August 18, 2003

Mr. James F. Klapproth, Manager
Engineering & Technology
GE Nuclear Energy
175 Curtner Avenue
San Jose, CA 95125

SUBJECT: REVIEW OF GE NUCLEAR ENERGY LICENSING TOPICAL REPORT, NEDE-32906P, SUPPLEMENT 1, "TRACG APPLICATION FOR ANTICIPATED TRANSIENT WITHOUT SCRAM TRANSIENT ANALYSES" (TAC NO. MB6359)

Dear Mr. Klapproth:

By letter dated September 18, 2002, and its supplement dated July 29, 2003, GE Nuclear Energy (GENE) requested that the NRC staff review and approve its licensing topical report (LTR) NEDE-32906P, Supplement 1, "TRACG Application for Anticipated Transient Without Scram Transient Analyses." The LTR establishes an agreed-upon process and scope for the application GENE reactor accident and transient analysis computer code TRACG02A (referred to hereafter as TRACG) for the analysis of anticipated transients without scram in the operating fleet of BWR/2-6. The TRACG code is a thermal/hydraulic analysis code intended to be used in a realistic analysis mode. The approach taken by GENE in qualification of the code for the proposed application is under the Code Scaling, Applicability, and Uncertainty evaluation methodology described in NUREG/CR-5249, "Quantifying Reactor Safety Margins: Application of Code Scaling Applicability, and Uncertainty Evaluation Methodology to a Large-Break, Loss-of-Coolant Accident." The staff finds the proposed approach specified in NEDE-32906P, as supplemented, is acceptable for referencing in licensing applications to the extent specified under the limitations delineated in the report and in the associated NRC safety evaluation. The enclosed safety evaluation defines the basis for acceptance of the LTR.

The NRC requests that GENE publish an accepted version of the revised LTR within 3 months of receipt of this letter. The accepted version shall incorporate this letter and the enclosed safety evaluation between the title page and the abstract, and add a "-A" (designating accepted) following the report identification number (i.e., NEDE-32906P-A).

If the NRC's criteria or regulations change so that its conclusion in this letter that the LTR is acceptable is invalidated, GENE and/or the applicant referencing the LTR will be expected to revise and resubmit its respective documentation, or submit justification for the continued applicability of the LTR without revision of the respective documentation.

Pursuant to 10 CFR 2.790, we have determined that the enclosed safety evaluation does not contain proprietary information. However, we will delay placing the safety evaluation in the public document room for a period of ten (10) working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects only. If you believe that any information in the enclosed is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.790.

If you have any questions, please contact Alan Wang, GENE Project Manager, at (301) 415-1445.

Sincerely,

/RA/

Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 710

Enclosure: Safety Evaluation

cc w/encl: See next page

If you have any questions, please contact Alan Wang, GENE Project Manager, at (301) 415-1445.

Sincerely,

/RA/
Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 710

Enclosure: Safety Evaluation

cc w/encl: See next page

DISTRIBUTION:
PUBLIC **(No DPC Folder for 10 working days)**
PDIV-2 Reading
RidsNrrDlpmLpdiv (HBerkow)
RidsNrrPMAWang
RidsNrrLAEPeyton
RidsOgcMailCenter
RidsAcrsAcnwMailCenter
FAkstulewicz
RLandry

*SE dated August 18, 2003

ADAMS Accession No.: ML032300504 **NRR-106**

OFFICE	PDIV-2/PM	PDIV-2/LA	SXRB*	PDIV-2/SC	PDIV:D
NAME	AWang	EPeyton	FAkstulewicz	SDembek	HBerkow
DATE	8/14/03	8/13/03	6/23/03	8/14/03	8/18/03

DOCUMENT NAME: G:\PDIV-2\GE\TracgatwsSE.wpd OFFICIAL RECORD COPY

cc:
Mr. George B. Stramback
Regulatory Services Project Manager
GE Nuclear Energy
175 Curtner Avenue
San Jose, CA 95125

Mr. Charles M. Vaughan, Manager
Facility Licensing
Global Nuclear Fuel
P.O. Box 780
Wilmington, NC 28402

Ms. Margaret Harding, Manager
Fuel Engineering Services
Global Nuclear Fuel
P.O. Box 780
Wilmington, NC 28402

