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

October 31, 1985
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Communication No. 6

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

RE: BWIP

Dear Jeff:

This letter transmits our document review of "Strategy and Preliminary Plans for Large-Scale Hydraulic Stress Testing of Selected Hydrogeologic Units at the RRL-2 Location" by Stone et al. (October, 1984). We have revisited this document because of its importance to the upcoming large-scale stress testing which will take place at the BWIP site this winter. We revisited the document due to its importance and the possibility that additional information could be gleaned from the document based on our meetings with DOE and Rockwell Hanford Operations. We believe there are several points which should be kept in mind based upon our review of the document.

Sincerely

Roy E. Williams

Roy E. Williams

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WMGT DOCUMENT REVIEW SHEET

FILE #:

ROCKWELL HANFORD OPERATIONS #:

DOCUMENT: Stategy and Preliminary Plans for Large-Scale Hydraulic Stress Testing of Selected Hydrogeologic Units at the RRL-2 Location (Stone, R., Rogers, P.M., Jackson, R.L., Lu, A.H. and Moak, D.J., October 1984)

REVIEWER: Williams and Associates, Inc.

DATE REVIEW COMPLETED: October 31, 1985

BRIEF SUMMARY OF DOCUMENT: DATE APPROVED:

The report under review describes the large-scale hydraulic stress test plan for the area near the exploratory shaft site near borehole RRL-2b. The document describes the test plans for the Rocky Coulee, Cohassett, Grande Ronde No. 5 and the Umtanum flow tops. The report under review states that the other "principle facilities completed in the Grande Ronde Basalt Formation that will be monitored during the LHS test at RRL-2 include: 1) piezometer clusters DC-19, DC-20, and DC-22; 2) boreholes DC-16a, RRL-6, and RRL-14; 3) dual borehole site DC-4/5; and 4) McGee well" (page 13). The previously noted sites are located from 1.4 to 4.5 miles of RRL-2b. The report also notes that the ongoing head monitoring program will continue in more distant observation boreholes during testing.

Pumping well RRL-2b will be constructed in stages. The first test will occur in the Rocky Coulee flow top. After testing the

Rocky Coulee flow top the well will be deepened to the Cohassett flow top. The Rocky Coulee flow top will be cemented and cased off prior to testing the Cohassett flow top. The same drilling and cementing-casing sequence will be implemented for the Cohassett flow bottom and the Grande Ronde No. 5 flow top. The last unit to be tested will be the Umtanum flow top which will not be cemented or cased after the completion of testing. The final design depth for RRL-2b is 3,755 feet; the final design diameter is 5.875 inches.

Observation well RRL-2c will monitor fluid pressures in selected flow tops and flow interiors within the Grande Ronde Basalt. RRL-2c will monitor interiors of the Rocky Coulee, Cohassett, and Grande Ronde No. 5 flows. Pressure and depth to water measurements will be obtained from the Rocky Coulee flow top, the Cohassett flow top, and the Cohassett flow bottom. Borehole RRL-2c is located approximately 250 feet east of RRL-2b.

Borehole RRL-2a is located approximately 500 feet from RRL-2b. Borehole RRL-2a is completed as a 2.980 inch diameter borehole. It was drilled to obtain information regarding a wide range of subsurface information. The borehole was hydrofractured during some of the geologic engineering testing. The plans call for the borehole to be retested prior to the installation of straddle packers. The document under review states that hydraulic test zones in the Cohassett flow interior that have been hydraulicly

fractured will be tested to verify the extent to which hydraulic fracturing has altered hydraulic conductivity in the vicinity of the borehole. The document under review states that the Rocky Coulee flow top, the Cohassett flow top, and the Cohassett flow bottom will be monitored in RRL-2a. Installation of the straddle packer system will require the removal of the bridge plug packers which were installed to isolate the zones during the base line data monitoring period.

The report under review states that Rockwell expects to be able to conduct conventional multiple well pumping tests in all flow tops except for the Cohassett flow top. The authors of the report under review believe that the Cohassett flow top has too low a hydraulic conductivity to permit the operation of a conventional pump test. This flow top will be tested by injection or by a pulse method.

Convergent tracer tests will be conducted during the multiple well pumping tests. Tracer will be injected into the same interflow being pumped at well RRL-2b. A tracer will be injected through borehole RRL-2c; a second, distinguishable tracer will be injected into RRL-2a except for the Rocky Coulee flow top.

The report under review states that the first step in the large-scale testing is the parametric analysis. The second step consists of step drawdown tests in the field. The purpose of the step drawdown testing is to verify the pumping equipment which

will be used for the subsequent large-scale constant rate stress testing.

The report under review states that data from the test will be evaluated using both analytical and inverse modeling techniques. The report under review states that a preliminary evaluation of the Rocky Coulee flow top suggests that a test duration of 30 days will result in a drawdown at the test well of between 1,000 and 1,500 feet, assuming a well efficiency of 100 percent.

