Charter: Declaration of Plant-Referenced Simulators and Qualification of Commission-Approved Simulation Facilities to Support the Cold Licensing Process

Tasks & Recommendations

Charter: Declaration of Plant-Referenced Simulators and Qualification of Commission-Approved Simulation Facilities to Support the Cold Licensing Process

Objective

A charter was established (Charter for Declaration of Plant-Referenced Simulators and Qualification of Commission-Approved Simulation Facilities to Support the Cold Operator Licensing Process," April 14, 2017 (ML17079A362)) stating that the objective of the "Task Team" is to formulate and develop cold operator licensing process recommendations for (1) the steps and activities necessary for a licensee to declare a simulator as a Plant-Referenced Simulator (PRS) and (2) the application and evaluation process used to qualify a simulation facility as a Commission-approved simulator (CAS).

The charter was divided into two parts, Tasks 1 and 2. A team was established consisting of staff from the Office of New Reactors, Office of Nuclear Reactor Regulation, and Region II Operator Licensing to provide recommendations to NRC management on the actions necessary to accomplish these tasks. The objective of this document is to identify the team's recommendations.

Task 1 of the charter is to recommend the steps and activities necessary for a licensee to declare a simulator as a PRS. Task 1 pertains to the more immediate need of Vogtle to obtain a PRS. Task 2 pertains to the longer term need of recommending generic acceptance criteria and guidance for performing an evaluation to qualify a simulator as a CAS for use in the administration of the NRC exam operating test. In addressing these Tasks, the team only provides recommendations. Any regulatory guidance (e.g., acceptance criteria) will go through the normal review and approval process.

Charter Team Activities

The team reviewed applicable regulations, standards, and guidance. A public meeting was held to formally communicate and discuss the team's proposed recommendations under Task 1 for specifying the Vogtle licensee's actions for declaring a PRS and to clarify the NRC's actions following a licensee's declaration of a PRS (August 10, 2017; Meeting Summary ML17237A167). The resulting recommendations were informed by the meeting and the public comments of industry representatives and external stakeholders. The team evaluated the recommendations for possible unintended consequences to the existing operating reactor licensing program.

Task 2 of this Charter is expected to be complete on May 25, 2018.

Tasks & Recommendations

Charter Task 1

Task 1.a. & b.

1. Recommend the steps and activities necessary for a licensee to declare a simulator as a PRS.

a. Specify licensee's actions for declaring a PRS.

b. Clarify the NRC's actions following a licensee's declaration of a PRS.

Discussion:

The team focused the recommendations on the actions that Vogtle Units 3 and 4 (the licensee) should complete to declare a PRS. The NRC staff also has activities that should be completed, so both task 1.a and 1.b will be discussed together.

The underlying reason for the licensee's absence of a PRS is the fact that the AP1000 instrumentation & controls (I&C) and Human Factors Engineering (HFE) design of the control room is not yet complete as per the licensee's Safety Analysis Report (SAR). The licensee used Design Acceptance Criteria (DAC) and implementation plans, which describe the activities to complete the I&C and HFE design, instead of providing an actual final control room design with the application for the COL, to ensure the as-built design would meet HFE regulations. The licensee's DAC were submitted and approved as part of the licensee's combined license (COL). Generally, the NRC staff verifies completion of the activities necessary to complete the I&C and HFE design, which are specified in implementation plans, by Inspection, Test, Analysis and Acceptance Criteria (ITAAC). Without these activities being completed it would not be possible, under existing regulations and standards, for the licensee to declare a PRS. As a result, the main focus of these two parts of this report is to recommend a path for completing the control room design. Once the control room design is complete and a simulator replicating that design is constructed, the licensee tests the simulator to determine whether the simulator meets the acceptance criteria in Regulatory Guide 1.149, "Nuclear Power Plant Simulation Facilities for Use in Operator Training, License Examinations, and Applicant Experience Requirements," and American National Standards Institute/American Nuclear Society (ANSI/ANS)-3.5, "Nuclear Power Plant Simulators for Use in Operator Training and Examination." Once the licensee determines that the simulator meets these standards, the licensee can declare a PRS. The licensee will then use its normal modification process, similar to that used throughout the operating fleet, for any subsequent plant design changes that are within the scope of the simulator.

Team Recommendations for Charter Tasks 1.a. & b.

Recommended Licensee and NRC Actions before and after PRS Declaration.

a. Recommended actions before PRS declaration.

