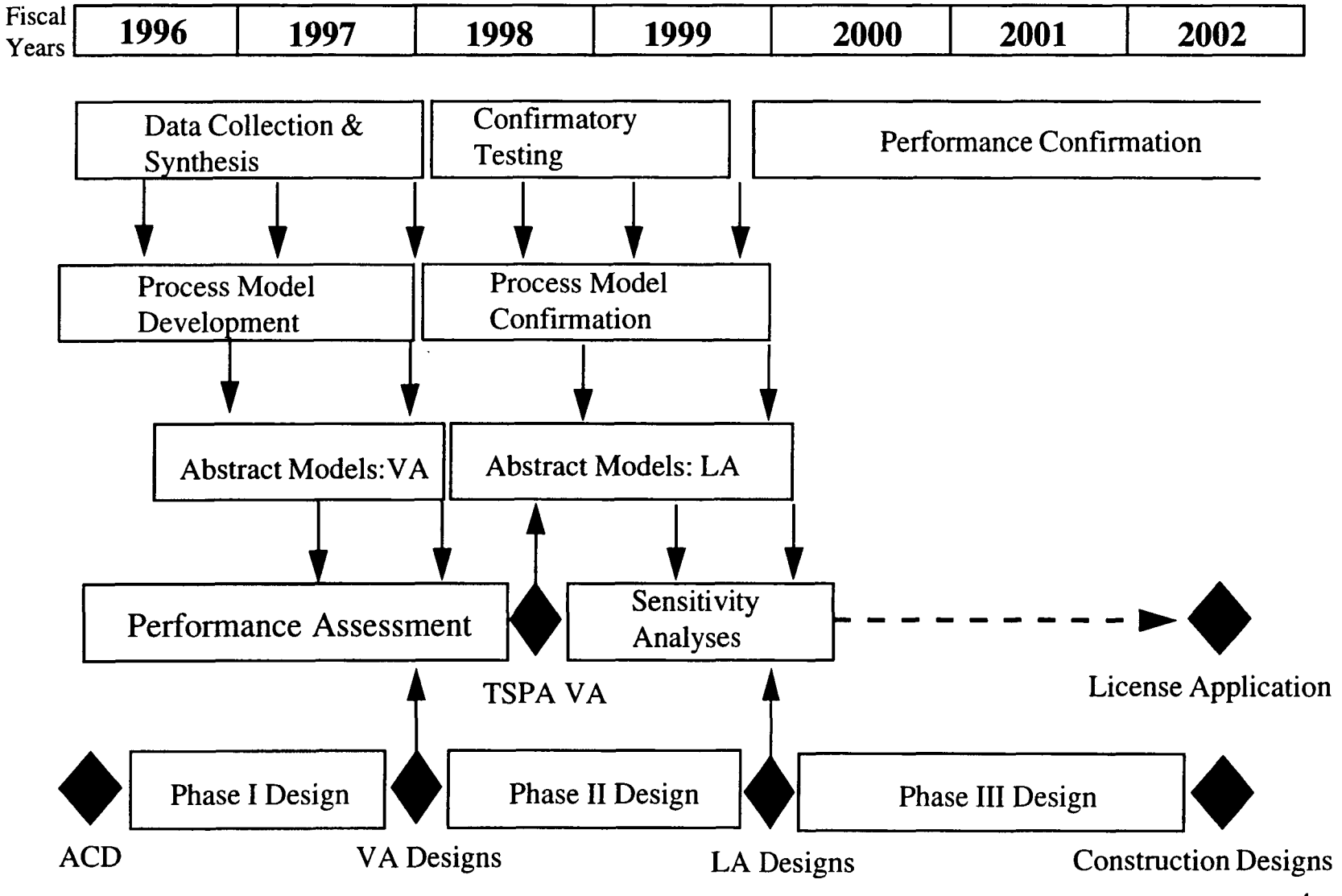
Presentation Outline

- Site investigations strategy
- Key drivers
- Logic ties in revised Program Plan
- Key products

