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DEC 19 1983

MEMORANDUM FOR: Those on Attached List
 FROM: M. J. Wise
 Repository Projects Branch
 Division of Waste Management
 SUBJECT: REVIEW OF PROGRAM PLAN FOR RSD SUPPLEMENT IN
 UNSATURATED TUFF

Attached for your review is the program plan for a supplement to the tuff repository site definition. The proposed report would provide data and information on the unsaturated zone of Yucca Mountain, and would be written by Sandia under FIN A-1158.

As you are aware, the RSDs were designed to serve two purposes. The primary purpose is to provide Sandia with the information necessary to develop appropriate computer codes under FIN A-1266. The code development work for tuff is scheduled to begin within the next year and is being coordinated with the University of Arizona's work on fractured and unsaturated media. A secondary purpose of the RSD is to provide a convenient reference for the NRC.

Recently, efforts have been made to focus the RSDs to address specific needs identified by NRC staff (e.g., development of conceptual models). Ideally, these identifications should be made before substantial work is performed. Therefore, I am requesting your comments and suggestions on the attached program plan. Please submit all comments to me by Friday, January 6, 1984.

RECEIVED SANDIA

M. J. Wise
 Repository Projects Branch
 Division of Waste Management

See Attachments:

8409120243 831219
 PDR WMRES EXISANL PDR
 A-1158

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| FC | :WMRP | :WMRP | : | : | : | : | : |
| WE | :MJWise | :HJMiller | : | : | : | : | : |
| ITE | :12/ /83 | :12/ /83 | : | : | : | : | : |

Addressees for Memorandum dated DEC 13 1983

- H. Miller
- P. Justus
- M. Knapp
- J. Greeves
- S. Coplan
- R. Johnson
- M. Logsdon
- D. Fehringer
- P. Ornstein
- J. Pchle
- C. Belote
- R. Shephard

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|----|------------|------------|-------------|---|---|---|---|---|
| FC | : WMRP | <i>MJW</i> | : WMRP | : | : | : | : | : |
| WE | : MJWise | | : HJ Miller | : | : | : | : | : |
| TE | : 12/19/83 | | : 12/19/83 | : | : | : | : | : |

Program Plan for Repository Site Data Report in Unsaturated Tuff

Purpose and Objective

The purpose of this project is to provide a data base that the NRC and SNLA can use as input to computer codes to be used to both evaluate the codes applicability to and perform risk assessment of radioactive waste isolation in unsaturated tuff. Although the specific computer codes to be used for the unsaturated zone have not been specified at this time, certain data needs are expected to be common to all or most codes.

Background

The work proposed here is part of a continuing program of repository site data (RSD) reports in various geologic media. Two media basalt and bedded salt--have been treated previously.

Sources for data on the unsaturated tuff area being considered; which is Yucca Mountain at the Nevada Test Site (NTS) are the U.S. Geological Survey, Sandia National Laboratories, Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, and the general geological literature. Additional data from the weapons testing program at NTS will be incorporated into the RSD report where appropriate.

Task 1: Definition of Data for Reference Site

Data to be acquired, evaluated, and included in the final report are to be used for the hydrologic, thermomechanical, and geochemical analyses of the unsaturated zone of the reference site. The more regional-scale data to be used in estimating the long term stability of the site are included in the previous RSD report on tuff (Guzowski and others, 1983).

Site-specific data for Yucca Mountain will be obtained whenever possible. Where deficiencies in these data occur, data from other parts of NTS will be used, if applicable to Yucca Mountain. In the event that NTS data for a particular parameter do not exist or are not applicable, data will be obtained from the general literature or a theoretical approach will be presented.

Data acquisition will terminate upon the definition of a data set that is adequate and sufficient for use in the development of the risk-assessment methodology. The data set will include both site-specific data and values, ranges, and distributions (where available) for unsaturated tuff as a whole.

An outline of the parameters to be investigated in this report is appended.

This task will require approximately 8 man-months of effort and \$74K to complete.

Task 2: Evaluation of Flow Regime

Because of the present lack of site specific data, the preliminary evaluation of water movement in the unsaturated zone at the reference site will be based on a review of the literature concerning water migration in unsaturated, fractured rocks with low matrix permeability and unfractured porous material. If site-specific field data become available during the data-collection stage of this study, appropriate modifications will be made in the discussion.

