

January 13, 2003

MEMORANDUM TO: Gary Holahan, Director  
Division of Systems Safety and Analysis  
Office of Nuclear Reactor Regulation

FROM: Farouk Eltawila, Director **Original signed by F. Eltawila**  
Division of Systems Analysis and Regulatory Effectiveness  
Office of Nuclear Regulatory Research

SUBJECT: RELEASE OF THE ALPHA-VERSION OF THE TRAC-M THERMAL-  
HYDRAULIC SYSTEM ANALYSIS CODE

Over the last five years, RES has actively pursued a program of code consolidation and modernization for its reactor safety thermal-hydraulic analysis codes. The culmination of this program will be the initial public release of the TRAC-M code at the end of calendar year 2003. Important milestones leading up to this public release are the release of the "alpha" version to internal USNRC users and the release of the "beta" version to CAMP members. This memo documents the release of the alpha-version of TRAC-M. The beta-version will be released at the Spring 2003 CAMP meeting to be held in Korea at the end of April.

The primary objectives of the TRAC-M development program have been to consolidate the modeling capabilities of four legacy codes (RELAP5, TRAC-B, TRAC-P, and Ramona) into one code that implements a modernized code architecture. Furthermore, to conserve the investment in input models and ease the transition for users, a further requirement was placed on TRAC-M, namely that it is capable of accepting input models constructed for RELAP5, TRAC-B or TRAC-P. Both the development objectives and this legacy input model requirement have largely been met with this alpha-release as detailed below. It remains to finish the capability of re-using legacy RELAP5 input models and to complete the demonstration of simulation fidelity for the consolidated code vis-a-vis the predecessor codes through a comprehensive code assessment process. The capability to use RELAP5 input models will be completed before the beta-release and the developmental assessment will be completed by the public release at the end of this calendar year.

Major accomplishments in this development program are:

- Modernization of the TRAC-M code that will significantly reduce future maintenance expenditures while greatly enhancing the ability to make necessary code improvements.
- Implementation of a coupled 3-D reactor kinetics and thermal-hydraulic analysis capability (the PARCS kinetics module).
- Development of a graphical user interface (SNAP) to facilitate both the development of input models and the examination of code results.

- Implementation of a coarse-grain parallel processing capability (e.g., the 3-D vessel component can be allocated to one CPU while the 1-D loops can be allocated to another).

Three development activities remain to be completed before the beta-release of TRAC-M:

- Redo the input processing logic of the TRAC-M control system to enable the mapping of control systems from RELAP5 input models.
- Development of an interim reflood model as the performance of the legacy TRAC-P model has been judged deficient.
- Implementation of a modularized interfacial friction package that also includes the models from the TRAC-B code for interfacial friction in rod bundles and subcooled boiling.

The first item, relating to the control system, is the last activity associated with the code consolidation process. It will be completed soon and testing of the capability of TRAC-M to re-use legacy RELAP5 input models will follow. The other two items, the interim reflood model development and incorporation of TRAC-B interfacial friction models, were not scheduled as part of the TRAC-M code consolidation activity. However, as early assessment results became available, it was judged necessary to upgrade the code simulation capability in these two areas. All three of the above items will be completed by the time of the beta-release of TRAC-M at the end of April 2003.

An itemized list of new features in the alpha-version of TRAC-M (since the last internal developmental release, version 3.790), in addition to the capabilities discussed above, is given in the attachment. The alpha-version of TRAC-M corresponds to the developmental version designated as 3.1113 and can be downloaded from the TRAC developer's website.

Attachment:

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Attachment:

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## ATTACHMENT

Specific new features in TRAC are:

1. Improved 1-D and 3-D level tracking model
2. Limited RELAP5 input conversion - hydro components only.
3. Advanced BWR CHAN component
4. Platform independent dump files (TPR functionality)
5. Advanced Transmutation of Waste (ATW) functionality
  - a. Fluid power component
  - b. Trace species tracking
  - c. Enhanced Equation of State model - support for numerous working fluids - H<sub>2</sub>O, D<sub>2</sub>O, Na, PbBi, He, N<sub>2</sub>, R<sub>5</sub>H<sub>2</sub>O, and air
6. Enhanced modeling flexibility
  - a. Single-volume separator component
  - b. Improved off-take model
  - c. Enhanced Single Junction component
  - d. Spherical Heat Structure model
  - e. Additional Heat Structure boundary conditions
  - f. Three new valve types - Check Valve, Inertial Valve, and Motor Valve
  - g. Generalized Radiation Enclosure component
  - h. ANS94 decay heat standard and non-seperable feedback types
  - i. RELAP5 General Table capability - enhanced input for material properties
  - j. BREAK is now an "active" component
  - k. Dead-ended components (no longer need a break or fill as a component terminator)
  - l. Two new pump types
  - m. new homologous pump curves for Bingham and Westinghouse pump types
7. Enhanced control system
  - a. Generic signal variable capability
  - b. New control block and signal variable types (improves compatibility with RELAP5 and TRAC-G)
  - c. Automatic sorting of control blocks, signal variables and trips
  - d. Improved modularity and readability
8. Co-located heat structures (heat structure and fluid nodes are synchronized)
9. Scaled residuals for testing the convergence of the semi-implicit mass and energy equations solution
10. Improved code robustness
11. Improved choked flow model - mitigated downstream dependence in model
12. Enhanced TRAC-B input processor to facilitate conversion of ESBWR input models
13. Command line arguments
14. Increased adherence to the F95 standard
15. True free format source code with pretty print capability.