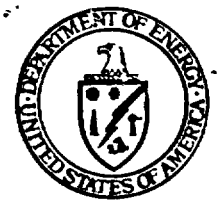
FC: Joe Youngblood, NRC



Department of Energy
Washington, DC 20585

DEC 15 1988

Mr. Richard Cunningham, Director
Division of Industrial and
Medical Nuclear Safety
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Cunningham:

The enclosures to this letter are documents describing the COBRA-SFS and HYDRA-II computer codes. These codes were developed for the Department of Energy by Battelle's Pacific Northwest Laboratory (PNL) to evaluate the thermal hydraulic performance of a wide variety of systems, including dry spent fuel storage casks. We are submitting the enclosed materials for your review and acceptance so that they may be designated by the NRC as acceptable for use by the nuclear industry.

The Department developed COBRA-SFS and HYDRA-II under the provisions of section 218 of the Nuclear Waste Policy Act (NWPA) of 1982. Specifically, section 218 requires that the Department of Energy provide generic research and development of alternative spent fuel storage systems to assist utilities in their licensing activities for interim at-reactor storage, which are covered under section 133 of the NWPA. The codes being submitted are intended to perform design calculations, which would be used as part of the basis for license submittals to the NRC for spent fuel storage systems. We do not recommend that COBRA-SFS and HYDRA-II replace presently approved codes, only that they be added to the pool of existing approved codes.

The enclosed COBRA-SFS and HYDRA-II documentation consist of a theory volume, user's manual, validation assessment, and a maintenance QA plan. The maintenance QA plan, which was written following the guidelines set in NUREG-0856, "Final Technical Position on Documentation of Computer Codes for High-Level Waste Management", will be used if the Department decides to update the codes.

Both COBRA-SFS and HYDRA-II are designed to analyze storage systems in three dimensions, considering all three heat transfer processes (conduction, convection, and thermal radiation) using conservation of mass, momentum and energy principles. Both codes were written in FORTRAN 77 and developed to be run on CRAY computer systems. It is possible to run COBRA-SFS on a workstation, however further

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customization would be needed. Copies of either code can be obtained from the Argonne code center.

The validation assessment for COBRA-SFS began with simulation of simple phenomena in simple geometries and proceeded systematically to complex phenomena and geometries. Fourteen case comparisons were made of the COBRA-SFS predictions with the test data from six separate spent fuel storage tests. The results of the comparisons demonstrated that COBRA-SFS was successful in predicting the thermal performance of single, multiassembly, and consolidated assemblies under a variety of backfills (air, helium, nitrogen, and vacuum), heat loadings, and orientations (vertical, horizontal, and inclined). These results demonstrate that COBRA-SFS can be used for designing and licensing safety analyses of spent fuel storage systems. All of the test comparisons are found in Enclosure 3.

The validation assessment for HYDRA-II was also based on a comparison of the computer code temperature distribution predictions with spent fuel storage tests. Eleven case comparisons were made from experiments employing four separate spent fuel storage tests. The results of the comparisons demonstrated that HYDRA-II was successful in predicting the thermal performance for single and multiassembly storage configurations under a variety of backfills (air, helium, and vacuum), heat loadings, and orientations (horizontal, vertical, and inclined). These results demonstrate that HYDRA-II can also be used for designing and licensing safety analyses of spent fuel storage systems.

The HYDRA-II code was also verified by comparisons of code predictions with analytical solutions to a simple pure-conduction problem (no fluid transport), and with detailed data obtained both experimentally and from separate numerical simulations from a simple-geometry, buoyancy driven, cavity problem. For both comparisons, HYDRA-II agreed well with the analytical results. All of the validation and verification test comparisons can be found in Enclosure 7.

The Department requests that you review the enclosed materials and, if you find the codes to be acceptable, endorse them as such in a Regulatory Guide or other appropriate NRC guidance document. If you have any questions or desire additional information, please do not hesitate to contact me (586-6046), Charles Head (586-9606) or James Creer

(503) 376-5853 (FTS 444-5853) of PNL. In addition, we would be happy to arrange briefings on any aspects of the code's development, verification or use, if you would desire.

Thank you for your assistance in this matter.

Sincerely,

Ralph Stein
Associate Director for Systems
Integration and Regulations
Office of Civilian Radioactive
Waste Management

Enclosures:

1. COBRA-SFS: A Thermal Analysis Computer Code, Volume 1: Mathematical Models and Solution, PNL-6042, Vol. 1.
2. COBRA-SFS: A Thermal Analysis Computer Code, Volume II: User's Manual, PNL-6049, Vol. 2.
3. COBRA-SFS: A Thermal Analysis Computer Code, Volume III: Validation Assessments, PNL-6049, Vol. 3.
4. COBRA-SFS: Maintenance QA Plan, QAP No. APC-011 Rev. O.
5. HYDRA-II: A Hydrothermal Analysis Computer Code, Volume 1: Equations and Numerics, PNL-6206, Vol. 1.
6. HYDRA-II: A Hydrothermal Analysis Computer Code, Volume II: User's Manual, PNL-6206, Vol. 2.
7. HYDRA-II: A Hydrothermal Analysis Computer Code, Volume III: Verification/Validation Assessments, PNL-6206, Vol. 3.
8. HYDRA-II Maintenance QA Plan, QAP. No. APC-013, Rev. 0.
9. Comparison of HYDRA-II Predictions to Temperature Data from Consolidated and Unconsolidated Model Spent Fuel Assemblies, PNL-6630.

cc:
J. Roberts, NRC 6-H-3
D. Kenyon, DOE/RL
Jim Creer, PNL