SAFETY EVALUATION BY THE OFFICE OF NEW REACTORS

RELATED TO THE REQUEST FOR A COMMISSION APPROVED SIMULATOR FOR

VOGTLE ELECTRIC GENERATING PLANT UNITS 3 AND 4

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

GEORGIA POWER COMPANY

OGLETHORPE POWER CORPORATION

MEAG POWER SPVM, LLC

MEAG POWER SPVJ, LLC

MEAG POWER SPVP, LLC

CITY OF DALTON, GEORGIA

DOCKET NOS. 52-025 AND 52-026

## 1.0 INTRODUCTION

By letter dated September 18, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15265A107); as supplemented by letter dated November 16, 2015 (ADAMS Accession No. ML15327A005); letter dated February 18, 2016 (ADAMS Accession No. ML16049A359); and by letter dated March 23, 2016 (ADAMS Accession No. ML16083A463); Southern Nuclear Operating Company, Inc. (SNC, facility licensee)[1] requested approval to use a simulation facility for Vogtle Electric Generating Plant Units 3 & 4 (VEGP 3 & 4), other than a plant-referenced simulator, in the administration of operating tests for operators and senior operators under Title 10 of the *Code of Federal Regulations* (10 CFR) § 55.45(b)(1).[2] A plant-referenced simulator models the systems of the reference plant (i.e., the specific nuclear power plant from which a simulation facility's control room configuration, system control arrangement, and design data are derived) with which the operator interfaces in the control room, including operating consoles, and permits use of the reference plant's procedures. However, VEGP 3 & 4, which are Westinghouse Electric Company's (Westinghouse) AP1000 nuclear power plants, are currently under construction, and SNC has not yet developed the simulation facility

[1] Vogtle Electric Generating Plant (VEGP) Unit 3 and Unit 4 are owned Georgia Power Company, Oglethorpe Power Corporation, MEAG Power SPVM, LLC, MEAG Power SPVJ, LLC, MEAG Power SPVP, LLC, and the City of Dalton, Georgia (together, "VEGP owners"). The VEGP owners authorized Southern Nuclear Operating Company, Inc. (SNC) to exercise responsibility and control over the physical construction, operation, and maintenance of the facility, and SNC is considered to be the facility licensee for purposes of this safety evaluation.

[2] The publicly-available portions of the Commission-approved simulation facility request submittal ("CAS request submittal") and enclosures are available at ADAMS Accession No. ML15265A107. Pursuant to 10 CFR 2.390, SNC requested that some information be withheld from public disclosure.

into a plant-referenced simulator. Therefore, SNC made the request to allow SNC to administer operating tests pending completion of a plant-referenced simulator.

This safety evaluation explains the staff's conclusion that there is reasonable assurance for the following:

- The simulation facility for VEGP 3 & 4 can be used to administer operating tests that require an applicant to demonstrate an understanding of and the ability to perform the actions necessary to accomplish a representative sample of the 13 items in 10 CFR 55.45(a) and that the simulation facility's response will model that of the reference plant during the operating tests.

- The simulation facility for VEGP 3 & 4 can perform a sufficient number of operating tests for any one of the 13 items in 10 CFR 55.45(a) so that a licensing exam is not predictable.

- Any open simulator discrepancies will not negatively affect a licensing exam.

This safety evaluation also addresses the usage of the simulation facility for VEGP 3 & 4 for control manipulations which, per 10 CFR 55.31(a)(5), must be done on either the facility itself or on a plant-referenced simulator. As explained in Section 3.4 of this safety evaluation, the Commission finds the simulation facility for VEGP 3 & 4 satisfies the criteria in U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.149, "Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations" (RG 1.149) to be suitable for control manipulations. RG 1.149 describes methods acceptable to the staff for complying with those portions of the Commission's regulations associated with approval or acceptance of a nuclear power plant simulation facility for use in operator and senior operator training and operating tests and for meeting applicant experience requirements. The staff notes that this finding regarding the simulation facility's suitability for control manipulations does not constitute an exemption from any applicable regulations, including 10 CFR 55.31(a)(5); any exemption would be addressed separately.

As explained below, the Commission also finds that the simulation facility for VEGP 3 & 4 and its proposed use are suitable for the conduct of operating tests for the facility licensee's reference plant under 10 CFR 55.45(a). Therefore, pursuant to 10 CFR 55.46(b)(2), the Commission approves the simulation facility for VEGP 3 & 4 for administration of operating tests. The approval to administer tests on this Commission-approved simulation facility (CAS) will expire as unneeded when SNC has available a plant-referenced simulator meeting the requirements of 10 CFR 55.46(c).

