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(P)DR - WM-10 (2)
WM-11 (2)
WM-16 (2)

WM Record File: WM-RES D1021 NWCI
WM Project: 10,11,16
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LPDR ✓ (B,N,S)
Distribution: Pohle
(Return to WM, 623-SS)

NUCLEAR WASTE CONSULTANTS INC.
8341 So. Sangre de Cristo Rd., Suite 14
Littleton, Colorado 80127
(303) 973-7495

June 12, 1987

009/2.3/TTI.013
RS-NMS-85-009
Communication No. 164

U.S. Nuclear Regulatory Commission
Division of Waste Management
Geotechnical Branch
MS-623-SS
Washington, DC 20555

Attention: Mr. Jeff Pohle, Project Officer
Technical Assistance in Hydrogeology - Project B (RS-NMS-85-009)

Re: Letter from TTI to T. Verma (NRC) Concerning Vertical Leakage at BWIP

Dear Mr. Pohle:

Attached please find a letter prepared by Mike Galloway (Terra Therma), with attachments, concerning TTI/NWC work to date on the issue of vertical leakage at BWIP. This information was requested by Dr. T. Verma during a recent series of telephone conversations with Mark Logsdon (NWC) and Mr. Galloway. A copy of this information has been sent to Dr. Verma directly.

If you have any questions concerning this letter or the attached report, please contact me immediately.

Respectfully submitted,
NUCLEAR WASTE CONSULTANTS, INC.

Mark J. Logsdon

Mark J. Logsdon, Project Manager

Att: Letter from M. Galloway re vertical leakage at BWIP, with attachments

cc: US NRC - Director, NMSS (ATTN: PSB)
HLWM (ATTN: Division Director) - 2
Mary Little, Contract Administrator
HLWM/TRB (ATTN: Branch Chief)
Dr. Tilak Verma, HLWM/TRB
Mr. Neil Coleman, HLWM/TRB

M. Galloway, TTI

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WM Project: WM-10,11,16
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WM Record File: D1021
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TERRA THERMA, INC.
WATER CONSULTANTS AND ENGINEERS
8341 S. Sangre de Cristo Rd., Suite 14, Littleton, CO 80127 (303) 973-7492

June 2, 1987

Mark Logsdon
Project Manager
Nuclear Waste Consultants, Inc.
8341 S. Sangre de Cristo Rd.
Suite 14
Littleton, Colorado 80127

RE: Request by Tilak Verma for a summary note on the vertical leakage issue

Dear Mark:

Dr. Tilak Verma of the Division of High-Level Waste Management of the NRC has requested that Terra Therma provide a brief "note" concerning the vertical leakage issue at BWIP, including reference to any relevant documents. This letter serves as that summary note.

In developing the conceptual model under the 2.4 Subtask heading, Terra Therma explored the possibility that vertical discontinuities exist within the various dense interiors (TTI, 1986a). Based on outcrop observation, some degree of heterogeneity would be expected, but at a frequency that might not permit detection with the relatively small area of investigation of the existing or proposed boreholes. Although dense interior heterogeneity has been a recognized part of the DOE conceptual model (DOE, 1982), little significance has been given to the heterogeneity in terms of regional and local flow systems and with respect to the various performance criteria.

In an attempt to determine the potential significance of heterogeneity in the flow interiors, Mini-Reports 1 and 2 (TTI, 1986b and 1986c) looked at the effects of variable hydraulic conductivity on the Ground Water Travel Time (GWTT) Criterion and the EPA Cumulative Flux Standard. In the case of GWTT, for feasible combinations of spacial density and geometry of the heterogeneous features, the use of bulk hydraulic conductivity will tend to overestimate GWTT. For EPA flux, the effect of using bulk hydraulic conductivity is a function of travel time. Use of bulk conductivity results in small uncertainties when the time consideration is large compared to travel time.

As part of the analyses of BWIP water level data for Mini-Reports 5, 8, and 9 (TTI, 1986d, 1986e, 1986f), the response of various piezometers at the DC-20C nest to drilling activity were noted. The response of the Rocky Coulee and Cohassett flow tops due to drilling activities at RRL-17 were essentially identical. With the data available at the time, our conclusion was that significant vertical communication had occurred, either within the borehole or through the formation.

During the BWIP Data Review in Richland, Washington (December, 1986), TTI had the opportunity to discuss this issue with Ron Jackson of Rockwell. Mr. Jackson stated that the nature of the Rocky Coulee flow interior at the site

of DC-20C was quite different than in other areas and actually made their efforts at sealing the piezometer strings very difficult. However, he felt that despite the difficulty in sealing the borehole, the seals are working properly and therefore the vertical communication is within the formation.