Mr. Glen A. Watford, Manager
Technical Services
GE Nuclear Energy
175 Curtner Avenue
San Jose, CA 95125

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

NEDE-32906P, SUPPLEMENT 1, "TRACG APPLICATION FOR

ANTICIPATED TRANSIENT WITHOUT SCRAM TRANSIENT ANALYSES"

GE NUCLEAR ENERGY

PROJECT NO. 710

1.0 INTRODUCTION

The staff has reviewed the GE Nuclear Energy (GENE) reactor accident and transient analysis computer code TRACG02A for application to the analysis of anticipated transients without scram (ATWS) in the operating fleet of boiling water reactors (BWR)/2-6. GENE submitted TRACG02A (referred to hereafter as TRACG) for NRC review for application to anticipated transient without scram analyses on September 18, 2002 (Reference 1), as supplemented on July 29, 2003 (Reference 2). The submittal includes the licensing topical report (LTR) on the subject. GENE previously submitted both code model documents that describe the TRACG code and the code itself to assist the staff review of the TRACG application to anticipated operational occurrences (Reference 3). The staff review and approval of that application of the TRACG code is documented in Reference 4.

The TRACG code is a thermal/hydraulic analysis code intended to be used in a realistic analysis mode. The approach taken by GENE in qualification of the code for the proposed application is under the Code Scaling, Applicability, and Uncertainty (CSAU) evaluation methodology described in Reference 5.

The TRAC family of computer codes began as a pressurized water reactor analysis tool developed for the NRC at the Los Alamos National Laboratory. A BWR version of the code was developed jointly by the NRC and GE at the Idaho National Engineering Laboratory as TRAC-BD-1/MOD1. GE, and later GENE, developed a proprietary version of the code designated as TRACG. The objective of the proprietary code development was to have the code capable of realistic analysis of transient, stability, and ATWS events. The code was modified to include a three-dimensional kinetics capability in addition to the multi-dimensional, two-fluid thermal/hydraulics modeling.

The plant types for which the TRACG code is to be applied includes the operating BWR/2, BWR/3, BWR/4, BWR/5, and BWR/6 designs. The code has not been submitted for review for application to any other operating plant design. The code is under separate review for application to the advanced plant design European Simplified BWR (ESBWR). This safety evaluation is applicable only to the operating BWR/2-6.

2.0 REGULATORY BASIS

The Code of Federal Regulations (10 CFR), Part 50.62, presents the requirements for reduction of risk from ATWS events for light-water-cooled nuclear power plants. The rule defines an ATWS to mean

> *...an anticipated operational occurrence as defined in appendix A of this part followed by the failure of the reactor trip portion of the protection system specified in General Design Criterion 20 of appendix A of this part.*

Furthermore, the rule states that, in the case of the BWR, there must be an alternate rod injection system, a standby liquid control system with the capability of injecting into the reactor pressure vessel a borated water solution, and equipment to trip the reactor coolant recirculating pumps automatically under conditions indicative of an ATWS.

At this point the staff has not prepared an appropriate Standard Review Plan (Reference 6) section to provide guidance in the review of the satisfaction of the requirements detailed in 10 CFR 50.62.

The staff has prepared suggested means by which the general requirements for a thermal/hydraulics analysis computer code can be met. References 7 and 8 describe acceptable approaches by which the calculated uncertainty in the analysis methodology can be assessed. References 7 and 8 express a preference for the CSAU methodology, as the means by which uncertainty in a code calculation is to be determined.

3.0 TECHNICAL EVALUATION

The GENE TRACG code is a proprietary methodological development based on the TRAC-BD1 code developed jointly by the NRC and General Electric at the Idaho National Engineering Laboratory. The code has models and correlations in place which were developed at the commercial expense of GENE and are, thus, considered to be proprietary. The staff reviewed and approved the TRACG code for application to anticipated operational occurrences (AOOs) in the current operating fleet of BWR/2-6s. The AOOs include the increase and decrease in heat removal by the secondary system, decrease in reactor coolant flow rate, reactivity and power distribution anomalies, and increase and decrease in reactor coolant inventory, all with reactor scram. The present review of the TRACG code for application to ATWS focused on those aspects of the code which extend the prior AOO review.