## 2.0 REGULATORY EVALUATION

The simulation facility for VEGP 3 & 4 for which SNC seeks approval under 10 CFR 55.46(b), comprises two AP1000 full scope simulators, which are designated "3A" and "3B." Both simulators are referenced to Vogtle Unit 3 and are intended to be maintained functionally identical. The simulators are licensed to conform to the requirements of ANSI/ANS-3.5-1998, "Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examination" (ANS 3.5), as endorsed by Revision 3 of NRC RG 1.149.

License examinations have two components, which are a written test and an operating test. The operating test is administered to applicants for operator or senior operator licenses in a plant walkthrough and in either a simulation facility that the Commission has approved under 10 CFR 55.46(b), a plant-referenced simulator that meets the requirements in 10 CFR 55.46(c), or the plant itself, if the Commission approves the use of the plant for the administration of the test under 10 CFR 55.45(b). When a simulation facility is used to license operators and senior operators, it must replicate the reference plant configuration and performance with sufficient scope and fidelity for the purposes for which it is used with respect to (1) operating tests, as provided in 10 CFR 55.45(a); (2) licensed operator requalification training requirements, as provided in 10 CFR 55.59; and (3) performance of control manipulations that affect reactivity to establish eligibility for an operator's license, as provided in 10 CFR 55.31(a)(5). This allows the staff examiners to evaluate the applicant's understanding of and ability to perform the actions necessary to accomplish a representative sample of the 13 items listed in 10 CFR 55.45(a), which are necessary to safely operate the reactor as part of the operating crew during normal, abnormal, and emergency conditions. It also allows the staff examiners to determine whether the applicant meets the experience and eligibility requirements for manipulating the controls that affect reactivity in 10 CFR 55.31(a)(5).

NUREG-1021, "Operator Licensing Examination Standards for Power Reactors," divides the operating test into two major parts, which are simulator scenarios and job performance measures (JPMs). Simulator scenarios expose the applicants to normal, abnormal and emergency conditions during all modes of operation. JPMs are used to determine the competence of the applicants in performing tasks identified in the facility's job task analysis. Both of these elements are used to evaluate the applicant's understanding of and ability to perform the actions necessary to accomplish a representative sample of the 13 items listed in 10 CFR 55.45(a). Applicants for operator and senior operator licenses must also meet the experience requirements in 10 CFR 55.31(a)(5), which require applicants to perform the control manipulations required by 10 CFR 55.31(a)(5) on plant-referenced simulators that have been approved under 10 CFR 55.46(c), or the plant itself.

To ensure a common understanding of the terms, concepts, and conditions applicable to this safety evaluation, the staff provides the following explanations.

- Plant-referenced simulators as compared to Commission-approved simulators:

  SNC requested that the Commission approve the simulation facility for VEGP 3 & 4, in its current configuration, as a Commission-approved simulation facility to be used to conduct operator licensing examinations until the simulators are accepted as plant-referenced simulators. The simulation facility for VEGP 3 & 4 does not yet meet the NRC's requirements for plant-referenced simulators because the design activities required by the AP1000 design certification to establish the human factors engineering (HFE) design for the main control room are in progress, but have not yet been completed. The definition of a plant-referenced simulator as stated in 10 CFR 55.4 means a simulator modeling the systems of the reference plant with which the operator interfaces in the control room, including operating consoles, and which permits use of the reference plant procedures. While the current configuration of the simulation facility for VEGP 3 & 4 models core physics, thermodynamic and heat transfer characteristics associated with integrated system operations, containment functions, and electrical and instrumentation and control system functionality, the actual control room console and operating station designs are incomplete.

However, a proposed control room console and operating station design has been established and tested in the integrated system validation (ISV) test. The ISV identified human engineering discrepancies (HEDs), which have been documented and are currently in the resolution process. For example, in the enclosure to the letter dated November 16, 2015, the facility licensee described that the ISV identified some aspects of the AP1000 Alarm Presentation System that did not conform to HFE guidelines. Specifically, the number of alarms present in the control room during abnormal plant conditions resulted in a higher level of workload than is desired for the AP1000. Therefore, Westinghouse provided an update for the simulation facilities for VEGP 3 & 4 to reduce the workload associated with managing alarms. The current configuration of the simulation facility for VEGP 3 & 4 models the configuration that was tested in the ISV with modifications that were made to resolve the significant issues identified by the ISV, and this configuration is consistent with the system and component designs, as well as the HFE guidelines, described in the AP1000 design control document (DCD).

As explained later in this evaluation, the HEDs that have been identified are either resolved or have been determined not to prevent the simulation facility for VEGP 3 & 4 from demonstrating sufficient fidelity with the reference plant for the purpose of administering operating tests in accordance with 10 CFR 55.45(a), and accordingly the simulation facility for VEGP 3 & 4 is suitable both for use in operating tests and for performance of control manipulations required by 10 CFR 55.31(a)(5).

