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Hydrogeology • Mineral Resources Waste Management • Geological Engineering • Mine Hydrology

November 6, 1987
Contract No. NRC-02-85-008
Fin No. D-1020
Communication No. 158

Mr. Jeff Pohle
Division of Waste Management
Mail Stop 623-SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: BWIP

Dear Jeff:

We have reviewed several documents prepared by Rockwell Hanford Operations that describe the drilling and tracer testing that was conducted in the pair of boreholes identified as DC-7 and DC-8. These reviews were conducted to assist in our efforts at completing Task #3 (Communication #126). The early documents prepared by Rockwell Hanford Operations contain little information which is evident from the brief nature of the document reviews. This letter outlines our primary concern about the nature of the tracer test conducted at BWIP and the danger of encountering similar conditions in future tracer tests at BWIP or elsewhere.

As you know these boreholes were used during the only tracer tests conducted at any of the proposed high level waste repository sites. Serious questions have arisen about the tracer tests, specifically the most recent test conducted in January of 1982. Considerable interest was generated by us about that tracer test; we initially expressed certain apprehensions during the July 1982 workshop held in Richland, Washington. Our interest has continued regarding this particular test.

As stated above, we first obtained information about this test during the July 1982 workshop. During the July 1982 meeting Dr. Leonhart stated that the cone of impression in borehole DC-8 was approximately 2 feet in elevation whereas the cone of depression in borehole DC-7 was approximately 77 feet. In theory, the magnitude of these cones of impression and depression in their respective boreholes should have been mirror images of each other. They obviously are not. We have explored the possible reason(s) for this disparity during the meetings with Rockwell Hanford Operations. The explanation we received from Dr. Spane at the July 1982

meeting was that the difference was due to plumbing losses in the piping of the well systems.

Another possible explanation for the differences in injection and withdrawal heads could be attributed to the borehole diameter. This explanation is based on the concept that there is less resistance to the movement of water out of or into a larger diameter borehole than out of or into a smaller diameter borehole. Borehole DC-7 has a drilled diameter of 8 5/8 in. Borehole DC-8 has a cored diameter of approximately 3 in. This explanation does not work for the DC-7/8 paired boreholes tracer test because the greater head change occurred in the larger diameter borehole. Obviously another explanation must be sought.

We have raised the specter of aquifer heterogeneity on the scale of the borehole separation at the depth of the test interval (McCoy Canyon flow top). The boreholes are approximately 55 feet apart at the McCoy Canyon flow top. This separation was determined from gyroscopic surveys of both boreholes. Rockwell Hanford Operations was not too pleased with our assertion that the difference in pumping heads could be due to heterogeneity at this scale. The theory developed by Dr. Gelhar for analyzing this recirculating tracer test assumes homogeneous porous media flow.

We have reviewed the following documents that describe the drilling, coring, and hydrogeologic testing of these two boreholes in the hope of finding some evidence that might help answer the critical question regarding the possible occurrence of heterogeneity at the scale noted above. These documents were prepared during the early years of the BWIP project; the lack of completeness of detailed information hampered our effort. But we did find one piece of substantive information from the drilling records for these two boreholes. There was a complete loss of drilling fluid during the drilling of the small diameter borehole (DC-8) in the depth interval equivalent to the McCoy Canyon flow top. There was no reported loss of drilling fluids during the drilling of borehole DC-7. The significance of this finding is that the relative hydraulic conductivity can be inferred for each borehole for the same flow top. A high hydraulic conductivity is required to lose drilling fluid circulation; a low hydraulic conductivity prevents the loss of any significant amounts of drilling fluid. Obviously, other variables must be assumed to be equal such as mud viscosity, the presence of drilling mud additives that prevent fluid loss, drilling rate, and head on the drilling fluid. Our data base is certainly lacking in detail but it appears that the flow top exhibits significant heterogeneity at the scale of 55 feet.

The two well test that was conducted to measure hydrogeologic coefficients (transmissivity and storativity) should be re-evaluated because the pumping well (DC-7) is located in a zone of apparently low hydraulic conductivity. The observation well is located in a zone of higher hydraulic conductivity. Hydrogeologic tests conducted in this manner are adversely influenced by the hydraulic conductivity adjacent to the pumped borehole. Drawdown measured in the observation well reflects this lower hydraulic conductivity; the

resulting transmissivity calculated from data obtained from the observation well is lower than the transmissivity that would have been calculated if the test equipment would have been reversed. We doubt that the equipment could be reversed because of borehole diameter limitations.