The requirements of a realistic methodology are somewhat different from a prescriptive methodology in that more realistic models can be used and a measure of the uncertainty in the code must be determined. Various means of achieving an estimate of uncertainty are available in the realm of statistical analysis. GENE has chosen to follow the basic CSAU approach outlined in NUREG/CR-5249. While the CSAU approach defines the process by which uncertainty analysis is performed, it leaves room for the applicant to determine the exact statistical methodology to be applied. In both the AOO application of TRACG and the ATWS application, GENE has chosen to apply an analysis of variance statistical methodology. An explanation of the various statistical approaches will be found in the discussion of Step 14 of the CSAU process which follows.

Comparison with the CSAU Methodology

1. Step 1. Scenario Selection

The processes and phenomena that can occur during an accident or transient vary considerably depending upon the specific event being analyzed. GENE has identified the main steam isolation valve closure (MSIVC) ATWS and pressure regulator failed open (PRFO) ATWS as the events to which the methodology under review will be applied based on previous licensing basis analysis. The MSIVC and PRFO have been found to be the limiting pressurization events in the historical analyses. Furthermore, the application of the methodology is limited to the determination of the peak vessel pressure up to the time of initiation of boron injection. The code has not been reviewed for, nor is it being approved for, evaluation of ATWS instability.

GENE is consistent with this step in the CSAU approach.

2. Step 2. Nuclear Power Plant Selection

The dominant phenomena and timing for an event can vary significantly from one nuclear power plant design to another. GENE has specified the nuclear power plant applicability for the methodology under review to be the BWR/2, BWR/3, BWR/4, BWR/5, and BWR/6 operating reactor designs.

GENE is consistent with this step in the CSAU approach.

3. Step 3. Phenomena Identification and Ranking

The behavior of a nuclear power plant undergoing an accident or transient is not influenced in an equal manner by all phenomena that occur during the event. A determination must be made to establish those phenomena that are important for each event and various phases within an event. Development of a Phenomena Identification and Ranking Table (PIRT) establishes those phases and phenomena that are significant to the progress of the event being evaluated.

The critical safety parameter for ATWS events is the peak reactor pressure vessel pressure. The main difference between an ATWS event and an AOO is that the reactor scram is not considered. The similarity, therefore, between an ATWS scenario and the AOO scenario indicates that the same phenomena apply to ATWS overpressure as for AOO with the exception of the absence of reactor scram. The PIRT developed for the AOO events is shown in Table 3-1 of Reference 3, and used by reference. The staff accepts the PIRT developed for the AOO application of TRACG as applicable to the TRACG ATWS analysis.

GENE is consistent with this step in the CSAU approach.

4. Step 4. Frozen Code Version Selection

The version of a code, or codes, reviewed for acceptance must be "frozen" to ensure that after an evaluation has been completed, changes to the code do not impact the conclusions and that changes occur in an auditable and traceable manner. GENE has specified that the TRACG02A code, which is under configuration control, was used for the ATWS analysis.

GENE is consistent with this step in the CSAU approach.

5. Step 5. Provision of Complete Code Documentation

This step is to provide documentation on the frozen code version such that evaluation of the code’s applicability to postulated transient or accident scenarios for a specific plant design can be performed through a traceable record. GENE has provided the necessary documentation through reference to code documentation in the possession of the staff from the previous review of the TRACG code reported in Reference 4.

GENE is consistent with this step in the CSAU approach.

6. Step 6. Determination of Code Applicability

The applicability of the GENE methodology is addressed in the following evaluation of the technical content of the documentation.

GENE has stated in Reference 9 that the application of TRACG would be to the ATWS event up to the initiation of boron injection. The specific purpose of the code is to calculate, in a realistic fashion, the peak vessel pressure. Table 1, which was provided by GENE, identifies the event sequence for an MSIVC ATWS and compares the capabilities of the currently approved GENE methodology, ODYN, with the proposed TRACG methodology. It should be noted that the peak vessel pressure typically occurs in the first ten (10) seconds, while the startup of the standby liquid control system (SLCS) pumps to begin boron injection does not occur until approximately 120 seconds. Also, a number of additional parameters are predicted by TRACG. Since the proposed application of the methodology is restricted to prediction of the peak vessel pressure, the staff review has focused on only this aspect of the code’s total capability.

