426.1/D1020/87/09/09/RC

Dr. Roy E. Williams
Williams and Associates, Inc.
P.O. Box 48
Viola, Idaho 83872

Dear Dr. Williams:

Please plan to send either George Bloomsburg or James Osiensky to a meeting "Development of tuff performance methodology to be held in Albuquerque NM on Sept. 21 and 22, 1987. The meeting is between NRC, Sandia National Laboratories and their subcontractors to discuss the development of strategies for modeling under the provisions of Research contract A-1266. We are interested primarily in keeping abreast of the approaches to performance assessment modeling at the Yucca Mountain site which will be developed under this contract. An agenda for this meeting and the draft Statement of Work for A-1266 are attached. Please have your representative observe this meeting and assist them with his input as appropriate.

The action taken by this letter is considered to be within the scope of the current contract NRC-02-85-008. No changes to costs or delivery of contracted products are authorized. Please notify me immediately if you believe this letter would result in a change to costs or delivery of contracted products.

Sincerely,

ORIGINAL SIGNED BY

Jeffrey A. Pohle, Project Officer
Technical Review Branch
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures:
As stated

H

87294180
WM Project: WM-10, 11, 16 WM Record File: D1020
PDR w/encl LPDR w/encl
(Return to WM, 623-SS)

TITLE: Development of a Methodology for Risk Assessment of Nuclear Waste Isolation in Alternative Geologic Media

FIN: A1266
CONTRACTOR: Sandia
SITE: Albuquerque
STATE: New Mexico

NRC PROJECT MANAGER: John D. Randall

PRINCIPAL INVESTIGATOR: Evaristo J. Bonano

BUDGET ACTIVITY: 601903

FY88 OBLIG:
FY89 OBLIG:
FY90 OBLIG:

WORK PERIOD: 10/1/87-9/30/90

BACKGROUND

Beginning in 1976 under FIN A1192, "Risk Methodology for High-Level Waste Isolation in Bedded Salt," Sandia has been developing for NRC a methodology for obtaining quantitative estimations of radionuclide migration from emplaced high-level radioactive waste (HLW) through the geosphere to the accessible environment. The approach taken in FIN A1192 was to implement existing mathematical models of the phenomena relevant to the migration of HLW in the geosphere in a suite of computer programs in order to allow the methodology to be used easily by the licensing staff in the Division of High-Level Waste Management of the Office of Nuclear Material Safety and Safeguards (NMSS/DHLWM). Some of the more often used computer programs which came from FIN A1192 are SWIFT, which implements finite difference solutions of the equations for fluid flow, heat transport, dissolved salt transport, and radionuclide transport in porous media; NWFT/DVM, which simplifies the SWIFT calculations by ignoring heat transport and salt transport and is based on the assumption that ground water flow and radionuclide transport take place only along a few significant paths in a porous medium; and DNET, which implements mathematical models of salt creep, heat transfer, and mechanical deformation of salt to estimate the collapse of tunnels in excavated repositories in bedded salt. In addition to these programs related to the phenomenology of radionuclide migration, Sandia prepared computer programs designed to select parameters for efficient sensitivity studies (based on Latin Hypercube Sampling) and to provide regression equations showing the relationship of dependent variables to dominant independent variables and parameters.

This project (FIN A1266), which was begun in FY82, is designed to extend the methodology developed under FIN A1192 to media other than bedded salt. To date, most of the work in this project has concentrated on extending the methodology to saturated basalt which is a fractured, rather than a porous, medium. As a result of this work, new versions of SWIFT and NWFT/DVM have been developed which implement mathematical models of the relevant phenomena in saturated fractured rocks which are visualized as dual porosity media consisting of fractures and porous matrices.

More recently, this project has also begun to develop a methodology for quantifying water flux and radionuclide migration in unsaturated tuff, primarily by making use of computer programs developed by Lawrence Berkeley Laboratory for geothermal applications.