Based on the reviews of these documents we believe that the analysis of the tracer test conducted in boreholes DC-7 and DC-8 should be re-evaluated in light of the probable existence of significant heterogeneity around these two boreholes. We recognize that the analysis of this tracer test under heterogeneous conditions may be be beyond the scope of current technology. However, we believe that the effort should be made. A re-analysis of the data may prove invaluable to future tracer testing at all the proposed repository sites. We believe that these facets of the only documented tracer test conducted at any site warrant further research into alternative means of corroborating calculated values of effective porosity. Williams and Associates, Inc. sent a proposal to the NRC in an attempt to find such a method. Our proposal involved the use of storativity calculated from large scale stress tests in association with analysis of barometric and tidal efficiency data. The resultant porosity should be less than total porosity but it probably would be greater than effective porosity. This methodology might be useful although several pitfalls exist. We suggest that the NRC attempt to find a corroborating technology for the quantification of effective porosity.

Sincerely,

Gerry

Gerry Winter

WMGT DOCUMENT REVIEW SHEET

FILE #:

DOCUMENT #: RHO-BWI-C-1

DOCUMENT: Fenix and Scisson, Inc., December 1977, Hole History Rotary Hole DC-7 Hanford, Washington.

REVIEWER: Williams & Associates, Inc., Terry Eckwright

DATE REVIEW COMPLETED: November 6, 1987

ABSTRACT OF REVIEW: APPROVED BY: Roy E Williams

The purpose of borehole DC-7 was to drill through the Umtanum basalt flow to provide a borehole for hydrogeologic testing.

Borehole DC-7 was drilled by rotary methods between October and December 1977 by Century Drilling Company, Shelby, Montana, for U.S. DOE and Rockwell Hanford Operations Dept. of Waste Isolation. Fenix and Scisson Inc. provided drilling supervision, cutting analysis and engineering support.

The original target depth of 3900 feet was exceeded by 199 feet. Total depth of DC-7 was 4099 feet. The open hole diameter is 8-5/8 inch from 2780 feet to 4099 feet. No hydrogeologic testing was performed during the drilling of this borehole.

Drilling chronology, casing schedules, casing tallies, bit record and cementing details are included in tabular form in the document.

BRIEF SUMMARY OF DOCUMENT:

Century Drilling Company of Shelby, Montana, commenced drilling borehole DC-7 on October 19, 1977. A 26 inch conductor hole was drilled to 230 feet and cased to 222 feet. A 17.5 inch hole was drilled to 730 feet with no drilling problems; a 13-3/8 inch diameter casing was set to 728 feet. A 12-1/4 inch hole was drilled to 2780 feet, lost circulation occurred at 833 feet. Other intervals of lost circulation occurred at 1214 feet, 1609 feet, 2452 feet and 2780 feet. The longstring casing was 9-5/8 inch diameter; the casing was set at 2780 feet. An 8-5/8 inch hole was drilled from 2780 feet to 4099 feet. No drilling problems were encountered. This range in depth

encompasses the Grande Ronde Basalt flow which is now referred to as the McCoy Canyon flow.

Tables in the report present casing tallies, design criteria, cementing details, deviation surveys, and mud records. No testing was reported.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

This document is important because it describes the construction of a borehole used for hydrogeologic testing and stratigraphic correlation. Borehole DC-7 in conjunction with borehole DC-8 were use for the only tracer tests conducted at any of the proposed high level waste disposal sites.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

All depths are relative to land surface but no land surface elevation is presented. No water level measurements before, during or after the drilling are reported.

Drilling fluid circulation was maintained throughout the depth range of 2780 to 4099 feet. This depth range includes the Grande Ronde Basalt flow that is now referred to as the McCoy Canyon flow. The maintenance of flow suggests that this borehole did not encounter any zones of high hydraulic conductivity within this drilling interval.

WMGT DOCUMENT REVIEW SHEET

FILE #:

DOCUMENT #: RHO-BWI-C-69

DOCUMENT: Staff, BWIP Systems Integration Dept., Rock Mechanics and Mining Technology Group, 1979, Geologic Characterization of Drill Holes DC-6, DC-8 and DC-4. Final Report, Rockwell Hanford Operations.

