March 23, 2004

Mr. Richard Watts
Manager, Nuclear Training
Rochester Gas and Electric Corporation
89 East Avenue
Rochester, NY 14649

SUBJECT: OPERATOR LICENSING MEETINGS/WORKSHOP SUMMARY FOR AUGUST 2003 - SUPPLEMENTAL INFORMATION

Dear Mr. Watts:

My previous letter of February 5, 2004 with respect to the subject conference indicated our intention to meet with your organization on February 12, 2004 concerning simulator fidelity and testing issues and to provide a supplement with the answers to the questions generated at the conference. The supplemental information is enclosed and we added the additional questions from our February 12th meeting.

In summary, Larry Vick and Dave Trimble from NRR and myself met with the Mid Atlantic Nuclear Training Group (MANTG) in a joint session of the Operation Subcommittee and Simulator Working Group. The primary mission was to address the answers to industry questions related to simulator fidelity and testing problems and more specifically Scenario Based Testing (SBT). We perceive that meaningful discussion occurred regarding the use of the appropriate simulator capability criteria in addition to training and procedural objectives unique to the SBT methodology. Also, current inspection experiences related to fidelity and testing issues on Indian Point 2 and at Salem/Hope Creek were discussed briefly.

We perceive that the outcome of the meeting was a better definition of the problems associated with simulator fidelity and testing and, in particular, the use of appropriate test criteria for SBT. Enclosures 1 and 2 represent a comprehensive list of issues related to this topic. This meeting should form a springboard for additional meetings between industry and NRC related to problem solving in this area. The effort was of mutual benefit in which a good exchange of information occurred along with historical insights as to how we got to today's issues.

Let me summarize our regulatory approach with respect to simulator fidelity and testing problems. 10 CFR 55.46c(1) and 55.4 require that the simulator replicate the plant which means that the demonstrated replication is continuous and any deviation would be a violation. The reactor oversight process has provisions for crediting licensee identification and analyzing as to whether or not the deficiency is more than minor. Simulator performance testing is defined in §55.4 as "testing conducted to verify a simulation facility's performance as compared to actual or predicted reference plant performance." The statements of consideration for the applicable rule endorse all three versions of the ANSI/ANS 3.5 standard. In the past through the certification process, the NRC staff received commitments from all licensees as to which

version of the standard the facility is using. In accordance with your commitment tracking processes, we expect notification that you have changed commitments to the various versions of the standard or if you are using a testing methodology not previously endorsed by the staff. If you are using a methodology not previously endorsed by the NRC staff then you should provide the details through correspondence to the NRC and seek such an endorsement. Any deviations from the endorsed testing methodology may be treated as findings (not necessary violations) after analysis of the related performance deficiency and determination of safety significance in accordance with MC0609 Appendix I. As a reminder and in accordance with 10 CFR 55.46(b) the Commission must approve the use of a simulation facility other than a plant-referenced simulator for initial and requalification examinations. The NRC staff encourages all licensees to have a strong testing program which, along with operator input, is focused on correcting identified simulator fidelity deficiencies. The reactor oversight process has provisions for crediting such identification and resolution in a timely manner.

The NRC will continue to work with the industry to address simulator fidelity problems and testing implementation issues. We appreciate the continued support, and the active participation of MANTG in this area. If you have any questions, comments, or need additional information, please contact me at (610) 337-5183 or by email rjc@nrc.gov

Sincerely,

/RA/

Richard J. Conte, Chief
Operational Safety Branch
Division of Reactor Safety

Enclosures:
1. Follow Up Questions & Answers From MANTG / NRC Conference Interactions Related To Simulator Fidelity and Testing (August 25-26, 2003 and February 12, 2004)
2. Revised Follow Up Questions & Answers From NEI / NRC Simulator Rule Workshop (February 19-20, 2003)

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ENCLOSURE 1

Follow Up Questions & Answers
From
MANTG / NRC Conference Interactions Related To
Simulator Fidelity and Testing (August 25-26, 2003 and February 12, 2004)

Q1. Why is Scenario-Based-Testing the simulator's performance a challenge?

A1. The challenge related to scenario based testing (SBT) appears to have a couple of aspects: 1) SBT is a relatively new concept and related guidance on the use of SBT may be unclear or ambiguous; and 2) how the industry started to implement the guidance, albeit with good intentions, may be different than what the staff believes is reasonably necessary to satisfy the provisions of ANSI/ANS-3.5-1998. Insufficient test scope and fidelity criteria as well as inadequate test results and evaluation of the test results are the overriding challenges to be met. Fortunately the industry and NRC are communicating in the area and additional guidance may be warranted.

First, NRC staff endorses the ANSI/ANS 3.5-1998 testing principles of section 4.4, Simulator Testing. The need to establish criteria, take data, evaluate data against acceptance criteria and take action on deviations (assumed to be more than minor) are fundamental and paramount testing principles as reflected holistically in section 4, in particular, and in the rest of the standard. The details as to how to implement SBT related to various types of tests (steady state, normal evolution, malfunction and transient tests) appears to be unclear to and/or misunderstood by a number of stakeholders.