Since the Data Review, TTI has received two additional documents which have provided additional information on the vertical leakage issue. Golder Associates (1987) have performed a preliminary analysis of piezometer seals in the RRL area for DOE. Their initial conclusion is that "naturally occurring flowpaths" are responsible for the various observed responses of the piezometers, rather than the seals. They note, however, that a diagnostic testing program would be required to confirm the seal integrity.

The second document, the completion report for RRL-2C (DOE, 1986), provides hydrographs of piezometer responses to testing and development of adjacent piezometers. In several cases, hydraulic responses were observed in flow interior and interflow piezometers during injection or withdrawal of water from an adjacent interflow. Although analyses have not been performed on this data, TTI's initial observation is that relatively efficient hydraulic communication exists either within the borehole or through some flow interiors at the RRL-2C location. These observations, as well as conclusions presented in Golder (1987), were incorporated in the TTI Conceptual Model Update (TTI, 1987) and the meeting preparation document for the DOE-NRC meeting on the Geohydrology Testing Program (April 7-9, 1987) (TTI, 1987b).

TTI considers the issue of vertical leakage to be of considerable importance to the LHS testing program, in addition to the continued feasibility of using this site for waste disposal. It would seem that BWIP is in the position of having to determine whether the observed vertical communication takes place within the boreholes or through dense flow interiors, either of which has significant implications to their program. Because of the significance of this issue, several Technical Reports are being proposed for continued work through the remainder of FY 86 and into FY 87. Technical Description Summaries of proposed reports dealing with the vertical leakage issue are attached.

If you have any questions or we can provide any clarifications, please do not hesitate to call.

Sincerely,

Michael Galloway
Team Leader

Attachments
References
Technical Description Summaries

REFERENCES CITED

DOE, 1982, Site Characterization Report for the Basalt Waste Isolation Project; DOE/RL 82-3, Rockwell Hanford Operations for U.S. Department of Energy.

DOE, 1986, Design, Drilling and Construction of Well RRL-2B and Piezometer Nest RRL-2C; SD-BWI-TI-329, Rockwell Hanford Operations for U.S. Department of Energy.

Golder Associates, 1987, Preliminary Evaluation of the Adequacy of Piezometer Seals; CA-988, February, 1987.

Terra Therma, Inc., 1986a, Development of Groundwater Conceptual Flow Models For the BWIP Site; Subtask 2.4, April, 1986.

Terra Therma, Inc., 1986b, Analysis of Flow Interior Heterogeneity: Ground Water Travel Time; Mini-Report Number 1, June, 1986, (Fred Marinelli).

Terra Therma, Inc., 1986c, Analysis of Flow Interior Heterogenity: Cumulative Flux; Mini-Report Number 2, June, 1986, (Fred Marinelli).

Terra Therma, Inc., 1986d, Analysis of Drilling Response at the Hanford Site: Theory; Mini-Report Number 5, June, 1986, (Barbara Basse).

Terra Therma, Inc., 1986e, Analysis of Drilling Response at the Hanford Site: Analysis; Mini-Report Number 8, December, 1986 (Barbara Basse).

Terra Therma, Inc., 1986f, BWIP Groundwater Levels: Will Further Stabilization Significantly Reduce Uncertainty?; Mini-Report Number 9, December, 1986 (Michael Galloway).

Terra Therma, Inc., 1987a, BWIP Conceptual Model Update; Subtask 2.4, May, 1987.

Terra Therma, Inc., 1987b, DOE-NRC Meeting on the Geohydrology Testing Program for the Hanford Site Before Construction of the Exploratory Shaft, Richland, Washington, April 7-9, 1987 - Trip Report; April, 1987.

TECHNICAL DESCRIPTION SUMMARY

Technical Report Number: 18

Title: Analysis Flow Interior Responses Observed During Piezometer Development

OBJECTIVE

The purpose of this technical report is to evaluate and analyze hydraulic responses observed within flow interiors during piezometer development at borehole RRL-2C. The results of this analysis can potentially provide values of hydraulic dispersivity of selected flow interiors and/or information regarding the integrity of borehole seals.

TECHNICAL APPROACH

Piezometers within the RRL-2C installation were developed by withdrawal of formation water. During the development of some piezometers within interflows, significant hydraulic responses were observed in adjacent flow interiors. These responses could represent pressure propagation within the flow interior or within the borehole due to an incomplete grout seal. Using a modification to well known consolidation equation, it is possible to develop an analysis which allows calculation of the effective hydraulic diffusivity (ratio of hydraulic conductivity to specific storage) which best reproduces the data. To evaluate the analytical solution, a fully documented computer program will be written in BASIC to operate on an IBM PC microcomputer. If characteristics of the field data closely match the analytical model, it may be concluded that the observed flow interior responses in fact represent properties of dense basalt. In this case, the results can be used to evaluate vertical hydraulic conductivity of the affected flow interior. On the other hand, if field data are inconsistent with the analytical model, integrity of borehole seals may be questioned.