OBJECTIVE

The objective of this project is to modify the risk methodology developed for the isolation of HLW in bedded salt (under FIN A1192) so that the methodology will be applicable to analyzing HLW isolation in basalt, tuff, domed salt, and granite.

SUMMARY OF PRIOR EFFORTS

At its inception in FY 82, this project consisted of two tasks: 1) Development of Methodology for Risk Assessment of Nuclear Waste Isolation in Basalt, and 2) Development of Methodology for Risk Assessment of Nuclear Waste Isolation in Welded Tuff. In FY85, the work plan was modified to reflect what had been learned since the project began and a third task was added: "Improvement of Existing Modeling Techniques and Computer Programs." The following work has been completed.

Prior to FY 84: The preparation of a basalt data base report (NUREG/CR-2739) containing the available data for use in developing a methodology for analyzing radionuclide migration from HLW emplaced in basalt. This effort was coordinated with NMSS/DHLWM's FIN A1158, "Reference Repository Definition."

The development of a one dimensional stochastic groundwater flow model. Predictions made by this model are being compared with predictions made by using Sandia's usual approach of combining deterministic modeling with statistical sampling.

In the FY 84-85 work plan:

Subtask 1.1: The completion of a report (NUREG/CR-3353) containing a preliminary list of scenarios for use in demonstrating the application of the methodology to basalt. Refinement of this list is being accomplished by modeling studies needed to identify dominant radionuclide release scenarios in basalt.

Subtask 1.2: The completion of a draft report (NUREG/CR-3328) containing the theory and implementation of the SWIFT II computer program that is the modification of SWIFT implementing dual porosity models of flow and transport in saturated fratured rocks.

The completion of a draft report (NUREG/CR-3162) describing the starting data needed by SWIFT II.

The development of a dual porosity version of NWFT/DVM. The computer program was prepared and appropriate documentation was initiated.

Subtask 1.3: The initiation of a demonstration of the methodology

developed for basalt. A three-dimensional ground water flow model of a hypothetical basalt site was developed. Scenario screening was carried out with the aid of this model and a model of thermomechanical effects.

Subtask 2.1: A comparison of the characteristics of bedded salt, basalt, and tuff. This comparison was made to determine the degree to which the bedded salt and basalt methodologies could be applied to tuff.

Subtask 2.2: A comparison of the capabilities and limitations of several computer programs used to simulate water movement in unsaturated media.

Subtask 2.3: Initiation of development of release scenarios for HLW disposal in welded tuff.

In the FY 85 work plan:

Task 3: Initiation of a task on improvement of modeling techniques and computer programs already prepared by the contractor for NRC. This task began with a comparison of uncertainty and sensitivity analysis techniques, some of which were developed under FIN A1192, some under this project, and some elsewhere.

In the FY 86-87 work plan:

Subtask 1.2: Completion of documentation of SWIFT II and the dual-porosity version of NWFT/DVM (renamed NEFTRAN in this new version). Documentation of SWIFT II is complete. The data input guide (NUREG/CR-3162), description of the mathematical models implemented in the program (NUREG/CR-3328), and a self-teaching curriculum (NUREG/CR-3925, released under FIN A1158's technology transfer task) have been printed in final form and distributed to the NRC staff. The document describing NEFTRAN, NUREG/CR-4766, combines the theory, usage, and self-teaching features that were treated separately for SWIFT II, has been reviewed by NRC and Sandia personnel, and will be printed very soon.

Subtask 1.3: Completion of demonstration of the computational methodology developed for basalt. This subtask required a much larger level of effort than either NRC or Sandia had anticipated when it was first formulated. The demonstration is complete, Sandia staff members associated with this project have briefed NRC staff members on the findings of the demonstration, and a draft version of the demonstration report is nearly complete.

Subtask 2.2: A comparison of computer programs that implement mathematical models of water movement in unsaturated media. A report on this subtask exists in draft form.