- Simulator performance discrepancies as compared to HEDs

  Discrepancies fall into two categories, which are simulator performance deficiencies and HEDs. Simulator performance discrepancies were identified by factory and site acceptance testing. Simulator performance discrepancies are specific to simulator functionality and its ability to replicate the reference plant performance. Simulator discrepancies typically measure how the simulator configuration differs from the reference plant configuration as documented in the DCD. Examples include a component or indication not operating as it would in the reference plant, incorrect labeling of control room indications, an automatic calculation not working properly, the simulator incorrectly modeling core physics, and inconsistent indications.

  HEDs were identified by the ISV and are associated with HFE design effectiveness. HFE design discrepancies include some simulator performance discrepancies, but they are primarily focused on providing a control room design that minimizes the potential for human error. Minimizing human error is not as predictable as the performance of electrical and mechanical systems. Westinghouse applied general HFE design principles that conform to Revision 2 of NUREG-0711, “Human Factors Engineering Program Review Model” (February 2004) and Revision 2 of NUREG-0700, “Human-System Interface Design Review Guidelines” (May 2002) to develop the AP1000 control room HFE design and tested the design with the ISV to validate that the HFE design supports the safe operation of the plant. The identification of HEDs during the ISV depends on the opinion of, and the performance of, the test personnel who perform the ISV test scenarios in the simulation facility. All HEDs will be assessed to determine if improvements can be made to the HFE design. Some HEDs will be left as is because proposed solutions would introduce more significant HFE-related challenges than the current configuration. Others will be addressed by modifying procedures or the training program, and others will be addressed by control room HFE design changes. It is important to remember that HEDs are a subjective measure of human performance and

judgement is being applied as to what provides the best solution to support long term operating crew performance. Similarly, judgement is being applied by the staff as to how significant these HEDs are in impacting simulator performance during license exams. However, as discussed further in Section 3.2 of this evaluation, none of the HEDs that have been identified prevents the simulation facility from demonstrating fidelity with the reference plant during operating tests that contain a representative sample of the 13 items in 10 CFR 55.45(a), and accordingly the simulation facility for VEGP 3 & 4 is suitable both for use in operating tests and for performance of control manipulations required by 10 CFR 55.31(a)(5).

- Discrepancy identification as compared to test scenario performance

  The performance test scenarios referred to in this evaluation did not test single component functionality. They are events that include the normal, abnormal, and emergency events applicable to the facility that demonstrate individual system performance as well as integrated system performance. To demonstrate simulator performance for comparison to the reference plant, the simulator must have accurate reactor physics models and thermal hydraulic models. The sophistication of these models is what allows simulator testing to identify system design problems such as components incorrectly sized, stroke times too long or too short, and control systems not calibrated correctly. Similarly, it is the sophistication of these models that provides for such things as accurate reactor physics models that support control manipulations and the translation of energy from the core and reactor coolant system into the containment providing for accurate modelling of the containment response in a loss of coolant accident. Large numbers of operating tests (at least on the order of thousands) can be supported by the current configuration of the simulation facility for VEGP 3 & 4. The capability of a simulation facility to run all of the transient tests and malfunction tests listed in ANS 3.5 as well as the test scenarios required to perform the ISV is a significant demonstration of simulation capability.

- Simulation facilities and operator licensing examinations

  The simulation facility is a tool used to support the operating test required by 10 CFR 55.45; a simulation facility may also be used to perform the control manipulations required by 10 CFR 55.31(a)(5). As such it must meet minimum standards specified in 10 CFR Part 55. The most fundamental is that the simulation facility must replicate the reference plant performance in scope and fidelity. ANSI/ANS 3.5-1998, “American National Standard for Nuclear Power Plant Simulators for use in Operator Training and Examination” (ANS 3.5), as endorsed by RG 1.149, Revision 3, (October 2001), establishes the functional specification for full-scope nuclear power plant control room simulators intended for use in operator training and examinations. In practice, a simulation facility runs scenarios, which are sequences of events selected from the range of normal, abnormal and emergency operating conditions that could occur in the plant. Scenarios (as specified by ANS 3.5) are used to verify that the simulator replicates the reference plant performance as documented in the DCD. Scenarios are also used to support the operating test administered to applicants for operator and senior operator licenses, as well as control manipulations.

  Operator licensing examinations must meet the requirements of 10 CFR 55 Subpart E, “Written Examinations and Operating Tests.” 10 CFR 55.40 requires the Commission

and power reactor facility licensees to use the criteria in NUREG-1021 to prepare and evaluate the operating tests required by 10 CFR 55.45. NUREG-1021 provides specific direction on operator licensing examination standards. As noted above, large numbers of scenarios can be supported by the current configuration of the simulation facility for VEGP 3 & 4.

Some of the possible scenarios are or may be affected by open discrepancies. NUREG-1021 provides that a facility licensee must provide the written examination, operating test, and a certification that its simulators can run the scenarios included in the operating test, to the NRC for review and approval prior to the administration of licensing examinations. NUREG-1021 also provides that the NRC staff must test the simulator prior to the administration of the licensing examination to confirm that the simulator can run the scenarios included in the operating test without malfunction or deviation.