PRODUCT DESCRIPTION

This task will result in a single document which presents the technical approach, results, conclusions, and discussion. Included will be the complete theoretical development of the analytical solution and documentation for the computer program used to evaluate the final equations. Detailed technical explanations will be presented to justify the conclusion of whether or not the observed responses are the result of flow interior hydraulic properties.

TASK ASSIGNMENT

This task will be performed by Fred Marinelli. Technical reviews will be completed by Adrian Brown and Mark Logsdon. QA review of the document will be performed by Catherine Kraeger-Rovey.

Technical Report Number: (continued)

MANPOWER

Estimated manpower requirements for this task are summarized below:

Development of analytical solution:		5 hours
Development of computer program:		20
Analysis of field data (assume 2 data sets)		15
Write-up:		15
	Subtotal:	55 hours
Review (technical and QA):		10
Final Preparation:		10
	Total:	75 hours

SCHEDULE

This technical report is not dependent on other work proposed or in progress.

TECHNICAL DESCRIPTION SUMMARY

Technical Report Number: 21

Title: A Computer Program for Simulating LHS Tests in Leaky Aquifers

OBJECTIVE

Sensitivity analyses of proposed LHS tests are required to determine to what extent they will provide relevant site characterization data. The purpose of this technical report is to develop and document a computer program which efficiently evaluates the modified Hantush leaky aquifer solution. This solution is considered appropriate for pre-analysis of BWIP LHS tests.

TECHNICAL APPROACH

A preliminary IBM PC computer program used to evaluate the modified Hantush leaky aquifer solution has been previously developed by TTI for purposes of the current contract. The method is based on numerical inversion of the LaPlace transform solution using the Stelfest algorithm. The current program includes an option to consider one image well. The purpose of this technical work is to rewrite certain portions of the algorithm, fully document the program, provide comment statements in the source code, and benchmark the program against appropriate analytical solutions. The original program will be modified to incorporate any number of image wells so that multiple boundaries and withdrawal/recovery can be simulated. Options will be written into the program to down-load input/output files onto disk and to plot results on a Hewlett Packard mechanical plotter.

PRODUCT DESCRIPTION

This task will result in a single document which presents the technical approach, results, conclusions, and discussion. The final report will describe theoretical development of governing equations and the solution algorithm. Computer results will be compared to appropriate analytical solutions and a complete listing of the source code will be provided in an appendix.

TASK ASSIGNMENTS

This technical report will be prepared by Fred Marinelli and Barbara Basse. Technical reviews will be completed by Adrian Brown and Mark Logsdon. QA review of the document will be performed by Catherine Kraeger-Rovey.

Technical Report Number: (continued)

MANPOWER

Estimated manpower requirements for this task are summarized below:

Rewrite portions of existing program:		20 hours
Benchmark against analytical solutions:		10
Write-up:		15
	Subtotal:	45 hours
Review (technical and QA):		10
Final Preparation:		10
	Total:	65 hours

SCHEDULE

This technical report is not dependent on other work proposed or in progress.

TECHNICAL DESCRIPTION SUMMARY

Technical Report Number: 22

Title: Integrity of Piezometer Seals Based on Placement History and Subsequent Geophysical Logging

OBJECTIVE:

Because recent hyraulic response data from various piezometers indicate that the integrity of these piezometers is in question, the NRC staff should become familar with both the sealing technology used at BWIP and the results of various testing results, such as bond logs. Therefore, the objective of this technical report is to review the actual borehole sealing techniques used, accounts of their actual placement, and the results of any diagnostic testing performed in order to comment on the integrity of those seals on the basis of physical data.

TECHNICAL APPROACH:

This study will be divided into four main areas of investigation, as listed below:

- o Grout permeability
- o Seal placement techniques
- o Seal integrity testing
- o Integrity of existing seals

The initial portions of this investigation will be primarily a brief literature review in an attempt to define the range and success/failure of possible sealing techniques. Documentation of BWIP seal placement activities will be reviewed for comparison with the literature review results. The last two areas of the investigation will deal specifically with the BWIP piezometer seals in an attempt to determine how their integrity could be tested and to comment on the actual integrity. However, any conclusions regarding the integrity will be based on physical evidence such as techniques and verification procedures used and cement bond logs, as opposed to analyzing the hydraulic responses.

PRODUCT DESCRIPTION:

This technical report will consist of one document containing the summary of the data review and results of the BWIP seal review and analysis.

TASK ASSIGNMENT:

This task is to be prepared by Michael Galloway. The technical reviews will be done by Adrian Brown and Fred Marinelli. QA review of the document will be by Catherine Kraeger-Rovey.

Technical Report Number: 22 (continued)

MANPOWER:

Literature Review:	20
Analysis:	10 hours
Write-up:	10 hours
Subtotal:	40 hours
Review (technical and QA):	10 hours
Final preparation:	10 hours
Total:	60 hours

SCHEDULE:

Not dependent on other work proposed or in progress.