The NRC staff understanding of section 4.4.3.1 third full paragraph is that the SBT could be used to take credit for malfunction and normal evolution testing provided: (1) the evolutions are performed in accordance with reference unit procedures; and (2) test results are evaluated and documented. We refer to these conditions later as "additional conditions" when SBT is elected and these additional conditions apply only when SBT is credited for certain types of operability testing. As noted in Regulatory Guide 1.149, Revision 3, section B: In the staff's view, verification and validation testing in the software development process, coupled with scenario-based testing in the training and examination preparation processes, provides additional assurance of acceptable simulator performance over that provided by previous simulator capabilities-based, stand-alone testing programs. Unfortunately, Revision 3 of the regulatory guide never continued the clarification from Revision 2 section C.1.5 third paragraph of the Reg. Guide 1.149:

> "Performance and malfunction testing may be integrated with a facility licensee's approved or accredited training program that uses a systems approach to training if performance data are obtained ... and analyzed for compliance with the performance criteria listed in ANSI/ANS 3.5-1993 [emphasis added]."

This may be a source of confusion.

With respect to the 1998 version of the standard for simulator performance testing, the

NRC has accepted the capability criteria noted in Section 4.1 (which address, among other things, real time and repeatability, steady state operation, normal evolutions, and malfunctions (including transients)). Section 4.4.3.1 references Appendix B as providing examples of acceptable simulator operability tests. Appendix B, in turn, refers to Section 4.1.4 as the acceptance criteria for transient performance testing. Thus, the NRC expects that the guidance in Section 4.1.4 will be used to develop the acceptance criteria for transient tests. We understand and expect that the guidance in Section 4.1 is being used to develop the acceptance criteria for performance tests if a facility commits itself to the 1998 version of the standard. Transient testing is defined in Appendix B of the standard, as applicable to the facility. There was no disagreement verbalized at the February 12th MANTG meeting on this point.

If SBT is elected for crediting malfunction and normal evolution testing as permitted by the standard, then the additional conditions referred to earlier also apply in addition to establishing the simulator capability criteria of Section 4.1 for malfunction and normal evolution testing. This point appeared to be in contention from the Feb. 12th MANTG meeting. We strongly suspect that the acceptance criteria used at some simulation facilities to satisfy the operability testing of Section 4.4.3.1 may not include one or more of the following acceptance criteria common to both the malfunction and normal evolution capability criterion: 1) observable change in the parameters correspond in direction to those expected for actual or best estimate of the normal unit operation or the response of the reference unit to the malfunction; 2) simulator shall not fail to cause an alarm or automatic action if the reference unit would have caused an alarm or automatic action under identical circumstances; 3) simulator shall not cause an alarm or automatic action if the reference unit would not cause an alarm or automatic action under identical circumstances. The NRC staff believes that these criteria will require some thought when malfunctions are combined in an SBT. Furthermore, the staff believes that the ANSI/ANS-3.5-1998 criteria are not unreasonable and that simulation facility testing personnel along with subject matters expert should be able to come up with reasonable criteria (based upon actual or best estimate reference plant data). More than minor deviations should then be evaluated.

At the Feb. 12th MANTG meeting NRC representatives acknowledged that the best estimate for SBT of the depths of EOP activity will be a considerable challenge and this area may warrant additional discussion between NRC staff and the industry. The NRC representative did indicate that detailed parameter chart comparisons for the depths of the EOP is difficult and may not be warranted. The NRC expectation is that it should at least be possible for SMEs (when actual plant or predicted data is not available), at the conclusion of an SBT to review tests results and confirm that observable changes in key parameters corresponded in direction to the expected response, the simulator did not fail to cause an expected alarm or automatic action, and that the simulator did not cause an unexpected alarm or automatic action.

It should be also be noted that the SBT methodology is permitted for only certain operability tests and they don't include steady state and transient tests. There did not seem to be much disagreement on this point at the Feb. 12th MANTG meeting.

SBT used to satisfy Section 4.4.3.2 must demonstrate capability to satisfy

predetermined learning and examination objectives without exceptions, significant performance discrepancies, or deviation from the approved scenario sequence. The NRC expects that the acceptance criteria of Section 4.1.4 should be applied to the SBT used to meet Section 4.4.3.2. This is to ensure that "no negative training" results not only because of failure to meet training and procedure objectives but also because of failure to meet the simulator capability criteria. Again, the NRC recognizes that detailed parameter chart comparisons for the depths of EOPs may not be practical and therefore is not warranted. However, the NRC expects that it should at least be possible for SMEs (when actual event or predicted data is not available), at the conclusion of a SBT, to review the test results and confirm that observable changes in key parameters correspond in direction to the expected response, the simulator did not fail to cause an expected alarm or automatic action, and that the simulator did not cause an unexpected alarm or automatic action.

Q2. What impact do computer upgrades and re-hosting have on performance tests?

A2. Upgrades to licensee simulation facility plant-referenced simulator computer systems and re-hosting onto new computer platforms should not alter model performance characteristics. It is expected that similar results will be achieved when comparing performance test runs after an upgrade or re-host to the same test runs before the upgrade or re-host. Verification and validation testing shall be conducted, as required by Section 4.4.1 and 4.4.2 of the standard (1998), following a system upgrade or re-host to confirm that model characteristics have not changed. Although not a requirement of the ANSI/ANS-3.5 standard or the 10CFR 55 regulations, it is prudent to run the simulator operability tests (i.e., steady-state, and transient tests) following a computer upgrade or re-host to ensure or demonstrate no unintended consequences to models.

Q3. Are simulator design specifications required to be updated?

