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Distribution:
Buckley
Tiktinsky
(Return to WM, 623-SS)

ITASCA Consulting Group, Inc.

30 April 1986

John Buckley
U.S. Nuclear Regulatory Commission
Division of Waste Management
Washington, D.C. 20555

"NRC Technical Assistance for Design Reviews"

Dear John:

Enclosed is a draft of the outline for the STP for the BWIP site. I am sending it to you and Dave Tiktinsky to get your comments prior to a complete review within NRC.

I believe our concept of the report is more extensive than your own. We feel the crux of what should come out of it is the NRC position on rationale and strategy—i.e., what type of testing and how much should be performed in a highly-fractured, highly-variable rock like basalt. Also, we feel that the process of modeling (how constitutive properties are defined and how the models are verified) should be explained in detail. Thus, we have included a detailed rationale section which describes the place of geotechnical models in the design and performance assessment process. A description of the role of models and the rationale for their verification is essential, and something which was totally missing from the BWIP test plan.

You will note that the outline is specific to the BWIP site. I see little overlap in this STP to the salt (in particular) and tuff sites, with the exception of general portions of the rationale. This is because the concerns at each site are very different, at least between the salt and hard rock sites. It is my feeling that one STP for all sites would consequently have to be very vague and general—something which we were hoping to avoid here.

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P.O. Box 14806 • Minneapolis, Minnesota 55414 • (612) 623-9599

Please note that Adrian is in Chile until 16 May and has not seen this but, because the schedule is tight, I wanted to get things rolling. A two-day meeting should be arranged to discuss the outline as soon as possible after Adrian's return. Please let me know your comments as soon as possible.

Thank you,

Mark

Mark Board

cc: D. Tiktinsky

encl.
mb/ks

OUTLINE FOR SITE TECHNICAL POSITION

FOR IN-SITU TESTING AT THE HANFORD SITE

I. INTRODUCTION (1 page)

A. Follow on to GTP

B. Provide Site Specific Guidance Regarding NRC's View of Test Needs at the Hanford Site

II. REVIEW OF THE REGULATORY BACKGROUND (2 pages)

A. Review of Applicable Laws, Standards Intent

B. NWPA, 1982

C. 10CFR Part 60

III. THE BWIP SITE (7-10 pages)

A. Location

B. General Geology of Site

C. Grande Ronde Flow System

1. thickness
2. lateral variability
3. dip

D. Reference Repository Location/Cohassett Flow

1. thickness
2. stress state
3. variability

E. Shaft Sinking

1. location
2. method
3. studies

IV. RATIONALE AND TEST DATA NEEDS (10-15 pages)

A. Repository Design and Performance Assessment Processes

1. A Scenario for Repository Performance in Basalt

a. excavation, mining-induced stress, rock mass yield, and dilation

b. fuel loading during operational and retrieval period/near-field phenomena

c. backfilling

d. closure/far-field phenomena

2. Respository Design Process

a. flow chart illustrating determination of structural repository design, allowable gross thermal load

b. definition of design objectives and criteria

c. the use of empirical and numerical design models—a modeling strategy

d. the role of geomechanics in design

3. Performance Assessment Process

a. flow chart illustrating the use of models in performance assessment and relationship of design to performance assessment

b. description of the long-term coupled processes, regional scale models

c. the role of geomechanics in performance assessment

IV. RATIONALE AND TEST DATA NEEDS (continued)

B. Enumeration of Geomechanical Information Needs for Engineering Shaft Facility

1. geotechnical characterization

   i. in-situ state of stress

   ii. lateral variability of basalt flows (presence of intraflow structures)

   iii. vertical variability of basalt flows

2. demonstration of constructability of underground galleries through highly variable ground conditions (includes documentation of presence and amount of groundwater inflow, methane drainage, and rock bursting); documentation of stability of openings and extent of yield of the rock mass

3. demonstration of ability to construct stable waste emplacement boreholes using the present conceptual horizontal scheme

4. demonstration of emplacement hole stability under thermal stresses from waste loading

5. determination of a thermomechanical constitutive model and constitutive properties for jointed basalt in the various ground conditions encountered in the repository development (the model must have the ability to represent the yield behavior of the rock mass); demonstration of an understanding of the thermal and mechanical behavior of the rock rather than merely a curve-fitting exercise

6. demonstration that numerical (or other) models using the above (e) constitutive relations can predict the range of behavior exhibited by the rock mass in the ES facility; definition of the conservatism inherent in the modeling approach

7. determination of the extent and hydromechanical character of the disturbed zone; determination of the need for detailed definition of coupling (hydrologic-heat-mechanical) phenomena in performance assessment

V. TESTING STRATEGY (5 pages)

A. Strategy for Resolution of Information Needs By In-Situ Characterization and Testing

1. "representativeness" of in-situ testing in basalt

a. variability of basalt

b. scale effects — concept of continuum vs discontinuum approach to constitutive model development

c. effects of anisotropy

d. determination of how many tests must be conducted and at what scale

2. measurement of the large scale or "integrated" response of the rock mass

Discuss the idea that the basalt flows are highly variable in nature, both laterally and vertically. It makes little sense to attempt to measure point rock properties using techniques which compress only the damaged skin of the opening because they will not likely represent the rock mass as a whole. A better approach is to measure the "integrated" response of the rock mass resulting from single and multiple excavation in the widest possible range of the ground conditions to be encountered. This is supplemented by a few "key" tests to help better define constitutive properties and thermal and coupling effects on the rock mass.