Subtask 2.3: Completion and documentation of development of release scenarios for the tuff methodology. A report on this subtask exists in draft form. If necessary as work on Task 2 progresses in FY88-90, additional scenarios may be added and the scenario report will be updated appropriately in that event, as required by Subtask 2.15.

Subtask 2.4: A workshop on on the flow of groundwater and transport of radionuclides in unsaturated tuff. This workshop was held, in cooperation with the University of Arizona, in January 1986.

Subtask 2.5: An analysis of and an associated report (NUREG/CR-4693) on vapor phase transport in unsaturated tuff. The conclusion of the work was that the transport of radionuclides in the vapor phase (as aerosols, in air, or in water vapor) in unsaturated tuff may be insignificant compared the transport of radionuclides in liquid water in unsaturated tuff.

Subtasks 2.6 and 2.7: Investigations of and associated computer implementations of mathematical models of radionuclide transport in liquid water in unsaturated welded tuff. The work in these subtasks did not progress as far as originally planned because 1) more effort that originally planned had to spent on completing the demonstration of the computational methodology for basalt, and 2) Sandia had to approach this problem more carefully than originally planned because of a still-unresolved controversy over the predominant direction of movement of liquid water in unsaturated tuff. In an effort to resolve this controversy, Sandia initiated laboratory-scale tests at the University of New Mexico.

Subtask 2.8: Collection of data for the demonstration of the computational methodology developed for unsaturated tuff. Due to the unanticipated effort needed to complete the basalt methodology and due to the difficulties encountered in Subtasks 2.6 and 2.7, this subtask was not initiated in FY 86-87 and is being replaced by Subtask 2.16.

Subtask 3.1: Comparison of uncertainty/sensitivity analysis techniques. Through a subcontract to MIT, Sandia acquired the means to calibrate flow models in the saturated zone by various geostatistical techniques. A computer program, INVS, was prepared to implement the calibration procedures and its documentation exists in draft form. Some of the comparisons and evaluations of other uncertainty/sensitivity analysis methods that originally were to be done in this subtask in FY 86-87 were done in the demonstration of the basalt methodology, which revealed that some generally accepted techniques may inappopriate for basalt. Because of this finding, other comparisons and evaluations originally planned for FY 86-87 were deferred.

Subtask 3.2: Development of methods of validation of mathematical models applied to HLW disposal. Sandia, in cooperation with the Colorado State University (through FIN D1674), assisted NRC in conducting a workshop entitled "Validation of Mathematical Models for Waste Repository Performance Assessment -- Confidence Building through Synthesis of Experiments and Calculations" on January 27-29, 1986 in Bethesda, MD. The proceedings of the workshop are being prepared by the NRC staff and are nearly complete. NRC HLW research investigators associated with this project and FIN D1674 have proposed a joint validation test of models of thermohydrologic phenomena for FY 88-89.

Subtask 3.3: Statement of capabilities and limitations of mathematical models implemented by the contractor in computer programs developed for NRC. During the demonstration of the computational methodology for basalt, the contractor identified many capabilities and limitations of the models being used in the demonstration. These capabilities and limitations will be reported in the basalt demonstration report.

Subtask 3.4: Improvement of existing mathematical models and computer programs. In performing Subtask 3.3, the contractor identified limitations in NEFTRAN matrix diffusion and groundwater flow models. The contractor is modifying the NEFTRAN computer program so that the matrix diffusion model implemented by the program can treat larger fluid velocities and inter-fracture separations than those that can be treated by the current version of the program. The contractor is devising and implementing in NEFTRAN a multi-steady-state distributed-velocity algorithm that accounts for time-dependent groundwater flow and contaminant transport coefficients.

WORK TO BE PERFORMED IN FY 88, FY 89, AND FY 90

During FY 88, 89, and 90, the contractor shall perform the work listed below. Task 1 is complete. Task 2 has been reorganized by dropping Subtasks 2.6 - 2.8 and adding Subtasks 2.9 - 2.19.