Together, ANS 3.5 and NUREG-1021 provide for the integration of the simulation facility with the licensing examination to ensure that the operating test provides for an equitable and consistent administration of examinations to all applicants. The satisfactory completion of the performance tests prescribed by ANS 3.5 demonstrates that the simulation facility is sufficient in both scope and fidelity with its reference plant. The method of administering, preparing, and evaluating licensing examinations described in NUREG-1021 ensures the equitable and consistent administration of licensing examinations and confirms that a simulation facility can function without malfunction or deviation for the particular scenarios to be included in a specific operating test.

The Commission's regulation at 10 CFR 55.46(b)(1) sets forth the information that a facility licensee such as SNC must include. Specifically, SNC's request must include a description of:

(i) The components of the simulation facility intended to be used for each part of the operating test, unless previously approved;

(ii) The performance tests for the simulation facility as part of the request, and the results of these tests; and

(iii) The procedures for maintaining examination and test integrity consistent with the requirements of 10 CFR 55.49.

The safety evaluation addresses the requirements of 10 CFR 55.46(b)(1)(i) - (iii) in Section 3.0 below.

The standard for approval of the request is set by 10 CFR 55.46(b)(2):

The Commission will approve a simulation facility for administration of operating tests if it finds that the simulation facility and its proposed use are suitable for the conduct of operating tests for the facility licensee's reference plant under 10 CFR 55.45(a).

In making its findings on the simulation and proposed use, the Commission must assess how the information in the request (i.e., the information about the components and performance tests of the simulation facility, and the procedures for test integrity) shows that the simulation facility meets the intent of ANSI/ANS-3.5-1998, "Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examination," as endorsed by Revision 3 of NRC RG 1.149. The showing must be sufficient to support the Commission's suitability findings to be used in

licensing examinations. In making its findings, the staff compared SNC's CAS request submittal with the VEGP 3 & 4 Updated Final Safety Analysis Report and also with the requirements in ANS 3.5.

Additionally, with respect to the performance of control manipulations required by 10 CFR 55.31(a)(5), the NRC and the nuclear power industry adopted a consensus standard for simulators used in operator licensing testing, which provides that the scope standard applicable for plant-referenced simulators applies to any simulation facility used for meeting the experience requirements in 10 CFR 55.31(a)(5). In RG 1.149, Revision 4, page 5, the staff stated "Although the scope statement of ANSI/ANS-3.5-2009 is limited to the use of full-scope nuclear power plant simulators in operator training and examination, the staff has concluded that simulators meeting this standard should also be satisfactory for meeting the applicant experience requirements described in 10 CFR 55.31(a)(5)."

Accordingly, this evaluation assesses whether the simulation facility for VEGP 3 & 4 replicates the AP1000 DCD predicted core model and whether sufficient fidelity has been demonstrated such that significant control manipulations required by 10 CFR 55.31(a)(5) can be completed without procedural exceptions, simulator performance exceptions, or deviation from approved training scenario sequence.

## 3.0 TECHNICAL EVALUATION

### 3.1 Simulation Facility Components

10 CFR 55.46(b)(1) states in part:

> *Facility licensees that propose to use a simulation facility, other than a plant-referenced simulator, or the plant in the administration of the operating test under §§ 55.45(b)(1) or 55.45(b)(3), shall request approval from the Commission. This request must include:*
> (i) – *A description of the components of the simulation facility intended to be used, or the way the plant would be used for each part of the operating test, unless previously approved*.

**Staff Evaluation**

A simulation facility contains static and dynamic components within its design. These components are addressed in ANS 3.5, Section 3.2, "Scope of simulation." The static component is best illustrated by ANS 3.5 criterion 3.2.1.1, "Scope of Panel Simulation," which states:

> Scope of Panel Simulation. The simulator shall include those operational panels, consoles, and operating stations required to provide the controls, instrumentation, alarms, and other human-system interfaces used by operators in the reference unit to conduct the normal evolutions of 3.1.3 and respond to the malfunctions of 3.1.4.

The dynamic component is best illustrated by ANS 3.5 Criterion 3.2.5.1, "Systems Controlled or Monitored from the Control Room," which states:

> The inclusion of systems of the reference unit in the scope of simulation shall be to the extent necessary to allow the operator to perform the evolutions described in 3.1.3 and respond to the malfunctions described in 3.1.4. These systems shall be complete to the extent that the operator can perform these control manipulations and observe simulated unit response as in the reference unit. The scope of simulation shall include system interactions with other simulated systems, so as to provide a total integrated unit response.

In both cases the normal evolutions and malfunctions address a range of plant conditions that ensure the simulation facility addresses all 13 items from 55.45(a).