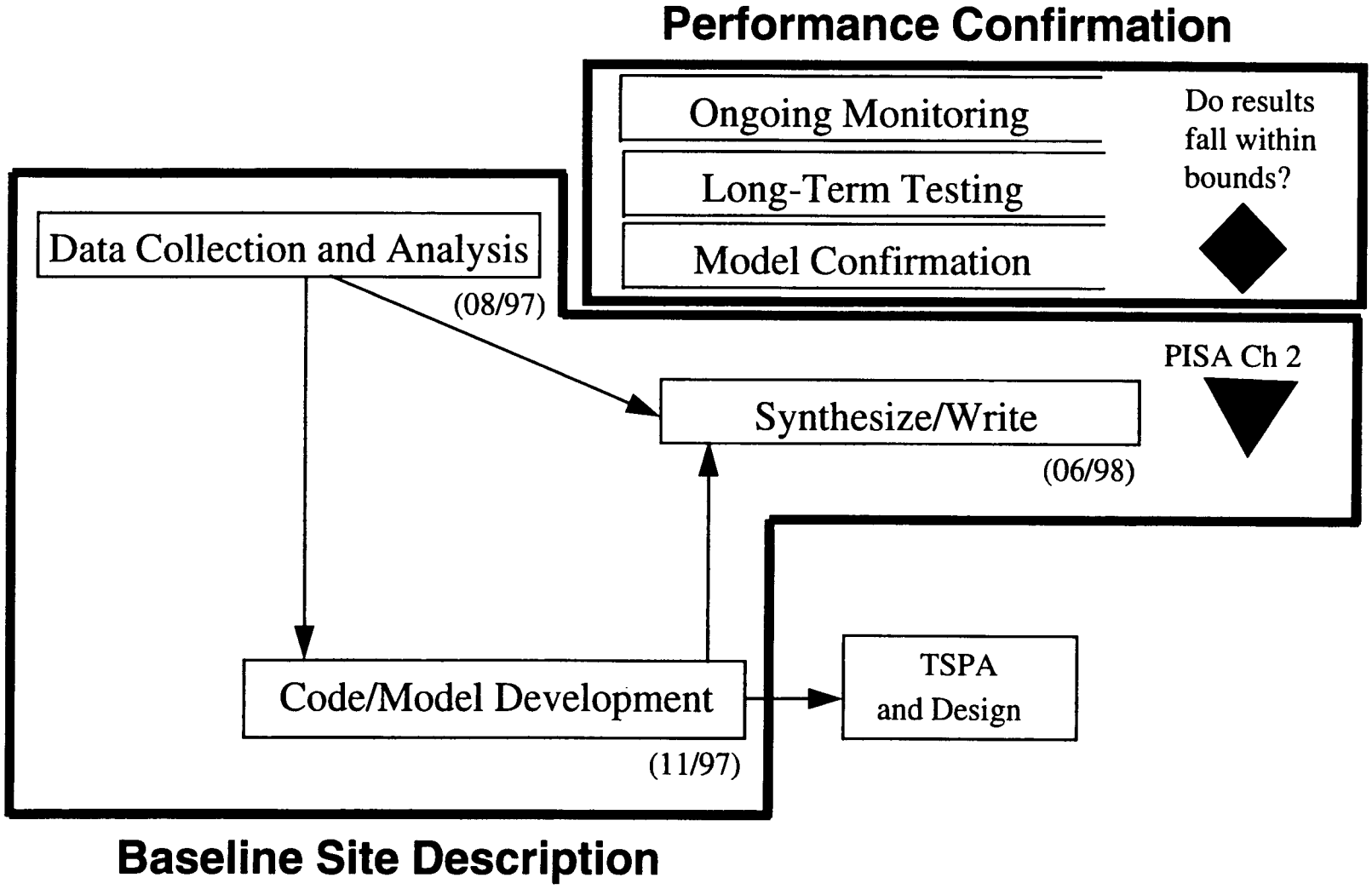
Project Strategy to Streamline and Focus

- Tied revisions of process models to key decision points
- Emphasize data synthesis and documentation of what we've learned to date
- Conduct a smaller, better focused data collection program
- Compile single, common data set
- Use Project Integrated Safety Assessment as a management tool

