



**Department of Energy**  
Office of Civilian Radioactive Waste Management  
Yucca Mountain Site Characterization Office  
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OVERNIGHT MAIL

JUL 31 1996

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Office of Nuclear Material Safety  
and Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

**TRANSMITTAL OF APPROVED YUCCA MOUNTAIN STUDY PLAN 8.3.1.15.1.7,  
"IN-SITU MECHANICAL PROPERTIES," REVISION 0 (SCP: 8.3.1.15.1.7)**

Enclosed is a controlled copy of Study Plan 8.3.1.15.1.7, Revision 0, prepared by the U.S. Department of Energy (DOE) for the Yucca Mountain, Nevada, site. The study plan numbers correspond to the same numbers used in the Site Characterization Plan (SCP) for the Yucca Mountain, Nevada, site.

Study plans are prepared, reviewed, and approved under Yucca Mountain Site Characterization Office quality assurance procedures. It should be noted that there may be some inconsistencies in the milestone report titles and schedules given in this study plan and those in the SCP. Study plans, in general, represent a further evolution of the study in the areas related to schedules and milestones relative to the SCP and, as such, represent DOE's current plans.

DOE has reviewed the study plan for consistency with the content requirements for study plans, as given in Attachment 1 to the 1993 DOE/U.S. Nuclear Regulatory Commission Level of Detail agreement and review process for study plans. DOE has identified one Site Characterization Analysis open item related to this study plan (comment 56). That comment is addressed in Enclosure 2.

The Document Transmittal/Acknowledgment Record for your controlled copy of the study plan should be signed, dated, and returned to the Document Control Center in Las Vegas, Nevada.

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Complete only applicable items.

DATE  
07/24/96

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## Description of Document(s)

TITLE	DOCUMENT IDENTIFIER	EFFECTIVE DATE	NO. OF SHEETS
8.3.1.15.1.7 Rev. 0 ICN 0  IN SITU MECHANICAL PROPERTIES		07/29/96	79

## Instructions/Remarks

Please incorporate changes required per the instructions  
of this CDI on the effective date noted.

ISSUANCE OF : 8.3.1.15.1.7, REV 0  
IN SITU MECHANICAL PROPERTIES.

\*\*\* NEW ISSUE - NO OBSOLETE MATERIAL \*\*\*

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## Receipt Acknowledgement

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Contact the Document Center staff member named below with any questions regarding these instructions.

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**YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT**

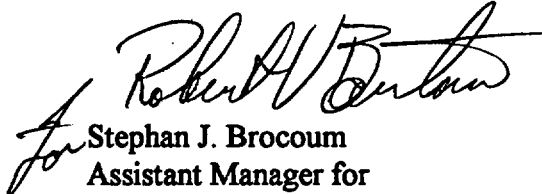
**Study Plan for  
In Situ Mechanical Properties  
SCP Study 8.3.1.15.1.7**

**Principal Investigator: John Pott  
Sandia National Laboratories  
Albuquerque, NM**

**Revision 0  
May 1996**

JUL 31 1996

If you have any questions, please contact Juliana M. Herrington at (702) 794-1312.

  
Stephan J. Brocoum  
Assistant Manager for  
Suitability and Licensing

AMSP:JMH-2022

Enclosures: (NOT RECORDS MATERIAL)

1. Study Plan 8.3.1.15.1.7, Revision 0
2. Resolution of SCA Open Item, Comment 56

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## **Enclosure 2: Resolution of SCA Open Item, Comment 56**

**Comment 56 provided concerns over the strategy for validation of rock-mechanics models. The study plans 8.3.1.15.1.5 "Excavation Investigations", 8.3.1.15.1.6 "In-Situ Thermomechanical Properties", 8.3.1.15.1.7 "In-Situ Mechanical Properties", and 8.3.1.15.1.8 "In-Situ Design Verification" have now been completed. A thorough discussion of the general validation strategy for rock-mechanics models is provided in Study Plan 8.3.1.15.1.6 (Section 3.6). This strategy is consistently used in the other study plans as well (for example see 8.3.1.15.1.7, Section 3.3). The study plans also discuss aspects of the validation process that are specific to the type of tests described in each plan. The general validation strategy calls for specific validation exercises to be developed for each model or set of models. The methods of collection and comparison of data with model predictions will depend on the type of model (empirical, numerical, etc.), scale of application, and level of confidence required. For rock-mass scale models, comparison with in situ data is needed.**