REVIEWER: Williams & Associates, Inc., Terry Eikenberg

DATE REVIEW COMPLETED: November 6, 1987

ABSTRACT OF REVIEW: APPROVED BY: Roy Z. Williams

The document presents the results of analyses of core from the Umtanum flow in boreholes DC-6, DC-8, and DC-4. All core were collected on the Hanford site; core analyses were conducted at the laboratory of rock mechanics testing at Colorado School of Mines. The methods of analysis included hand specimen description, microscopic description, and x-ray diffraction analysis. A suite of mechanical and thermal tests also were conducted on the core. Results of the test analyses are not reported in the document.

BRIEF SUMMARY OF DOCUMENT:

This document presents the results of geological characterization studies performed by the Earth Mechanics Institute of the Colorado School of Mines during fiscal year 1979. Basalt was tested from boreholes DC-6, DC-8 and DC-4 in the Umtanum flow on the Hanford site. The document provides detailed descriptions of 255 feet of core from borehole DC-6, 93 feet of core from borehole DC-8 and 195 feet of core from borehole DC-4. All core were obtained from the Umtanum basalt flow. Testing consisted of uniaxial compressive strength tests, triaxial compressive strength tests, static elastic property tests, thermal expansion coefficient tests, rock hardness tests, dynamic wave velocity tests, post-failure deformation behavior tests and density tests. The geological characterization presented in this document includes a lithologic log from hand specimen description, a petrographic description from microscopic analyses, and an x-ray analysis of certain minerals.

Selected samples were chosen for post-test petrographic characterization. These samples had undergone high temperature testing, contained joints or exhibited unusual behavior during testing.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

The detailed lithologic descriptions of the core from the Umtanum flow for boreholes DC-6, DC-8, and DC-4 are important for stratigraphic depth correlation and assessment of potential heterogeneity of hydrogeologic coefficients. Borehole DC-8 was used in conjunction with borehole DC-7 for conducting the only tracer test at any of the proposed sites being considered for the disposal of high level radioactive waste.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

The report is of limited value because of the lack of useful information in the report. The information is not oriented toward hydrogeologic interpretations.

WMGT DOCUMENT REVIEW SHEET

FILE #:

DOCUMENT #: RHO-BWI-LD-37

DOCUMENT: Clawson, T.S., Ledgerwood, R.K., Diediker, L.D., January 1981, Drilling History of the Extension by Coring of Borehole DC-7.

REVIEWER: Williams & Associates, Inc., Terry Eckenrode

DATE REVIEW COMPLETED: November 6, 1987

ABSTRACT OF REVIEW: APPROVED BY: Roy E Williams

The document presents the summary of drilling activities for the extension of borehole DC-7. Borehole DC-7 was deepened 900 feet by coring. A 99.3 percent core recovery rate occurred during the extension coring.

One hydrogeologic test was performed; the results are inconclusive and the data are not presented. Geophysical logging of the extension was conducted but the data are not presented in this document. Lithologic descriptions of the recovered core are presented in a stratigraphic column of the borehole extension.

The report is very limited in scope and therefore limited in use. The hydrogeologic test results are inconclusive.

BRIEF SUMMARY OF DOCUMENT:

This document describes the coring operations in borehole DC-7. Coring was completed in June 1980 by Boyles Brothers Drilling Company of Spokane, Washington. Borehole DC-7 was extended approximately 900 feet from 4100 feet to 5000 feet below ground surface. Ground surface elevation is 543 feet MSL at the well site.

The purpose of borehole DC-7 was for future hydrogeologic testing and cross-hole vertical transmissivity measurements. The extension by coring of borehole DC-7 was to provide additional hydrogeologic data on the lower Grande Ronde basalts.

Few permeable zones were encountered; coring operations were completed in less than the time projected for the project. Drilling problems, as a result of highly fractured rock, were few.

One hydrogeologic test was conducted during coring operations on an interval from 4110 feet to 4493 feet. The zone was pulse tested. The test interval was found to have low permeability; the results were inconclusive. The document states this interval will be included as a part of the continuing BWIP hydrogeologic testing programs on DC-7 and DC-8 using straddle packers and long-term tests (p. 9).

