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MAR 2 1984

Mr. O. L. Olson
U. S. Department of Energy
Richland Operations Office
BWIP Project OFfice
P. O. Box 550
Richland, WA 99352

Dear Mr. Olson:

SUBJECT: DOCUMENT RHO-BW-CR-140P, "NUMERICAL MODELING OF PARAMETRIC UNCERTAINTIES"

We appreciate the opportunity of reviewing a draft copy of document RHO-BW-CR-140P, "Numerical Modeling of Parametric Uncertainties: Development and Initial Testing of PORSTAT". The report has been examined by the staff of NRC's Division of Waste Management, by Golder Associates, Inc., and by Sandia National Laboratories.

NRC recognizes the need for a stochastic approach in analyses of Hanford Reservation hydrology, and the second order method, along with its numerical application PORSTAT, appears promising. As described in the subject document, PORSTAT appears to be in a developmental stage. For this reason, we believe that questions about the effectiveness and appropriateness of applications of PORSTAT to analyses of the Hanford Site can be addressed only through sensitivity studies and further testing. We suggest that BWIP consider such work in order to verify the correctness of PORSTAT's computed solutions, qualify its advantages and disadvantages over random sampling methods, and further delineate the method's limitations.

A summary of the principal comments that we can make at this time is provided below. Specific comments from the NRC staff and contractors are attached.

Summary of Principal Comments by NRC and Contractors

1. The second-order method outlined in the subject document appears to be a sensible and economical approach toward accounting for uncertainties in hydrologic parameters. BWIP should, however, consider performing additional studies in order to weigh the advantages of PORSTAT against the loss of unbiased (infinite-order) statistics, as compared to random sampling (e.g., Monte Carlo) methods. The discussion on page 20 of the subject document appears

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to indicate that the truncation of terms of higher order than two in the Taylor series expansion of hydraulic head with the second-order method may be the cause of differences in test case results between PORSTAT and Monte Carlo simulations. DOE should consider exploring further the sensitivity of PORSTAT to the truncation of moments and sensitivity coefficients of order higher than two.

2. As noted in the document title, the PORSTAT code has only been subjected to initial testing (two sample test problems). Testing PORSTAT with more complex sample problems, including nonisothermal cases and cases where boundary conditions, initial conditions, and storativity are random variables as well as hydraulic conductivity, should be considered in order to verify the code.

3. BWIP should consider the possibility of addressing more fully the limitations of the second-order analysis in application to Hanford site hydrology. In particular, the limitation of second-order analysis application "to problems where the parameter uncertainties are not large" (p. 5) may reduce PORSTAT's applicability to BWIP.

4. NRC considers that the method by which deterministic treatments of heat transport are coupled to the stochastic analysis of groundwater flow is unclear. BWIP may wish to consider the value to the reader of clarification of this aspect of the code.

5. Once the second order method and the performance of PORSTAT have been verified and demonstrated, BWIP may wish to consider the value of extending the method to allow a stochastic approach to contaminant transport.

If you have any questions, please contact Matthew Gordon of the Division of Waste Management (FTS 427-4133), who is responsible for this review.

Sincerely,

"ORIGINAL SIGNED BY"

Robert J. Wright
Senior Technical Advisor
Repository Projects Branch
Division of Waste Management

Attachments:
As stated

OFC	WMGT	WMGT	WMRP	WMRP		
NAME	MGordon:dm	MRKnapp	RJWright	HJMiller		
DATE	2/28/84	2/29/84	3/1/84	3/1/84		

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ATTACHMENT 1

Specific NRC Comments

Comment	Pages	
1	3	PORSTAT solves the flow equations stochastically, while the heat and contaminant transport equations are solved deterministically. The authors' statement that uncertainties in transport parameters are relatively small is unproven and does not justify the non-use of a stochastic approach to contaminant transport.
2	6	The inclusion of a separate section for discussion of the adjoint method (Sec. 2.3) outside of the "Review of Groundwater Flow Uncertainty Analysis Methods" (Sec. 2.2), is confusing. Since the adjoint method is not used by PORSTAT, the section may be less confusing if directed towards a general discussion of methods of computation of sensitivity coefficients.
3	7	The separation of the "buoyancy gradient" term (B) in the groundwater flow equation (1) is unusual. A discussion of the decoupling of B from the pressure term would be helpful to the reader. Also, the term B as defined in equation (3) does not appear to represent a gradient.
4	9	In equation (6), it appears that the fourth product term, A (I, J-½, N+1) should be A(I, J-½, N).
5	15	In equation (23), the factoring out of [R] from equation (17) is unclear, particularly since it contains a stochastic quantity (S_s).
6	16-29	The two test cases examined are both isothermal, near-field problems with hydraulic conductivity as the only random

Comment	Pages	
		variable. More complex cases should be examined. PORSTAT should be tested using conceptual models more closely resembling the Hanford site, in order to demonstrate and support application to BWIP.
7	25	The 54% difference between standard deviations computed by PORSTAT and by MAGNUM-MC requires further examination.
8	16-29	It would be interesting to see the difference between computed moments of darcy velocity, as well as hydraulic head, between the two models (PORSTAT and MAGNUM-MC).
9	Section 2 or 3	It would be helpful to the reader to have, in an early section of the report, a tabular list of the assumptions on which the PORSTAT code is based, including the assumptions inherent in the second-order method.