A3. Plant-referenced simulators model systems of a reference plant. "Reference plant" is defined in 10 CFR 55.4 as “the specific nuclear power plant from which a simulation facility’s control room configuration, system control arrangement, and design data are derived.”

ANSI/ANS-3.5-1998, Section 5.1.2 Simulator Design Data Base Update, requires that the simulator design data base (i.e., design specifications) shall be periodically updated (i.e., within 18 months of the reference unit's commercial operation date or the simulator's operational date, whichever is later; or following the initial update, new data shall be reviewed, and revised, once per calendar year.) Maintaining the fidelity of the plant-referenced simulator includes updating the design specifications. The particular methodology for updating design specifications is determined, for the most part, by the facility licensee's simulator configuration management control (i.e., ANSI/ANS-3.5 standard requires, among other criteria, that a means for establishing and maintaining a simulator design baseline shall be included in the configuration management.)

Q4. Is the NRC rethinking how simulator performance and testing is being conducted?

A4. No, the NRC is not rethinking the types of tests or how simulator testing is to be done. The staff is interested in clarifying expectations for acceptable scenario based testing for certain types of tests in light of industry feedback and results of inspections to date. See question No. 1 above.

With respect to scenario based testing (SBT) as noted in ANSI/ANS-3.5-1998, Section 4.4.3.2, SBT provides a methodology, along with Section 4.4.3.1, "Simulator Operability Testing," by which the plant-referenced simulator is to be performance tested. The '98 standard requires that, "scenarios developed for the simulator, ..., shall be tested before use for operator training or examination." The standard also requires that "a record of the conduct of these tests, ..., and the evaluation of the test results, shall be maintained." Historically, as well as currently, simulator scenarios used in the operator licensing programs (both initial and requalification) are developed, for the most part, in accordance with guidance from the NRC's NUREG-1021, Operator Licensing Examiner Standards, for the primary purpose of evaluating the performance of operators in an operating test setting. NUREG-1021s' scenario development scheme does not provide guidance, and is not intended, to evaluate a plant-referenced simulator's performance. NUREG-1021s' overriding supposition is that the plant-referenced simulator is to be operated in the same manner as the reference plant using the plant operating procedures.

Additionally, as a result of experience gained from conducting plant-referenced simulator inspections since implementation of the simulator rule (November 16, 2001), the staff has raised concerns regarding how simulator performance testing is being conducted to ensure compliance with the definition of performance testing as described in 55.4. To-date, the concerns are generally case specific but could reach a threshold whereby it is a generic concern. As long as simulation facility licensees honor their commitment to a specific ANSI/ANS-3.5 standard, which provides adequate requirements on how the plant-referenced simulator is to be performance tested and the conduct of the tests, the staff believes that compliance with the rule requirements can easily be met. The NRC's participation on the standard's working group helps to ensure that a balanced approached is taken when formulating a new standard.

Q5. What type of plant reference data is used when designing a plant-referenced simulator? (i.e., Is it acceptable to use plant procedures, as-built instrument and electrical prints, Licensee Event Reports, Technical Specifications, and Final Safety Analysis Report?)

A5. The intent of reference plant data used for simulator design is to provide the basis information for design of a simulator that accurately models the actual reference plant response. Controlled plant documents can provide valuable information as to expected response. Examples of design data are provided in Appendix A of ANSI/ANS 3.5 and include most of the sources listed in the question above. Other possible sources include piping diagrams, instrument and control diagrams, startup tests, component operational data, and observed operations.

Q6. What is actually required when documenting SBT (Scenario-Based Test)?

A6. Documentation of a plant-referenced simulator's performance tests, including Scenario-

Based-Test (SBT), provides evidence that testing has been properly conducted and that test results have been properly evaluated. The documentation of the performance tests should verify a simulation facility's performance as compared to actual or predicted reference plant performance and to learning and examination objectives. The rule 10 CFR 55.46(d)(1) requires that the results of performance tests must be retained for four years after completion of each performance test or until superseded by updated test results.

For SBTs used to satisfy the operability testing of Section 4.4.3.1, the NRC expects that acceptance test criteria and test results showing the acceptance criteria were satisfied should be documented.

For SBTs used to satisfy the testing of Section 4.4.3.2, the NRC expects that the following should be documented: (1) the initial conditions, description of the scenario and perturbations used to induce the transient; (2) learning and examination objectives and the performance criteria of Section 4.1.4; (3) positive demonstration or, alternatively, an assertion that the learning / examination objectives were met; (4) listing of key parameters checked and assertion that there were no unexpected changes; (5) listing of key alarms / automatic actions occurring and assertion that they would be expected for the scenario; and (6) assertion that no unexpected alarms / automatic actions occurred.

Q7. What is the periodicity for SBT? (i.e., how recent that data is verified?)

A7. SBT periodicity is not specifically addressed by the regulations but can be reasonably inferred as "when needed" periodicity. The regulations do require that facility licensees conduct performance testing throughout the life of the simulation facility in a manner sufficient to ensure that simulator fidelity requirements are met. The ANSI/ANS-3.5-1998 standard in Section 4.4.3.2 requires that the scenarios be tested before use for operator training or examination. The standard does not elaborate further as to retesting scenarios. It is expected that configuration control procedures will identify facility expectations for testing scenarios based on changes to previously tested scenarios, changes to plant procedures that may affect SBT results, modifications to the plant and simulator that may affect SBT results, and simulator modeling changes that may affect scenario test results.

