PACKAGE ID - 000683D500000 MLTAP

KWIC TITLE - Modular Helium Reactor Plant Transient Thermal-Hydraulic Analysis

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

COMPLETION DATE - 11/07/1992 **PUBLICATION DATE -** 11/06/1992

DESCRIPTION - MLTAP is an integrated system transient analysis code for modular helium reactor (MHR) plants with superheated steam for Rankine power cycle and/or process heat applications. It is used for normal operational transient analyses as well as design basis/accident condition analyses with forced convection reactor cooling. MLTAP calculates the time-dependent temperatures, pressures, and flow rates for helium primary coolant and steam/water secondary coolant; reactor system and steam system structural temperatures; reactor neutronic behavior; pump, compressor, and steam turbine performance; reactivity control and other plant control systems responses; reactor and plant protection systems responses.

PACKAGE CONTENTS - Software Abstract; CEG002911, Rev. O; Media Includes Source Code, Executable Module, Object Module, Sample Problem Input and Output, Read.Me File;

SOURCE CODE INCLUDED? - Yes

MEDIA QUANTITY - 1 Mag Tape

METHOD OF SOLUTION - MLTAP employs transient finite difference and algebraic equations to model the various plant components and thermo-dynamic processes. Implicit integration is used in the reactor core and heat exchanger thermal model transient equations solution. Explicit Euler integration with subdivision of main time step, as required, is used in the solution of other transient equations. Iterative solution by modified Newton-Raphson method is used to solve algebraic loops or implicit equations. In general, the thermal-hydraulic transport models are one-dimensional formulations with homogenous incompressible flow and negligible fluid inertia. Thermal capacitance of structures and steam/water secondary coolant is modeled. Helium primary coolant is treated as an ideal gas with negligible thermal inertia. Compressibility effects are considered for certain flow paths such as valves and turbine stages where critical pressure ratios may be encountered.

COMPUTER - DEC 5000 WS

PACKAGE ID - 000683D5000000 MLTAP

OPERATING SYSTEMS - UNIX

PROGRAMMING LANGUAGES - FORTRAN77 (99.5%), FORTRAN90 (0.5%)

SOFTWARE LIMITATIONS - Disk space is a potential limiting factor along with acceptable run time. As configured, MLTAP requires 1.1 Mbytes of core memory on DEC 5000 workstation and run time is not an issue. Significant increase in mesh points and/or added component modeling can be made with acceptable run time. Core thermal model is dimensioned for 8x18 radial-axial gridlines, 36 regions, and 8 material types. Reactor kinetics model is dimensioned for 6 delayed neutron groups and up to 6 temperature-induced reactivity feedback components. Primary coolant circuit is dimensioned for two loops. Reactor internals thermal model is dimensioned for 50 segments. Secondary coolant circuit is dimensioned for two loops with 30 sections per loop and up to 10 nodes per section, 6 pipe volumes (plena), 6 feedwater heater modules, one deaerator, and 3 turbine units with up to 5 nodes per unit. Control system model is dimensioned for 36 control loops. The namelist input data change list is dimensioned for 100 data change specifications. Each of the three namelist printed output data lists is dimensioned for 100 variables. Each of the two namelist plot output data lists is dimensioned for 100 variables. Two of the three printed output data lists are also stored on plot files. It is not intended for use in calculating loss of forced cooling transients, rapid depressurization/blowdown transients, or detailed local effects such as temperature/flow/pressure distributions within a component.

SOURCE CODE AVAILABLE (Y/N) - Y

UNIQUE FEATURES - MLTAP is a comprehensive and fast running plant transient code for MHR steam cycle plant configurations. User has access to over 12,000 variables through time-dependent namelist input/output specifications. User can exercise extensive control of the transient event sequencing to perform parametric studies and to simulate various equipment failures and/or plant operator actions.

RELATED SOFTWARE - This version of MLTAP is an extension of earlier versions that were developed for past generations of large helium reactor plant configurations. An auxiliary graphics program, MZC-PLOT, is helpful in generating transient plots.

OTHER PROG/OPER SYS INFO - Documentation file is saveset.rme. Sample problem (initial input model) input file to generate a steady-state restart file is ss.dat. Linking file is makefile. Subroutine MERR is a system routine that is invoked during an error exit to provide traceback to the error location. Length is a system routine used to calculate the number of words in a common block. Loc is a system routine used to compute the address of a stored variable in INTEGER*4 format. GETPID, DATE and TIME are system routines used to establish the process identification number, date

PACKAGE ID - 000683D500000 MLTAP

OTHER PROG/OPER SYS INFO -(CONT) and time of the run. EXTIME is a system routine used to compute the cumulative CPU time consumed in calculating the various models and performing input/output operations. FORTRAN units 8, 9, 10, 11 are input files containing user-selected plot output variables in binary format. FORTRAN unit 12 is an output file for storing debug messages and steady-state plant data printout. FORTRAN unit 13 is the input binary data file for a restart run. FORTRAN unit 14 is the output binary data file written at the end of a run. MLTAP is configured to run on byte-addressable computers with a 4-byte word length.

HARDWARE REQS - 10 Mbytes of free disk space.

TIME REQUIREMENTS - Run time requirements depend highly on computer load, size and complexity of model, and type of transient to be simulated. Rule of thumb is 5 to 6 minutes of simulation time on a lightly loaded VAX 8600 or DEC 5000 workstation.

REFERENCES - T.W. Chan, User's Manual for the Multiple Loop Transient Analysis Program (MLTAP) Code for the MHTGR, CEGA-002545 Rev.0, October 1993.

ABSTRACT STATUS - Submitted December 1993. AS-IS due to package missing a library (it appears to be an in-house library).

SUBJECT CLASS CODE - HK

KEYWORDS -
COMPUTER PROGRAM DOCUMENTATION
M CODES
THERMAL ANALYSIS
HELIUM COOLED REACTORS
TRANSIENTS
POWER PLANTS
REACTOR KINETICS
HEAT TRANSFER
FLUID FLOW
HEAT EXCHANGERS
STEAM GENERATORS
CONTROL SYSTEMS
REACTOR PROTECTION SYSTEMS
REACTOR ACCIDENTS
REACTOR SAFETY
REACTIVITY INSERTIONS
PUMPS
STEAM TURBINES
SUPERHEATERS
XENON
TEMPERATURE COEFFICIENT
SCRAM
PRISMATIC CONFIGURATION

PACKAGE ID - 000683D500000 MLTAP

NUCLEAR POWER PLANTS
GAS COOLED REACTORS
HTGR TYPE REACTORS
FORCED CONVECTION
GRAPHITE MODERATED REACTORS
MATHEMATICAL MODELS
POWER REACTORS
RANKINE CYCLE POWER SYSTEMS
THERMODYNAMIC PROPERTIES

EDB SUBJECT CATEGORIES -
990200 220100

SPONSOR - DOE/NP

PACKAGE TYPE - AS - IS