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

NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: ENGINEERING APPROACH

PRESENTER: RICHARD CRAUN

PRESENTER'S TITLE AND ORGANIZATION: ASSISTANT MANAGER FOR ENGINEERING AND FIELD OPERATIONS
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE
LAS VEGAS, NEVADA

TELEPHONE NUMBER: (702) 794-5429

AUSTIN, TEXAS
APRIL 30 - MAY 1, 1996

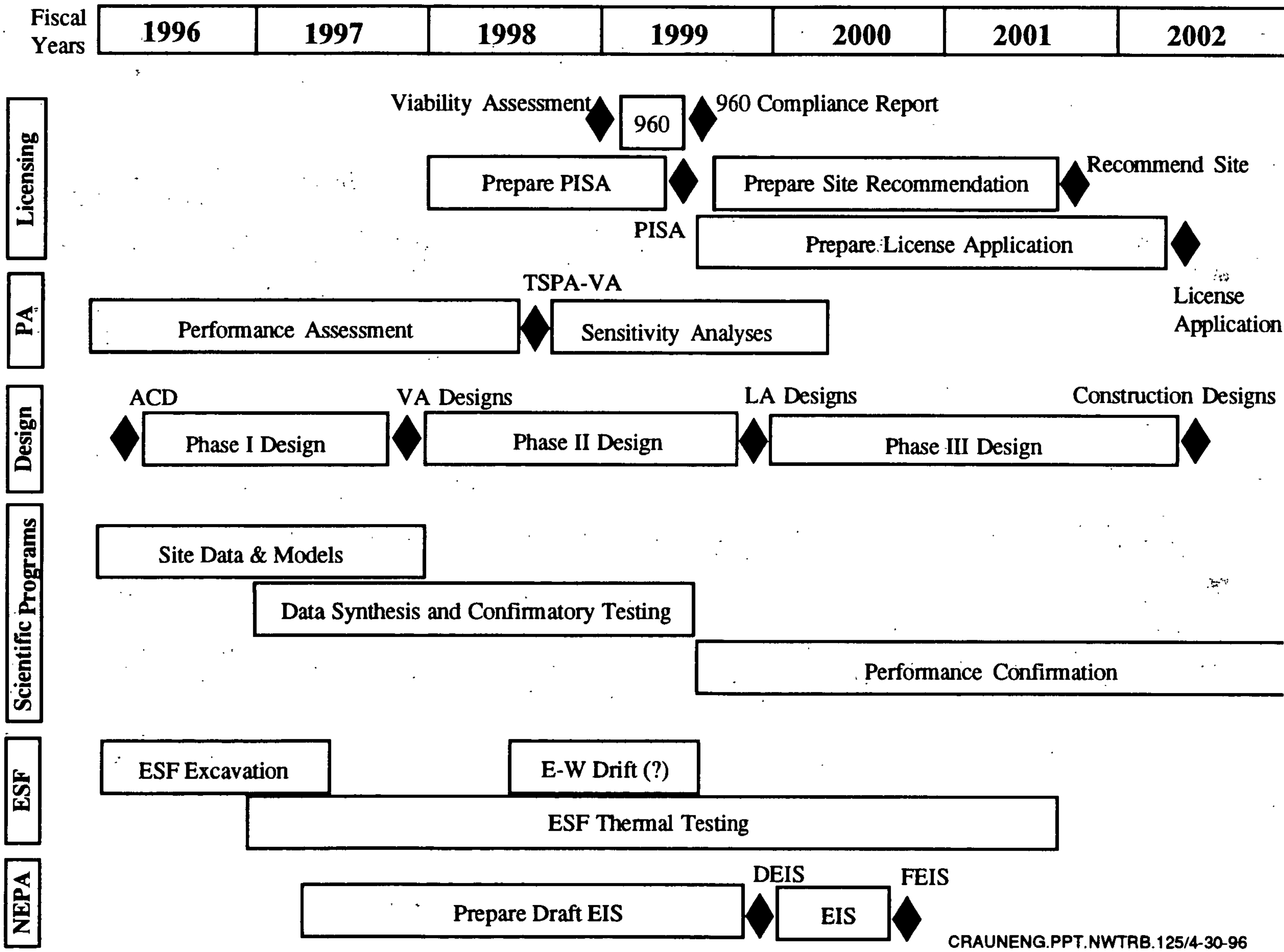
Overview

- Revised Engineering Approach
- Engineering Schedule Overview
- Total System Performance Assessment Model Hierarchy: Key Engineering Models
- Summary of Engineering Integration with Other Project Elements
- Design Detail for Viability Assessment and License Application/Construction

