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U.S. Nuclear Regulatory Commission
ATTN: Ms. Deborah A. DeMarco
Office of Nuclear Materials Safety and Safeguards
Program Management, Policy Development and Analysis Staff
Office of the Director
Mail Stop T8-A23
Washington, DC 20555

Subject: Transmittal of Abstract for Probabilistic Safety Assessment and Management (PSAM) Conference

Dear Ms. DeMarco:

The purpose of this letter is to transmit for your programmatic review an abstract proposed for presentation at the Probabilistic Safety Assessment and Management (PSAM) Conference to be held in San Juan, Puerto Rico, from June 23–28, 2002. The abstract by O. Pensado, G. Wittmeyer, B. Sagar and V. Troshanov is entitled "A Partitioning Method for Identifying Important Model Parameters."

This abstract is being submitted simultaneously to the PSAM 6 organizing committee for approval; however, if this abstract is found to be programmatically unacceptable, it will be withdrawn from the conference.

Please advise me of the results of your programmatic review. Your cooperation in this matter is appreciated. If you have any questions regarding the technical content of the report please contact O. Pensado at (210) 522-6084.

Sincerely yours,

Budhi Sagar, Ph.D.
Technical Director

BS/cw

cc:
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A Partitioning Method For Identifying Important Model Parameters

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ABSTRACT

For complex models incorporating multiple stochastic parameters, it is frequently helpful to determine the parameters that most influence an output, and values at which they can become influential. In this paper, we describe a novel method for accomplishing this task. This technique, referred to as partitioning method, has greater power in identifying possible correlations among variables than traditional methods such as linear regression.

The motivation for the partitioning method was to develop a technique to analyze results of a model to assess the performance of the proposed geologic repository at Yucca Mountain, Nevada. The model, implemented in a code called the Total-system Performance Assessment (TPA) code, has over 300 parameters that have assigned probability distributions. The code is executed in a Monte Carlo mode using the Latin Hypercube method to sample values of the stochastic parameters. The main output of the code is a large number of realizations, each realization consisting of annual dose as a function of time, and a mean dose rate as a function of time calculated from these realizations. Each realization is associated with a particular set of values of input parameters. Regulations require that the maximum (or peak) of this mean annual dose within 10,000 years is below a specified value. The partitioning method is used to identify the set of most important stochastic parameters affecting the peak of the mean annual dose.

An outline of the partitioning method is provided as follows. Let the time of occurrence of the peak mean annual dose be T_p. Partition the output realizations into two bins, one bin containing those realizations contributing the most to the peak mean annual dose (contributing realizations) and a second bin enclosing all the remaining realizations (non-contributing realizations). For example, the contributing realizations can be those in which the annual dose at T_p is greater than the peak mean annual dose. In general, only a small fraction of the total are contributing realizations. Let A be the parameter whose importance is to be evaluated. Plot a cumulative distribution function and a complementary cumulative distribution function for the set of values of A that are associated with the contributing and non-contributing realizations, respectively. Let (A_i, P_A) be the coordinates of the intersection of these two curves. The probability value P_A is an index that can be used to measure the importance of the parameter A. Low values of P_A are associated with an evident partitioning of parameter A related to the contributing and non-contributing realizations. The more evident the partitioning (i.e., the lower the value of P_A), the more important is the parameter A. P_A values in the range of 0.4 – 0.6 suggest a lack of partitioning and a lack of importance of the parameter. Large values of P_A (> 0.6) also suggest existence of partitioning and that the parameter is important, but in this case high values of the parameter are associated with low values of the peak mean annual dose and vice versa. Another

interesting interpretation of A_i is that if P_A is small then there is greater likelihood of $A > A_i$ for contributing realizations and $A < A_i$ for non-contributing realizations. In summary, for a parameter A, P_A identifies the degree of partitioning of the range into two sets related to contributing and non-contributing realizations, and A_i defines a partitioning value. Direct comparison of the P_A values for all of the parameters yields the most important (those with very low and very high values of P_A) parameters in the stochastic model.

Although there was a direct motivation to analyze the performance assessment model of a geologic repository, the method is quite general and can be applied to the analysis of any data in which the output depends upon stochastic input parameters. In the particular example of the geologic repository, the partitioning method indicated that the peak mean annual dose rate is influenced most by parameters controlling the rate of release of radionuclides, corrosion rates of container materials, the amount of water available for radionuclide transport, and sorption coefficients for neptunium, which was the main radionuclide contributing to the dose in 100,000 yr computations.

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