The documentation (Reference 9), refers to applicability of the TRACG ATWS methodology to the operating fleet of BWR/2-6, and the MELLLA+ (NEDC-33006P) operating limits. However, MELLLA+ is not applicable to the BWR/2 class of plants. GENE clarified this point in its response to a staff's request for additional information dated July 29, 2003. This point needs to be made in the approved version of the LTR. At any rate, since MELLLA+ is still under staff review, the review of TRACG for application to the ATWS vessel peak pressure calculation has focused on the power level and reactor coolant flow rather than any specific operating limit curve. This review does not address or imply approval of MELLLA+.

Table 1
ATWS MSIVC Event Sequence
ODYN and TRACG Predictions

Key Output?	Response	Event Time (sec)	ODYN	TRACG
No	Main Steam Isolation Valve (MSIV) Isolation Initiates	0.0	Start Transient	Start Transient
No	High Pressure ATWS Setpoint	≅4	Trip Predicted	Trip Predicted
No	MSIVs Fully Closed	≅4	Modeled	Modeled
No	Peak Neutron Flux	≅4	Peak Predicted	Peak Predicted
No	Opening of First Relief Valve Tripped	≅4	Trip Predicted	Trip Predicted
No	Suppression Pool Heatup Calc Initiated	≅4	Modeled	Not Modeled
No	Recirculation Pump Tripped	≅5	Trip Predicted	Trip Predicted
Yes	Peak Vessel Pressure	≅10	Peak Predicted	Peak Predicted*
Yes	Peak Clad Temperature	≅45	Peak Predicted	Predicted but Not Used
No	Feedwater Reduction Initiated	≅20	Modeled	Modeled
Yes	Boron Injection Temperature Reached	≅40	Predicted	Not Predicted
Yes	Pre SLCS Pump Start Reactor Pressure	≅124	Predicted	Predicted
No	SLCS Pumps Start	≅124	Modeled	Transient Terminated
No	Water Level Increased	≅1700	Modeled	N/A
Yes	Hot Shutdown Achieved	≅1800	Predicted	N/A
Yes	Peak Suppression Pool Temperature	≅4000	Peak Predicted	N/A

*The transient may be terminated after peak pressure is predicted. Data after this point may be used to determine reactor pressure up until the point that SLCS injection begins.

Furthermore, while the minimum MELLLA+ flow rate has been quoted in the MELLLA+ review as 80 percent, in Reference 9 the minimum flow rate is quoted as 73 percent, a more conservative value since less energy is transferred from the fuel. While this is more conservative, individual applications of the TRACG ATWS methodology are expected to clearly state the power level used for the analysis. Should the MELLLA+ operating limit approach be approved, separately from this review, simply referring to MELLLA+ in application of the TRACG methodology to ATWS is not sufficient. The specific flow rate and power level used in the individual applications of the methodology must be clearly stated rather than reference to MELLLA+.

Reference 9 also quotes the reactor power level as 100 percent. The staff understands that to be referring to 100 percent of the plant's licensed power level, which in the case of the demonstration plant used for the application, corresponds to 113.4 percent of the original rated power. For each application of the TRACG ATWS methodology, it must be made clear exactly what power level is being used, not only the percentage of licensed power but the actual power level.

In its review of the applicability of TRACG to AOO events, the staff performed numerous comparisons between the neutronic modeling used by GENE and methodologies available to the staff (Reference 4). The staff noted that GENE uses finite difference methods while the staff uses the more modern nodal methods, which more accurately account for inter-assembly gradients. For that evaluation, three test cases were run, a slow pressure increase, an inlet flow decrease, and an MSIVC transient, all for a two fuel type core. The core specification was developed by the staff and GENE to minimize the effects of different methods used to generate the cross sections while focusing on the differences in kinetics modeling.