The facility licensee described the simulation facility for VEGP 3 & 4 in Enclosure 2 of its submittal to the NRC dated September 18, 2015. Enclosure 2 listed the plant systems modeled by the simulation facility for VEGP 3 & 4. The staff compared the systems listed in Enclosure 2 with those listed in the VEGP 3 & 4 FSAR, Table 1.7-2, "AP1000 System Designators and System Diagrams." With the exception of the two items identified below, the staff finds the systems listed in Enclosure 2 to be a complete list of those systems that interface with the control room and include the facility's heat removal systems, auxiliary systems, emergency systems, radiation monitoring systems, and the controls for plant equipment that affect reactivity and power level, including the control console. The two exceptions to the reference plant configuration are not modeled in the simulation facility for VEGP 3 & 4 for the following reasons:

- The communication system in the simulation facility for VEGP 3 & 4 does not model the networking feature (i.e., a feature that allows for multiple people to talk on one line) that will be available in the control room, but it does provide a phone system that allows operators to simulate communication with personnel onsite and offsite, which are the same actions that applicants will be required to perform in the actual plant. Therefore, the staff finds this exception acceptable.

- The CAS request submittal, Enclosure 6, simulator deficiency report number 237, states that the simulation facility for VEGP 3 & 4 does not have the radiation monitoring panel on the back wall as depicted in the reference design. However, all the indications on this panel can be viewed at the operator consoles in the simulation facility for VEGP 3 & 4. Therefore, applicants using the simulation facility for VEGP 3 & 4 still have a method of obtaining the information that they will need to take actions directed by procedures, which are the same actions that operators will be required to perform in the actual plant. Therefore, the staff finds this condition acceptable.

With respect to the static simulator modeling, the staff determined that all the systems and components needed to manage the AP1000 safety functions (e.g., reactivity control, heat removal, containment integrity, and radiation control) are included in the simulation facility for VEGP 3 & 4.

In the CAS request submittal, Enclosure 3, "Description of the Performance Tests for the Simulation Facility and Results of the Tests," the facility licensee listed all of the performance

tests and malfunction tests prescribed by ANS 3.5 that it performed on the simulation facility for VEGP 3 & 4. Because the facility licensee performed these tests, which include normal, abnormal, and emergency events applicable to the AP1000 design, this demonstrates that the simulation facility for VEGP 3 & 4 includes the specific controls, alarms, and indications needed to operate the plant systems. This testing and how the test results demonstrate that the simulation facility for VEGP 3 & 4 models the reference plant with sufficient scope and fidelity concerning these systems and components is described in more detail in the next section. In conclusion, the staff finds that the simulation facility for VEGP 3 & 4 includes the AP1000 plant systems needed to support operating tests with respect to each of the 13 items in 10 CFR 55.45(a) and that the descriptions submitted by the licensee of the simulation facility systems conform to 10 CFR 55.46(b)(1)(i).

3.2 Simulation Facility Performance Tests

10 CFR 55.46(b)(1) states in part:

> *Facility licensees that propose to use a simulation facility, other than a plant-referenced simulator, or the plant in the administration of the operating test under §§ 55.45(b)(1) or 55.45(b)(3), shall request approval from the Commission. This request must include:*
>
> (ii) *A description of the performance tests for the simulation facility as part of the request and the results of these tests;*

**Staff Evaluation**

This section explains the staff's conclusions on how simulator testing demonstrated the adequacy of the dynamic modeling of the simulation facility for VEGP 3 & 4. In the CAS request submittal, Enclosure 3, "Description of the Performance Tests for the Simulation Facility and Results of the Tests," the facility licensee stated that it conducts simulator performance testing in accordance with ANS 3.5. Regulatory Guide 1.149, "Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations," Revision 3, (October 2001), fully endorses ANS 3.5 as an acceptable way for complying with the NRC's requirements for demonstrating simulator performance.

ANS 3.5 describes two types of performance testing, which are simulator operability testing and scenario-based testing (SBT). The purpose of both types of performance testing is to ensure that the simulator is sufficient in scope and fidelity to the reference plant it models. In the CAS request submittal, Enclosure 2, the facility licensee stated that because VEGP 3 & 4 are under construction, the simulation facility for VEGP 3 & 4 has been tested to verify that it conforms to the AP1000 design as documented in the AP1000 DCD, which is incorporated by reference in the VEGP 3 & 4 Final Safety Analysis Report.

In the CAS request submittal, Enclosure 3, the facility licensee addressed how it performs simulator operability testing and SBT. This is described below for each of the two types of simulator performance testing for the simulation facility for VEGP 3 & 4.