Two series of geophysical logs were run in the cored portion of DC-7 by Pacific Northwest Laboratory. The first series were run April 1980 in the interval from 3802 feet to 4463 feet. The second series were run June 1980 in the interval from 4102 feet to 5008 feet. Tools used included caliper, natural gamma, and neutron-epithermal-neutron.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

This document is of importance in the presentation of lithologic information on the extension of borehole DC-7. Boreholes DC-7 and DC-8 were used during the only tracer tests conducted at any of the proposed high level waste disposal sites.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

The document does not present water level data for the coring operation. This information would be useful in understanding the response to drilling of the stratigraphic units being cored. Document RHO-BW-CR-131P states that the water level was 419.7 feet MSL (Appendix E, page 31). The hydrogeologic test (page 9) does not mention any test data. The pulse test is not described. The description "low permeability" used in connection with this test is not documented or explained.

It appears that it will be difficult to include the cored section of borehole DC-7 as part of the continuing BWIP hydrologic test program with DC-8. Borehole DC-8 has a total depth of 4100 feet; the cored section of DC-7 begins at 4100 feet and continues to 5000 feet.

WMGT DOCUMENT REVIEW SHEET

FILE #:

DOCUMENT #: RHO-BWI-C-29

DOCUMENT: Fenix and Scisson, Inc., October 1978, Drilling History Core Hole DC-8, Hanford, Washington.

REVIEWER: Williams & Associates, Inc., Terry Eckenright

DATE REVIEW COMPLETED: November 6, 1987

ABSTRACT OF REVIEW: APPROVED BY: Roy E Williams

The purpose of core hole DC-8 was to determine stratigraphic depths of basalt and interbed units, to obtain core, and to provide a borehole for hydrogeologic testing.

The document describes the design, drilling, and construction of core hole DC-8 to a total depth of 4100.5 feet in the Grande Ronde Formation.

Core drilling procedures are described and documented. Lithologic descriptions of the core are presented on a scale of 1 inch = 20 feet from 700 feet to 2674 feet, and on a scale of 1 inch = 4 feet from 2674 feet to 4100.5 feet. Fracture data are recorded on Basalt Core Geochemical Data forms to facilitate entry for computer data processing.

Core recovery is reported at 97%. Lost circulation occurred during coring at several intervals during the operation. Casing schedules and cementing details are provided.

Hydrogeologic testing was not performed on borehole DC-8. Water level data were not collected.

BRIEF SUMMARY OF DOCUMENT:

Corehole DC-8 was completed to a total depth of 4100.5 feet in August, 1978, to provide stratigraphic depth determinations for the basalts and interbeds as well as to provide a borehole for later hydrogeologic testing involving borehole DC-7.

Borehole DC-8 was drilled by cable tool from surface to a depth of 690 feet; the hole was cored from 690 feet to 702 feet and from 718 feet to 4100.5 feet. Coring began in the Elephant Mountain Member of the Saddle Mountain Basalt and continued through the Wanapum Basalt and into the Grande Ronde Basalt. Coring was completed 277.5 feet below the base of the Umtanum unit. The Umtanum unit lies between depths of 3559.5 and 3823 feet. Lithology of the core was described on a 1 inch = 20 feet scale from 700 feet to 2674 feet, and on a 1 inch = 4 feet scale from 2674 feet to 4100.5 feet. The corehole was cased to 1612 feet with 4-1/2 inch OD casing. From 1612 feet to 2734 feet 3-1/2 inch OD casing was cemented in place. The hole remains open from 2734 feet to 4100.5 feet.

Partial circulation returns were observed while drilling from 1730 feet to 1765 feet. Circulation was lost at 1830 feet and resumed from 1930 feet to 1973 feet. Drilling mud was observed at ground surface near DC-7; the mud issued from a 2 inch pipe that was connected to the 9-5/8 casing of borehole DC-7. Circulation was lost also at 3450 feet and continued to total depth except for an interval from 3920 feet to 4000 feet when partial mud returns were observed. The depth at which drilling mud circulation was lost (3450 feet) is coincident with the Grande Ronde Basalt flow that is now referred to as the McCoy Canyon flow.

