

TRACE PEER REVIEW by
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Review area: Conservation Equations and Numerical Methods

INTRODUCTION

I. BACKGROUND

The U. S. Nuclear Regulatory Commission (USNRC) Office of Nuclear Regulatory Research (RES) has organized a panel to review the TRACE/RELAP Advanced Computational Engine(TRACE) Version 5.0 computer code and the associated theoretical and test assessment documentation. TRACE is currently being developed in RES to provide a modernized, state-of-the-art method to provide thermal-hydraulic analyses of nuclear reactor systems. Because TRACE is used by the USNRC to audit licensee calculations, an independent review of the code is important especially since the range of code applications is broadening.

II. OBJECTIVE

The peer review panel has reviewed the TRACE code and associated documentation, which includes the Theory Manual, the Theory Manual Supplement, the Assessment Manual and the User's Guide. This report that summarizes peer review panel's opinion on the strengths and deficiencies of the code as documented, and provides recommendations for code changes and improvements. The panel will present these findings to the Advisory Committee on Reactor Safeguards Thermal-Hydraulic (ACRS T/H) subcommittee.

III. SCOPE OF WORK

Each peer review panel member has reviewed the TRACE 5.0 code and associated documentation, which includes the Theory Manual, Theory Manual Supplement, the Assessment Manual, and the User's Guide where these pertain to each reviewer's area of focus. The TRACE Theory Manual describes the underlying theory, empirical models, and special features within TRACE. The Theory Manual Supplement provides greater detail of each physical model and certain mathematical derivations. The Assessment Manual documents the results of a number of TRACE simulations of experimental tests ranging from fundamental tests such as a manometer problem to complex integral effects tests such as the LOFT series of experiments. The review is not intended to be a line-by-line review of the coding; however, the source code has been made available to the reviewer panel. The panel members have not been expected to run the code, but sample inputs and outputs have been provided, as well as guidance in executing the code if the reviewer chose to make a run.

USNRC-Furnished Material:

- (1) TRACE 5.0 documentation
 - (a) TRACE Theory Manual
 - (b) TRACE Theory Manual Supplement
 - (c) TRACE Assessment Report
 - (d) TRACE User's Manual
- (2) TRACE 5.0 executable and source code
- (3) TRACE sample input and output files

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The panel members should consider the following topics when reviewing the documentation.

- Capabilities and limitations
 - Is there a description of the code mission, its purpose, objectives, capabilities and range of applicability?
 - Is there a description of the code limitations?
- Numerical solution methods
 - Is the numerical solution scheme described?
 - Are the time and space averaging approaches described?
- Fundamental equations, models and correlations
 - Are descriptions included for all models and correlations?
 - Are the original published sources referenced along with supporting data, and a description of the accuracy and applicability of the model or correlation to power reactor conditions?
 - Is the model or correlation implementation approach described including any modifications used to overcome computational difficulties?
- General quality
 - Is the documentation well written, well organized and understandable?

Each panel member has provided comments on all portions of the code and documentation; however, each member has paid special attention and has provided a more detailed review in specific focus areas. The list of the focus areas that have required special attention and detailed review by one or more of the panel members includes:

1. Conservation equations as applied in the code
2. Numerical solution scheme
3. Thermal-hydraulic closure relations and physical models
4. Nuclear system components and features, such as pumps, valves, fuel rod models and reactor kinetics
5. The test assessment matrix, specifically its sufficiency and completeness relative to other thermal-hydraulic computer codes

Mr. Marv Thurgood shall provide specific comments regarding the (1) application of the conservation equations and the (2) numerical solution methods used in TRACE.

Each panel member has provided a draft report which includes an evaluation of the topics and focus areas. Following review of each other's reports and discussions by the panel members, the panel members shall assemble a final report that addresses the findings of all the panel members. The final report shall address the adequacy of the TRACE Version 5.0 computer code based on the documentation review. This final report indicates areas where a consensus exists among the panel members, and specify areas with differences of opinion. The USNRC project manager will confer with the panel members to reach a consensus when possible. The USNRC will also provide logistic support (e.g., editing, printing, etc.) to the review panel members in preparing the final

report of the panel's findings and in preparing the presentation of its findings to the ACRS T/H subcommittee.

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Exemption 5

7 Pages

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