Task 2: Methodology Development for Risk Assessment of Radioactive Waste Isolation in Welded Tuff. In performing this task, the contractor shall 1) make use of the results of Subtasks 2.1-2.5 (described in this project's FY84-85 and FY86-87 work plans and summarized in the SUMMARY OF PRIOR EFFORTS section of this SOW), and 2) coordinate this task with FIN's A1158, A1195, B7291, and D1662, as described in the section on RELATIONSHIP TO OTHER PROJECTS in this SOW.

Subtask 2.9: Development or Modification of Computer Program for Simulating Groundwater Flow in Unsaturated Tuff. Based on the findings of Subtask 2.2, the contractor shall evaluate the following options for NRC's consideration:

1) Adoption, without modification, of one of the computer programs examined.

2) Modification of one or more of the computer programs examined.

3) development of a new computer program.

After reviewing the contractor's evaluation, the NRC Program Manager shall select one of the options listed above as the course of action leading to a computer program that is suitable for NRC's use in simulating groundwater movement in unsaturated tuff.

Subtask 2.10: Analysis of Groundwater Travel Time in Unsaturated Tuff. The contractor shall investigate the feasibility of extending the inverse methods applied in the development of the basalt methodology to the analysis of groundwater travel times in unsaturated tuff. The

contractor shall report the results of the feasibility study to the NRC Project Manager by the end of FY 88. Based on an evaluation of the contractor's findings, the NRC Project Manager shall decide whether to pursue further the extension of the basalt methodology's inverse techniques to welded tuff for the purpose of evaluating groundwater travel times.

Subtask 2.11: Experiments in Support of Model Development. Using existing laboratory facilities, the contractor shall conduct experiments in order to resolve the following issues.

1) Are rock surfaces in unsaturated geologic media, under conditions comparable to repository conditions, covered with liquid water? This question needs to be addressed in order to decide how to model radionuclide retardation. If the rock surfaces are covered with liquid water, then radionuclide retardation models applied to saturated media can be applied to unsaturated media under the conditions stated.

2) Does liquid water, under conditions comparable to repository conditions, move along fractures between matrices or across fractures from one rock matrix block to another? Selection of the appropriate mechanism of liquid water movement is necessary in order to select appropriate mathematical models of water and contaminant movement in unsaturated media under the conditions stated.

The contractor shall design the experiments and submit the designs to the NRC Project Manager by the end of FY 88. The contractor shall design the experiments so that they do duplicate work done under FIN's B7291 and D1662. The experimental designs should be complementary to the field and laboratory experiments performed under FIN's B7291 and D1662. The NRC Project Manager shall review the experimental designs submitted by the contractor, and approve them, suggest modifications, or reject them within 30 days of receiving them.

Subtask 2.12: Investigation of Perturbations to Liquid/Vapor Equilibria in Unsaturated Welded Tuff. In the absence of any perturbations, air and the liquid and vapor forms of water can coexist in equilibrium in unsaturated geologic media. Under such conditions, there may be very little movement of liquid water and, consequently, very little movement of contaminants. Such a favorable situation is cited by DOE in its advocacy of the candidate HLW repository site in unsaturated tuff in Nevada. However, this equilibrium can be perturbed intermittently by rainfall. For rock matrices with a sufficient degree of saturation, liquid water from rainfalls could move very rapidly from the ground surface of a repository of HLW in unsaturated tuff to the emplaced waste, so that a very short groundwater travel time could result. Estimations of groundwater travel time that account for rainfall depend on whether the mathematical models used are based on liquid water movement across fractures or along fractures and whether recharge from rainfall is a) averaged so that it is modeled as a continuous phenomenon, or b) treated as an intermittent phenomenon. Estimations of groundwater travel time based on assuming liquid water movement

across fractures and using averaged recharge yield large values of groundwater travel time. DOE's estimations of groundwater travel time at its prospective HLW site in Nevada are based on these assumptions. With a sufficient degree of saturation in rock matrices, these assumptions may not be valid. The contractor shall compare estimations of groundwater travel time based on assuming liquid water movement along fractures and intermittent recharge with estimations based on the assumptions adopted by DOE. The contractor shall identify conditions under which the assumptions of liquid water movement across fractures and along fractures are valid and the conditions under which a) assuming average recharge is sufficient for groundwater travel time calculations, and b) accounting for intermittent recharge has to be done in order to predict realistic groundwater travel times.

