Methodology for Meeting Simulator Performance Testing Requirements of ANS-3.5

George McCullough

george.mccullough@exitech.com

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Nostalgia – How old are you?
Simulator Performance Testing Reference Documents

- ANS-3.5 2009 Nuclear Power Plant Simulators for Use in Operator Training and Examination

- Regulatory Guide 1.149 Rev. 4 Nuclear Power Plant Simulation Facilities for Use in Operator Training, License Examinations, and Applicant Experience Requirements

- 10 CFR 55.46(d) Continued assurance of simulator fidelity
2009 - 4.1.1 Real time and repeatability

It shall be demonstrated that the simulator performs the capabilities defined in Sec. 3.1, completes execution within the designed time interval, and is repeatable. In addition, it shall be demonstrated that between successive simulator tests no noticeable differences exist with respect to time base relationships, sequences, durations, rates, and accelerations.
ANS-3.5 Performance Testing Guidance

2018 – 4.1.1 Real time and repeatability

A real time and repeatability test shall be conducted

(1) upon completion of simulator initial construction;

(2) once per reference unit fuel cycle.

It shall be demonstrated that the simulator completes execution within the designed time interval and is repeatable. In addition, it shall be demonstrated that between successive simulator tests no discrepancies exist with respect to time base relationships, sequences, durations, rates, and accelerations. Discrepancies shall be assessed in accordance with Sec. 5, “Simulator configuration management.”
2009 - 4.4.3 Simulator performance testing

It shall be demonstrated that simulator performance testing is conducted as specified below. *A record of the conduct of these tests, and data comparison that the results meet reference unit data, shall be maintained.*
ANS-3.5 Performance Testing Guidance

2018 - 4.4 Simulator performance testing

It shall be demonstrated that performance testing is conducted to identify discrepancies between the simulator control room or simulated systems when evaluated against the control room or systems of the reference unit. Discrepancies shall be assessed in accordance with Sec. 5.

Simulator performance testing shall be conducted as specified in Secs. 4.4.1 through 4.4.5. A record of the conduct of these tests and their evaluations shall be maintained.
2009 - 4.4.3.1 Simulator operability testing
A simulator operability test shall be conducted once per reference unit fuel cycle by testing the following:
(1) simulator steady-state performance;
(2) simulator transient performance for a benchmark set of transients.
A record of the conduct of this test and its evaluation shall be maintained.
ANS-3.5 Performance Testing Guidance

2018 - 4.4.1 Steady-state testing
Steady-state testing shall be conducted
(1) upon completion of simulator initial construction;
(2) once per reference unit fuel cycle.

2018 - 4.4.2 Simulator transient testing
Simulator transient testing shall be conducted once per reference unit fuel cycle by evaluating simulator transient performance for a benchmark set of transients. Simulator transient performance shall be demonstrated through the comparison of transient performance response to actual or predicted reference unit performance.
ANS-3.5 Performance Testing Guidance

- 2009 - 4.4.3.2  2018 – 4.4.3 Simulator scenario-based testing
Covered in detail last year. NO CHANGES BETWEEN 2009 and 2018 STANDARDS.
ANS-3.5 Performance Testing Guidance

• 2009 - 4.4.3.3 Simulator reactor core performance testing

Simulator reactor core performance testing shall be conducted each reference unit fuel cycle. Testing shall be performed in accordance with the reference unit procedures and shall be compared and demonstrated to replicate the response of the reference unit.

It shall be demonstrated that the simulator response during conduct of simulator reactor core performance testing meets the reference unit procedures’ acceptance criteria.

A record of the conduct of this test and its evaluation shall be maintained.
ANS-3.5 Performance Testing Guidance

• 2018 4.4.4 Simulator reactor core performance testing

Simulator reactor core performance testing shall be conducted each reference unit fuel cycle. Tests shall be established that quantitatively measure relevant nuclear and thermal-hydraulic parameters.

It shall be demonstrated that simulator core performance meets actual or predicted reference unit performance within predetermined acceptance criteria.
Post-event simulator testing should be conducted when a reference unit event generates relevant data for evaluating simulator performance. Such testing shall:

1. consider the sequence of events, consider operator actions, and be performed in accordance with reference unit procedures;

2. demonstrate that post-event simulator testing is conducted and relevant data compared to ensure that the simulator is capable of reproducing the response of relevant reference unit parameters within the scope of simulation.
ANS-3.5 Performance Testing Guidance

2018 - 4.4.5 Post-event simulator testing

Post-event simulator testing should be conducted when a reference unit event generates relevant data for evaluating simulator performance. Such testing shall

1. consider the sequence of events and operator actions as performed on the reference unit;

2. demonstrate that post-event simulator testing is conducted and relevant data compared to ensure that the simulator is capable of reproducing the response of relevant reference unit parameters within the scope of simulation.
Plant-Referenced Simulator Performance Testing

“Performance testing” means testing conducted to verify a simulation facility’s performance as compared to actual or predicted reference plant performance.

In addition to enhanced readability, users of the revised standard (ANSI/ANS-3.5-2009) will find improvements and clarifications in simulator scenario-based performance testing, new sections addressing simulator core performance testing and post event simulator testing, and other important guidance required to ensure accurate simulation for use in operator training and examination.
10 CFR 55.46(d) Regulation

(d) Continued assurance of simulator fidelity. Facility licensees that maintain a simulation facility shall:

(1) Conduct performance testing throughout the life of the simulation facility in a manner sufficient to ensure that paragraphs (c)(2)(ii), as applicable, and (d)(3) of this section are met. The results of performance tests must be retained for four years after the completion of each performance test or until superseded by updated test results;

(2) Correct modeling and hardware discrepancies and discrepancies identified from scenario validation and from performance testing;

(3) Make results of any uncorrected performance test failures that may exist at the time of the operating test or requalification program inspection available for NRC review, prior to or concurrent with preparations for each operating test or requalification program inspection; and

(4) Maintain the provisions for license application, examination, and test integrity consistent with § 55.49.
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- Export to CSV Format for Manipulation if Desired
Questions?