The first two transients were run to evaluate TRACG's ability to predict changes in total reactivity. The two methodologies compared well with each other with regard to the change in reactivity from the imposed transient. The third transient, the MSIVC, was intended to examine the GENE methodology's ability to predict prompt critical power changes. The conclusion reached based on those studies was that the GENE methods were reasonable for non-reactivity insertion accidents (RIAs). Comparison of the TRACG predicted power versus the TRAC-B/NESTLE predicted power for the MSIVC simulated pressurization transient found the TRAC-B/NESTLE peak power to be slightly more conservative than TRACG (Figure 5 in Reference 9). However, the integrated energy deposited matched very well because while the peak for TRACG was slightly lower, the drop off was slower and the tail of the power/time curve was higher. This would indicate acceptable performance for application of TRACG to the ATWS events under consideration.

Based on the results of the above noted transient analyses, the staff concluded that the TRACG kinetics code can adequately model the types of anticipated transients examined, including the MSIVC event.

Finally, application of TRACG to ATWS events assumes there is no thermal/hydraulic - neutronic instability. The methodology has not been reviewed for applicability to instability conditions.

GENE is consistent with this step in the CSAU approach.

7. Step 7. Establishment of Assessment Matrix

Support of the application of TRACG to AOOs (Reference 3), provided the assessment of the code against appropriate separate effects tests, component tests, integral systems tests, plant tests, and plant operating data. The assessment matrix adequately covered the range of conditions expected in the current application of the methodology.

GENE is consistent with this step in the CSAU approach.

8. Step 8. Nuclear Power Plant (NPP) Nodalization Definition

Reference 5 discusses the tradeoffs in determining an adequate NPP nodalization. GENE has developed guidelines for use of TRACG for transient and accident analyses that are explicit and reduce nodalization as a contributor to calculational uncertainty. The guidelines provide rules for deriving the appropriate nodalization, thus defining a method for automating the generation of input for a TRACG analysis that maintains consistency in approach from one analysis to another.

GENE is consistent with this step in the CSAU approach.

9. Step 9. Definition of Code and Experimental Accuracy

Simulation of experiments developed from Step 7 using the NPP nodalization from Step 8 provides checks to determine code accuracy. The differences between the code calculated results and the test data provide bias and deviation information. Code scale-up capability can also be evaluated from separate effects data, full scale component tests data, plant test data, and plant operating data where available. Overall code capabilities are assessed from integral systems test data and plant operational data. These assessments were performed as part of the AOO qualification of the TRACG methodology documented in Reference 3.

GENE is consistent with this step in the CSAU approach.

10. Step 10. Determination of Effect of Scale

Assessment of the TRACG AOO methodology was performed using results of separate effects tests, with both scaled and full-size components, integral facility tests, and tests performed on operating nuclear power reactors. GENE has shown in Reference 3 that full-scale plant data are bounded in the application of TRACG to AOO events. Evaluation of code results from these assessments demonstrates there is not a significant impact of scale on TRACG for the range of plants to which it is being applied.

GENE is consistent with this step in the CSAU approach.

11. Step 11. Determination of the Effect of Reactor Input Parameters and State

The purpose of this step is to determine the effect that variations in the plant operating parameters have on the uncertainty analysis. Plant process parameters characterize the state of operation and are controllable by the plant operators to a certain degree. GENE has reviewed the operating parameters important to the progress of the ATWS event in its operating fleet of plants. The parameters identified come from the PIRT, technical specifications, and operational input.

The analyses performed were at the operating limits currently allowed and at those being reviewed by the staff for possible future operation. The staff notes that the flow rate/power condition proposed as MELLLA+ is still under staff review. The approval granted herein for use of TRACG for calculation of the reactor pressure vessel peak pressure under ATWS conditions is in no way an approval of the use of MELLLA+. The review and approval are consistent with a power condition and a flow rate. In addition, the MELLLA+ operating limits line is not applicable to the BWR/2 line of plants.

GENE is consistent with this step in the CSAU approach, but approval of the use of TRACG for ATWS reactor pressure vessel peak pressure does not imply approval of the MELLLA+ operating limits.