Subtask 2.13: Development of a Conceptual Model for a Hypothetical HLW Repository in Unsaturated Welded Tuff. Preparatory the application of mathematical models to the prediction of groundwater flow and contaminant transport in unsaturated welded tuff, the contractor shall develop a conceptual model of a hypothetical HLW repository in unsaturated welded tuff. The conceptual model developed shall be based on experimental information obtained from Subtask 2.12 and all available information on typical candidate tuff sites. In developing the conceptual model, the contractor shall consider boundary conditions, initial conditions, appropriate spatial dimensionality for modeling purposes, mechanisms of water and contaminant movement in unsaturated tuff, retardation of contaminants, and appropriate conceptualization of the fracture systems in the hypothetical site.

Subtask 2.14: Preparation of Computer Programs for Implementing Mathematical Models of the Transport of Radionuclides in Unsaturated Welded Tuff. Once satisfactory mathematical models of transport of radionuclides in unsaturated fractured media have been selected as a result of work done in Subtasks 2.1 - 2.13, the contractor shall

1) locate and obtain existing computer programs that implement these models, or (if such programs do not exist)

2) prepare new computer programs that implement the models.

The decision to adopt Step 2 above shall require the approval of the NRC Project Manager.

Subtask 2.15: Revision of Scenario Selection. When deemed necessary by the contractor and the NRC project manager, the contractor shall review and revise, if necessary, the list, prepared under Subtask 2.3, of scenarios for the release of radionuclides from HLW emplaced in unsaturated welded tuff the the accessible environment. Any necessary revisions of the list shall be published as addenda to the report prepared under Subtask 2.3.

Subtask 2.16: Collection of Data Needed to Demonstrate the Application of the Flow and Transport Models Assembled in Subtasks 2.1 - 2.15 to Unsaturated Welded Tuff. The contractor shall collect all data needed

Schedule and Cost Summary			
	Year		
Subtask	1	2	3
2.9	****aaaa	aaaaaaaa	
2.10	********	********	
2.11	********	********	
2.12	********	********	
2.13	********	********	****
2.14		********	********
2.15		aaaaaaaa	aaaaaaaa
2.16	********	********	
2.17		********	****
2.18		********	********
2.19			********
Task 2 Costs	$400K	$460K	$460K
3.1	********	********	********
Subtask 3.1 Cost	$100K	$100K	$150K
3.2	********	********	********
Subtask 3.2 Cost	$80K	$75K	$50K
3.4	**aaaaaa	aaaaaaaa	
Subtask 3.4 Cost	$40K	$0	$0
Total Costs	$620	$635	$660

*: Work required by SOW
a: Work requires approval by NRC Program Manager

performance. This information is necessary to assess the degree of confidence to be placed in the methodologies developed under this project.

FIN's B7291 and D1662, The University of Arizona's projects on flow and transport in unsaturated rocks. FIN B7291 provided and FIN D1662 is providing information on the validity of current concepts which are inherent in the mathematical models of flow and transport in unsaturated rocks. This information will be useful to this project by providing a basis for accepting or rejecting candidate computer programs for evaluation under Subtask 2.2 and selection under Subtask 2.9.

FIN B8956, Massachusetts Institute of Technology's project on stochastic analysis of contaminant transport in saturated and unsaturated porous media. Information from FIN B8956 will be useful to this project's Subtask 3.1 on the use of stochastic modeling equations as alternatives to statistical sampling with deterministic modeling equations.

FIN B5694, Pacific Northwest Laboratory's project on the field validation of stochastic models of contaminant transport. FIN's B5694 and B8956 are closely related and serve as an example to this project of how field validation of models might be approached in Subtask 3.2.