It should be noted that the scope of 10 CFR 55.46 c(1)(i) includes those activities of 10 CFR 55.45 which include initial exams and requalification exams and the specific steady state and transient tests of 10 CFR 55.59(c)(3)(i)(A) through (AA). Because of this scope, SBT applies <u>before the use</u> of scenarios for initial and requalification exams required by part 55.

Q8. The Operator Requal Human Performance SDP (Significant Determination Process) makes no mention of implementation of modifications. ANS-3.5 allows time for reference plant modifications to be simulated based on training-needs-analysis. What is

the staff's position with regard to installing modifications on the simulator before being installed on the referenced plant?

A8. The focus of the SDP is to ensure a finding is analyzed based on the effect on operator actions or the actual or potential for negative training. The ANSI/ANS-3.5 allows for simulator modifications to be completed either before or after the modifications in the reference plant. Decisions as to timing of the simulator modifications should be based on an analysis of training needs and must also take into consideration proposed uses of the simulator and the effect on operator actions. Plant-referenced simulators are used in initial and requal examinations and, in some cases, for eligibility requirements of 10 CFR 55.31. When used to meet these requirements, plant-referenced simulators must accurately reflect current design of the referenced plant and not produce negative training.

Under almost all circumstances, the staff expects that a plant-referenced simulator used for 10CFR55 purposes will reflect current as-built design of the reference plant. Use of other-than-plant-referenced simulator (or a plant-referenced simulator that differs from the plant only because of a recent modification) requires Commission approval. In cases where a plant-referenced simulator differs from its reference plant as a result of plant modifications, the NRC expects differences training to compensate for deviations from the reference plant to preclude or compensate for any negative training. For example, if a reference plant modification is planned for completion in the last few weeks leading up to an initial license examination, it might be desirable to delay installation of the modification on the simulator until after the examination to avoid disrupting the orderly planning and administration of the exam. However, this choice could call any licensing decision made using that simulator into question because the potential exists that skills demonstrated on the simulator would be different from what would be required in the plant for which a license is to be issued. In this case, a facility licensee could request in writing Commission approval to use the simulator while it differs from the reference plant. The request should address steps to be taken to prevent or compensate for negative training. The NRC has the option of granting such a request.

Q9. How is simulator performance validated?

A9. Validation of simulator performance is addressed by ANSI/ANS-3.5-1998 Section 4.4.2 of the 1998 standard. It states that: "Validation testing is a form of software development testing performed by comparison of simulated component or system results against actual or predicted reference unit performance data in either a stand-alone or integrated fashion." Validation testing is conducted prior to the simulator's use in training and examination for the following situations: (1) completion of simulator initial construction; (2) whenever models are changed or modified; and (3) whenever there are changes which have the potential to affect simulator capabilities or repeatability. The method for accomplishing and documenting validation testing is dependent on the software/hardware changes to be validated and the licensee's configuration control requirements. ANSI/ANS-3.5-1998 allows validation to be conducted in either a fully integrated, partially integrated, or stand-alone mode of system operation. As a minimum, each facility must generate and maintain validation test documentation.

Region-based inspectors conduct periodic (biennial) baseline inspections of the licensed operator requalification programs (under IP 71111.11 guidance) and these inspections now include a review of simulator fidelity. Among other things, inspectors will review validation testing documentation to determine the effectiveness of the licensee's process for identifying and resolving simulator problems especially when the results of performance testing raise questions or there is insufficient documentation to show that adequate performance testing was conducted.

Q10. Will the staff determine whether or not a particular model is correct?

A10. The facility licensee has responsibility for maintenance and testing of their plant-specific simulators. Accordingly, the licensee is expected to ensure their simulator adequately demonstrates expected plant response through appropriate testing. NRC staff evaluates simulator performance during the biennial baseline requal inspection. Inspectors review simulator test documentation and the facility's deficiency reporting to ensure fidelity of the simulator is being maintained.

Q11. We have replaced some models with new models; What if the new model shows a different response than the old model? (With regard to malfunctions such as LOCAs and transients with no plant data).

A11. Steady state and transient testing is performed to verify fidelity of simulator response as compared to actual or best-estimate (where actual performance data is not available) reference plant response. With regard to the situation where a new computer model yields results that differ from previously validated results, two possible causes are indicated. One is that the new model is not as accurate as the old. The second possibility is that the new model is more accurate than the previous model. If the licensee has confidence that the original model matches best estimate data, then it is apparent that the new model needs additional development effort before it is ready for training.

The more difficult situation is the one where the new model calls the old model's validity into question. This situation could occur if there were problems with data originally used to represent best estimate data for the reference plant response. A re-evaluation must be performed to determine best estimate data when doubt exists as to which model (or whether either model) accurately reproduces expected reference plant response. In the absence of actual plant data, a detailed engineering analysis would provide a best-estimate of expected plant response.

If the best-estimate revealed significant problems with the existing model and this model had been used to negatively train operators, then reactor safety may have been impacted. The facility corrective action program would need to determine the extent to which the operators had been negatively trained. Retraining, if indicated, would follow. NRC requalification baseline inspections monitor performance in this area.

Q12. We are on the '98 standard, how often do I need to validate the simulator's response?

