Release Notes for RELAP5-3D© Version 2.2

Improvements in Version 2.2

The following is a brief description of improvements and new features in version 2.2. Links to associated material in the User Manuals show as yellow boxes around text. Open the appropriate volume before clicking on the link.

IMPROVED TURBINE MODEL

The following improvements were made to the turbine model:

- Addition of dissipation to the turbine energy equation
- Addition of models to allow for variable frictional torque and variable moment of inertia
- Addition of a new type of turbine in which the user can specify the efficiency as a function of normalized speed and load
- Addition of a moisture separator into the turbine model
- Remove restrictions in the as coded input processing routine for the turbine model.

See section 3.5.5 in Volume I, section 2.4.12 in Volume II, and sections 7.7.15, 7.7.16, 7.7.17, 7.7.19 and 7.7.20 in Appendix A, Volume II, and section 4.6.6.4 in Volume V.

IMPROVED RADIATION/CONDUCTION ENCLOSURE MODEL

Several improvements were made to this model:

- Removal of the requirement to re-input the data for the model at restart
- Implementation of a check on the input data to ensure that the conduction enclosure conserves energy
- Implementation of an initialization of the heat structure temperatures consistent with the input data for the radiation/conduction enclosure model.

In addition, in the initialization process the radiation/conduction heat flux is linearized with respect to the temperature of the surface of a heat structure to which it is applied to make the solution of the conduction equations for the temperature distribution in the heat structure more implicit. A current restriction precludes changing the model on restart or changing *any* heat structure on restart regardless of whether it is in a radiation/conduction enclosure or not. See section 8.7 in Volume II, section 9 in Appendix A, Volume II, and section 4.7.4 in Volume V.

HENRY-FAUSKE CRITICAL FLOW MODEL

This model can now be invoked in conjunction with either the semi- or nearly-implicit solution schemes. Previously it only functioned with the semi-implicit scheme. See page A2-6 in Appendix A, Volume II.

NEUTRON KINETICS

Neutron flux correction was added that corrects either local burnup values or the value of the group 2 fission cross section that is input to NESTLE for RBMK reactors. See section 12.14.28.5 in Appendix A, Volume II.

REFLOOD MODEL

The option to specify the reflood model be applied on either the left or right side of a heat structure has been restored. Previously, it was restricted to the right side. In addition, the capability to invoke the reflood model on one side in conjunction with a convective boundary condition on the other side was implemented. See section 8.1.1 in Appendix A, Volume II.

STRATIFICATION ENTRAINMENT/PULLTHROUGH MODEL

This model, which calculates the quality of coolant leaving a main pipe through an offtake when the liquid in the main pipe is stratified, was modified to remove an inconsistency for the case of a bottom offtake. Users had reported instances in which the void fraction in the offtake junction exceeded that of the donor volume, which is unphysical. The respective correlations used to predict the liquid height at which vapor would begin to be pulled through to the offtake and the offtake fluid quality were made consistent. See section 3.4.2.1 in Volume I and section 7.4.2.2.2 in Volume IV.

NEW USER OPTIONS

Multiple Connections to Time-Dependent Volumes – Previously, users could only connect one component to a time-dependent volume. That restriction has been removed, making it unnecessary to use multiple instances of the same source or sink condition.

Inverse Kinetics Control Component – This new control component solves the point reactor kinetics equations for the reactivity rather than for the neutron density. The input to the inverse kinetics control block should be one of the following: the total fission power computed by the point kinetics model, the total fission power computed by the nodal neutron kinetics model, the fission power in one of the nodal neutron kinetics zones, or the response of a neutron detector that senses the neutron flux computed by either of the two neutron kinetics models. See section 6.8 in Volume I, section 4.2.1 in Volume II, and section 14.3.22 in Appendix A, Volume II.

Optional Noncondensable Mass Fraction Input – Users can now specify the mass fractions of noncondensable gases for each hydrodynamic component, which can differ from the specification on card 115. The mass fractions specified on card 115 will be used in all other components for which a noncondensable is specified and the optional input is absent. See sections 7.2.9, 7.3.4, 7.6.31, 7.7.26, 7.9.11, and 7.12.4 in Appendix A of Volume II.