FIN B2862, Pacific Northwest Laboratory's project at Chalk River, Canada on the field validation of mathematical models applied to low-level radioactive waste sites. FIN B2862 will also serve as an example to this project of how field validation of models might be approached in Subtask 3.2.

FIN's B5753 and D1672, The University of Arizona's projects on flow and transport in saturated fractured media. Under FIN B5753 and its sequel, FIN D1672, the validity of various models of flow and transport in saturated fractured rocks is being tested in the field. Both FIN B5753 and D1672 provide information on data collection methodologies for parameters needed in flow and transport models applied to saturated fractured media and relationships among flow and transport parameters. All of the information gathered under FIN's B5753 and D1672 will be of value to this project in assessing the validity of the basalt methodology and (if it is developed) the granite methodology.

FIN D1163, In-Situ, Inc.'s project on flow and transport in saturated fractured media. FIN D1163, which began on October 1, 1985, also is a sequel to FIN B5753 and its relationship to this project is essentially the same as that of FIN's B5753 and D1672.

FIN B3040, Lawrence Berkeley Laboratory's geochemical assessment of radioactive waste isolation. Various aspects of geochemical retardation are being investigated under FIN B3040, both experimetally and theoretically. The results of the work done under FIN B3040 will be value to this project by providing information on the uncertainty associated with using the very simplified geochemical models which are part of both FIN A1192's and this project's methodologies.

2.11	Results of experiments in support of model development	Journal article(s)	9/89
2.12	Perturbations to liquid/vapor equilibrium in unsaturated welded tuff	NUREG/CR, Journal article	9/89
2.13	Conceptual model for HLW repository in unsaturated welded tuff	NUREG/CR	3/90
2.14	Modeling strategy for analyzing radionuclide transport in unsaturated welded tuff	Letter, Conference paper	3/89
2.14	Computer program implementing modeling strategy for analyzing radionuclide transport in unsaturated welded tuff	NUREG/CR	9/90
2.15	Addenda for tuff scenario selection report	NUREG/CR (added to report from Subtask 2.3)	TBD
2.16	Data base required to support computational methodology for assessing performance of HLW repository in unsaturated welded tuff	NUREG/CR	12/89
2.17	Progress report on uncertainty and sensitivity analysis techniques specific to unsaturated fractured geologic media	Letter	3/89
2.17	Uncertainty and sensitivity analysis techniques needed for application to computational methodology for assessing HLW repository performance in unsaturated welded tuff	NUREG/CR	9/90
2.18	Integration of results of subtasks 2.1 - 2.17 into a computational methodology for assessing HLW repository performance in unsaturated welded tuff	NUREG/CR	9/90
2.19	Plan for demonstrating computational methodology for assessing HLW repository performance in unsaturated welded tuff	Letter	9/90
3.1	Comparison of uncertainty analysis techniques - stochastic models vs. Monte Carlo simulations	Journal article	12/87
3.1	User's manual for the INVS computer program	NUREG/CR	3/88

at a conference or published in a journal. These papers shall be subject to peer review by appropriate technical experts prior to their publication.

Letter Reports on Meetings and Field Trips

For each technical meeting (with personnel not associated with this project) and each field trip attended by this project's staff, the contractor shall prepare a letter report on the meeting or field trip and submit the letter report to the NRC Project Manager within 10 working days of the meeting or field trip. These letter reports shall identify the purpose, participants, itinerary, and significant findings of the meeting or field trip.

Report Distribution

Copies of all reports and publications derived from this project shall be sent to the following NRC personnel.