Integration Through Performance Assessment



Complete Site Characterization and Move Directly to Performance Confirmation

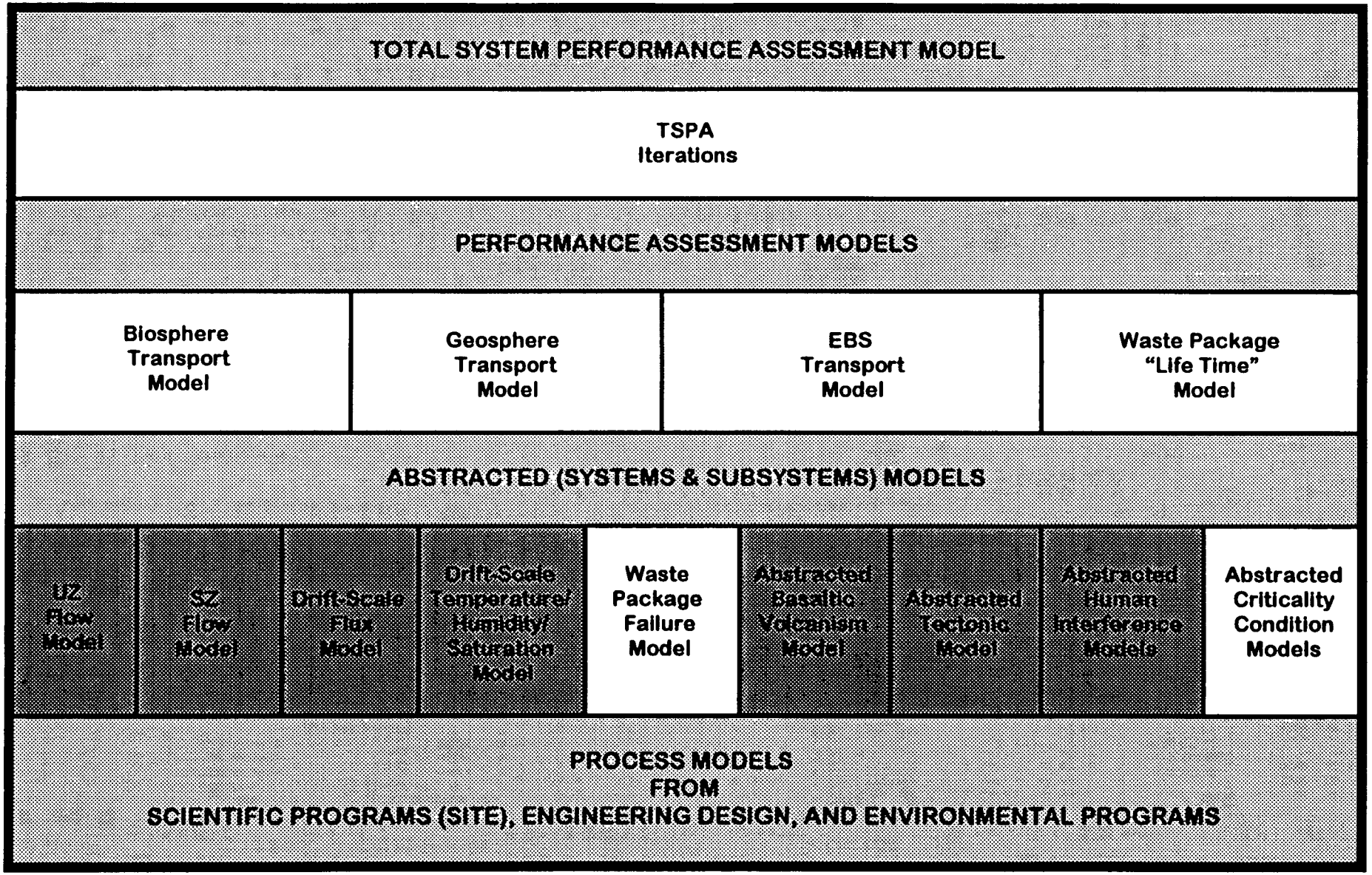


Key Drivers: Waste Containment and Isolation Strategy

- Rate of water seepage into the repository
- Near-field environment conditions for waste package
- Dilution in the groundwater below the repository

Key Drivers: Performance Assessment

- Process models (highlighted on next page)
- TSPA-95 results, summarized as
  - Amount of water present in the natural and engineered systems
  - Magnitude of aqueous flux through these systems


TOTAL SYSTEM PERFORMANCE ASSESSMENT MODEL
TSPA
Iterations
PERFORMANCE ASSESSMENT MODELS
Biosphere Transport Model
Geosphere Transport Model
EBS Transport Model
Waste Package "Life Time" Model
ABSTRACTED (SYSTEMS & SUBSYSTEMS) MODELS
UZ Flow Model
SZ Flow Model
Drift-Scale Flux Model
Drift-Scale Temperature/ Humidity/ Saturation Model
Waste Package Failure Model
Abstracted Basaltic Volcanism Model
Abstracted Tectonic Model
Abstracted Human Interference Models
Abstracted Criticality Condition Models
PROCESS MODELS
FROM
SCIENTIFIC PROGRAMS (SITE), ENGINEERING DESIGN, AND ENVIRONMENTAL PROGRAMS

