August 15, 2001

Dr. George E. Apostolakis
Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: ISSUES RAISED BY ACRS PERTAINING TO INDUSTRY USE OF THERMAL-HYDRAULIC CODES

Dear Dr. Apostolakis:

In your June 19, 2001, letter to me entitled "Response to Your April 12, 2001, Letter on Issues Raised by ACRS Pertaining to Industry Use of Thermal-Hydraulic Codes," you requested that the staff reconsider its position on Advisory Committee on Reactor Safeguards (ACRS) recommendations 6, 8, and 9 (provided in your January 11, 2001 letter). The original recommendations are delineated below to put the staff's views in context. Since the points are closely related, recommendations 8 and 9 are treated together as in the original April 12, 2001, response.

6. The staff, perhaps in cooperation with an industry-supported entity such as the Nuclear Energy Institute (NEI), should undertake an authoritative study assessing when, how, and why codes produce reasonable results despite numerous assumptions and simplifications. This study should include measures of code strengths and weaknesses and include an assessment of circumstances under which the shortcomings of the codes may have significant influence on regulatory outcomes.

The original staff response to this recommendation indicated that cost would make such a study impractical. However, the staff recognizes the importance of understanding a code's ability to predict both an individual phenomenon and the integral response of the specified system and we offer the following clarifying information on the original response. As you know, with regard to both NRC and industry codes, the staff practice is to use the Phenomena Identification and Ranking Table (PIRT) process to focus the review and assessment effort on phenomena that are expected to dominate the system response. Regarding code "simplification", the evaluation of the code's adequacy is based on the results of assessment against separate effects and integral effects test data. The data relevancy and sufficiency must be demonstrated through scaling arguments to ensure that the data cover similar ranges of conditions as the plant is expected to experience under the postulated accident scenario for all of the high-ranked and medium-ranked phenomena. Since experimental data are not always available, some code models cannot be thoroughly assessed. When a model cannot be thoroughly assessed, bounding calculations or tests must be performed to demonstrate that a deficient model does not influence the figure of merit of the transient. Examples of figures of merit are peak clad temperature in the case of a large-break loss-of-coolant accident, two-phase level in small-break loss-of-coolant accidents, and departure from nucleate boiling ratio or peak pressure in transients. A code adequacy determination is made for a particular code for a particular transient of a particular design, as specified in draft regulatory guide, “Transient Accident Analysis Methods” (DG-1096). The assessment effort is focused on the important phenomena of this system so circumstances under which shortcomings of the code may have significant influence are identified explicitly and are ameliorated accordingly. Therefore, the impact of any simplifications or assumptions is assessed for the application in question.

Staff agrees that there is a need to better address the question of how adequately the phenonena are actually modeled. As you are aware, the staff currently is working to enhance its thermal-hydraulic predictive capability as outlined in the 5-Year Thermal-Hydraulic Research Plan. When the consolidation is completed in late 2002, the staff will place increased emphasis on improving code accuracy. This will involve code development and assessment. As part of these efforts, we intend to conduct a study that will define measures of code performance. We expect that the measures of code performance will be expressed in terms of the conditions for which the code is applicable, the phenomena that it can represent, and the bias and uncertainty for models utilized by the code to predict phenomena most significant to a given scenario. Since industry and NRC codes share similar heritage, the results of this study may be of use to industry and will be widely disseminated.

With regard to the concern that code models and results are proprietary and cannot be published in the open literature, the staff believes that its current approach is adequate to enhance public confidence. Safety evaluation reports written by the staff approving any code are publicly available and contain information about the process used by the staff for that specific code evaluation, including the licensees’ assessment process. This information will continue to be provided to the public as will information from open public meetings held during the code review process, since this information is generally not proprietary. Furthermore, public confidence in the process can be increased by using NRC codes to verify licensee submittals. Over 25 countries use NRC system analysis codes, and they have been extensively assessed. To date, 202 NUREG/IA (international agreement) reports have been published. These reports summarize the results of code assessment against test data and operational data taken at a variety of plants. Additionally, the NRC staff and its contractors participate in International Standard Problem benchmark cases, in which several independent participants submit code calculations and compare and contrast the results to the other calculations and data. Therefore, confidence in NRC codes can be gained in the public forum.

8. The staff should consider how definite measures of code quality, such as bias and uncertainty in predicting significant phenomena and success criteria, can be more specifically required as outputs from the code assessment process.

9. The staff should investigate and recommend how uncertainties in code predictions can be best quantified to be suitable for incorporation into risk-informed regulation

The staff recognizes the merit of understanding the uncertainty of its thermal-hydraulic system analysis codes and will address uncertainty in the study discussed above, that will be conducted when the consolidation effort is completed.

Regulatory Guide 1.174, “An Approach for using Probabilistic Risk Assessment in Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis,” and the associated Standard Review Plan Chapter 19 provide guidance on how to take uncertainty into account when making regulatory decisions. This guidance has enabled the staff to successfully make risk-informed decisions with appropriate consideration of uncertainty. To complement this approach, the staff will develop more formal guidance as to how uncertainty analysis can be incorporated into regulatory decision making as permitted by budgetary considerations.

The staff intends to present their plans for code development, assessment, and uncertainty determination at an upcoming meeting with the ACRS Thermal-Hydraulic Subcommittee as part of the regular review of research programs.

Sincerely,

/RA/

William D. Travers
Executive Director
for Operations

cc: Chairman Meserve
Commissioner Dicus
Commissioner McGaffigan
Commissioner Merrifield
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