WM DOCKET CONTROL CENTER

'86 AUG -7 P2:12

ITASCA
Consulting Group, Inc.

August 4, 1986

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

Dear John:

Enclosed is a draft outline which Loren and I have developed for the 4 day (±) rock mechanics course to be held at Silver Spring in September. We plan on using as many demonstration tools as possible, such as slides, samples of instrumentation, and numerical exercises on the PC to avoid boredom. The outline is developed from the broad theme of Geotechnical Engineering in the Repository Design and Performance Assessment Process. This is used to narrow the focus a bit so that the topics should be of interest to everyone.

We need you to look at this and make suggestions. Please add things you feel are left out and indicate which areas you feel should be discussed in detail and which in a general fashion. Also, please give us some guidance as to what constitutes "detail". We plan on discussing principals and practical aspects only, and not to spend time on the mathematics or theory unless desired. Can you please send us one reply fairly soon so we can begin planning the course? Thanks.

Regards,

Mark

Mark Board

MB/LG
Enclosures

WM-RES
WM Record File
D1016
ITASCA

WM Project 10, 11, 16
Docket No.
PDR ✓
LPDR B, N, S

Distribution:
Buckley
Tikinsky
Joan - ticket
(Return to WM, 623-SS)

8609090123 860804
PDR WMRES EECITAS
D-1016 PDR

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

3285

# GEOMECHANICS IN REPOSITORY DESIGN, PERFORMANCE ASSESSMENT AND SITE CHARACTERIZATION

I. OVERVIEW OF REPOSITORY DESIGN AND PERFORMANCE ASSESSMENT PROCESS; THE ROLE OF GEOMECHANICS IN SITE CHARACTERIZATION

II. REVIEW OF ROCK MECHANICS PRINCIPLES

A. Rock Mass Deformability and Strength

1. <u>intact rock, general stress-strain curve</u>

   (a) constitutive laws
   (b) meaning of properties
   (c) strength/creep/laboratory techniques

2. <u>joints</u>

   (a) stress-strain behavior, properties, etc.
   (b) laboratory techniques

3. <u>rock mass deformability</u>

   (a) concept of size effect

   (b) combination of joints and intact rock

   (c) concept of equivalent continuum (review of Singh's approach to calculating equivalent moduli)

4. <u>rock mass strength</u>

   (a) meaning of rock strength (a discussion of modes of failure in jointed and viscous rock masses

   (b) yield criteria

      (i) Mohr Coulomb

      (ii) von Mises

      (iii) Hoek and Brown

      (iv) cap models

      (v) viscosity (power laws, visco-elasticity, visco-plasticity)

(c) size effect on strength (empirical relations from pillar and lab)

(d) practical demonstration of determination of opening stability by analytic means

B. Thermal Behavior

1. thermal conductivity and specific heat lab techniques/temperature and stress dependence

2. thermal expansion/lab techniques/temperature and stress dependence

3. creep — effects of temperature

III. METHODS FOR DESIGN AND ANALYSIS

A. General Philosophy on Rock Mechanics Design (use of analytic, numerical and empirical techniques)

B. Discussion of Methods

1. analytic techniques

(a) closed-form solutions for mechanical and thermal applications (useful solutions and when, and how to use them)

(b) pillar design formulae

(c) ground reaction curves

2. numerical techniques

(a) introductory remarks (role of modeling in repository design and performance assessment)

(b) types of numerical methods (where best applied, coupling phenomena, advantages/disadvantages)

(c) demonstration of MUDEC and FLAC, possibly for problem of size effect

(d) current DOE approach to modeling at various sites—i.e., current state-of-the-art (problems, limitations)

(e) strategies for validation and verification (what constitutes a qualified model)

3. empirical techniques

(a) rock support design methods (Barton, Bieniawski

(b) opening design (Hoek and Brown)

IV. GEOTECHNICAL SITE CHARACTERIZATION

A. Introduction (Geomechanics in the Site Characterizatin Process)

B. Site Exploration

1. in-situ stress measurement (different methods/ limitations)

2. drilling (methods, geotechnical core logging)

C. In-Situ Testing/Construction Monitoring

1. philosophy on in-situ testing (its role in providing rock mass behavior and model validation)

2. general forms of in-situ testing

(a) construction monitoring

(b) rock mass properties determination

(c) thermomechanical (small scale)

(d) large-scale excavation response/full-scale simulation

3. <u>representativeness of testing</u>

   (a) geologic variability
   (b) scale effects
   (c) excavation influence
   (d) anisotropy
   (e) boundary conditions

4. <u>testing methods</u>

   (a) instrumentation

      (i) instrument types, uses, limitations, accuracies

         displacement, stress change, strain, temperature, pressure, water content, crosshole ultrasonics, acoustic emission, borehole measurements, data acquisition

      (ii) review of nuclear waste testing methodology to date

         hard rock — Stripa, NSTF, CSM, Spent Fuel, G-Tunnel; salt — Avery Island, WIPP, Salt Vault

      (iii) construction monitoring

         purpose, methodology, data analysis, case study—The Silver Shaft

      (iv) rock mass properties determination

         discussion of scale effects, two approaches to rock mass constitutive model determination—empirical or continuum equivalent and mechanistic (based on discrete properties of intact rock and joints), types of tests (plate bearing, block tests, heater tests—discussed in detail as to how constitutive properties are determined using real test data and possibly using FLAC or MUDEC to model to illustrate equivalent continuum).

(v) large-scale excavation response

purpose, "mine-by" and thermomechanical room scale, back-calculation, use in model validation, determination of confidence limits in modeling

V. SPECIAL TOPICS

A. Dynamics

B. Excavation Techniques

C. Support Mechanics/Systems

VI. CONCLUDING REMARKS