I. Licensee action: Complete the activities associated with design ITAAC for the I&C systems. Specifically, complete the activities associated with ITAAC 519 (for the Diverse Actuation System), ITAAC 550 (for the Protection and Safety Monitoring System), and ITAAC 553 (for the Component Interface Module), with the exception of the plant installation phases.

II. Licensee action: Complete the HFE verification and validation (V&V) activities associated with design ITAAC 742 and 743 in accordance with the previously approved HFE implementation plans listed in Appendix C, Section 3.2, "Human Factors Engineering," of the plant combined license.

Specifically, human engineering discrepancy (HED) issue resolution and retesting should be completed in accordance with APP-OCS-GEH-320, "AP1000 Human Factors Engineering Integrated System Validation Plan," and APP-OCS-GEH-420, "AP1000 Human Factors Engineering Discrepancy Resolution Process." The I&C system(s) that result from completion of the activities associated with the I&C design ITAAC listed above should then be to be incorporated into the simulator that is used for conducting HED retesting.

III. NRC staff action: Because the HFE V&V activities and the I&C activities are related to ITAAC 519, 550, 553, 742, and 743, listed in Appendix C of the plant combined license, NRC staff would then confirm that the HFE V&V activities and I&C activities had been completed satisfactorily during inspections (e.g., inspection of ISV retest procedures and observation of ISV retest).

NRC staff would document conclusions regarding the completion of these HFE V&V and I&C activities in an inspection report for the associated targeted ITAAC. Even though these activities are related to ITAAC, the licensees would not need to submit the ITAAC closure notifications before proceeding with the next actions to declare a PRS.

IV. Licensee action: The licensee should confirm that the simulator at the site models the control room HFE design that resulted from completing the HFE V&V activities described in APP-OCS-GEH-320 and APP-OCS-GEH-420. If differences exist between the site simulator and the HFE design that resulted from the HFE V&V activities, then the licensee would perform an evaluation demonstrating that there are no significant differences between the site simulator and the HFE design that resulted from the HFE V&V activities that could result in negative training, as defined in Regulatory Guide 1.149, "Nuclear Power Plant Simulation Facilities for Use in Operator Training, License Examinations, and Applicant Experience Requirements," and American National Standards Institute/American Nuclear Society (ANSI/ANS)-3.5, "Nuclear Power Plant Simulators for Use in Operator Training and Examination." If any issue resulting in negative training was identified, PRS declaration should not be made until mitigating actions were established according to the licensee's systems approach to training (SAT) program and procedures.

Additionally, the licensee should complete simulator performance testing in accordance with Regulatory Guide 1.149, "Nuclear Power Plant Simulation Facilities for Use in Operator Training, License Examinations, and Applicant Experience Requirements," and American National Standards Institute/American Nuclear Society (ANSI/ANS)-3.5, "Nuclear Power Plant Simulators for Use in Operator Training and Examination," as specified in the Updated Final Safety Analysis Report (UFSAR), to demonstrate fidelity of the simulator to the design that results from completion of the HFE V&V activities (i.e., ISV and HED resolution). The licensee committed in the UFSAR to using the ANSI/ANS-3.5 guidance for the malfunctions applicable to simulator testing, which Regulatory Guide 1.149 endorses, and the site-specific procedures for simulator performance testing. In accordance with 10 CFR 55.46(c), "Plant-referenced simulators," and the definition of "reference plant" in 55.4, the licensee could declare a PRS following the aforementioned actions.

b. Recommended actions after PRS declaration.

I. NRC staff action: Following the Licensee's PRS declaration, the NRC could, at its discretion, perform a simulator inspection per IP-41502 as delineated per the operational readiness inspections outlined in Inspection Manual Chapter 2504.

II. Licensee action: Design changes following PRS declaration should be evaluated for training impact per ANS 3.5 and the licensee's SAT program.

- Basis: The steps and activities above are recommended for completion of the instrumentation & controls (I&C) and human factors engineering (HFE) designs described in the Safety Analysis Reports (SARs) for Vogtle Units 3 and 4. If these recommended steps and activities are completed, and other appropriate activities are conducted (e.g., ANSI-3.5 testing), the licensee could appropriately declare its simulator as a PRS.

Task .1.c.

c. Identify the appropriate document(s) in which to locate this information for the long term.

Team Recommendations for Charter Task 1.c.

