NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

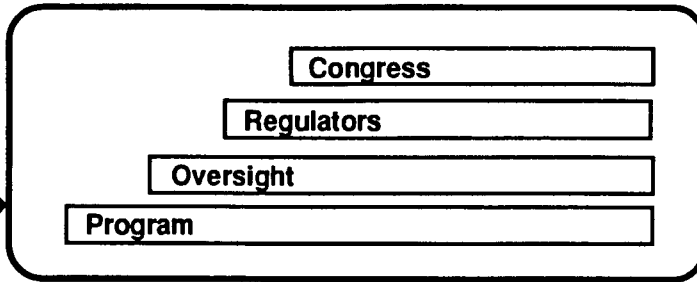**SUBJECT:** **PROJECT IMPLEMENTATION PROCESS: PERFORMANCE ASSESSMENT**

PRESENTER: **DR. ABRAHAM VAN LUIK**

**PRESENTER'S TITLE
AND ORGANIZATION:** **TEAM LEADER, TECHNICAL SYNTHESIS TEAM
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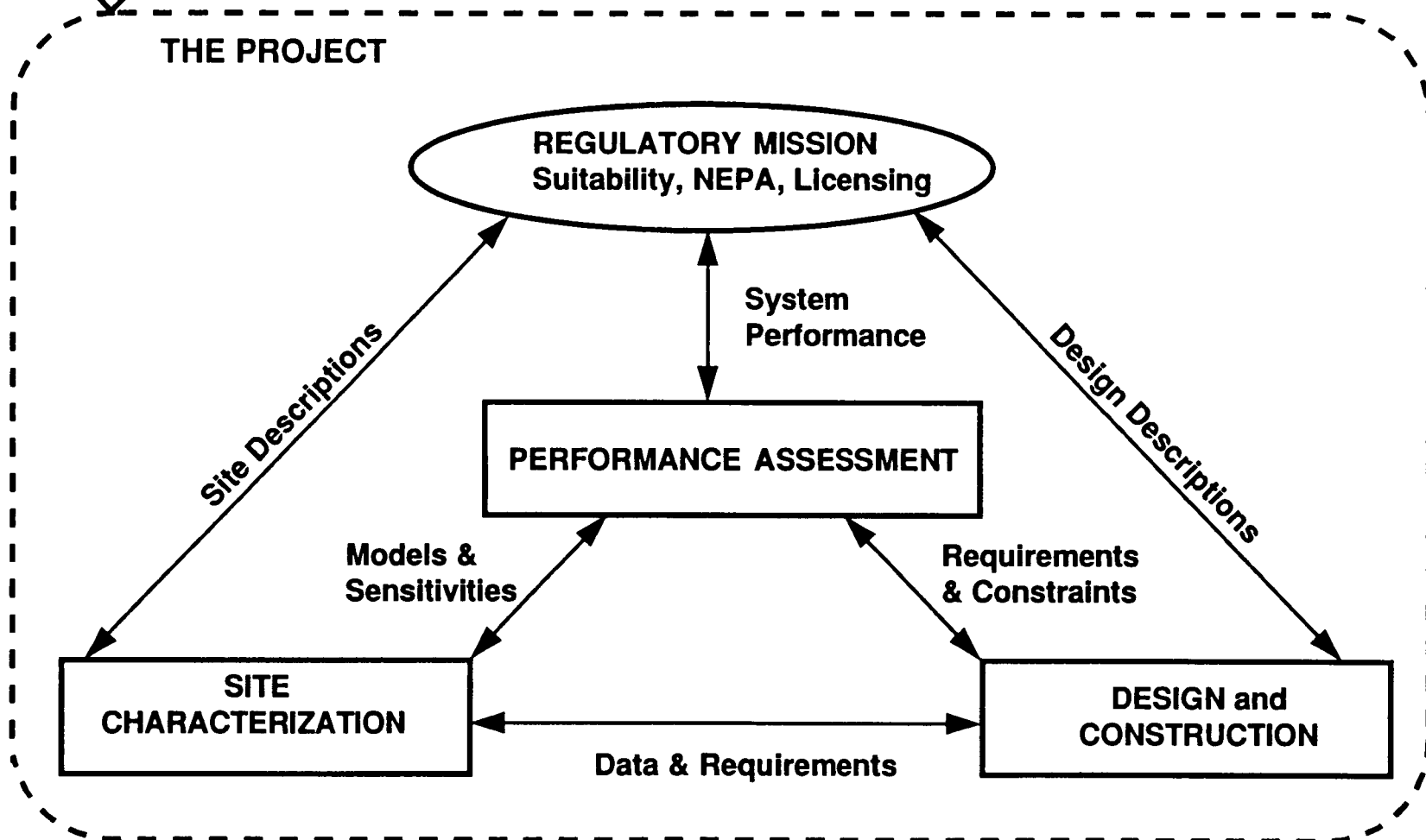
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**AUSTIN, TEXAS
APRIL 30 - MAY 1, 1996**

YUCCA MOUNTAIN INTEGRATED PROJECT MISSION

External

| Congress |
| Regulators |
| Oversight |
| Program |

THE PROJECT

REGULATORY MISSION
Suitability, NEPA, Licensing

Site Descriptions

Design Descriptions

System
Performance

PERFORMANCE ASSESSMENT

Models &
Sensitivities

Requirements
& Constraints

**SITE
CHARACTERIZATION**

**DESIGN and
CONSTRUCTION**

Data & Requirements

Role of Performance Assessment

- Performance assessment integrates scientific, engineering/design and environment information