12. Step 12. Performance of NPP Sensitivity Calculations

Sensitivity calculations are typically performed to evaluate methodology sensitivity to parameters predicted by the methodology, and to various plant operating conditions that arise from uncertainties in the reactor state at the initiation of the transient. In the case of ATWS analyses, due to the extremely low probability of an ATWS event, the staff has accepted nominal plant parameters for ATWS analysis. For ATWS analysis, technical specification allowable values have been used for analytic limits. GENE procedures require that both GENE and the licensee agree to the limiting input values. When individual applications of the methodology are submitted for staff review, the critical ATWS plant parameters will be reviewed for consistency with plant design and technical specification allowable limits.

GENE is consistent with this step in the CSAU approach.

13. Step 13. Determination of Combined Bias and Uncertainty

The individual uncertainties resulting from code models of important phenomena, scale effects, and NPP input parameter variations must be combined to obtain an overall bias and uncertainty.

GENE provided sample calculations of the MISVC and PRFO events. The models used are taken as demonstrations of the applicability of the TRACG methodology to the ATWS event in the operating fleet of BWRs.

GENE is consistent with this step in the CSAU approach.

14. Step 14. Determination of Total Uncertainty

The first few steps in the CSAU methodology identify and rank the physical phenomena important to judging the performance of the safety systems and margins in the design. The phenomena are compared to the modeling capability of the code to assess whether the code has the necessary models to simulate the phenomena. Most important, the range of the identified phenomena covered in experiments or test data is compared to the corresponding range of the intended application to assure that the code has been qualified for the highly ranked phenomena over the appropriate range. The result is then provided in a PIRT. The staff has reviewed the PIRT provided for TRACG in References 9 and 3 by inclusion, and finds it acceptable and consistent with the staff's experience in judging the important phenomena associated with the ATWS event in BWRs.

The discussion of the uncertainty analysis approach presented in References 5 and 10 envisioned the use of response surfaces for quantifying uncertainty. The staff recognizes that there are other valid and acceptable means by which the uncertainty can be assessed. Other means include that developed following the work by Wilks (Reference 11), referred to as order statistics, and a related method referred to as analysis of variance. Each has advantages and disadvantages.

Briefly, the statistical methods can be described as follows.

Response Surface: Response surface for the safety parameter is generated from parameter perturbations of each parameter singly. Statistical upper bound is determined from the Monte Carlo method using a response surface.

Order Statistics: Monte Carlo method using random perturbations of all important parameters is done at once. Sample size defined to yield desired statistical confidence. Statistical upper bound is determined from most limiting perturbation (for the first order statistics).

Normal Distribution: Monte Carlo method using random perturbations of all important parameters is done at once. Normality of output distribution established by statistical checks. Statistical upper bound is determined from sample variance from all perturbations.

The GENE methodology as described in Reference 8, applies a statistical method based on normal distribution-one-sided upper tolerance limit (ND-OSUTL). As noted above, the staff recognizes that there are various means by which uncertainty in a code calculation can be obtained. While the staff has referred to the response surface approach in References 5 and 10, there are advantages in use of other methods such as ND-OSUTL. Most notably, the methodology can require significantly reduced calculational cases, thus reducing the cost of performing an analysis. But, there are significant restrictions, such as demonstration of normality of the resulting probability distribution function. There is not one single correct method of determining uncertainty. Each of these methods has been reviewed carefully by the staff in various submittals that have been reviewed in recent years.

The acceptability of the ND-OSUTL approach is discussed further in Reference 4.

GENE has determined the mean vessel peak pressure by using Monte Carlo sampling of the applicable internal model parameters and initial condition biases and uncertainties to produce an overall peak pressure bias and uncertainty. By using 39 trials (giving a probability of 95 percent at a confidence level of 87 percent, from $\beta = 1 - \gamma^N$, where β is the confidence level, γ is the probability and N is the number of samples) a peak pressure distribution has been obtained which has been shown to be normal by application of the Anderson-Darling test. For the test plant, the MSIVC event returns a vessel peak pressure of 1415 pounds per square inch (psi) and the PRFO a peak vessel pressure of 1391 psi.

GENE is consistent with this step in the CSAU approach.

4.0 CONDITIONS AND LIMITATIONS

Based on review of the proposed application of the TRACG methodology to analysis of the ATWS event in the current GENE operating fleet, that is BWR/2-6 plants, the following conditions on use of the methodology are imposed.

