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MEMORANDUM

TO: Uranerz U.S.A., Inc. Ruth Site, R & D #9

FROM: Jim Finley, Hydrologist

DATE: March 26, 1985

SUBJECT: Baseline Determination

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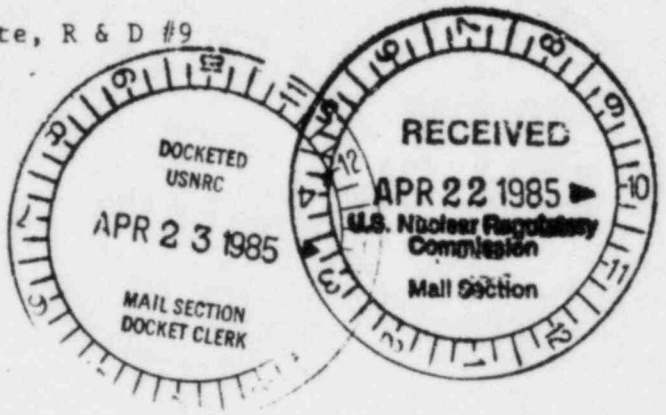

A. Introduction

The objective of this determination evolved in response to a meeting between representatives of Uranerz, DEQ/LQD, DEQ/WQD, and the NRC held December 7, 1984, at the LQD office. Of the several topics discussed, one in particular is addressed in this memo. A determination describing which sets of pre-operation water quality data are valid to use in defining baseline conditions for the 20-sand aquifer.

As a result of this meeting, Uranerz submitted water quality data collected at five wells (I-M-20, 5-M-20, 7-M-20, 4L, and 8L) plus the results of one sampling from each of the 31 wells comprising the ISL well field. Also included was a table representing a compilation of all the available pre-operation water quality data.

B. Discussion

Baseline water quality for the mineralized 20-sand aquifer is presented as Table D-6.9(i) in the approved permit. Wells included in this compilation were 4L, 8L, 1-M-20, 4-M-20, and 5-M-20. Two of these, 4L and 8L, are located within the well field and the others lie outside the well field configuration. A total of 31 samples were used in the production of the table.

In deciding what data to use in a revised baseline evaluation, it is first necessary to check the data to see whether or not there are significant differences between the water quality as a function of well location. The fact that the well field was constructed in its present location suggests that this area is more mineralized than the surrounding zone. As such, there might exist a difference in the observed water quality between those wells within the well field and those outside the well field. The assumption is made that the water quality of the aquifer is homogeneous both outside and inside the well field within the natural variation of the total population. Based upon this assumption statistical comparisons were attempted on the data submitted.

The data were analyzed after splitting the information into two categories. Parameters which occurred in measurable (i.e., detection limit) amounts in all samples were considered as full data sets and those parameters having some non-detectable measures were considered

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as incomplete data sets. Two different statistical schemes were used to evaluate each category of data.

Incomplete Data Sets

In their original baseline determination, Uranerz assigned parameters existing in non-detectable quantities the analytical detection limit when at least one sample in a series was measurable. This elevates the calculated mean statistic and does not accurately estimate the population parameter. Therefore, another statistical comparison was conducted wherein the proportion of non-detectables to detectables was tested in order to determine whether or not the data from outside the well field could be combined with that collected inside the well field.

The resultant statistical test has a binomial distribution since the proportions are determined from counts. Snedecor and Cochran (1974) describe the chi-square test and how it is completed. The previously mentioned assumption of homogeneity implies that the proportion of non-detectable to detectable measures remains constant over time. Acceptance of the null hypothesis, i.e., no difference in the two proportions, suggests that there is no basis upon which to claim any difference between the water within the well field and outside the well field. Results of the tests conducted on a parameter-by-parameter basis indicate that combining the data is valid. The plus signs in Table 1 indicate those parameters which were tested with this statistical procedure.

Complete Data Sets

Calculation of a mean, standard deviation, etc., is possible for any given set of data and these statistics are also useful in comparing two sets of data. The statistical comparison is again whether or not data from outside the well field is sampled from the same population as the data collected inside the well field. Two tests, an analysis of variance and a t-test of means, are potential procedures to make this comparison.

Several assumptions, none of which may be relaxed, control whether or not either of these tests are valid. In a general sense, the populations from which the samples are drawn are normally distributed, the samples are randomly collected, and the variances are equal. The first is checked by plotting frequency diagrams, the second by investigating sampling procedures, and the third by conducting a simple F-test. Normality is generally approached as sample size increases unless some transformation of the data is required.