Modeling of the water migration in the unsaturated zone may be included in this task at the discretion of the NRC project manager. What code(s) will be used for this portion of the task and what will constitute acceptable results, in view of the limited understanding of flow in unsaturated material, will require joint NRC-SNLA agreement.

This task will require approximately 4 man-months of effort and \$37K to complete, the effort may need to be extended should modeling be included and prove to be difficult. This extension probably would not delay the delivery date of the final report.

Task 3: Preparation of Draft Final Report

The preparation of the draft final report will follow the proposed outline contained in the statement of work for this contract. This document, which will be submitted at the end of the second month, will contain the data base necessary for methodology development.

This task will require approximately 3 man-months of effort and \$27.5K to complete.

Task 4: Preparation of Final Report

The preparation of the final report will include incorporation of responses to pertinent review comments by members of Division 6413 and other Sandia personnel, in addition to comments received from subcontractors and NRC.

This task will require approximately 1.4 man-months and \$11.5K to complete. This effort may need to be increased depending on the nature of the comments. Sandia will provide to NRC, if necessary, an estimate of the increase two weeks after receiving NRC's comments.

Work to be Performed

| | <u>1983</u> | | | | | <u>1984</u> | | | | | | | | | | | | | | | | | | |
|--|-------------|-------|---|---|-------|-------------|---|---|-------|---|---|---|---|-------|---|---|-------|--|---|-----|--|--|---|-----|
| | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | | | | | | | |
| 1. Definition of data for reference site | o | _____ | | | | | | | | | | | | | | o | 8mm | | | | | | | |
| 2. Priliminary evaluation of flow regime at reference site | | | | o | _____ | | | | | | | | | | | | | | o | 4mm | | | | |
| 3. Preparation of draft final report | | | | | | | | o | _____ | | | | | | | | | | | | | | o | 3mm |
| 4. Preparation of final report | | | | | | | | | | | | | o | _____ | | o | 1.4mm | | | | | | | |

Contract Personnel

Robert V. Guzowski
 Ph.D. Geology - Syracuse University
 Areas of Expertise: Structural geology, stratigraphy, igneous, metamorphic, and sedimentary petrology, geo-hydrology

Amount of Time Committed: 80%

Pei-Lin Tien
 Ph.D. Geology - University of Kansas
 Areas of Expertise: Mineralogy, petrology, stratigraphy

Amount of Time Committed: 50%

Krishan Wahi
 Ph.D. Mechanical Engineering - University of Washington
 Areas of Expertise: Thermomechanics, material modeling, numerical modeling of coupled thermal/mechanical/hydrological systems

Amount of Time Committed: 20%

David Updegraff

M.S. Hydrology - New Mexico Institute of Mining and Technology

Areas of Expertise: Groundwater flow, well testing, numerical
modeling of fluid flow and mass transport

Amount of Time Committed: 20%

*Amount of time committed is expressed as a percentage over the
period of the study in FY-84.

Parameters for Unsaturated Zone to be Investigated for Each Unit

Degree of Welding - horizontal and vertical variation

Degree of Alteration - for bedded tuffs

Mineralogy

Fractures

Density

Orientation

Aperture

Fracture filling (amount and type)

Moisture Content

Vertical and horizontal variations

- Type of water
1. Hygroscopic
 2. Capillary or pellicular
 3. Gravitational

Porosity

Total

Effective - whole rock

Fracture

Interstitial

pore size

distribution of size

effective

Geothermal Gradient

Hydraulic Properties

By unit or rock type

Permeability to air

Hydraulic conductivity as function of water content

Tensometer measurements

Characteristic curves

hydraulic conductivity vs capillary head

pressure head vs moisture content

wetting and drying cycles

Geochemistry

matrix potential

Sorption kinetics

Diffusion coefficients as function of saturation

Capillary fringe effects

Organic Content

Thermomechanical Properties

Relationship between properties and degree of saturation:

Specific heat

Thermal conductivity

Thermal diffusivity

Thermal expansion

Tensile strength

Compressive strength

Elastic constants