John D. Randall, Project Manager
Division of Engineering, RES,
(1 copy of each letter report and conference or archival publication,
10 copies of each NUREG contractor report),

Office of the Director, RES
Attention: Program Management, Policy Development, and Analysis Staff;
1 copy,

Guy A. Arlotto, Director
Division of Engineering, RES, 1 copy,

Robert J. Boznak, Deputy Director
Division of Engineering, RES, 1 copy,

Frank A. Costanzi, Chief
Waste Management Branch
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Robert E. Browning, Director
Division of High-Level Waste Management, NMSS, 1 copy,

Michael J. Bell, Deputy Director
Division of High-Level Waste Management, NMSS, 1 copy,

Sandia National Laboratories
Albuquerque, New Mexico 87185

date: August 25, 1987

to: Distribution

from: E.J. Bonano, 6416

subject: Meeting on Development of Methodology for High-Level Waste Disposal in Unsaturated Tuff Formations

The next meeting for Sandia staff and contractors on the development of the performance assessment methodology for high-level waste disposal in unsaturated tuff formations will be held September 21 and 22, 1987. The meeting will be in the conference room of the Technology Transfer Center (TTC, Bldg. 825) at Sandia National Laboratories - Albuquerque. Enclosed is a preliminary agenda for the meeting and, for those of you who plan to drive, a rough map of the location of the TTC inside Kirtland Air Force Base. If you have any questions please do not hesitate to contact me at (505/FTS) 844-5303.

Distribution:

Staff 6416
N. Ortiz, 6410
R. Bras, MIT
D. Evans, UA
E.J. Davis, UW
D. Galson, NRC
A. Gutjahr, NM Tech
J. Randall, NRC
D. Smith, UNM
J. Wilson, NM Tech
P. Wierenga, NMSU

Enclosure:

Meeting on

DEVELOPMENT OF TUFF PERFORMANCE ASSESSMENT METHODOLOGY

September 21 & 22, 1987
Technology Transfer Center
Sandia National Laboratories
Albuquerque, New Mexico