The majority of parameters with complete data sets did not meet all three assumptions and an alternative comparison was required. Bivariate plots, or plots of one parameter against another, containing data from all wells will graphically indicate whether or not

any discrimination between groups, exists. Based on these plots and statistical tests of those parameters meeting the assumptions, no significant difference exists between samples collected from within the well field and outside the well field.

One parameter, radium 226, was measured in significantly different amounts outside and inside the well field. These two groups of samples represent different populations and can not be combined as they were in the original baseline determination. The variation about the resultant mean is quite large as is seen in Table 1.

Table 1 is a revision of Table D, submitted January 4, 1985. Changes include sample sizes, minimum and maximum levels, and the treatment of parameters with non-detectable measures.

C. Conclusion

Expansion of the original baseline data set is justified and using data collected from outside the well field is valid for this determination. Elevating the mean by assigning non-detectable samples the analytic detection limit is not valid, and the procedures used herein better address the problem of statistically handling non-detectables.

Small sample sizes require the application of alternative statistical techniques unless the ruling assumptions are satisfied. Baseline determinations require close scrutiny of the data before any lumping of data is made. Applying statistical procedures to a set of data without first looking at distributions is not valid and could result in gross misinterpretations of the data collected.

D. Recommendation

As a result of the investigation conducted as well as conversations with both Randy Brich and Kent Peterson of the NRC, and Dick Lennox of DEQ/WQD, the following is recommended:

Table 1 is suggested as a revision of Table D in defining baseline water quality conditions of the 20-sand aquifer. Comparisons of data collected subsequent to the restoration process should follow the same procedures used in this determination.

JF:lg

cc: District III
Dick Lennox, WQD
Randy Brich, NRC
Kathy Ogle
Bill Kearney
Attachments
/jfrd#9/

Reference

Snedecor, G. W. and W. G. Cochran, 1974, "Statistical Methods," The Iowa State University Press, Ames, Iowa, 593 p.

TABLE 1
Baseline Water Quality Data for 20-Sand Aquifer
Pre-operational Data: Wells 7-M-20,
4L&8L, 5-M-20, 1-M-20, and Wellfield Wells

Parameter	N	Max	Min	Mean	Std. Dev.
Temperature, C, Field	47	15	11	13.5	1.05
pH-Field(s.u.)	47	9.4	7.7	8.5	0.32
pH-Lab(s.u.)	49	9.4	6.2	8.1	0.42
Conductivity-Field umhos	41	605	390	440	42.5
Conductivity-Lab umhos	49	636	450	516	35.6
TDS, Evaporation @ 180 C	80	394	288	335	23.7
Sodium	80	129	98	112	5.8
Potassium	56	10	2	4	1.4
Calcium	56	11	1	7	2
Magnesium	56	7	0	2	1.4
Sulfate	80	203	68	101	16.7
Chloride	80	14	2	6	2.2
Carbonate	75	65	0	+	
Bicarbonate	80	207	54	161	33.4
Hydroxide		NR			
Ammonia as N	56	0.30	ND	+	
Nitrate as N	56	0.22	ND	+	
Floride	48	0.85	0.14	0.49	0.03
Total Alkalinity as $CaCO_3$	80	190	64	157	13.7
Total Hardness as $CaCO_3$	56	49	12	26	6.4
Boron	56	0.19	ND	+	
Aluminum	56	0.40	ND	+	
Arsenic	56	0.09	ND	+	
Barium	56	0.08	ND	+	
Cadmium	56	0.008	ND	+	
Chromium	56	0.02	ND	+	
Copper	56	0.02	ND	+	
Iron	56	0.94	ND	+	
Lead	56	0.15	ND	+	
Manganese	46	0.07	ND	+	
Mercury	56	ND	ND	+	
Nickel	56	ND	ND	+	
Selenium	55	0.04	ND	+	
Zinc	46	0.89	ND	+	
Molybdenum	56	ND	ND	+	
Uranium, U_3O_8	80	0.335	ND	+	
Vanadium, V_2O_5	56	0.07	ND	+	
Radium 226, pCi/L	25	225	0.6	111	61.6

+ indicates no mean or standard dev. was calculated because of the occurrence of non-detectable levels of the particular parameter
ND - non-detectable
NR - not reported