Simulator Operability Testing:

The facility licensee provided a list of simulator operability tests that it performed on the simulation facility for VEGP 3 & 4. ANS 3.5, Section 4.4.3.1, "Simulator Operability Testing," states that ANS 3.5, Appendix B, "Guidelines for the Conduct of Simulator Operability Testing," provides examples of acceptable simulator operability tests. The tests include steady-state tests and transient tests. ANS 3.5, Sections 4.1.3.1 and 4.1.1, contain the acceptance criteria for each of the tests. The staff compared the list of simulator operability tests that the facility licensee performed with ANS 3.5, Appendix B. The staff found that the facility licensee's list of steady-state and transient tests performed on the simulation facility for VEGP 3 & 4 conformed to the testing specified by ANS 3.5.

The facility licensee stated that all simulator operability tests performed on the simulation facility for VEGP 3 & 4 were completed satisfactorily with one exception: the reactor trip recovery test, which is a transient test, could not be completed. The facility licensee documented this as simulator change request (SCR) #5656 in the CAS request submittal, Enclosure 9, "List of Open Simulator Discrepancies." The staff reviewed SCR #5656, which stated that the test could not be performed because of a deficiency with the procedure. SCR #5656 states that the facility licensee documented the procedure deficiency in its corrective action program, revised the procedure, and performed the reactor trip recovery test again with satisfactory results. Accordingly, the staff concludes that the facility licensee identified, documented, and resolved this issue.

The CAS request submittal, Enclosure 5, "Evaluation of AP1000 Simulation Facility Summary of Unresolved Items (UIs) Issued by the NRC," the facility licensee stated that it documents noticeable differences between expected reference plant response and simulator response. The facility licensee refers to these differences as simulator discrepancies and documents these discrepancies with SCRs. In the CAS request submittal, Enclosure 3, the facility licensee stated that the performance testing identified simulator discrepancies, which the facility licensee included in Enclosure 9, "List of Open Simulator Discrepancies."[3] These simulator discrepancies identify portions of the simulation facility for VEGP 3 & 4 that do not have sufficient fidelity with the reference plant.

The facility licensee evaluated each of the 166 open simulator discrepancies to determine if any of the simulator discrepancies precluded the simulation facility for VEGP 3 & 4 from being used to administer operating tests containing a representative sample of the 13 items listed in 10 CFR 55.45(a). The facility licensee determined that 101 simulator discrepancies were applicable to the items listed in 10 CFR 55.45(a), and that the remaining 65 simulator discrepancies were not applicable to any of the 13 items listed in 10 CFR 55.45(a). In the CAS request submittal, Enclosure 6, "Commission Approved Simulator Aggregate Study - Simulator Training," the facility licensee documented the results of its aggregate impact evaluation of the 101 discrepancies. The facility licensee evaluated each of the individual deficiencies and determined that none of the issues, by themselves, challenged the ability of the simulation facility for VEGP 3 & 4 ability to address any of the 13 items in 10 CFR 55.45(a). The facility licensee did determine that, in the aggregate, 42 of the deficiencies could challenge the ability of the simulation facility for VEGP 3 & 4 to address 10 CFR 55.45(a)(3) ("Identify annunciators and condition-indicating signals and perform appropriate remedial actions where appropriate") and

[3] Note: Not all of the simulator discrepancies in Enclosure 9 were identified by performance testing; some discrepancies were identified during the performance of other activities on the simulators.

55.45(a)(5) ("Observe and safely control the operating behavior characteristics of the facility"). The reasoning for the determination involved four main areas:

1. Indication deficiencies
2. Alarms management deficiencies and challenges
3. Rod Control System deficiencies
4. Secondary control challenges

Independently, the staff evaluated all 166 simulator discrepancies in Enclosure 9 to the CAS submittal. Table 1 compares the results SNC's evaluation to the results of the NRC's evaluation.

Table 1: Comparison of Aggregate Impact Evaluations

| SNC Evaluation | NRC Evaluation |
|---|---|
| Indication Discrepancies – The facility licensee identified discrepancies with some plant indications, which could prevent an applicant from obtaining accurate information that he or she would need to monitor and control the plant. | Nuclear Applications (NAPs) challenges – NAPs are computerized support applications that provide information to the applicants. The staff concluded that discrepancies with NAPS would impact the ability of the simulation facility for VEGP 3 & 4 to meet 10 CFR 55.45(a)(3) and (5). This category is a subset of what the facility licensee identified as Indication Discrepancies. |
| Alarm Management Discrepancies and Challenges – The facility licensee identified discrepancies related to the Alarm Presentation System that caused the simulation facility for VEGP 3 & 4 to provide an excessive number of alarms or not provide some necessary alarms. The facility licensee determined that alarm management was a significant burden for applicants throughout all scenarios and plant conditions. | Alarm management – The staff concluded this was a crosscutting deficiency affecting the ability of the simulation facility for VEGP 3 & 4 to perform multiple items in 10 CFR 55.45(a) based on the increased workload created by the complexity associated with alarm analysis. |
| Rod Control System Discrepancies – The facility licensee identified inconsistencies in the performance of the Rod Control System during performance of reactivity control tasks. The facility licensee determined that the Rod Control System could inhibit the applicant's ability to perform reactivity (i.e., control) manipulations in a precise and controlled manner. | Reactivity control challenges – The staff concluded that challenges with reactivity control would impact the ability to meet 10 CFR 55.45(a)(1), (5), and (6). |
| Secondary Systems Control Challenges – The facility licensee identified that some secondary plant systems could not be controlled in automatic mode of control, but rather required manual control. | Secondary system control challenges – The staff concluded that challenges with controlling secondary plant systems in automatic modes of control would impact the ability of the simulation facility for VEGP 3 & 4 to meet 10 CFR 55.45(a)(5). |

