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

July 15, 1985
Contract NRC-02-82-044
FIN # B7372-3
Communication #135

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

Dear Matt:

I have enclosed two copies of our review of SD-BWI-TP-039. Please call if there are any questions.

Sincerely,

Gerry

Gerry Winter

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WMGT DOCUMENT REVIEW SHEET

FILE #:

ROCKWELL HANFORD OPERATIONS #: SD-BWI-TP-039

DOCUMENT: Integrity Testing Plans for Selected Hanford Site Monitoring Wells

REVIEWER: Williams and Associates, Inc.

DATE REVIEW COMPLETED: June 1985

BRIEF SUMMARY OF DOCUMENT: DATE APPROVED:

The document under review contains descriptions of the site, geologic setting, and hydrologic setting. These descriptions provide the background for the topic (integrity testing) of the document under review. This document describes the planned tests and the types of geophysical logs which will be used on several boreholes located around the Hanford Reservation. The testing strategy, expected results of the testing, and the possible results of the testing are described for each borehole. The subject boreholes are DB-1, DB-2, DB-4, DB-7, DB-9, DB-11, DB-12, DB-14, O'Brian well, DH-8B, Ford well, and Enyeart well.

The basic testing strategy outlined for these wells and boreholes will be initiated by running several borehole geophysical logs. The logs will be evaluated. A straddle packer system will be installed in the borehole based on the evaluation of these logs. The straddle packer will be installed so that the casing shoe is located between the two packer units. The next phase of the testing consists of either evacuating or filling the annulus with water while monitoring pressure responses in the straddled interval and in the annulus. It should be noted that the term annulus is used in the report under review (see attached figure) to define that portion of the borehole located between the packer assembly connector tubing and the casing in which the packer is installed. This distinction should be noted since the term annulus usually is used to designate that portion of the borehole located between the wall of the borehole and the outermost string of casing. This distinction should be kept in mind when reviewing the predicted results of the testing for each borehole.

The final testing procedure consists of either evacuating or filling the test interval with water while monitoring the annulus and interval water pressures. The outlined methodology is aimed at testing the integrity of the casing shoe and seal at the lower end of the last string of casing. The investigators hope to observe no pressure changes after evacuating or filling the test interval. The length of time allowed for monitoring pressures is not addressed. The absence of pressure change, they believe, will indicate that the casing shoe and the bottom of the casing are sealed. The outlined test strategy is modified for particular instances involving variations from the basic well configuration. These modifications are outlined in the report under review.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

The procedures outlined in the document under review are important to the overall licensing process because these procedures will help verify that the wells are suitable for obtaining high quality water level and/or downhole pressure data. The water level and downhole pressure data are required for the measurement of hydraulic gradient and the direction of ground water flow at the Hanford site. High quality data are required for the site because low hydraulic gradients apparently exist. both in lateral and vertical directions.

PROBLEMS, DEFICIENCIES, OR LIMITATIONS OF REPORT:

A consistent error occurs in the discussion of "Expected Results" and "Possible Results" of the testing throughout the document under review. This consistent error consists of the absence of recognition that the basalts either below the lowermost straddle packer or between the straddle packers probably have a finite hydraulic conductivity. In order for the test results to be interpreted in a unique manner it is necessary that the basalt (interior?) beneath the lowermost packer be essentially impermeable. This information must be assumed because the tests will be conducted in this basalt flow (interior?). This hydraulic conductivity may or may not be sufficiently low to inhibit the movement of fluid and the transfer of a pressure pulse from the test interval or annulus. The descriptions of possible and expected results are adequate for this low hydraulic conductivity case because the investigators are looking for a zero pressure change after imposing a stress. On the other hand, the hydraulic conductivity of the basalts exposed in the borehole may be high enough that a pressure pulse and fluid can be transferred away from the stressed interval. Leakage of fluid around the packer elements may not result in a concomitant, detectable pressure change in an adjacent "isolated" interval because the fluid may bleed-off into the finite hydraulic conductivity basalt in the interval that is assumed to be

"isolated".