- One form this integration takes is total system performance assessment (TSPA)

- A TSPA can be used to support decision making, to evaluate regulatory compliance, to optimize the overall system, and to determine where more information may be useful

Planning for TSPA-VA

- The planning for TSPA-VA, illustrated in the morning talk, shows that structural and interactive processes are being defined

- Past experience of using unstructured information exchanges suggested that more structured interactions were needed

- Completion of process-level models and the need to abstract from them forces close and structured cooperation

Experience in the Implementation of PA Recommendations

- Recommendations for site and design were outlined in each of the recent TSPAs (1991, 1993 and 1995)

- TSPA 1995 listed recommendations for more work to be done in site characterization and engineering/design

- TSPA 1995 recommendations to a large extent have been factored into the planning discussed in the first presentation

- Focus here is on TSPA 1993 and the informal way its key recommendations were handled (changes in TSPA 1995 modeling were a direct result)

TSPA 1993 Recommendations and Responses

- The TSPA-93 recommendations were divided into three categories of interest to the site and engineering/design functions:

    - Site data

    - Waste-package data and near-field processes

    - Repository and waste-package design

- Near-field processes are addressed by both the site and engineering functions

TSPA 1993 Site Data Recommendations

- **Search for evidence for flowing fractures at present and in the past**

    - Current effort with dating of samples from the ESF also addresses second recommendation: isotopic dating of fracture coatings and fillings

- **Gas flow (bulk-permeability data are useful for characterizing fractures for water-flow and hydrothermal modeling)**

    - New air-permeability data have been obtained

TSPA 1993 Site Data Recommendations

(Continued)

- **Characterization of percolation flux (now and for future climates)**

  - **A lot of new work: estimates of surface infiltration, climate modeling progress, calcite-opal work to constrain past/present percolation**

- **Amount of dilution in the saturated zone (now and for future climates)**

  - **New data in this area is expected, and there is additional modeling work**

TSPA 1993 Site Data Recommendations

(Continued)

- **Potentially important items were also listed:**
  - **Colloids****
  - **Fracture-matrix coupling**
  - **Persistence of flow paths through time****
  - **Scaling of properties and heterogeneity***
  - **Cross-correlations among parameters***
  - **Hydraulic properties of unsaturated fractures, rock matrix, and faults***

* indicates areas where there has been progress

** indicates areas with current activity

Waste-Package and Near-Field Process Data Needs

- **Integrated testing recommended to aid development of near-field process models**

- **Testing and modeling is either planned or in progress**

Waste-Package and Near-Field Process Data Needs

(Continued)

- Container corrosion, including the transition between non-aqueous and aqueous corrosion and galvanic effects

  - Improved models of these processes were developed for TSPA-95

  - Laboratory experiments are either planned or in progress

- Waste-package chemistry and how it affects solubilities and fuel-alteration rates

  - Being addressed as part of process-level model development

Waste-Package and Near-Field Process Data Needs

(Continued)

- **Repository performance could be improved if**
  - **Container failure could be spread out over time**
  - **Moisture contact could be reduced**
  - **Reducing conditions could be maintained within waste packages**
    - » **These ideas were not new, and the design group has at least considered such concepts**

Waste-Package and Near-Field Process Data Needs

(Continued)

- **Recommendations in the seismic-effects follow-on to TSPA-93 (see "Focus '95" conference proceedings):**

  - **Total system performance not likely to be seriously degraded by seismic effects**

  - **Repository performance might be improved by backfilling drifts**

    » There is a systems study in progress to evaluate EBS enhancements

  - **Amount of rockfall and size of fallen rocks from seismic and thermal-mechanical stresses**

    » Work in progress

Waste-Package and Near-Field Process Data Needs

(Continued)

- ## Recommendations (Continued)

  - Longevity of effective roof support and the threshold value of seismic acceleration that could cause significant damage to drifts

    » Work in progress

  - Changes in fracture and fault apertures due to seismic stresses and on secondary faulting in the region

    » Work in progress

  - Models to predict drift stability, effects of large-scale thermal expansion, container puncture by rockfall, effects of seismic shaking on containers and on hydrology

    » There has been additional work on damage to containers from rockfall and seismic shaking

Summary of Experience with Less Structured TSPA Recommendations

- **Experience suggested a more structured cooperative relationship is needed; it is being planned and implemented**

Guidance Clarified PA Needs for Process-Level Models

- Two preliminary site program process models were reviewed by PA thus far

- Review of first model identified need to specify PA needs and expectations

- A content guide was written and distributed

- Positive feedback from site and engineering program management and modelers

- Joint, structured abstraction program is planned

Expected Outcome of Structured Cooperation in Modeling

- A TSPA-VA that reflects what is in site and engineering process-level models

- A TSPA-VA that is understood and supported by the site and engineering function's management and Principal Investigators

Coordinating and Integrating PA, Engineering, and Site Modeling Work

- Addressing uncertainties and showing applicability of the models is largely a process-level modeler responsibility

- Addressing system-level sensitivities and uncertainties is largely a PA responsibility

- Joint Abstraction Working Groups will ensure that responsibilities are properly shared and addressed in a coordinated fashion