A12. ANSI/ANS-3.5-1998 Section 4.4.2 requires that validation tests shall be conducted prior

to the simulator's use in training and examination for the following situations: (1) Completion of simulator initial construction;(2) Whenever models are changed or modified in a way that potentially affects fidelity relative to the reference unit; and, (3) whenever there are changes which have the potential to affect simulator capabilities or repeatability, including changes to computer platforms, operating systems and run-time utilities, interface systems, or instructor stations.

Q13. What constitutes an adequate degree of replication and if not adequate what is the safety significance.

A13. The degree of replication depends on the type of evolution (steady state, transient/malfunction, normal evolution) and the applicable operability test acceptance criteria assuming adequate acceptance criteria have been established. For example the ANSI/ANS requires that certain steady state parameters meet at 2% tolerance. If there as been an identification of a fidelity issue in which the applicable parameter is beyond 2%, then the degree of replication is unacceptable since it would fail the steady state acceptance criterion.

For alarms and automatic action (or interlocks), the plant's calibration and surveillance testing acceptance criterion (instrument tolerances) should be an adequate method for determining the degree of replication.

An ancillary question to the above is: "What are the first order principles for NRC staff analysis in order to determine if a simulator fidelity performance deficiency is minor or not with respect to 55.46c(1) and what safety significance level could result? The issue is related to the human performance attribute in the three reactor safety cornerstones of initiating events, mitigation, and barrier controls per MC 0612 App. B. Performance deficiencies are more than minor and are of very low safety significance if they involve actual or potential impact on operator actions per MC 0609 Appendix I Blocks 6 and 12 along with the basis statements for the questions in the blocks (Note: This a broader definition of negative training from that defined in ANSI/ANS 3.5-1998 definitions section). These issues are not of greater significance because they did not have an adverse impact on operator actions such that safety related equipment was made or would have been made inoperable during normal operations or in response to a plant transient. If there was an effect to this degree, the performance deficiency would be analyzed per MC 0609 App. A (PRA basis). Minor performance deficiencies that have no effect or impact on operator actions are generally not documented in the inspection report.

See also Enclosure 2 Q8.

Q14. How should the MANTG SBT evaluation form be revised to satisfy the NRC staff. What level of detail is needed in the scenario guide used to support SBT.

A14. See Q6 of this enclosure.

Q15. For malfunction and normal evolutions that do not constitute steady state and transient tests, do the associated SBTs have to have the appropriate to the circumstance simulator capability criteria (section 4.1) for the following situations: 1) used as an operability test; 2) used to test a malfunction or normal evolution specifically listed in the rule 10 CFR 55.46(c)(1)(i) scope which references the specific steady state and transient tests of 10 CFR 55.59(c)(3)(i)(A) through (AA); and , 3) used to test a malfunction or normal evolution not specifically listed in the requal rule of part 55 but the malfunction or normal evolution is used to support a scenario for an exam required by Part 55 based on 10 CFR 55.45 operating test criteria.

A15. Yes to all of the above situations.

Q16. What communication to the NRC is needed related to modification of the simulator done before the plant but the simulator is in use for initial exams or requal exams?

A16. See Q8 of this enclosure.

Q17. How long does the following test documentation have to be kept and where are those requirements: V&V tests, Operability Tests, SBTs?

A17. See Enclosure 2, Q1.

Q18. What is the simulator capability criteria (SCC) for transient tests listed in the App. B of the standard? Is it more than the equipment malfunction or normal evolution SCC but not as much at the Steady State- i.e., parameter traces compared to best estimate data?

A18. Also see Q1 of this enclosure. Based on a careful review of the list in the Appendix B of the various versions of the ANSI/ANS 3.5, the transient test are essentially malfunction tests subject to the SCC for malfunction testing. In addition to the procedural objectives of a malfunction test, other important criteria apply: 1) observable change in the parameters correspond in direction to those expected for actual or best estimate of the normal unit operation or the response of the reference unit to the malfunction; 2) simulator shall not fail to cause an alarm or automatic action if the reference unit would have caused an alarm or automatic action under identical circumstances; and, 3) simulator shall not cause an alarm or automatic action if the reference unit would not cause an alarm or automatic action under identical circumstances.

ENCLOSURE 2

Revised Follow Up Questions & Answers
From
NEI / NRC Simulator Rule Workshop (February 19-20, 2003)

NOTE: Substantial changes made to Question Nos. 1 and 15.

Q1. Record retention: "... retained for four years after the completion of each performance test or until superseded by updated test results." How long can the "or" in this statement be - the life of the plant, for example?

A1. [10 CFR 55.46(d)(1)] The performance test results (as defined in 10 CFR 55.4) are expected to be retained for four years after the completion of each performance test. Generally, simulator performance tests are conducted on a periodic basis in accordance with ANSI/ANS 3.5 and the facility licensee's simulator testing schedule. The test results are subject to review by the NRC and a retention period of four years is prescribed so that an evaluation and comparison can be made for a given performance test over a period of time (up to four years) to ensure that simulator fidelity is being maintained. However, if a performance test is not repeated until a period of more than four years has passed, then the record of the performance test should be retained until superseded by the subsequent test. When a performance test is superseded before four years, then the four year period resets for the updated test. The rule still requires that the facility licensee conduct performance testing throughout the life of the simulation facility.