SNC's aggregate evaluation identified the simulator discrepancies that, because of insufficient fidelity with the reference plant, could limit the simulation facility for VEGP 3 & 4 from being used to administer operating tests containing a representative sample of the 13 items listed in 10 CFR 55.45(a). As shown in Table 1, the staff independently verified the information in SNC's application. Based on a review of the analysis results provided in the SNC's aggregate impact evaluation the staff concluded that SNC's methodology provided a good balance between limiting discrepancies to specific identified impacts and generalizing the discrepancies to identify potential generic impacts. The judgements made as to discrepancy impact provided an acceptable balance between what did happen in simulator operability tests and what could happen in actual plant operating conditions.

Based on the aggregate impact evaluation results, the facility licensee completed corrective actions to resolve the 42 discrepancies associated with the four areas that challenged the 13 items in 10 CFR 55.45(a) and then completed testing to determine that the corrective actions were effective. The corrective actions satisfactorily addressed simulator discrepancies that could, in aggregate potentially impact significant, cross cutting operating activities such as reactivity control, operator workload, and operator decision making.

SNC's aggregate impact evaluation concluded that the aggregate impact of the remaining discrepancies would not impact the suitability of the simulation facility for VEGP 3 & 4 for the performance of operating tests. The staff verified that testing completed by SNC used the ANS 3.5 scenarios appropriate for testing the resolution for the identified discrepancy.

Based on the SNC's corrective actions and the two aggregate impact evaluations, the staff dispositioned the 166 simulator deficiencies identified by the ANS 3.5 performance testing as follows:

- 61 of the 166 discrepancies determined to impact 10 CFR 55.45(a) items were fixed, including the 42 discrepancies the facility licensee identified by the aggregate review results.

- 19 of the 166 discrepancies did not affect any of the 13 items in 10 CFR 55.45(a). The discrepancies were associated with computer administrative functions such as printing special reports that are not used during operator licensing exams. The discrepancies were identified because these computer administrative functions are an aid to the simulator booth operator (i.e., the operator of the simulation facility).

- 15 of the 166 discrepancies were determined to be invalid based on additional testing performed by the facility licensee. Subsequent testing found the simulation facility for VEGP 3 & 4 to be working properly. These discrepancies were typically caused by initiator error or incomplete knowledge of the design.

- 11 of the 166 discrepancies were associated with indications for which redundant indication was readily available in the simulation facility for VEGP 3 & 4.

Sixty simulator performance testing discrepancies remained. The facility licensee determined that none of the remaining discrepancies, by themselves, constituted a challenge to the ability of the simulation facility for VEGP 3 & 4 to address any of the 13 items in 10 CFR 55.45(a). The staff concludes that these discrepancies are not of sufficient scope to impact the ability of the simulation facility for VEGP 3 & 4 to replicate the reference plant in scenarios based on 10 CFR 55.45 requirements because the simulation facility for VEGP 3 & 4 is capable of running a large

number of scenarios (as demonstrated by the ability of the simulation facility for VEGP 3 & 4 to perform all of the simulator testing scenarios in ANS 3.5 and the test scenarios for the ISV) in support of any of the 13 items in 10 CFR 55.45(a). Therefore, the remaining simulator performance discrepancies do not preclude approval of the simulation facility for VEGP 3 & 4 as a Commission-approved simulator for use in operating tests. Similarly, the remaining discrepancies do not prevent the simulation facility for VEGP 3 & 4 from replicating the reference plant with sufficient scope and fidelity to support its use by applicants for control manipulations required by 10 CFR 55.31(a)(5).

The remaining simulator performance testing discrepancies can have a limited impact on selected scenarios chosen as part of the operating test. The staff concludes this is not of concern because the simulation facility for VEGP 3 & 4 is capable of running a large number of scenarios (as demonstrated by the testing scenarios) in support of any of the 13 items in 10 CFR 55.45(a). Additionally, SNC completed a training needs assessment in accordance with ANS 3.5 for each discrepancy and concluded the discrepancies did not impact operator actions or detract from training. Furthermore, NUREG-1021 provides that a facility licensee must provide the written examination, operating test, and a certification that its simulators can run the scenarios included in the operating test, to the NRC for review and approval prior to the administration of operator licensing examinations. NUREG-1021 also provides that the NRC staff must test the simulator prior to the administration of the licensing examination to confirm that the simulator can run the scenarios included in the operating test without malfunction or deviation. NUREG-1021, Part 301 Section D, which provides instructions for preparing initial operating tests, states that for each category of the operating test that:

> Every facet of the operating test, including the walk-through JPMs and simulator scenarios, should be planned, researched, validated, and documented to the maximum extent possible before the test is administered.