Artesian flows to the ground surface did not occur in borehole DC-8. Several permeable horizons associated with brecciated basalt flow tops and interbed units were indicated by loss of drilling fluid. Mud circulation was lost at 1220 feet in the Cold Creek interbed, at 1830 feet in the Roza Member flowtop, at 1930 to 1973 feet, and at 3450 feet in the seventh Grande Ronde flow breccia.

Hydrogeologic tests were conducted to measure hydraulic conductivity for the interval from 1710 feet to 2700 feet. Testing occurred from June 14 through June 20, 1978. No data are presented in the report.

Tables presented include coring record and lithologic descriptions of the core. All depths presented are relative to land surface.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

This document is important to the Waste Management program because it describes the core drilling of borehole DC-8 which was used for later hydrogeologic testing in conjunction with borehole DC-7. The lithologic descriptions and stratigraphic depth determinations constitute an important part of large scale stratigraphic correlation of rock units in the Pasco basin. These two boreholes were used during the only tracer tests conducted at any of the proposed high level waste disposal sites.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

The elevation of the site and all depths are not referred to mean sea level. Elevations to a common datum are required for proper correlation of geology from borehole to borehole.

During the entire coring operation no reference is made to the measurement of water levels. The only reported water levels refer to drilling with an occasional mention of "fluid levels within a few feet of the surface." A subsequent report lists the static water level for DC-8 as 418.6 feet MSL (Appendix E, p. 31, RHO-BW-CR-131P).

Drilling fluid circulation was lost at a depth of 3450 feet which is coincident with what is now referred to as the McCoy Canyon flow. The loss of circulation suggests the presence of high hydraulic conductivity at this depth in the vicinity of this borehole.

WMGT DOCUMENT REVIEW SHEET

FILE #:

DOCUMENT #: AEG-85-3

DOCUMENT: Leonhart, L.S., Jackson, R.L., Graham, D.L., Gelhar, L.W., Thompson, G.M., Kanehiro, B.Y., and Wilson, C.R., 1985, Analysis and Interpretation of a Recirculating Tracer Experiment Performed on a Deep Basalt Flow Top. Bulletin of the Association of Engineering Geologists, vol. XXII, no. 3, p. 259-274.

REVIEWER: Williams & Associates, Inc., Terry Eckwright

DATE REVIEW COMPLETED: November 6, 1987

APPROVED BY: Roy E Williams

ABSTRACT OF REVIEW:

The purpose of this report is to describe the design, results and analysis of two recirculating groundwater tracer experiments performed on the McCoy Canyon flow top of the Grande Ronde Basalt at the U.S. DOE controlled Hanford Site in southcentral Washington. The experiments were performed in December 1979 and January 1982. The results of these experiments provided numerical estimates of effective thickness and dispersivity. The experiments were performed at approximately 3450 feet below land surface in pair of boreholes separated by about 55 feet at the depth of the McCoy Canyon flow top. Transmissivity is estimated from a pumping test to be 0.7 $feet^2$/day; storativity is estimated to be $3x10^{-5}$. The tracer tests provided estimates of longitudinal dispersivity ranging from 1.5 to 2.8 feet and estimates of effective thickness ranging between $6x10^{-3}$ feet and $1x10^{-2}$ feet. The tracer tests were closed-loop recirculation tests at borehole DC-7 and DC-8 using iodine-131 and potassium thiocyanate tracers. Type curve methodologies were used to interpret the data.

BRIEF SUMMARY OF DOCUMENT:

Two recirculating ground water tracer experiments were performed on the McCoy Canyon flow top within the Grande Ronde Basalt of the Columbia River Basalt Group. The experiments were conducted in December 1979 and January 1982 at the U.S. DOE controlled Hanford site borehole pair DC-7 and DC-8. The borehole pair DC-7/8 is within the southeastern portion of the Cold Creek Syncline of the Pasco Basin. Land surface elevation is approximately 545 feet above MSL.

The McCoy Canyon flow top is described as a high porosity zone located between 3422 feet and 3459 feet BLS (below land surface). Boreholes DC-7 and DC-8 are situated 55 feet apart at the test interval. Both holes are cased across the Vantage interbed and uncased within the Grande Ronde Basalt. A water inflatable straddle type packer was used to isolate the test interval in both boreholes. The straddled interval in borehole DC-7 was from 3410.2 feet to 3477.6 feet BLS (67.4 feet) and in DC-8 the interval was from 3407.0 feet to 3480.4 feet BLS (73.4 feet). The effective interval is believed to be shorter than the test interval based on evaluation of geophysical logs and core data. The effective interval is believed to extend from 3422 feet to 3459 feet BLS (37 feet). The prepumping water level within the test interval was 139 feet BLS.