Keep in mind that the standard requires that: (A) in Section 4.4.1, that verification tests (i.e., software design documentation) be generated and <u>is updated</u>. (B) in Section 4.4.2, that validation test documentation be generated and that a record of the conduct of this test, the test's results, and the test's evaluation <u>be maintained</u>. It further requires that these tests be conducted prior to the simulator's use in training and examination for the following situations: (1) completion of simulator initial construction; (2) whenever models are changed or modified in a way that potentially affects fidelity relative to the reference unit; and, (3) whenever there are changes which have the potential to affect simulator capabilities or repeatability. (C) in Section 4.4.3.1, that operability tests be conducted on a periodic basis and that a record of the conduct of this test and its evaluation <u>be maintained</u>. (D) in Section 4.4.3.2, that SBTs be tested before use for operator training or examination and that a record of the conduct of these tests, and the evaluation of the tests results <u>be maintained</u>. Implementing these standard requirements are measures acceptable to the staff for implementing the demonstration requirements of 10 CFR 55.46(c)(1).

Updating and maintaining tests documentation is ongoing. No relief is provided in the standard that allows cessation of maintaining the test records. Simulator test records provide evidence of simulator fidelity. If for no other reason, it would be prudent for licensees to retain all such records as a means of providing assurance of fidelity should it be brought into question by a future plant or industry event.

Q2. Scenario validation: is there a shift in mind set on scenario validation? In other words, the '98 standard reads as if no student should be exposed to an un-validated scenario. Are you saying this is not the case?

A2. The ANSI/ANS-3.5-1998 standard, in Section 4.4.3.2, states that, "Scenarios developed for the simulator, including the appropriate instructor interfaces and cueing, shall be tested before use for operator training or examination." The staff understands this section of the standard to mean that a performance test which evaluates the performance of the simulator as compared to the actual or predicted reference plant response must have been satisfactorily conducted for each scenario used for operator training or examination. Minor deviations from these scenarios, such as those used in training to demonstrate sensitivity of plant response to changes in initial conditions, need not be performance tested. A scenario-based test, once properly conducted with satisfactory results, need not be repeated provided nothing has changed (in the plant, simulator, or operating procedure) that could alter the results of the performance test.

The issue of previously used scenarios prior to adopting the ANSI/ANS-3.5-1998 standard is not addressed by the standard. "Grand fathering" previously used scenarios should be carefully reviewed before declaring that the scenario is a "simulator scenario-based test." Such a practice would likely be questioned because previously used scenarios were developed solely to train and evaluate individual operators or operating crews and were not designed to evaluate the performance of the simulator per se against the reference plant. In general, it was assumed that the simulator was operated like the actual plant, irrespective of whether or not it had been performance tested to validate the assumption. As a consequence, individual operator or crew performance was evaluated while simulator performance was not, by design, evaluated and documented. Hence previous testing may not be sufficient.

Q3. Core performance: what standards are being used to ensure the simulator performance replicates reference plant nuclear and thermal hydraulic operating characteristics, since there is a broad range of core models out there?

A3. ANSI/ANS-3.5- 1998 (1993)(1985) establishes the functional requirements for the plant-referenced simulator. It also establishes the criteria for the degree of simulation, performance, and functional capability. With regard to ensuring that the nuclear and thermal hydraulic characteristics are replicated appropriately, the standard, in Section 3.1, "Simulator Capabilities," requires that the response of the simulator resulting from operator action, no operation action, improper operation action, automatic reference unit controls, and inherent operating characteristics shall be realistic and shall not violate the physical laws of nature. Nuclear and thermal hydraulic characteristics are fundamental and must be consistent with the laws of nature. The standard (1998), in Section 4.1.3.2, requires that performance of procedures on the simulator, including core performance type procedures, shall be compared to and demonstrated to represent correctly the response of the reference unit at the same power level consistent with the reference unit procedures and data availability. The standard establishes six acceptance criteria with regard to simulator response during the conduct of the performance tests: (1) be the same as the reference unit startup test procedure acceptance criteria; (2) be the same as the reference unit surveillance procedure acceptance criteria; (3) be the same as the

reference unit normal operating procedure acceptance criteria; (4) require that the observable change in the parameters correspond in direction to those expected for a best estimate of normal unit operation; (5) require that the simulator shall not fail to cause an alarm or automatic action if the reference unit would have cause an alarm or automatic action under identical circumstances; and (6) require that the simulator shall not cause an alarm or automatic action if the reference unit would not cause an alarm or automatic action under identical circumstances. These standards are quite high when applying them to the nuclear and thermal hydraulic characteristics.

See also Q9 of this enclosure.

Q4. Malfunction tests: when on the '98 standard and asked for a malfunction test (which is no longer required), what are we supposed to give the inspector? For example, the individual was asked to produce a malfunction test showing a single reactor feed pump trip and he did not have such a test nor could he find the requirement to do one.

A4. ANSI/ANS-3.5-1998, in Section 3.1.4, discusses that the determination of the type and number of malfunctions to be simulated shall be part of a Systematic Approach to Training process for the design of performance-based operator training programs. The specific malfunction testing required of the simulator must at least encompass the requirements specified in the reference unit's accredited licensed operator training programs. Loss of normal feedwater, or normal feedwater system failure is one the required malfunction(s) that shall be included in the simulator design. For any malfunction that is within the design of the simulator but not included within the training program, the NRC would expect that the malfunction would either be tested directly as part of the annual simulator operability tests requirements of the standard or that the annual operability testing program would be sufficiently robust that it would provide confidence that the basic models utilized in the simulation of the malfunction remain sound. If the licensee does not have a scenario-based-test or annual operability test for this malfunction, the licensee should be able to provide an annual operability test that confirmed the soundness of the basic model related to this malfunction.