**The design and implementation of field test (the subject of the above noted study plans) has included the model validation process as an integral element. The general process for the validation exercises involves three analysis phases: analysis for design of the test, pre-test analyses, and post-test analyses. The process also includes comparisons of alternative models and modeling approaches to determine which, if any, provide the best results for the particular applications of interest. This process is currently being implemented in the First ESF Thermal Test. Other variations of the process are being implemented for validation of proposed empirical models for the relationships between intact rock properties and rock-mass properties.**

## SCA C 56 (Relates to Study Plan 8.3.1.15.1.7)

Section 8.3.1.15.1 Investigation: Studies to provide the required information for spatial distribution of thermal and mechanical properties, page 8.3.1.15-31.

Section 8.3.5.20 Analytical Techniques Requiring Significant Development.

### COMMENT 56

The validation of models should be a part of the overall test program. It is not clear that these aspects have been addressed by the test program.

### BASIS

o On p. 8.3.1.15-31 (2d paragraph), it is stated that "temperature fields induced during the heater tests will be modeled using numerical techniques, with values for thermal properties being varied until an optimum match of predicted and actual temperatures is obtained." Such an approach does not address the uniqueness of the final set of thermal properties.

o Chapter 6 of the SCP discusses several potential constitutive models and numerical model types to be used for performance assessment and design analysis. However, the discussion does not clearly show how testing will be used to resolve the issue of proper constitutive model and numerical method, and how this testing will feed into design and license application.

o The discussion on validation in Section 8.3.5.20 is general in nature. However, it does discuss two (2) parts to the validation process: "(1) ascertaining when the model has achieved a good representation of the system, and (2) comparing predictive results to appropriate observations and experimental results" (p. 8.3.5.20-8). It is not clear how the second part of the validation procedure will be evaluated.

### RECOMMENDATION

A testing rationale which addresses validation of models should be presented in the study plans.

### RESPONSE

The discussion of model validation is presented in several places in the Site Characterization Plan (SCP); testing related to the validation of rock-mechanics models is discussed in SCP Section 8.3.1.15.1. The U.S. Department of Energy (DOE) recognizes that the details of the validation process are not presented in the brief descriptions of in situ tests in Section 8.3.1.15.1. The Study Plans relating to the in situ tests (studies 8.3.1.15.1.6, 8.3.1.15.1.7, and 8.3.1.15.1.8) will contain additional detail, as was done for the study plan for excavation investigations (8.3.1.15.1.5).

DOE is currently developing a general validation strategy, which will be consistent with the existing SCP and which will be implemented through the Test and Evaluation Plan (see response to comment 1) using the present structure of Study Plans, augmented by procedures regarding data and model evaluation.

### REFERENCES:

DOE (U.S. Department of Energy), 1989. Study Plan 8.3.1.15.1.5, "Study Plan for Excavation Investigations." Yucca Mountain Project Office, Las Vegas, NV.

### NRC EVALUATION OF DOE RESPONSE

DOE refers to discussion of model validation presented in several places in the SCP, and specifically to SCP Section 8.3.1.15.1 for "testing related to the validation of rock-mechanics models." However, it recognizes that the details of the validation process are not presented in the brief descriptions of in situ tests in Section 8.3.1.15.1. DOE states in its

reponse to this comment that additional detail will be provided in the study plans relating to the in situ tests, as was done for the study plans for excavation investigations.

DOE further indicates that it "is currently developing a general validation strategy,... which will be implemented through the Test and Evaluation Plan (see response to Comment 1) using the present structure of study plans, augmented by procedures regarding data and model evaluation."

DOE's response does not address any of the specific concerns that form the basis of Comment 56.

Progress toward closure of Comment 56 will require DOE to submit (1) the study plans relating to the in situ tests cited in the DOE's response, when they become available, and (2) the general validation strategy, to be implemented by DOE in the Test and Evaluation Plan.

The NRC staff considers this comment open.

Validation of models for mechanical and thermal properties.