PACKAGE ID - 000135MLTPL01 COBRA-SFS CYCLE 3

KWIC TITLE - Thermal Hydraulic Analysis of Spent Fuel Casks

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LIMITATION CODE -UNL **AUDIENCE CODE -** UNL

COMPLETION DATE - 09/01/1997 **PUBLICATION DATE -** 09/01/1995

DESCRIPTION - COBRA-SFS (Spent Fuel Storage) is a code for thermal-hydraulic analysis of multi-assembly spent fuel storage and transportation systems. It uses a lumped parameter finite difference approach to predict flow and temperature distributions in spent fuel storage systems and fuel assemblies, under forced and natural convection heat transfer conditions. Derived from the COBRA family of codes, which have been extensively evaluated against in-pile and out-of-pile data, COBRA-SFS retains all the important features of the COBRA codes for single phase fluid analysis, and extends the range application to include problems with two-dimensional radiative and three-dimensional conductive heat transfer. COBRA-SFS has been used to analyze various single- and multi-assembly spent fuel storage systems containing unconsolidated and consolidated fuel rods, with a variety of fill media, including air, helium and vacuum. Cycle 0 of COBRA-SFS was released in 1986. Subsequent applications of the code led to development of additional capabilities, which resulted in the release of Cycle 1 in February 1989. Since then, the code has undergone an independent technical review as part of a submittal to the Nuclear Regulatory Commission for a generic license to apply the code to spent fuel storage system analysis. Modifications and improvements to the code have been combined to form Cycle 2. Cycle 3., the newest version of COBRA-SFS, has been validated and verified for transient applications, such as a storage cask thermal response to a pool fire.

PACKAGE CONTENTS - Media Directory and Installation Instructions; Software Abstract; Media Includes Source Code, Text Library, Auxiliary Material, Compilation Instructions, Linking Instructions, Sample Problem Input and Output Data, PNL-10782;

SOURCE CODE INCLUDED? - Yes

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MEDIA QUANTITY - 1 CD Rom

METHOD OF SOLUTION - The solution of the governing equations for fluid flow and heat transfer in COBRA-SFS is fully implicit and proceeds iteratively through a series of steps that address each of the conservation equations in turn. Within an iteration the code solves the momentum equations for the velocity field, then the energy equations for the temperature and enthalpies, and then the mass continuity equation for the pressure field. The finite difference equations for mass, momentum, and energy conservation are solved using a Newton-Raphson technique that is similar to Hirt's method, but has been made implicit in time. The fluid solution is applicable to single-phase flow at very low velocities, with or without buoyancy driven natural circulation. The code can also resolve flow and pressure fields in which the net flow is zero, allowing solutions for sealed storage or shipping casks. The strong coupling of the fluid energy equation and the heat transfer in the solid structure requires simultaneous solution of the energy equations for the fluid, fuel rods and solid structure nodes.

COMPUTER - MLT-PLTFM

OPERATING SYSTEMS - Machine Dependent

PROGRAMMING LANGUAGES - FORTRAN 77

SOFTWARE LIMITATIONS - INTEL platforms need something equivalent to Microsoft's PowerFortran. A minimum of 8MB of memory is recommended for any workstation applications.

SOURCE CODE AVAILABLE (Y/N) - Y

UNIQUE FEATURES - The code has extremely flexible noding features that allow almost any geometric configuration of storage cask or system to be modeled; it runs on a wide variety of platforms, and is reasonably fast, even for very large problems (i.e., on the order of 5,000 to 10,000 nodes.)

RELATED SOFTWARE - An auxiliary code, RADGEN, is included in the package. This code can be used to generate the grey body view factors for radiative heat transfer within an enclosure modeled as an assembly in COBRAS-SFS. Radgen calculates the grey body view factors from two-dimesional black body factors, using an extension of Cox's crossed-string correlation approach, for square and triangular pitch rod arrays. It can also be used to define the view factors for an arbitrary enclosure made up of user defined surfaces, and containing no internal structures to block or reflect radiation exchange among the surfaces. RADGEN can be used to create the code input read from logical unit 10 in input group RADG. RADGEN is written in standard Fortran-77. and has no platform-dependent coding.

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RELATED SOFTWARE -(CONT)
OTHER PROG/OPER SYS INFO - COBRA-SFS expects the input file to be a local file named 'input'. Optional grey body view factors are read from local file 'tape10'. Optional restart input is read from local file 'tape8'. Code results are written to local file 'output'. Optional output for later restart is written to local file 'tape8'.

HARDWARE REQS - 1.0 MB for executable up to 1.5 MB or more for output of large problem.

TIME REQUIREMENTS - Run time depends on the size of the problem, and the platform on which it is run. The following list gives the run time on the various platforms for the test cases included in the transmittal package. tn24 vertical (large problem): SGI R8000 200 sec, Sun Sparcstation: 1600 sec, RS/6000 (IBM/aix): 990 sec, Intel (Pentium): 650 sec, DEC workstation: 650 sec, Hewlett-Packard HP9000: 260 sec, Apple/Mac-II MPW: 4200 sec, CRAY mainframe: 2200 sec.

REFERENCES - T.E. Michener, D.R. Rector, J.M. Cuta, R.E. Dodge, and C.W. Enderlin, COBRA-SFS: A Thermal-Hydraulic Analysis Code for Spent Fuel Storage and Transportation Casks, PNL-10782, September 1995.

ABSTRACT STATUS - Submitted 10/8/97. Released AS-IS 12/02/97.

SUBJECT CLASS CODE - HD

KEYWORDS -
COMPUTER PROGRAM DOCUMENTATION
C CODES
HEAT TRANSFER
HYDRAULICS
SPENT FUEL STORAGE
RADIOACTIVE WASTE MANAGEMENT

EDB SUBJECT CATEGORIES -
990200 052002

SPONSOR - DOE/RW

PACKAGE TYPE - AS - IS