Q5. 71111.11 Appendix C: are resident inspectors trained on the contents of this new appendix, and more importantly if regional examiners are going to extract data from the resident's reports, are the residents trained on the proper use of terminology with regard to simulator performance?

A5. The NRC's expectation for resident inspectors in this area is primarily to identify significant simulator fidelity issues. Such identification is within the current capability and training of the inspectors.

Q6. Scenario based testing results: there does not seem to be a requirement to have firm documentation for documenting scenario based testing results. Is this correct?

A6. ANSI/ANS-3.5-1998 standard, in Section 4.4.3.2, states that a record of the conduct of these tests, typically in the form of a completed scenario or lesson plan checklist, and the evaluation of test results, shall be maintained. The level and degree of documentation of the record of the scenario-based test conducted is not prescribed in the standard. Absent the inclusion in the record of acceptance criteria used for the scenario based tests and documentation of results in some form that would allow the NRC to confirm that acceptance criteria were met, the NRC will be unable to confirm that a proper evaluation was conducted. This could adversely impact NRC's crediting of the simulator for training and experience and use of the simulator for examinations.

See also Enclosure 1, Q6, for more details on documentation.

Q7. 55.31 vs 55.46: If a candidate got some of his reactivity manipulations on a core in the plant that was then refueled and he then got additional manipulations, the earlier manipulations would still count and yet this is not the case with the simulator core load. Why?

A7. Reactivity manipulations which are performed on the plant-reference simulator for an applicant to meet the experience eligibility requirements are credited when the simulator at the time of performance meets the requirements of 55.46(c)(2)(i) and (ii). The rule requires that the plant-referenced simulator utilizes models relating to nuclear and thermal-hydraulic characteristics that replicate the most recent core load in the nuclear plant for which a license is sought; ... The Commission, in its response to public comments during the rule making process, interpreted "most recent" as the current core, or if in a refueling outage, the previous core. The intent is to ensure that the applicant has a like-kind experience as he would have in the reference plant. As is the case with reactivity manipulations conducted on the plant, any appropriate reactivity manipulation performed on the simulator may be credited provided the simulator replicates the most recent core at the time of the manipulation.

Q8. "Replicate": please define the term "replicate" as found in 10CFR55.31 and 46.

A8. SECY-01-0125, dated July 10, 2001, Analysis of Public Comments, Comment 3-3 Response addressed this question. The Commission believes that the terminology (in the proposed rule and subsequently in the final rule) is appropriate and consistent with ANSI/ANS-3.5-1998. It means that the plant-referenced simulator's nuclear and thermal-hydraulic models operate within the tolerances specified in section 4.1.3, "Steady-State and Normal Evolutions," of the industry standard.

See also Enclosure 1, Q13.

Q9. Core performance testing (ANSI/ANS-3.5-1998, Section 3.1.3, item 9): what is core performance testing? I understand it to be the same thing an operator would do in the course of his job, and this differs greatly between PWRs and BWRs.

A9. The regulations, in 10 CFR 55.4, define performance testing as testing conducted to verify a simulation facility's performance as compared to actual or predicted reference plant performance. Core refers to the nuclear reactor core, including but not limited to the design, configuration, and nuclear and thermal hydraulic characteristics of the core as well as the associated nuclear instrumentation that monitors or measures the various parameters which provide insight to the behavior and operating characteristics of the core. In summary, core performance testing means testing conducted to verify a simulation facility's core performance replicates actual or predicted reference plant core performance. Core performance testing is not the same thing an operator may or may not do in the performance of his job. Absent conduct of the same core performance tests on the simulator as are performed on the plant and demonstration through such testing that the simulator meets actual or predicted plant performance within the acceptance criteria of the ANSI/ANS 3.5 standard, the NRC may not be able to confirm core replication in the simulator. This could adversely impact crediting of experienced gained on the simulator.

See also Q3 of this enclosure.

Q10. 1985 standard vs. new 55.46 rule: if I'm on the 1985 standard, how do I meet 55.46 requirements to use the simulator for reactivity manipulations when the 1985 standard does not have detail for core model testing?

A10. Refer to answers to Q3 and Q9 of this enclosure.

Q11. Core vs. Thermal-hydraulics replication: we've talked a lot about core performance testing: how does the NRC propose how to test thermal-hydraulic performance?

A11. Generally, the NRC does not prescribe how to conduct a performance test, but instead challenges a licensee to demonstrate that certain regulatory requirements are being met. Thermal-hydraulic performance could be demonstrated by comparing simulator performance to actual plant performance during startup, power ascension, normal operation, and transient response. Startup test procedures and licensee event reports are good data sources.

Q12. Core performance testing: is it acceptable to do "off-line" testing of core performance (i.e., not use the actual simulator but instead a stand-alone system)?

A12. The ANSI/ANS-3.5-1998 standard, in Section 3.1.3, requires that the evolutions, such as core performance testing, be supported by the simulator, using only operator action normal to the reference unit. There is nothing to preclude testing off-line for the sake of designing, debugging, and testing without other system interfaces to assure that the model is ready to be integrated into the simulated plant. However, fully integrated core performance testing on the plant-referenced simulator is necessary to ensure that the appropriate input and output from and to other models are sufficient in scope and fidelity

to ensure that the simulator responds as the plant would under the same conditions.