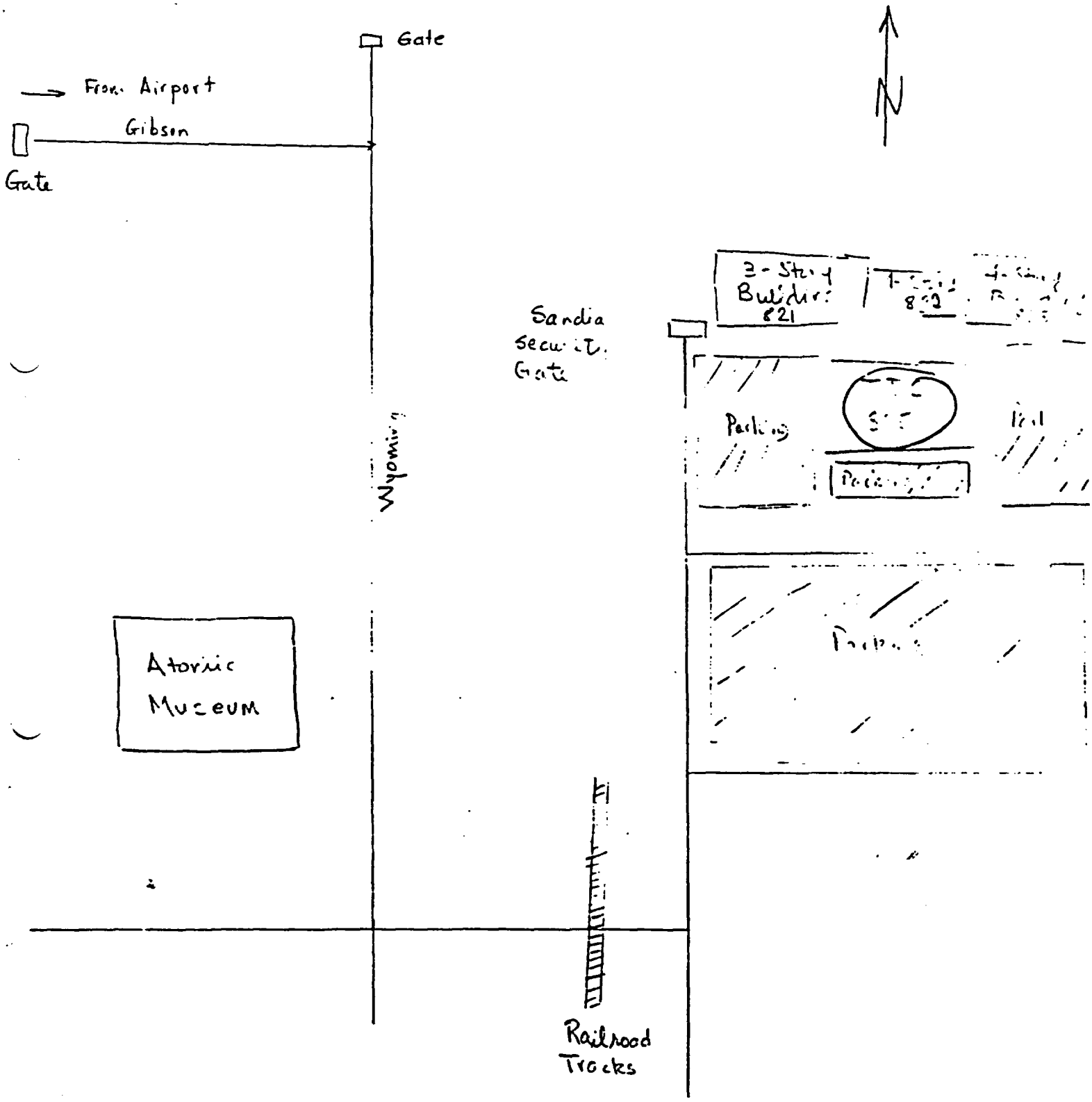
AGENDA

Monday, September 21

9:15 - 9:30	Introduction	T. Bonano
9:30 - 10:30	Statement of Work for Development of Unsaturated Tuff PAM for FY 88-90	T. Bonano
10:30 - 11:30	Scenarios for HLW Disposal in Unsaturated Tuff	B. Guzowski
11:30 - 1:00	Lunch	
1:00 - 2:00	Review of Flow and Transport in Unsaturated Media	J. Davis
2:00 - 3:00	Ground-Water Flow Uncertainty in Unsaturated Media	R. Bras
3:00 - 4:00	Experimental Characterization of Tuff Samples	D. Smith
4:00 - 5:00	Preliminary Flow Visualization Studies	J. Wilson

Tuesday, September 22

8:30 - 9:30	Uncertainty and Sensitivity Analysis Techniques for Ground-Water Flow in Unsaturated Media	P.Davis
9:30 - 10:30	Validation of Models for Flow and Transport in Unsaturated Media	P. Wierenga
10:30 - 11:30	Field Studies in Unsaturated/ Fractured Tuff	D. Evans/ T. Rasmussen
11:30 - 1:00	Lunch	
1:00 - 3:00	Discussion in Needed Experiments for Model Development	T. Bonano, Moderator
3:00	Adjourn	


Gate
From Airport
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Sandia
Security
Gate
3-Story
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821
Parking
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Wyomin
Atomic
Museum
Railroad
Tracks

SEP 10 1987

426.1/D1020/87/09/09/RC

OFFICIAL CONCURRENCE AND DISTRIBUTION RECORD

LETTER TO: Dr. Roy E. Williams
Williams and Associates, Inc.
P.O. Box 48
Viola, Idaho 83872

FROM: Jeffrey A. Pohle, Project Officer
Technical Review Branch
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

SUBJECT: ATTENDANCE OF MEETING ON RESEARCH CONTRACT A-1266 BY A REPRESENTATIVE OF WILLIAMS AND ASSOCIATES

DATE:

DISTRIBUTION

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NColeman, HLTR	DChery, HLTR	JPohle, HLTR

CONCURRENCES

ORGANIZATION/CONCUREE	INITIALS	DATE CONCURRED
HLTR/RCodell	RC	87/09/10
HLTR/JPohle		87/09/10
HLTR/DChery		87/09/10

original sent out 9/10/87.