PROCESS MODELS FROM SCIENTIFIC PROGRAMS (SITE), ENGINEERING DESIGN, AND ENVIRONMENTAL PROGRAMS

Natural System Models	Near-Field Environments Models	Waste Package/ EBS Models			Potentially Disruptive Features, Events, and Processes Models	
		Waste Package Degradation Models	Waste Form Alteration/ Dissolution Models	Waste Package/ EBS Release Models	Basaltic Volcanism Models	Tectonics Models
Geologic (3-D) Framework Models UZ Gaseous Flow Models UZ Aqueous Flow Models UZ Gaseous Transport Models UZ Aqueous Transport Models SZ Flow Models SZ Transport Models Climate Change Models	Repository-Scale T-H Environment Models Drift-Scale T-H Environment Model Repository-Scale T-C Environment Models Drift-Scale T-C Environment Models Effect of Man-Made Materials on T-C Environment Models Effect of Colloid Formation on T-C Environment Models	Corrosion-Resistant Barrier Degradation Models Corrosion-Allowance Barrier Degradation Models Cladding Degradation Models Galvanic Protection Models	Waste Package T-H Environment Models Waste Form Alteration Models Waste Form Dissolution Models	Waste Package Advective/ Diffusive Transport Models EBS Advective/ Diffusive Transport Models EBS Colloidal Transport Models	Recurrence Models Direct Effects Models Indirect Effects Models	Recurrence Models Direct Effects Models Indirect Effects Models
Biosphere Models						

Key Drivers: MGDS Design

- Near-Field Environment Data and Models
  - Relative humidity distribution
  - Changes in permeability of EBS/host rock
  - Changes in H_2O chemistry
  - Thermal effects on hydrology, chemistry, and rock stability
- 3-D Geologic Model
  - Distribution of lithologic and thermomechanical units
- Geological/Geotechnical Data
  - ESF monitoring data
  - Strength data
  - Rock mechanics
- Probabilistic Seismic Hazards Analysis
  - Seismic design inputs
- Unsaturated Zone Moisture Distribution
  - Perched H_2O
  - General moisture distribution

Key Drivers: Environmental Program

- **Saturated Zone Transport Model**
  - **Provides prediction of radionuclide concentration in groundwater at the accessible environment**
  - **Supports biosphere modeling for the EIS**

- **Drift-scale Thermal Model**
  - **Provides temperature perturbations at the earth's surface due to repository thermal loading**
  - **Supports information/data requirements for the EIS**