The above described deficiency in this report can be noted under Item 6 of "Expected Results" on page 14 of the document under review. This item refers to the integrity testing of borehole DB-1. This item states that the pressure remains constant in interval P2 (see attached figure) subsequent to stressing the interval monitored by P2. We wish to point out that a constant pressure is not possible if the basalt has a finite hydraulic conductivity; some pressure bleed-off into the finite hydraulic conductivity basalt must occur. However, the hydraulic conductivity may be so low that the pressure bleed-off from the stress will be minimal over the test period in which case the pressure may appear to be constant when in reality it is not.

The point that the basalt may have a finite hydraulic conductivity is not considered adequately in the discussion on page 14 under "Possible Results", Item 5a, 6a, and 6c. Item 5a assumes that a pressure change in transducer P2 does not occur although a pressure change does occur in the annulus (P3) after the annulus is stressed. The absence of pressure change in interval P2 is stated as being indicative of a casing leak. This conclusion is not warranted because flow could occur around the packer into the interval P2 without detection by the transducers. Pressure build-up would not occur in interval P2 because the hydraulic conductivity of the basalts would allow the dissipation of the influx of water without a concomitant, measurable increase in pressure. This point is especially relevant due to the moderate sensitivity of the transducers to small pressure changes. The report under review does not describe the amount of head (pressure) changes which will be induced on the units being tested.

Item 6a (page 14) considers the stressing of the interval monitored by transducer P2. Item 6a assumes that a constant pressure detected by transducer P1 is indicative of a good straddle packer seal. As noted above, fluid could move into the P1 zone without causing a concomitant pressure change. The high hydraulic conductivity of the zone could prevent the build-up of pressure at P1. Item 6c makes the same tacit assumption in the description of another possible result of stressing the interval monitored by transducer P2. It is assumed that there is a pressure change in transducer P2 but not in transducer P1. Again, it is possible for fluid to move from transducer P2 to transducer P1 without a measurable pressure increase in transducer P1. The high hydraulic conductivity of the basalt at P1 may allow the dissipation of pressure without causing a measurable pressure change at P1.

The previous discussion is appropriate for subsequent discussions

of testing results in the document under review. The same basic lack of consideration of all possible test results is consistent.

Some uncertainty exists with respect to the design of equipment in borehole DB-9 (page 21-23). Figure 7 (page 22) indicates that the stainless steel screen was set in the bottom of the hole without a riser pipe extending up into the casing. This is not a common well completion practice. No description is given in the document under review with respect to this point. Figure 7 indicates that the screen is separated from the casing by a 29-foot gap. This unusual well completion should be explained in the document under review.

The testing strategy for borehole DB-11 differs from that described for the other boreholes and wells. It appears that Rockwell does not intend to set a packer and tubing string in this well. This well has a sidetracked hole which is open to the annulus between the inner casing and the borehole wall. The apparent test strategy will allow water to flow from the sidetracked hole and interconnected borehole annulus during the monitoring of the pressure in the interval isolated by the inner casing. The second part of the test strategy allows water to flow from the interval below the inner casing during the monitoring of pressure in the borehole annulus that is open only to the sidetracked hole. This procedure will allow Rockwell to determine whether there is an adequate seal at the casing shoe or whether there is an interconnection between units via this sidetracked hole. Rockwell presents the planned test strategy as a means of testing the integrity of the casing shoe seal. The integrity of the casing shoe seal can be verified only if there is no corresponding pressure change in the nonstressed zone. The results of the test will be indeterminate as to whether the pressure response in the unstressed interval is due to the shoe seal leaking or the hydraulic interconnection created by the sidetracked hole.

Borehole DB-14 has two strings of tubing hanging in the well at this time. The testing strategy description and subsequent descriptions of expected results and possible results in this document do not correspond with the numerical order of their presentation as practiced in the other descriptions. This problem of presentation is particularly relevant with respect to the expected results. The expected results are numerically out of order with respect to the numerical order of the testing strategy.

The description of possible results for the Enyeart well (page 35) is not consistent with the numbered items of the testing strategy. This problem with item numbering is noted in our discussion of the previous borehole. This problem leads to

difficulty in interpreting the outline of expected results of the testing. This problem should be clarified in the document under review.