Revised Engineering Approach

- Change in approach represents both scope and Project changes
- Continuous design effort through Viability Assessment and License Application into construction
- Focus on and prioritize design elements important to the Strategy for Evaluating Waste Containment and Isolation and need sequence
- Generation of discrete designs will be used to develop design basis for License Application
- Eliminated major design reports and technical basis reports

Summary Schedule



Design Phase Focus

Phase I

- Items important to waste containment and isolation
- Items important to retrieval
- Other items important to safety without any NRC licensing precedent

Phase II

- Items important to safety with an established NRC licensing precedent

Phase III

- Balance of plant

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

SITE (CORE SCIENCE), DESIGN/ENGINEERING, AND ENVIRONMENTAL PROGRAMS PROCESS MODELS

Natural Barrier System Performance 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 Zone Gaseous Transport Models UZ Aqueous Transport Models SZ Flow Models SZ Transport Models Biosphere 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

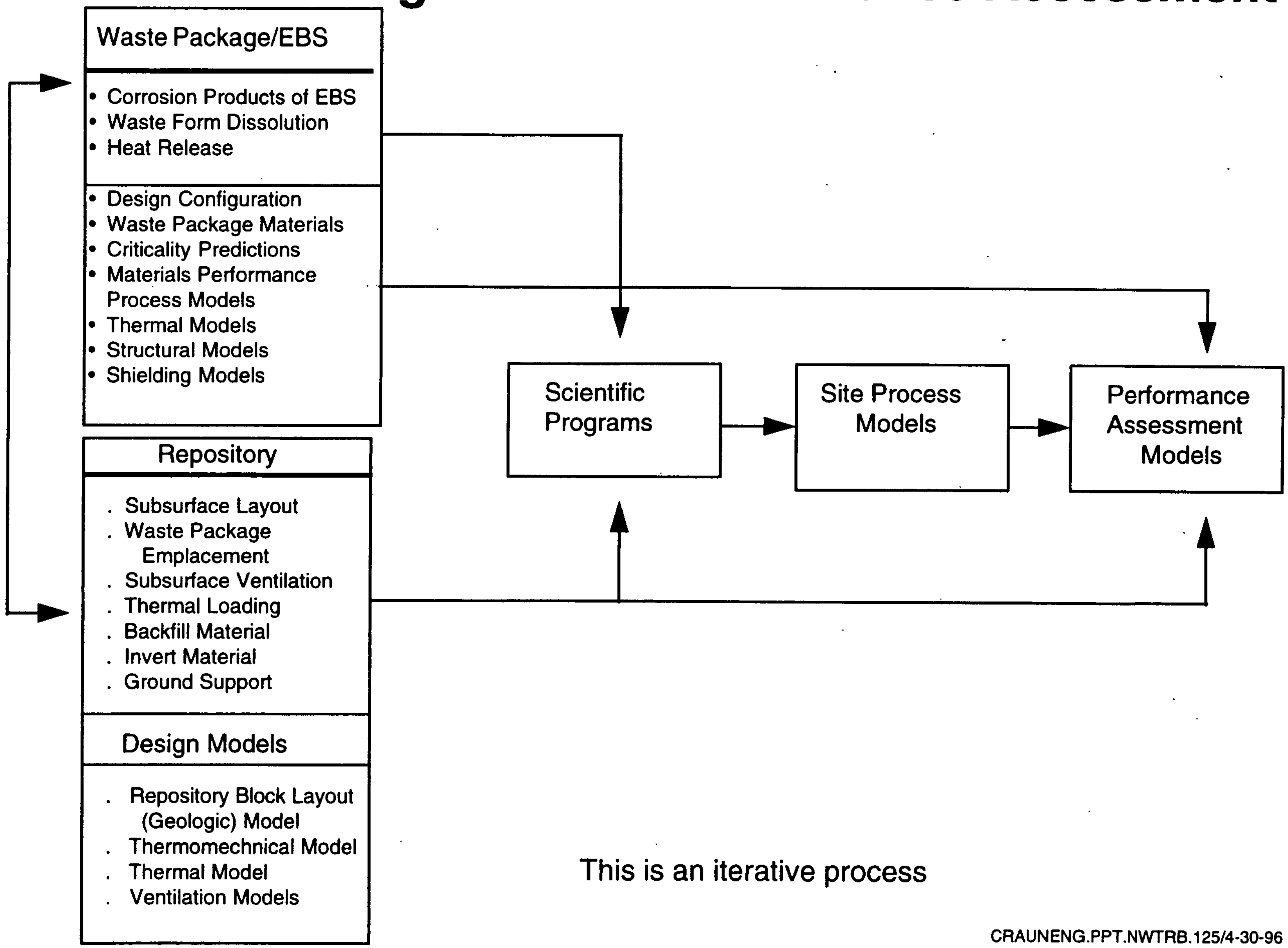
Key Engineering Models Supporting Performance Assessment