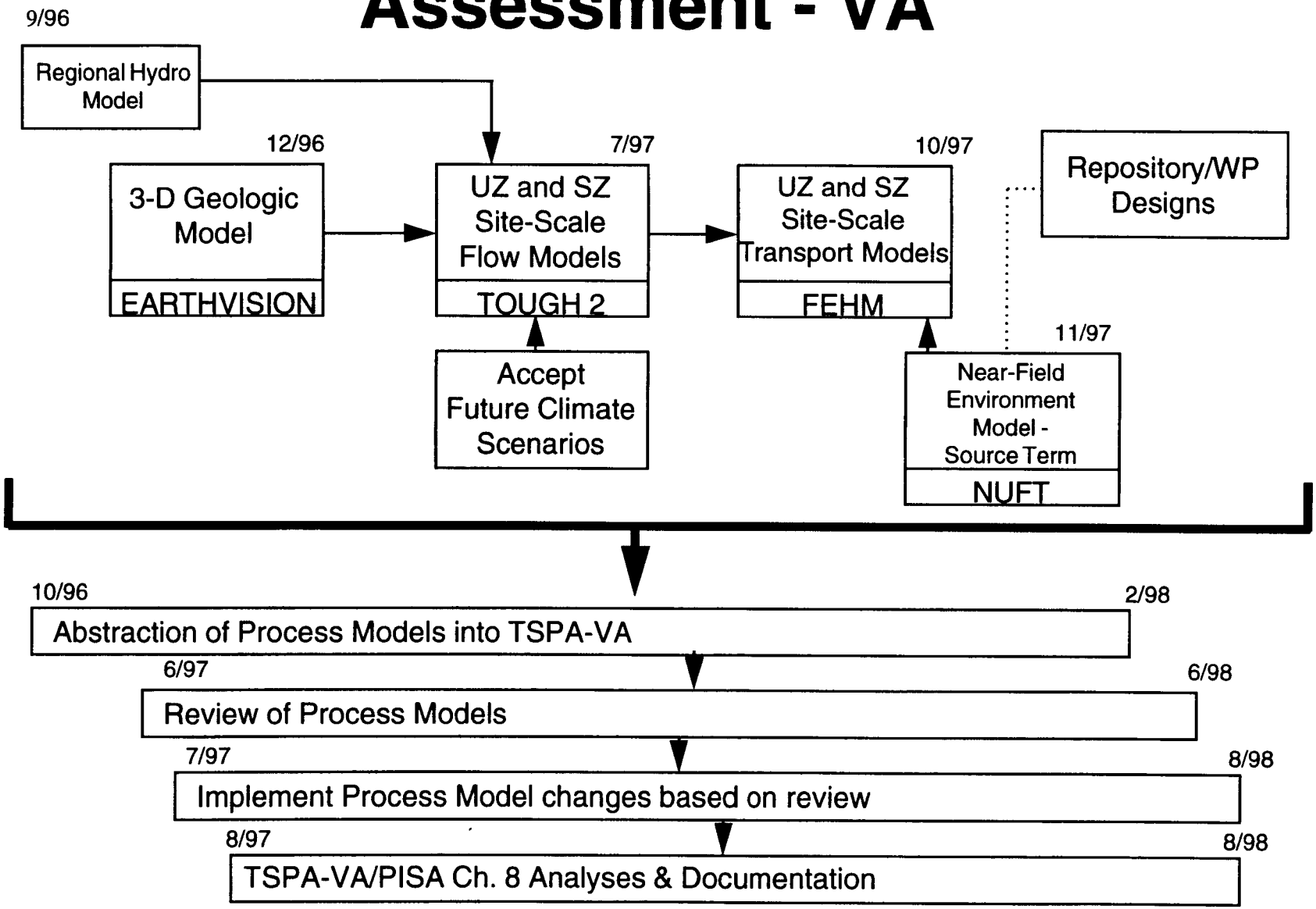
Key Drivers: Within Site Program

- Percolation flux at repository horizon
- Hydrologic properties of major faults
- Saturated zone flow characteristics
- *In situ* thermal tests
- Confirmatory testing for process models

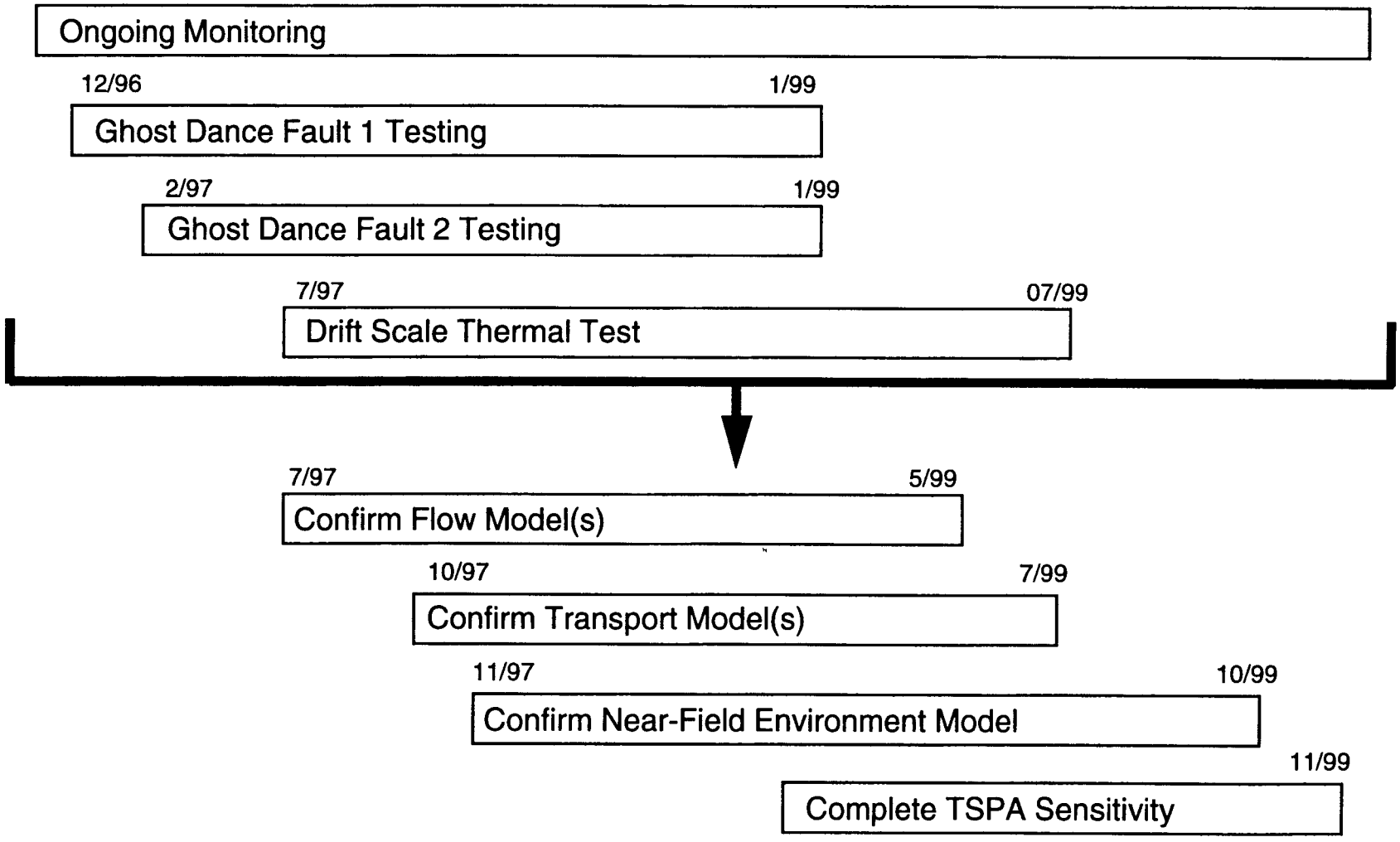
Overview of Testing Program Tied to Needs