The team recommends that the final agency position on these issues, informed by the recommendations above, be publicized via the appropriate mechanism (e.g., a Regulatory Information Summary (RIS), inspection procedure).

Task 1.d.

d. Consider whether existing ANSI standards for simulators are adequate for the AP1000 design, and what means can be utilized to ensure the process is sufficiently robust for application to any new reactor licensee (e.g., determine whether regulatory guides by new reactor plant type would be a viable option).

Team Recommendations for Charter Task 1.d

1. **The team recommends no further review of the adequacy of ANSI 3.5 as a standard for AP1000 simulators.**

   - Basis: The licensee performed ANSI-3.5 testing on their CAS facility. The CAS facility was approved via a safety evaluation that was based, in part, on the ANSI-3.5 testing performed by the licensees and the results of a partial simulator inspection the NRC staff performed using simulator Inspection Procedure IP-41502. At this time, the licensee is unable to develop a PRS due to the lack of a complete I&C and HFE control room design. The team determined that, based on a review of the licensee's previously completed ANSI-3.5 testing as part of the safety evaluation for the CAS determination, that ANSI-3.5 as endorsed by Regulatory Guide 1.149, is an adequate standard for accomplishing the testing needed to determine the acceptability of a PRS for an AP1000 facility.

     ANSI-3.5, which the licensee commits to follow in the UFSAR, provides guidance to make a determination as to whether an AP1000 simulator adequately reflects its reference plant. The testing criteria required by ANSI-3.5, 2009 revision is written so the application can be applied across the spectrum of large light water reactor designs. For example, section 3.1.3.2, Normal Evolutions, requires the simulator to support unit startup from cold shutdown to rated power conditions. This startup involves the use of reference plant systems and procedures, which are specific to each site. Unit startup can be fully accomplished for the AP1000 design in accordance with ANSI-3.5 using reference plant procedures. Also, Section 3.1.4, Malfunctions, states "the determination of the type and number of malfunctions simulated shall be part of a systematic approach to training process for the design of performance-based operator training programs," and one of the

references to be utilized in this determination is the reference unit SAR. This statement provides adequate guidance to establish the expectation that all systems or events postulated for the AP1000 design be included in the malfunction testing. As an example, failure of the PRHR HX is not specifically mentioned in Appendix B of ANSI-3.5 as an example malfunction. However, it is an event analyzed in the AP1000 site-specific SAR. The licensees included failure of the PRHR HX in their malfunction testing because it is an analyzed failure described in the SAR. Additionally ANSI-3.5, section 3.1.4 prescribes malfunctions to be tested and includes passive failures of components in systems, such as engineered safety features or emergency feedwater systems.

There are some items that understandably cannot be completed such as post event testing, as discussed in ANSI 3.5, Section 4.4.3.4, which requires comparing actual plant events to simulator response. This would be the case for any plant without operating history. The licensee has generated a document detailing the application of the ANSI-3.5 standard to the testing conducted on its simulator and how each requirement is met, or as in the case of post event testing, why it was not completed. It is anticipated that future revisions to the ANS-3.5 standard and Regulatory Guide 1.149 will take the opportunity to provide additional guidance which is more specific to the AP1000 design. However, the team determined that the existing standard provides the appropriate baseline guidance for an effective evaluation of an AP1000 PRS.

2. The **team recommends subsequent review of Regulatory Guide 1.149, which endorses ANSI 3.5, to determine whether ANSI 3.5 provides the necessary guidance for the licensee to make a PRS determination for future power reactors that differ from traditional large light water PWR/BWR designs.**

   - Basis: The team identified one example that would require additional review and evaluation. ANSI 3.5 prescribes 25 malfunctions that shall be included in testing. For some future designs, it is possible that many of those malfunctions listed will not be applicable. In this case, the NRC staff may revise Regulatory Guide 1.149 to clarify that the malfunctions listed may or may not apply to a particular design, and if they do not apply, then they do not need to be included in malfunction testing. Additional exceptions or modifications to the Regulatory Guide also may be included. Given the length of time it takes to complete a design certification review, a revision to Reg. Guide 1.149 could be developed and issued by the time design certification approval is obtained. This would be an activity in parallel with the design certification review similar to the development of the AP1000 Knowledge and Abilities Catalog, NUREG-2103, which was developed while the design certification review was taking place. Any document revisions, whether Regulatory Guide, NUREG, etc., would go through the normal review and approval process.