Corrosion-Resistant Barrier Degradation Models Corrosion-Allowance Barrier Degradation Models Cladding Degradation Models Galvanic Protection Models	Waste Form Alteration Models Waste Form Dissolution Models

Engineering Program Activities Important to Strategy for Evaluation of Waste Containment and Isolation

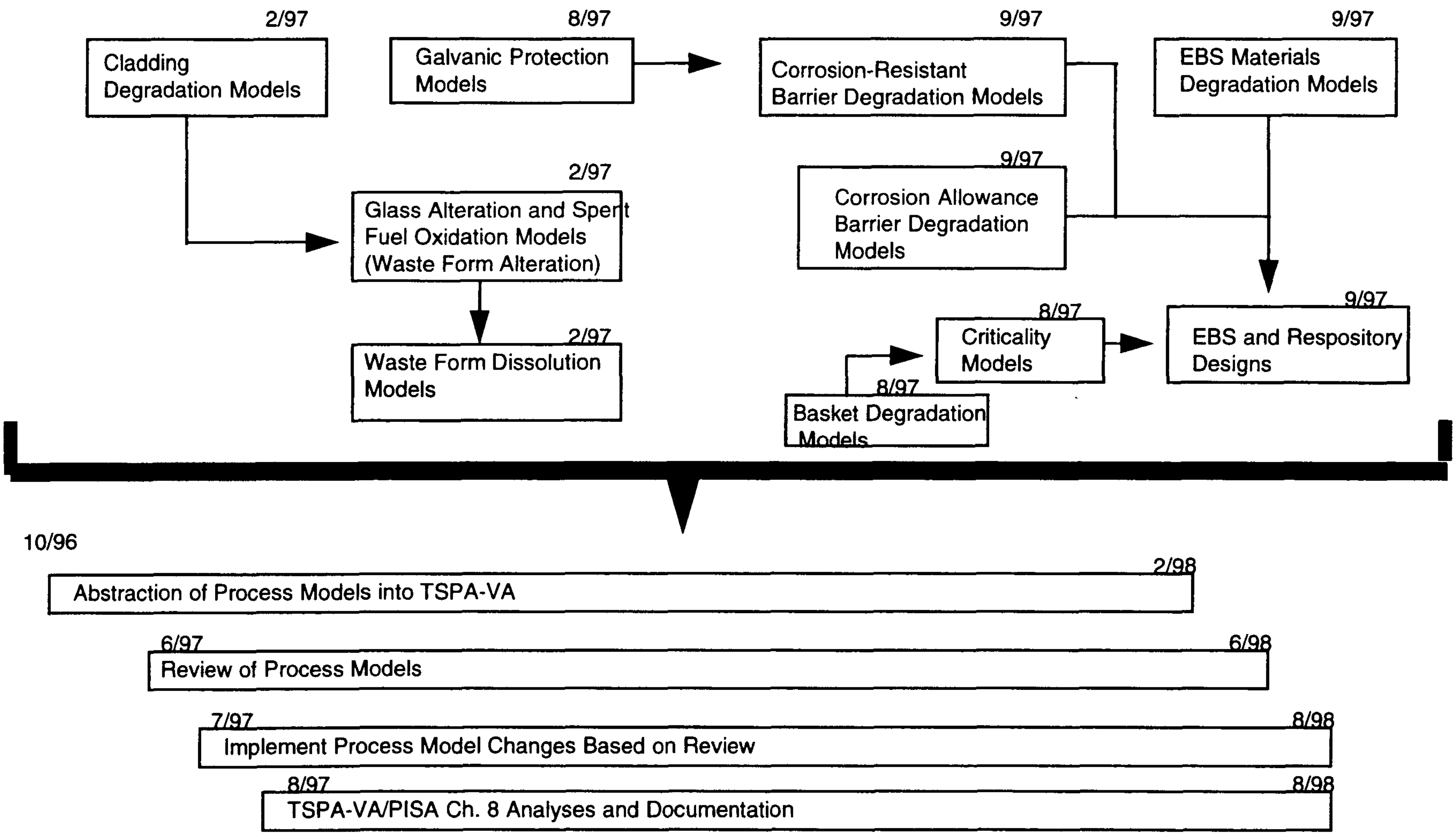
Attribute	Hypothesis	Parameters to be Established/Bounded
Containment	Heat reduces humidity	Thermal behavior of repository and drift-scale engineered systems to determine heat release
Containment	Corrosion rates are negligible at low humidity	Corrosion rates of containment barrier materials as a function of temperature, humidity and surface condition
Containment	Galvanic effects significantly increase containment times	Corrosion rates of inner containment barrier material as influenced by galvanic coupling with outer containment barrier material
Reduced Radionuclide Concentrations in EBS	Engineered barriers have radionuclide depletion and dispersion potential	Radionuclide dispersion (e.g., surface area) characteristics and degradation behavior (e.g., EBS component degradation by-products) of all engineered barrier materials