Testing Program	WIS	PA	DESIGN	ENV	SITE
In situ thermal testing	X	X	X	X	X
Unsaturated zone flow and transport	X	X	X		X
- water balance in ESF	X	X	X		X
- infiltration data	X	X			X
- isotopic age dating	X	X			X
Saturated zone flow and transport	X	X		X	X
In situ transport tests	X	X			X
Geotechnical monitoring			X		

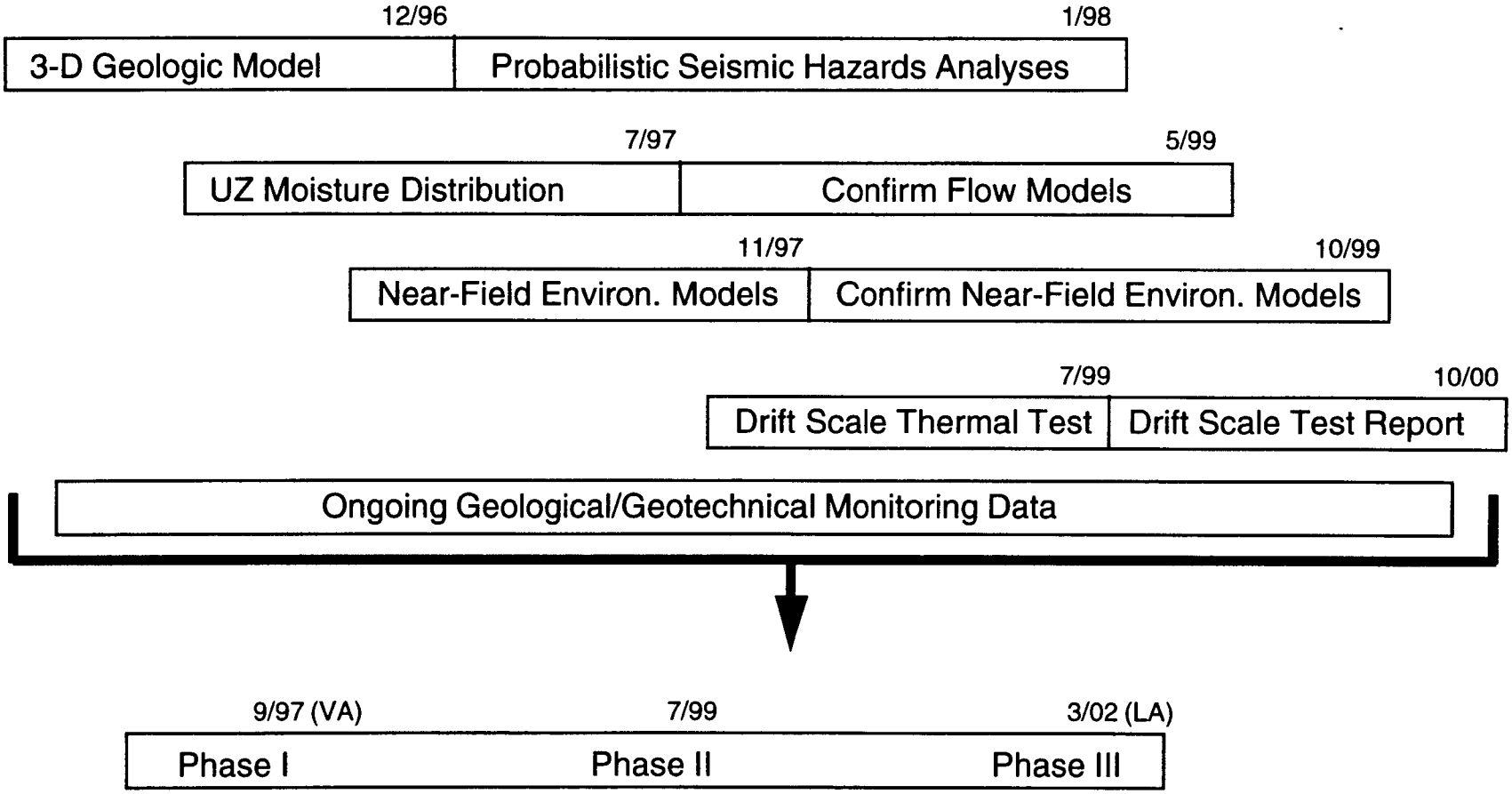
Logic Ties to Performance Assessment - VA