Discuss the strategy for definition of a set of numerical models to be used in design and risk assessment. Discuss the instrumentation of excavation and field testing as a means of providing proper constitutive laws and properties as well as a method of providing for code verification. We wish to emphasize the importance of the practical demonstration of the ability to excavate stable openings in the basalt and that, as greater experience is gained in more types of ground, we will gain greater confidence in the ability to predict rock mass response with models.

V. TESTING STRATEGY (continued)

B. Components of Geomechanics Testing Plan

1. site characterization, exploration, quantification of flow variability

2. examination of single excavation response, assessment of stability

3. quantification of thermomechanical constitutive behavior of basalt

4. examination of multiple excavation response, yield behavior, disturbed zone formation

5. model verification, determination of conservatism of model approach

VI. DESCRIPTION OF TEST PLANS (20 pages)

A. Shaft Response

1. pore pressure monitoring behind liner

2. liner stress change

3. liner closure measurement

4. liner sealing and disturbed zone

B. Site Characterization, Exploration

1. outline of exploration drifting and drilling

2. construction monitoring

a. drilling, blasting
b. methane, water inflow
c. air temperature, humidity
d. diamond drilling

VI. DESCRIPTION OF TEST PLANS (continued)

B. Site Characterization, Exploration (continued)

3. geotechnical mapping

a. geotechnical classification, development of an engineering basis for classifying rock mass response and support performance

b. data base management

4. in-situ stress measurement

5. geophysical logging

C. Excavation Response Monitoring Under Variable Rock Mass Conditions

1. introduction (reiterate the idea of "integrated" rock mass response through measurement of closure, displacement)

2. instrumentation

a. closure measurement
b. extensometry
c. borescope
d. acoustic emission
e. time domain reflectometry
f. support effectiveness

3. empirical, numerical modeling of excavation response; comparison to field data, establishing conservative bounds

D. Multiple Excavation Response and Stability

1. Introduction (excavation of full-sized panel with pillar to evaluate rock mass stability under simulated conditions)

VI. DESCRIPTION OF TEST PLANS (continued)

D. Multiple Excavation Response and Stability (continued)

2. excavation plan

a. two parallel openings, driven one at a time by heading and bench

b. instrumentation from first drift to monitor second

i. primarily multi-point extensometer and closure

ii. possible stress gauges

iii. acoustic emission

c. disturbed zone determination (using above instrumentation)

d. numerical model comparison

i. use in constitutive law development

ii. verification of numerical models

aa. continuum approach
bb. discrete approach

E. Borehole Stability

1. introduction (discuss ideas of retrievability and need to demonstrate borehole stability under thermal gradients in excess of those expected in the repository)

2. drilling of heater boreholes (monitoring)

VI. DESCRIPTION OF TEST PLANS (continued)

E. Borehole Stability (continued)

3. heater testing

a. concept of multiple heaters in horizontal emplacement made in pillar after mine-by

b. use bulk of previous mine-by instrumentation to monitor thermal and mechanical response

c. other instrumentation

i. borescope
ii. acoustic emission

d. numerical model comparison

F. Constitutive Model Development/Validation of Numerical Models

1. introduction

2. process of constitutive model development

a. flow chart illustrating process of lab data and field data to develop a material model for basalt

b. lab testing

c. NSTF testing

d. thermo-mechanical response from heated flat-jack test

3. model verification

a. flow chart to show verification process

b. using constitutive model, examination of thermomechanical response of excavations, refining code as necessary

VI. DESCRIPTION OF TEXT PLANS (continued)

F. Constitutive Model Development/Validation of Numerical Models (continued)

4. from excavation monitoring, define level of variability in input properties required to conservatively model the actual response (Does the constitutive model account for major response mode of the excavations?); define, to the best ability possible, the confidence and conservatism of the modeling approach

VII. CONTINUATION OF TESTING AND MONITORING DURING REPOSITORY DEVELOPMENT (2 pages)

A. Short Discussion on Continuation of Excavation and Support Modeling During Repository Development and Waste Emplacement

B. Continue Comparison to Model Results and Assurance of Model Conservatism

VIII. SCHEDULE (1 page)

Illustrate how data feeds into license application and construction authorization.

IX. CONCLUDING REMARKS (2 PAGES)

X. APPENDICES (5 pages)

A. Example Model of Multiple Excavations to Illustrate Rock Mass Yield and Formation of the Distrubed Rock Zone

B. Model of Multiple Excavation Mine-by Illustrating Stress and Displacement Change

FROM	DATE OF DOCUMENT	DATE RECEIVED	NO
ITASCA	4/30/86	5 '86	WM-86419

LTR	MEMO	REPORT	OTHER
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TO: JBuckley

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ACTION NECESSARY	☒	CONCURRENCE	☐	DATE ANSWERED
NO ACTION NECESSARY	☐	COMMENT	☐	BY 5/12

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Draft outline for STP BWIp site

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JGreeves	5/5		
JBuckley			

ENCLOSURES

Cancelled
No response required
5/8

REMARKS

U. S. NUCLEAR REGULATORY COMMISSION

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