Q13. Updating models: is it encouraged to update our reactor vessel/core models to comply to 55.46?

A13. The Commission in its statements of consideration during the rule making, emphasized that facility licensee's would not be required to update their core models in order to comply with the requirements of 55.46. Refer to RG 1.149, Rev 3. This assumes that the simulator core model has been performance tested and the test results meet the appropriate acceptance criteria when compared to the reference plant performance or best estimate performance where actual performance data is not available.

Q14. Inspector's simulator inspection training document: would you make this available to the USUG?

A14. IP-71111.11 Simulator Fidelity Inspection Guidance for Sections 2.11, 3.11, and Appendix C , is attached. Bear in mind that this is not intended to replace IP-71111.11 but to provide guidance to inspectors who are responsible for conducting this part of the inspection for the first time.

Q15. Transition from 1985 to 1998 Standard: if initial license candidate training scenarios worked fine under the 1985 standard, would they have to be tested again prior to adopting the 1998 standard?

A15. See Q2 of this enclosure.

Q16. Certification Requirements: it's been hinted that the NRC may have to revisit the removal of the old simulator certification requirement. Is this the case?

A16. A revisit of the old simulator certification (i.e., old NRC Form-474) would only be prompted if the current rule is found to be inadequate to ensure continued assurance of simulator fidelity. As more and more simulator inspections are conducted, the staff will be able to better evaluate the need for simulator certifications. This does not appear to be the case at the present time. The rule is quite robust in ensuring simulator fidelity.

Q17. Four Year Record Retention: do records older than four years have to be retained, such as acceptance tests from original certification, etc?

A17. See Q1 of this enclosure.

Q18. IP-71111.11 Appendix C: it doesn't appear that there's anything I can do to prepare for this inspection. Would you agree?

A18. On the contrary, the facility licensee should be cognizant of the ANS-3.5 standards and the IP-71111.11 areas that the inspector will look at.

Q19. Core Performance Testing (statement, not a question): MANTG is working on a core performance testing position paper. This will be shared with USUG when completed.

A19. No comment other than it is a good initiative!

Q20. Scenario-based Testing: what additional documentation beyond a checklist would be required to validate the testing?

A20. See Enclosure 1, Q6, and Q6 of this Enclosure 2.

Attachment for Enclosure 2, Question # 14

IP 71111.11 Simulator Fidelity Inspection Guidance for Sections 2.11, 3.11, and Appendix C

This guidance is not intended to replace IP 71111.11 but to provide guidance to NRC inspectors who are responsible for conducting this part of the inspection for the first time.

During Entrance

A. Re-emphasize the scope of the simulator inspection. (Scope statement is in Section 02.11.)
B. Inquire if the licensee has read and understood the revised IP. (If not, ensure they have a copy and briefly walk them through the new sections: 02.11, 03.11, and Appendix C)
C. Ask if they have any questions regarding the new sections.
D. Inquire as to what ANSI 3.5 Standard the simulator is operating under (i.e., commitment).
E. Inquire if the plant-referenced simulator has been used for reactivity manipulations for initial license applicants to meet eligibility requirements.

Recommended Simulator Inspection Protocol

F. Request /obtain hard copy of **organization chart**, in particular, location of people on the simulator staff.
G. Request/obtain hard copy of **Simulator Management and Configuration Procedure(s)** - i.e., the administrative procedure, including the procedure that governs simulator discrepancies (prioritization scheme, corrective action process and resolution schedule), and performance testing.
H. Request list of **all open simulator discrepancies (DR-s)**. (Review for importance relative to impact on 10 CFR 55.45 & 59 operator actions as well as nuclear & thermal hydraulic operating characteristics).
I. Request list of **closed DRs** for the last 12 months. (Review for same type of issues as open DRs and timeliness for resolution).
J. Request list of **simulator performance tests**: (Test results should meet acceptance criteria. Confirm that significant DRs are processed in the licensee's simulator corrective action program).
Transient Tests - Review at least 2 (suggest Rx trip at 100% power and all RCP pumps trip).
Malfunction Tests - Review at least 5 (2 or 3 malfunctions can be from the requal operating test scenarios. 3 or 4 of the malfunction tests should relate to nuclear and thermal-hydraulic operating characteristics and 1 or 2 of the tests should relate to extensive logic/interlocks performance). Suggestions include: loss of a feed-water pump, main turbine trip at rated power, loss of all off-site power, or main steam line isolation.
Core Performance Tests - Examples of items to review include plant heat balance, determination of shutdown margin and measurement of reactivity coefficients and control rod worth using permanently installed instrumentation. Nuclear and thermal-hydraulic operating characteristics such as xenon and samarium effects, 1/M plots, and other low power physics test can be used to assess the simulated core performance.
Normal Plant Evolutions Tests - Confirm that the simulator has been operated from cold shutdown conditions to rated full power and back. Generally, if these test are performed during use of the simulator for operator training, credit may be taken for having performed the required verification, provided that the evolutions are performed in accordance with reference unit procedures, are evaluated, and documented.
Operator conducted surveillance tests - on safety related equipment or systems. (Same general comment applies as for normal evolutions).

Note: For any performance test that has plots/trends, ensure that parameters are not divergent from expected reference plant results.

During Exit

K. Re-emphasize the scope of the simulator inspection.
L. Note any potential findings (open, closed, or discussion items).