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Dr. Daniel Fehringer, Project Officer
Division of Waste Management
MS 623 SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Contract No. NRC-02-81-026
Benchmarking of Computer Codes and Licensing Assistance
Letter Report on Code Selection for the Waste Package Codes

Dear Dan:

This letter report includes our recommendation on the codes to be benchmarked in the waste package area. The code recommendations are based on the following selection criteria:

- Codes likely to be used by DOE for repository licensing purposes
- Codes that will provide for analysis of important waste package phenomena
- A number of codes consistent with the project budget

Overall, we are recommending five waste package codes. These codes are discussed briefly below:

- WAPPA is an overall waste package performance assessment code that can analyze the effects of radiation damage, temperature and thermal effects, mechanical stresses, corrosion, and leaching. We would plan to benchmark the individual process modules of the WAPPA code during the course of this work and compare the predictions from WAPPA with predictions from more detailed and sophisticated design codes. It is important to note that sophisticated codes for analysis of corrosion and leaching of the waste package are not yet available although at least two major development efforts for such codes are underway.
- ANSYS is a computer code capable of performing thermal and mechanical analyses. ANSYS is considered to be one of the more widely used codes for these assessments. DOE has indicated that it will use this code for waste package design analyses.

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- ANISN is a one-dimensional shielding code that can be used to estimate the radiation field around a cylindrical waste package. Analysis of more complex waste package forms (e.g., other than cylindrical geometry) may require the use of a two- or three-dimensional shielding code (e.g., MORSE).

- HEATING6 is a thermal analysis code that will be used by DOE for waste package thermal analysis. HEATING6 can be used for phase change analyses.

- COVE1 is a creep buckling computer program that can be used to assess the likelihood of geometric instability associated with creep-enhanced ovality of a thin-walled tube. If DOE proposes waste package designs that are relatively thin, assessments using a code such as COVE1 will be necessary.

We believe that this set of computer programs will give the NRC capability for extensive in-house analysis of a waste package and will allow us to benchmark codes that are most likely to be used by the DOE in waste package performance assessment and design. We believe that the major deficiency in the waste package code area is the lack of computer programs that can be used for detailed engineering assessments of corrosion and leaching of waste package materials.

In addition to the five codes recommended above, the following codes may provide useful features for waste package analysis.

- ADINAT is available to the NRC at BNL for thermal analysis including phase change. While the code does not have all the capabilities of ANSYS or HEATING, it may be used by NRC for waste package analysis.

- ADINA and SAP are available to the NRC at BNL for structural analysis. These codes are less flexible and have fewer capabilities than ANSYS.

- HYDRA is capable of analyzing a specialized thermal problem, an intact 15 x 15 fuel assembly in a canister. If thermal analysis of intact fuel assemblies will be required, we would recommend benchmarking HYDRA.

- BUCKLE, BOSOR5, and STAGS are creep buckling computer codes. They may be used to complement the capabilities of the code COVE1.

- WECAN is a structural and thermal analysis code developed by Westinghouse. The code has capabilities similar to those of ANSYS and is likely to be used by Westinghouse for waste package design analysis.

We would like your guidance as to whether these codes should be considered for benchmarking.

If you have any questions regarding these recommendations or wish to discuss them further, please contact me.

Sincerely,

Douglas K. Vogt

Douglas K. Vogt
Project Manager

cc: Pauline Brooks