Engineering Information and Model Inputs to Scientific Programs and Performance Assessment



This is an iterative process

Engineering Interface with Performance Assessment for Viability Assessment



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

Binning Process

- Developed to address need for prioritizing work to complete License Application design
- Start early on tasks that
  - Have longer lead time
  - Higher risk
  - Are more difficult
- Structures, Systems, and Components are assigned to bins based upon safety significance and regulatory precedent
  - Bin 1 is least significant
  - Bin 3 is most significant
- Bins support assignment of work into the appropriate design phases

Binning Process
(continued)

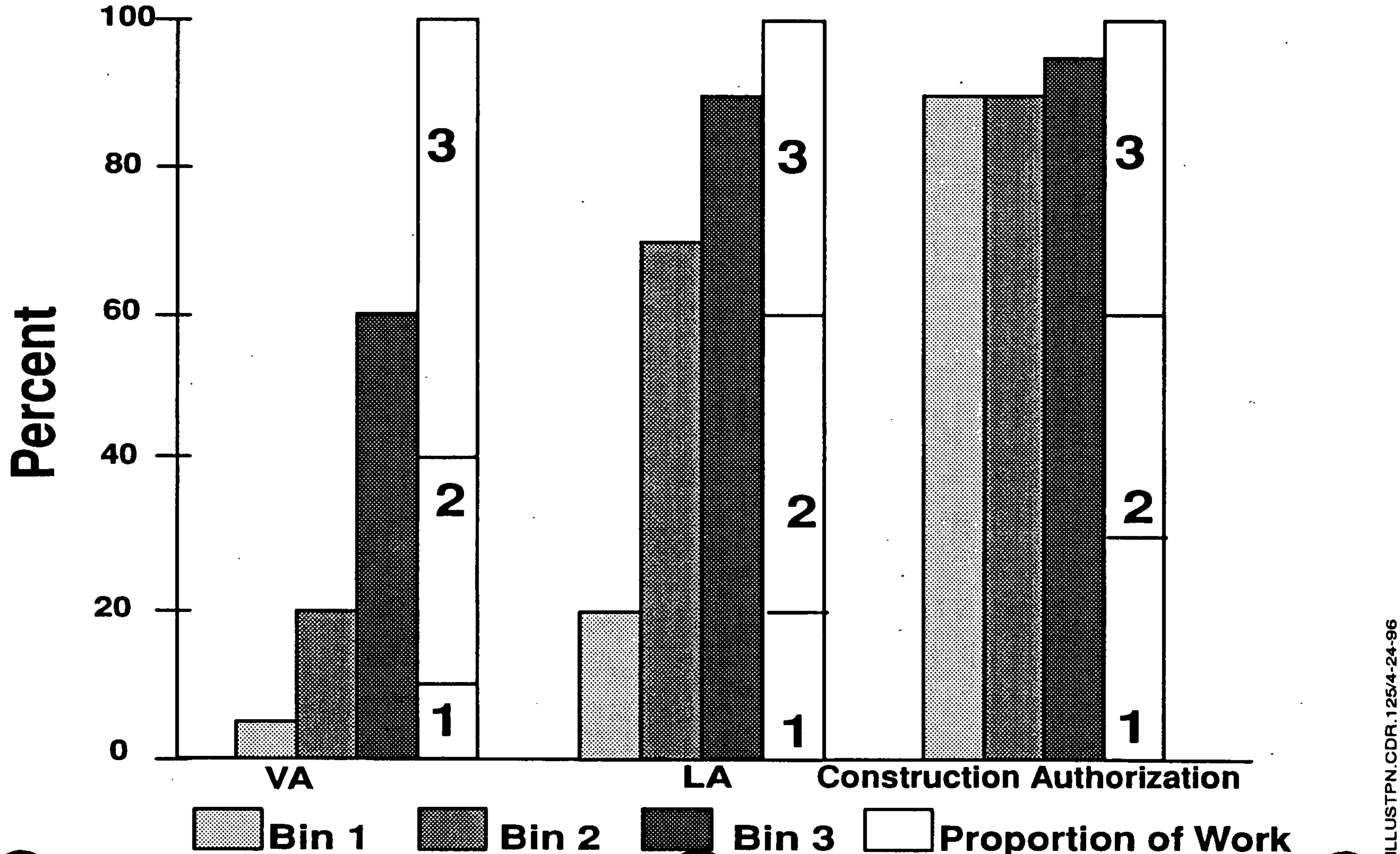
- Focus for License Application design will be on Bin 3 activities, minimal Bin 1 and moderate Bin 2 activities

- Bins do not change the need for completion of work in accordance with design program

Binning Process

- Developed to address need for prioritizing work to complete License Application design
- Start early on tasks that
  - Have longer lead time
  - Higher risk
  - Are more difficult
- Structures, Systems, and Components are assigned to bins based upon safety significance and regulatory precedent
  - Bin 1 is least significant
  - Bin 3 is most significant
- Bins support assignment of work into the appropriate design phases

Comparisons of Binning and Percent Completion Over Time



Level of Design Detail for License Application

- **Bin 1 will be approximately 20% complete:**
  - Conceptual design documents will be started
  - Minimal work on physical design documents and design guides
- **Bin 2 will be approximately 60% complete:**
  - Conceptual design documents will either be completed or in draft
  - Physical design documents will be started
  - Design guides will be draft
- **Bin 3 will be approximately 90% complete:**
  - Conceptual design documents will be completed
  - Physical design documents will be nearly completed
  - Design guides will be completed

Conclusion

- The engineering licensing design basis work scope will be captured in the schedule
- Engineering has to transition to a production mode to develop the licensing design basis documentation
- The interface requirements must be captured in the integrated schedule
- Our short term focus needs to continue to be development of the detailed schedule