Logic Ties to Performance Assessment - LA



Logic Ties to Design



Key Products

- Synthesis Reports
  - Definition
    - Summary of all data collection and analysis so that results can be assessed with respect to waste isolation strategy
  - Contents
    - Organized by scientific discipline, generally at the SCP Investigation level
    - Full accounting of observations and data collected
    - Interpretation and analysis of data
    - Status of data for viability assessment

Synthesis Reports

- **Generic Contents:**

1.0 Introduction

1.1 Purpose

1.2 Scope

- What does the report cover/present
- What is not covered

1.3 Background

- History of data collection/program

1.4 Quality Assurance

- Treatment of Q vs. non-Q data in the report
- Q-status of software used (if relevant)
- Identify Q-procedures and data sources used in data collection and interpretation

2.0 Text of Report

- Presentation of data followed by conclusions supported or drawn from those data

Synthesis Reports

(Continued)

3.0 State of Knowledge

- Confidence levels of data, models, and conclusions
- Statement of unknowns

4.0 Summary and Conclusions

- Conclusions drawn or repeated

5.0 Reference Cited

6.0 Appendices

- List of Q and non-Q data sources
- Technical procedures applicable to data
- Data appendices
- Other appendices

Key Products

- 3-D framework, flow, transport, and near-field environments models
  - Technical descriptions
  - Comparison of model predictions with observations
  - Alternative conceptual models

Information Provided with Numerical Models

- Goals and objectives
- Technical basis for
  - Processes considered in the model and processes excluded
  - Temporal and spatial scale considered in the model
  - Boundary conditions applied to the model domain
  - Initial conditions applied to the model domain
  - Physical-chemical properties within the model domain
  - Effect of scale within the model domain
- Description of model testing/calibration
- Comparison of model predictions with observations

Information Provided with Numerical Models
(Continued)

- Sensitivity analyses
- Uncertainty analyses
- Alternative models that could explain observations
- Applicability of models and alternatives to making long-term predictions
- Relevant natural analogs

Project Integrated Safety Assessment (PISA)

- The focus of the Project Integrated Safety Assessment is to
  - Describe individual components of the natural system and characteristics of the site, specifically the "controlled area"
  - If conditions outside the controlled area affect waste isolation, then the relevant information will be included

- Technical consolidation of all information relevant to the site description
  - Geologic history of the site
  - Ambient conditions
  - Future variations