Discharge from the test will be measured by using four flow meters. The flow meters will be arranged in a series-parallel arrangement. This arrangement will allow for the repair of one series of flow meters should repairs be required. The discharge rate for the pumped well will be regulated by an automatic flow controller. Tracer concentrations will be measured and monitored using an ultraviolet absorption spectrophotometer and a liquid chromatograph. Barometric pressure will be monitored during the test. The temperature of the water discharged from the pumping well will be monitored and recorded also. The report under review states that both drawdown and recovery data will be collected from the multiple well tests.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

This document is very important to the waste management regulatory program. This document outlines the first large-scale

hydraulic stress testing that will be conducted at the BWIP site. This document describes both the conventional pumping test procedures that will be used and the tracer tests which also will be conducted simultaneously at the site. The document describes the monitoring equipment and procedures that will be used and the collection of ancillary data which are required for the complete analysis of the test data.

The DOE stated in the May 1985 meeting that the planned tests at the RRL-2 location will be smaller in scale than are indicated in the document under review. The changes in the test plans will result in cones of depressions that are smaller in areal extent. The smaller cones of depression will reduce the capability of detecting hydrogeologic boundaries. The hydraulic properties quantified from the smaller scale test data will be representative of a smaller volume of saturated material. Another planning document will be required to outline the revised test plan as presented during the May 1985 NRC/DOE meeting.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

We have noted several items in the report under review that we think are sufficiently important to point out. The first item has not been discussed to any degree in any of the workshops that we recall. The document under review (page 21) states that borehole preparation activities will include "brief hydraulic tests of zones in the Cohassett flow interior that have been

hydraulically fractured (during in situ stress measurements) to determine if conductivity in the vicinity of the borehole was materially changed as compared to estimates of conductivity from tests conducted prior to hydraulic fracturing...." This aspect of the pre-large-scale testing is important because it is necessary to verify the integrity of borehole RRL-2a for purposes of packer setting and for monitoring pressures and water levels.

The document under review (page 26) states that inverse modeling techniques using the finite difference numerical model conducted by Trescott (1975) will be used for determination of K_v. We wish to point out that the use of inverse modeling to quantify K_v is subject to many limitations. One limitation can occur due to the manner in which the model is used. We will discuss this limitation later in our review.

The document under review states that pressure measurements will be checked "periodically by water-level measurements" (page 29). This statement indicates a proper approach toward verifying pressure data; however, insufficient details are presented to indicate how frequently the pressure measurements will be verified.

The document under review states (page 30) that the discharge water temperature will be measured and recorded. It further states that measurements will be "collected on a daily basis." It is not clear from these statements how frequently water

temperature measurements will be made and recorded. This point should be clarified to insure that frequent temperature measurements are made during the early portions of the discharge test.

The report under review (page 32) states that test data reduction will begin by converting pressure measurements to equivalent hydraulic head values. It states further that the data will be evaluated first using appropriate analytical techniques. We wish to point out that barometric corrections to the data should be applied prior to the application of conventional analytic techniques. Page 32 states also that "If responses indicate that test conditions diverge from those required to apply certain analytical techniques, numerical techniques of data analysis will be used." We believe that this statement probably is misstated; but the point should be clarified with DOE. The assumptions upon which analytical techniques are applied invariably are violated to some degree in field situations. Violations of the assumptions do not necessarily make the application of analytical techniques invalid or highly inaccurate. Difficulties also arise with the application of inverse modeling techniques.

The report under review states that axially symmetric and quasi-three-dimensional groundwater flow codes are available for analyzing test results by parameter variation techniques. The document under review does not state what codes would be used.

The codes that would be used should be noted in the document under review. The NRC should verify the validity of the codes finally selected.

Tables 1 through 4 indicate the current monitoring intervals for measuring water levels in the boreholes at the BWIP site. We believe that these monitoring intervals should be reconsidered for the large-scale testing due to the possibility that the cone of depression will be quite expansive at early times during the test.

Page 68 of the document under review states that the quasi-three-dimensional model by Trescott (1976) will be used to evaluate the sensitivity of drawdown to parameter variation. We have pointed out in a previous communication to the NRC that the use of the inter-aquifer transfer coefficient (TCF) ignores storativity in the confining units. This omission necessitates that the inverse technique use only late time drawdown data because only late time drawdown data are minimally affected by storativity in the confining units. Early time drawdown data will reflect storativity to some extent.

Figure C on page 73 of the report compares the Theis and Hantush analytical solutions with numerical simulations. The figure readily illustrates the early time deviation from the theoretical evaluation derived from the analytical solutions. The numerical simulation approaches but does not coincide with the correct

analytical solutions until approximately three-fourths of a day has elapsed in the test. This difference indicates that the inverse technique will not be applicable to early time data, as we explained above.

The report under review states (page 80) that a high number of "interactions" were required due to numerical instability in certain case runs. The report under review does not state why the instability occurred nor does it explain "interactions" in sufficient detail. The reasons for the instability should be stated.