Heat Transfer Data Output - Previously, all the terms that make up the net heat transfer rate out of a heat structure (convection, radiation/conduction enclosure heat flux, generation) were only available from major edits. The minor edits/plots only showed the convection term. Now, the

radiation/conduction enclosure heat flux and generation (internal heat source) terms are both available in the minor edits/plots. See sections 4.6 and 4.8 in Appendix A, Volume II.

Nodal Kinetics Output - Previously, for nodal kinetics, the user must enter a significant number of 2080XXXX cards for many groups and nodes. Now, for nodal kinetics, the user can enter -1 for the parameter on the 2080XXXX cards for some of the alphanumeric variable codes. This will cause the data for all groups and nodes to be written to the restart-plot file. See section 4.9 in Appendix A, Volume II.

Restart Problem Time - Finding and entering the correct restart number on Word 1 of the 103 Card can be awkward. Now, there is a new option to enter the restart time on Word 1 of the 103 Card. See section 2.6 in Appendix A, Volume II.

Input Data Limit Increased - With the addition of the 3D features (nodal kinetics and multi-dimensional hydrodynamics) in RELAP5-3D, input processing failures have sometimes occurred because there were too many words in the input deck. The code has been changed to increase the limit. Now, the total number of input words on all cards in the input deck was increased from 524,287 to 2,097,151.

Individual Noncondensable Gas Mass Fractions Output – Users can now request minor edits/plot variables for each noncondensable gas specified. See sections 4.4 and 4.5 in Appendix A, Volume II.

Mixed Variables in a Trip – Previously, the code required both variables used in a variable trip to have the same units. Now, one of the variables can be a control variable. See section 5.3 in Appendix A, Volume II.

Improvements/Corrections to RGUI

SNAP DECK BUILDER

The SNAP (Symbolic Nuclear Analysis Package) code, developed by Information Systems Laboratories, Inc. (ISL), has been added to this release of RELAP5-3D and may be accessed through a button in RGUI. SNAP has been adapted by ISL to RELAP5-3D. It facilitates the assembly or modification of a plant model and corresponding RELAP5-3D input file using a Windows environment. This version of SNAP includes a feature for creating 3D input. Users must contact Terry Gitnick at ISL (**terryg@islinc.com**) for questions or guidance on using SNAP.

MOVIE CAPABILITY

The movie capability is actually a feature that automates the creation of files that show the RGUI plant image. These image files can later be turned into a movie with a third party application. The image files are numbered sequentially and placed in the same folder or directory as RGUI for user convenience when creating the movie.

A menu item in the File Menu activates the movie feature. Once activated, RGUI writes a new image file once every second or every new advancement whichever comes first. The movie feature must be turned off after the desired segment of the run is completed to terminate the file creation process.

In order to create a better quality movie than could be made with the RGUI jpeg files, another output file format, namely TIFF, was added. The image files are automatically written in the TIFF file format. On a Windows PC, we have used CorelDraw to combine the TIFF files into a movie file.

CORRECTIONS

The RGUI loss of color on temperature color grid problem that was caused by SCDAP changes was corrected.

The Magnify entry on the "Number Bar" of the plant image window was bullet-proofed. It now prevents invalid (non-numerical) data from being used as a resizing value; this had caused core dumps. Also, the 2x and 0.5x resizing items under the Movement menu of the plant image window were reactivated and given better hot keys.

A user had reported that for one of his large input files, RGUI 2.0.3 caused a core dump on the Windows 2000 platform. The error was caused by not dynamically allocating enough space to an array in HSCOPY. This was corrected.

RELAP5-3D Code Corrections in Version 2.2

The following table describes significant corrections in version 2.2. The list is not all-inclusive.

User Problem No.	Model/Feature	Problem Description	Correction
02085	Restart	A double restart failure occurred when executing through RGUI. A user was able to restart a problem once, but could not restart the restart.	Corrected a bug in the direct access restart file generating routine.
03031	Cladding Deformation Model	A large mass error occurred in the core channels of an RBMK model in steady-state mode.	A volume term was corrected to account for the effect of cladding deformation on volume.
03036	Nodal Kinetics	The fission cross section was going negative at a node in the kinetics mesh that had zero burnup. The burnup-based neutron flux correction was being used.	Bypass the correction if burnup is zero.