DC-7 was pumped at 1 gpm during a planned long-term constant drawdown test but the test was terminated after 402 minutes because of excessive drawdown. Water level recovery was monitored for about one week. Drawdown and recovery data were used to estimate transmissivity (0.4 to 0.85 feet^2/day) and storativity (1.1×10^{-5} to 4.1×10^{-5}). The best estimate for transmissivity is 0.7 feet^2/day; the best estimate for storativity is 3×10^{-5}. The average hydraulic conductivity is 0.01 feet/day for the 37 feet thick effective interval.

Borehole DC-7 was pumped at an essentially constant rate of 1 gpm during the tracer test conducted in January 1982. The water was recirculated in a closed loop by injecting the discharged water from DC-7 into DC-8 in equal volumes. Circulation and monitoring occurred for two days with drawdown stabilizing at 77 feet below the static water level in DC-7. A groundwater mound buildup of 2 feet above the static water level occurred in DC-8.

Potassium thiocyanate was poured rapidly into the open surface tubing of DC-8. Break-through occurred at the detection point in approximately 1250 minutes. Peak tracer levels (130 ppm) were observed at about 1420 minutes. Type curve matching techniques were used to interpret the data. The type curve methodology (Gelhar, 1982) is considered to be a more precise solution than two point matching techniques. The estimates of dispersivity for the Hanford basalts from the DC-7/8 tests range from 1.5 to 2.8 feet.

It should be noted that the calculated values of hydraulic conductivity and effective porosity are dependent upon the value selected to represent the effective thickness of the test interval. The maximum value for effective thickness is the distance between the packers, 67.4 to 73.4 feet. Formational heterogeneities probably are present within the McCoy Canyon flow top. The cones of impression and depression at the recharge well (DC-8) and discharge well (DC-7) exhibited "definite asymmetry". The difference in the cones could result from a local pinch-out of a more highly transmissive zone within the flow top.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

This document is important because it describes the design, results and analysis for the only tracer tests conducted at any of the proposed high-level waste disposal sites. The tracer test is the only mechanism currently available for quantifying effective porosity and dispersivity.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

The ground surface elevation of the site is listed as being approximately 545 feet MSL. All other references to elevations are presented as distances below land surface. References to elevations should be based on a common datum (mean sea level) and should be measured from a surveyed bench mark.

The prepumping water level within the test horizon was "approximately" 139 feet BLS in the test horizon. Gelhar (1982) states that the 'static' water level was 419.7 feet MSL in DC-7 and 418.6 feet MSL in DC-8 (Appendix E, p. 31). The one foot difference in measured water levels in the two wells over a separation of only 55 feet was not addressed. The difference in water levels may be indicative of pretest conditions that are not static. The difference may be an indication that the flow top exhibits significant heterogeneity.

The meaning of the phrase "excessive drawdown" (p. 263) should have been explained in detail. One can only assume that during pumping the water level in the well must have declined to a level that placed the submersible pump in jeopardy.

It is stated (p. 270) that transmissivity is 0.7 feet^2/day and effective thickness is 6×10^{-3} feet. These values were presented as a best estimate and an estimate earlier in the report. The wording on this page (270) infers that these values are definite values for these coefficients.

In the discussion on effective thickness it is stated that the impact of thickness H on hydraulic conductivity and effective porosity can be shown by varying thickness, H, within known physical bounds (p. 270). The known physical bounds are the distances between the straddle packers. That distance is not 37 feet as stated; the maximum distance between the packers is 67.4 to 73.4 feet. The 37 feet is an interpreted value based on analysis of essentially qualitative data, geophysical logs and core.

REFERENCES

Gelhar, L.W. 1982. Analysis of Two-Well Tracer Tests with a Pulse Input. Rockwell Hanford Operations, RHO-BW-CR-CR-131P, Richland, Wash.

PDR
LPDR WM-10(2)
WM-11(2)
WM-16(3)

WM Record File D-1000
WM Project 10, 11, 16
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