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March 18, 1986

Mr. Neil Coleman
Geotechnical Branch, NMSS
Division of Waste Management
U.S. Nuclear Regulatory Commission
7915 Eastern Avenue
Silver Spring, MD 20910

Dear Mr. Coleman:

Enclosed please find a report which outlines issues pertaining to software and hydrology which were discussed at the January 27-29 workshop on "Validation of Mathematical Models for Waste Repository Performance Assessment." Please feel free to contact me if you have any questions or comments.

Sincerely,

Ginger Wilkinson

G. F. Wilkinson
Waste Management Systems
Division 6431

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Software and Hydrologic Issues Raised
at the January 27-29 Validation Workshop

On January 27-29, 1986, the NRC's Office of Nuclear Regulatory Research sponsored a workshop entitled "Validation of Mathematical Models for Waste Repository Performance Assessment." The purpose of the workshop was to bring together experimentalists and mathematical modelers to build a basis and consensus for confidence in model predictions and to define critical experiments for testing models and their supporting assumptions.

One area of discussion which was of particular interest to FIN A-1158 involved validation of computer software. The opinion was expressed that, at present, there are too many codes being used for waste management applications and that it is unrealistic to expect complete validation of all codes that are proposed for use. Some confidence can be gained for a code, however, through benchmarking activities--comparing codes which use different techniques to solve similar problems. Opposition to the idea of limiting the number of codes was expressed by some who felt that there could never be too many codes. They maintained that a modeler could get better results from a code which he developed, even if somewhat inferior, than with one which he could understand only superficially. This led to the idea of coupling an "expert" versus an "amateur" with a code.

In response to this discussion, the participants were reminded that the uncontrolled multiplicity of the codes would indeed need to be checked, since ultimately the NRC staff would be using the codes and they could not be "experts" with all of the codes.

In addition, there were several hydrologic issues raised at the workshop:

1) POROUS MEDIA

The problem with validating ground-water flow models for porous media arises not out of any concern that Darcy's law is not valid, but out of our inability to adequately describe the geology that controls the flow. While some numerical techniques for addressing this issue were discussed, no experiments were proposed or identified which could be used to validate these techniques.

2) FRACTURED MEDIA

Major problems still exist with identifying appropriate techniques of modeling fracture flow and, therefore, it is

critical that experiments be identified or designed to address the fundamental differences between the equivalent porous media, dual-porosity, and discrete fracture approaches.

3) UNSATURATED FLOW IN FRACTURED ROCK

The problem with validating models for unsaturated flow is more basic than any of the problems mentioned above. That is, the physics of the flow are not completely understood. Therefore, most of the discussions about validation-type experiments centered around whether the flow would occur as film flow along fracture walls, as plug flow in fractures, or as flow within the rock matrix.

4) GROUND-WATER FLOW MODELS IN GENERAL

A generally-accepted viewpoint arising from the workshop is that models will only be validated if they are able to either mimic experimental results (either field or lab) by using independently-derived parameters with no adjustment of these values or mimic two sets of data with adjustments allowed in reproducing the results of the first set. For ground-water flow models, we are unaware of any model that has adequately simulated a real system without some sort of calibration. In addition, ground-water models developed to predict water-level trends have a relatively poor track record.

A final point that was raised by several participants is that when we are talking about validating ground-water flow models we mean the code plus the conceptual model and input parameters. Therefore, validation is only meaningful on a site-specific basis.

A transcription of the proceedings is currently being prepared under FIN A-1266, as well as a formal report which will contain a synthesis of the major points and experiments which were identified to answer validation questions.