1. Application of the methodology is considered for prediction of the reactor vessel peak pressure only. The prediction is to be terminated at the time of the signal to initiate SLCS pump injection of boron into the reactor coolant system.

2. Simply referring to MELLLA+ in the application of the TRACG methodology to ATWS is not sufficient. The flow rate and power level used in the individual applications must be clearly stated and the power-to-flow ratios must not be outside the ranges used in this review. MELLLA+ is not applicable to the BWR/2 class of plants. This point needs to be made in the approved version of the LTR.

3. For each application of the TRACG ATWS methodology, it must be made clear exactly what power level is being used, not only the percentage of licensed power, but the actual power level.

4. Application of TRACG to ATWS events assumes there is no thermal/hydraulic - neutronic instability. The methodology has not been reviewed for applicability to instability conditions.

The staff also notes that a generic topical report describing a code such as TRACG cannot provide full justification for each specific individual plant application. When a licensee proposes to reference the TRACG-based ATWS methodology for use in a license amendment, the individual licensee or applicant must provide justification for the specific application of the code in its request which is expected to include:

1. <u>Nodalization</u>: Specific guidelines used to develop the plant-specific nodalization. Deviations from the reference plant must be described and defended.

2. <u>Chosen Parameters and Conservative Nature of Input Parameters</u>: A table that contains the plant-specific parameters and the range of the values considered for the selected parameter during the topical approval process. When plant-specific parameters are outside the range used in demonstrating acceptable code performance, the licensee or applicant will submit sensitivity studies to show the effects of that deviation.

3. <u>Calculated Results</u>: The licensee or applicant using the approved methodology must submit the results of the plant-specific analyses reactor vessel peak pressure.

5.0 CONCLUSIONS

The staff concludes from its review of the documentation and code submitted that the TRACG methodology when applied to the prediction of the ATWS vessel peak pressure is structured consistent with the CSAU methodological process, and satisfactorily reflects the intended use of the methodology to address licensing requirements for the event in the operating fleet of BWR/2s, BWR/3s, BWR/4s, BWR/5s and BWR/6.

The review resulted in conditions on use of the code already noted in this safety evaluation. In particular, since MELLLA+ is still under staff review, the review of TRACG for application to the ATWS vessel peak pressure calculation has focused on the power level and reactor coolant flow rather than any specific operating limit curve. This review does not address or imply approval of MELLLA+.

6.0 REFERENCES

1. Letter from George Stramback (GENE) to U.S. NRC dated September 18, 2002.

2. Letter from George Stramback (GENE) to U.S. NRC, "Request for Additional Information Related to the Review of GE Licensing Topical Report NEDE-32906P Supplement 1, 'TRACG Application for Anticipated Transient Without Scram Transient Analyses'," dated July 29, 2003.

3. NEDE-32906P, Rev. 0, "TRACG Application for Anticipated Operational Occurrences (AOO) Transient Analyses," January 2000.

4. Safety Evaluation Report by the Office of Nuclear Reactor Regulation for NEDE-32906P "TRACG Application for Anticipated Operational Occurrences (AOO) Transient Analyses," June 2002.

5. NUREG/CR-5249, "Quantifying Reactor Safety Margins: Application of Code Scaling Applicability, and Uncertainty Evaluation Methodology to a Large-Break, Loss-of-Coolant Accident," December 1989.

6. NUREG-0800, "United States Nuclear Regulatory Commission Standard Review Plan," Revisions as of January 1, 2002.

7. Draft Regulatory Guide, DG-1120, "Transient and Accident Analysis Methods," U.S. NRC, December 2000.

8. Draft Standard Review Plan, Section 15.0.2, "Review of Analytical Computer Codes," U.S. NRC, December 2000.

9. NEDE-32906P Supplement 1, "TRACG Application for Anticipated Transient Without Scram Transient Analyses," September 2002.

10. Regulatory Guide 1.157, "Best-Estimate Calculations of Emergency Core Cooling System Performance," May 1999.

11. Wilks, S. S., "Determination of Sample Sizes for Setting Tolerance Limits," Ann. Math. Statistics, Vol. 12, 1941.

Principal Contributor: R. Landry

Date: August 18, 2003