Development of the PISA

PROJECT ELEMENT	PISA CHAPTERS
Repository and Waste Package Design and Systems Engineering	3. Design of Structures, Components, Equipment, and Systems **4. Repository Design** 5. Waste Package Design 6. Engineered Barrier Design 9. Radioactive Waste Management 11. Conduct of Operations
Performance Assessment	7. Performance of the Repository Through Permanent Closure **8. Performance of the Repository After Permanent Closure** **12. Accident Analyses**
Core Science	**2. Site Characteristics**
Environment, Safety and Health	10. Radiation Protection

Primary Author
Contributor

PISA Chapter Components

- Geologic system
  - Site geology
  - Regional geology
  - Natural resources
  - Future variation in geologic processes
- Hydrologic system
  - Site water hydrology
  - Regional hydrogeology
  - Site hydrogeology

PISA Chapter Components

(Continued)

- Geochemical system
  - Regional geochemistry
  - Site geochemistry described separately or in conjunction with the geology, hydrology, etc
- Climatological and meteorological systems
  - Present climate and meteorology
  - Paleoclimate
  - Future climate variation
- Integrated natural system response to thermal loading
  - Near-field environment

PISA Chapter Discussions

- **Disruptive process and events in relation to potential impact on the system's ability to isolate waste:**
  - **Tectonics**
  - **Climate change**
  - **Integrated natural system response to the thermal loading (response of the geomechanical, hydrological, and geochemical systems)**
- **Additional discussions:**
  - **Sources of information and collection methods**
  - **Variability/uncertainty in the data; representativeness of the data**
  - **Effects of varying geologic conditions**
  - **Reliability of geological and geophysical interpretations**
  - **Uncertainties associated with the extrapolation of data and information to repository conditions**

PISA Chapter Discussions

(Continued)

- Conceptual models with respect to
  - Uncertainties in the data base
  - Applicability and appropriateness of geologic assumptions
  - Sensitivity of the model results to the uncertainty of the geologic input data
  - Model validation

License Application

- Primary author of Chapter 3, The Natural Systems of the Geologic Setting
- Builds on PISA with performance confirmation results, if needed
- Add 10 CFR Part 60 regulatory discussions

Draft Project Summary Schedule
Key Milestones - Site

	Revised Program Plan	1994 Program Plan
FY96		
Single Heater Test: Installation	Aug 96	Feb 97
FY97		
Initiate Ghost Dance Fault 1 Testing	Sep 96	Jul 96
Initiate Ghost Dance Fault 2 Testing	Feb 97	Nov 96
Single Heater Test: Heat-Up	May 97	--
Initiate Drift Scale Thermal Test	Aug 97	--
FY98		
Single Heater Test: Cool-Down	Mar 98	--
Single Heater Test Final Rpt Acceptance	Jun 98	--

Draft Project Summary Schedule
Key Milestones - Site

FY99	Revised Program Plan	1994 Program Plan
Complete Ghost Dance Fault Testing	Jan 99	FY96/FY99
Complete Solitario Canyon Fault Testing	Jan 99	FY96-FY99
Complete East-West Drift	Apr 99	Sep 98
Confirm Flow Models for LA Acceptance	May 99	Sep 99
Confirm Transport Models for LA Acceptance	Jul 99	Aug 99
Complete Drift Scale Test Heat-Up	Jul 99	--
FY00		
Confirm Near-Field Models for LA Acceptance	Oct 99	Jan 00
FY01		
Drift Scale Heater Test Summary Rpt	Oct 00	--

Scientific Programs Process Models to Performance Assessment

PROCESS MODEL	DATE DUE VA	DATE CONFIRMED LA
Site Hydrologic Models		
- Unsaturated Zone (USGS/LBL)	16 Jul 97	17 May 99
- Saturated Zone (USGS)	16 Jul 97	17 May 99
Site Transport Models		
- Unsaturated Zone (LANL)	08 Oct 97	02 Jul 99
- Saturated Zone (LANL)	08 Oct 97	02 Jul 99
Near-Field Environment Model		
- Transport and Thermohydrology (LLNL)	19 Nov 97	01 Oct 99

Summary

FY96 - FY97

- Complete site characterization for TSPA-VA
- Address critical interfaces with PA, design, EIS
- Initiate thermal testing

FY98 - FY99

- Project Integrated Safety Assessment (PISA)
- Perform confirmation testing and monitoring
- Confirm flow and transport models for LA

FY00 - FY01

- Report thermal testing results to date
- Confirm near-field environment model for LA
- Continue confirmation testing and monitoring
- Preparing the License Application