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MEMORANDUM FOR: Pauline Brooks
                  Repository Projects Branch
                  Division of Waste Management, NMSS

FROM: Timothy C. Johnson, Section Leader
                  Materials Engineering Section
                  Engineering Branch
                  Division of Waste Management, NMSS

SUBJECT: COMMENTS ON BENCHMARKING COMPUTER CODES PDR

In response to your note of 5 February 1985 (Ref. 1), we have examined
CorSTAR's letter of 18 January 1985 (Ref. 2) regarding benchmarking of computer
codes. In that letter, CorSTAR re-examines the selection of codes previously
nominated (by CorSTAR) for the benchmarking process. Their conclusions remain
unchanged. That is, five specific codes (WAPPA, ANSYS, ANISN, HEATING 6 and
COVE1) should be benchmarked. We agree that these five computer codes form a
representative set of codes that could be used in the analysis of high level
radioactive waste repository performance.

Before developing our specific comments on the CorSTAR selection, we have
reconsidered the goals of the benchmarking exercise. We believe there are two
possible aims of this program:

1. Assess the adequacy of the computer codes to be used by the DOE in the
    performance analysis of high level waste repositories.

2. Develop a set of (not necessarily independent) audit codes, suitably
    benchmarked and verified, to be used by the NRC in confirming the
    adequacy of computer codes used by the DOE in performance analysis of
    high level waste repositories.

In the first case, the goal appears premature for a number of reasons outlined
below. In the second case, it is our opinion that the NRC has insufficient
resources to properly develop and maintain an independent set of audit codes
for the high level waste repository program. This opinion appears to be shared
by the Repository Projects Branch.

    "The NRC staff will not have sufficient resources available to it to
    independently develop, operate and maintain a full suite of codes for all
    facets of repository performance." (Ref. 3)

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Because we appear to be in agreement that Item No. 2 is not the goal of the benchmarking process, we have focused our attention on Item No. 1. We believe that further action in the benchmarking process is inappropriate (at this time) because:

° It is not clear that comments of ourselves (e.g., Ref. 4) and others on the benchmark problem report have yet been addressed by CorSTAR.

° Many of the codes to be used by the DOE have either not yet been identified or are currently being modified in anticipation of the licensing process. It would be inappropriate to benchmark a code (or version of a code) which will not be used in the licensing process.

° There is a possibility that NRC's continued activity in the benchmarking process at this time will lead to modification or elimination of the DOE benchmarking process. There is some evidence (Ref. 5) that this may already be the case.

It is our opinion that the DOE should benchmark the codes selected for the repository performance analysis and the NRC should review the benchmarking - insisting on additional information or performing confirmatory analysis if required.

With regard to the specific codes selected by CorSTAR, we have the following comments to offer. [It should be noted that CorSTAR has already performed a review of the codes (Ref. 6), which may be sufficient for the time being].

ANSYS -   This code is capable of performing simultaneous thermal and structural analysis. It has been verified against a list of analytical solutions, but has not been compared to experimental results. The BWIP repository tests are to be modeled by ANSYS.

ANISN -   This is a radiation code that has been used since the 1960's for neutron shielding calculations. Assuming that the capture cross-sections of waste package materials are sufficiently well known (and they should be except in the case of packing materials), the code should be able to predict radiation levels in a satisfactory manner because the physics methods are unchanged. The code has been verified on shielding analytical solutions and it may have been validated. It has not been validated on nuclear waste problems.

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HEATING 6 - This is a general thermal analysis finite element code.
It has been verified against numerous analytical solutions.
However, Brookhaven has pointed out that the DOE will probably
use TEMPV5 rather than HEATING6 because it takes less time to
run. However, TEMPV5 is not yet available to the public.

COVE1 - This code predicts creep collapse phenomena. It has not been
verified, although it has been compared against other stress
analysis codes. Since it is a creep code, it is most
applicable to salt, but DOE does not mention it in the
Salt-EAs. DOE refers to WAPPA, ANISN-W, HEATING 6/5, but not
ANSYS or COVE1.

WAPPA - Brookhaven National Laboratory has thoroughly documented the
deficiencies of WAPPA (Ref. 7) and has recommended that nothing
further be done by NRC except to keep it readily operable in
its most recent form.

We conclude that further effort on this program should be redirected towards
improving the existing set of benchmark problems, rather than application of
the existing problem set to those codes identified in CorSTAR's letter of 18
January 1985.

If you require further information concerning our comments, please call me on
extension 74088.

Original signed by

Timothy C. Johnson, Section Leader
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REFERENCES

1. Pauline Brooks (NRC) note to Timothy C. Johnson (NRC) on "Updating of Codes for Benchmarking in the Waste Package Area (CorSTAR FIN B-6985)," dated February 5, 1985.

2. D.K. Vogt (CorSTAR) letter to P. Brooks (NRC) on "Contract No. NRC-02-81-026, Benchmarking of Computer Codes and Licensing Assistance," dated January 18, 1985.

3. Revised Modeling Strategy Document for HLW Performance Assessment, Draft NRC Document 3111/DJF/84/02/14/0, page 23, February 14, 1984.

4. J.C. Voglewede (NRC) memorandum for P.P. Brooks (NRC) on "Review of Draft Report, 'Benchmark Problems for Waste Package Computer Codes'" dated November 14, 1984.

5. Salt Repository Project Technical Progress Report for the Quarter 1 April -30 June, 1984, Office of Nuclear Waste Isolation Report ONWI-9(84-3), page 13, Battelle Memorial Institute, Columbus, OH.

6. W. Coffman, D. Vogt and M. Mills (CorSTAR Research, Inc.), A Summary of Computer Codes for Waste Package Performance Assessment, U.S. Nuclear Regulatory Commission Report NUREG/CR-3699, March 1984.

7. C. Anderson et al. (BNL), Review of Waste Package Verification Tests, Biannual Report, U.S. Nuclear Regulartory Commission Report NUREG/CR-3091 (BNL-NUREG-51630, Vol. 6), To be published.

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