SUGGESTED FOLLOW-UP ACTIVITY:

DOE and Rockwell Hanford Operations should clarify the questions raised in our review of this document. The "Expected Results" of testing and the "Possible Results" of testing are not developed adequately in the document under review. The document should be expanded to present a more comprehensive analysis of the results of the testing. A cursory review of the data developed from these tests could lead to a misinterpretation of the data. Erroneous conclusions can result without a complete understanding of the system being tested.

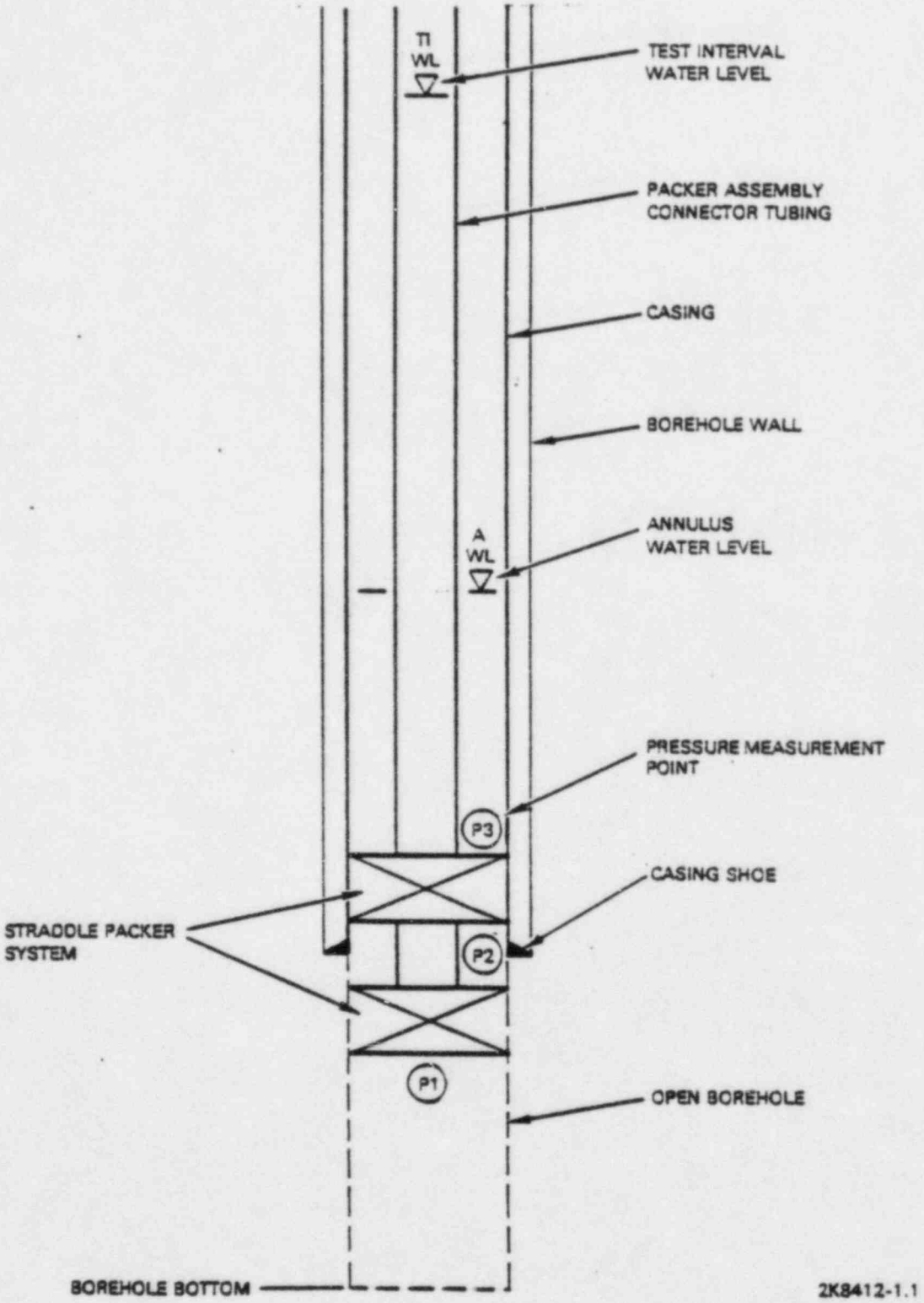

FIGURE 2. Typical Configuration of Straddle Packer System as Used for Integrity Testing.