Facility licensees must also validate the simulator scenarios that are part of the operating tests prior to their administration using the method of Scenario-Based Testing (SBT) as described in ANS 3.5. ANS 3.5, Section 4.4.3.2, "Simulator Scenario-Based Testing," states, "The intent of scenario-based testing is to ensure the simulator is capable of producing the expected reference unit response to satisfy predetermined learning or examination objectives." ANS 3.5 directs that SBT be performed for simulator scenarios developed to administer the operating tests, as well as for simulator scenarios used to meet the experience requirements in 10 CFR 55.31(a)(5) for applicants. If the results of the SBT indicate that there is not sufficient fidelity with the reference plant during the operating tests, then the scenario cannot be used, and the scenario must be revised to exclude the discrepancy.

As described in Enclosure 3 to its application, the simulation facility for VEGP Units 3 & 4 is committed to the SBT methodology described in the 1998 ANS-3.5 standard as endorsed by RG 1.149, Revision 3, and in Nuclear Energy Institute (NEI) 09-09, Revision 1, "Nuclear Power Plant-Referenced Simulator Scenario-Based Testing Methodology," (December 2009). As described by SNC, SBT is the parallel testing and evaluation of simulator performance while instructors validate NRC's initial license examination scenarios, licensed operator requalification annual examination scenarios, and scenarios used to satisfy the reactivity control manipulation requirements for license candidates in 10 CFR 55.31(a)(5). As instructors validate satisfactory completion of training or evaluation objectives, procedure steps and scenario content, they are also ensuring satisfactory simulator performance in parallel, not series, making the process an "online" method of evaluating simulator performance. SBT is conducted to ensure the simulator is capable of producing the expected "reference unit" response to satisfy predetermined learning

or examination objectives by utilizing the existing training and examination scenario validation process.

The staff finds the facility licensee's method for performing SBT to be consistent with the method provided in RG 1.149 and acceptable. This testing will ensure that simulator scenarios that are affected by any of the remaining sixty discrepancies in the simulation facility for VEGP 3 & 4 will not be used in a licensing examination or for simulator scenarios used to meet the experience requirements in 10 CFR 55.31(a)(5) for applicants. In addition, SBT also ensures that if there is any discrepancy not previously identified by the facility licensee and the staff that impacts the ability of the simulation facility for VEGP 3 & 4 to replicate the reference plant for operating tests, adherence to the normal NUREG-1021 examination preparation process will allow the staff to screen the scenario out and prevent its use in an operator licensing examination.

ISV testing:

ISV testing is not simulator performance testing but rather a test of the control room. Similar to an operator licensing examination, the ISV uses a simulator to test the control room design. The objective of the test, which is required by the AP1000 design certification, is to verify that the integrated system, which includes training, procedures, the human-system interface (including the operating consoles), and personnel elements (including the facility licensee's conduct of operations) will minimize human errors and support the safe operation of the plant. Westinghouse performed the test on the VEGP 3 & 4 control room design and identified design problems and HEDs.

*Design* problems: Simulators are capable of showing system design problems such as improperly sized components and integration issues between systems. These problems are not control room design issues, but they are documented and fed back into the design modification process.

*HEDs*: An HED is an ISV finding. While design problems and simulator discrepancies are identified, the focus of the test is on identifying operator error, operator confusion, and operator efficiency improvements. The first two (operator error and operator confusion) are reactive. Corrective actions are focused on improving the operator interface with the control room design. The last (operator efficiency improvements) is proactive and accomplishes the same purpose. All involve subjective judgements made by the test personnel who perform the ISV test scenarios on what will minimize human error. For some HEDs, no action will be taken because proposed changes are not demonstrably better that the current configuration and may introduce other errors. Others will be addressed by changes in procedures and training. All others will result in control room design changes that are fed back into the control room design modification process. These changes potentially impact operator performance and are addressed by the facility licensee's training program. Until then, the HEDs may result in increased work load, but the skills, knowledge and abilities needed to operate the plant remain the same.

To accomplish ISV testing, the simulation facility replicates an initial control room design. The initial control room design for VEGP 3 & 4, together with the corrective actions described earlier and above, constitute the simulation facility for VEGP 3 & 4 that SNC requests approval of as a Commission-approved simulator, which has been evaluated as described in this safety evaluation. The staff has determined that the facility licensee has demonstrated that its configuration of the simulation facility for VEGP 3 & 4 successfully accomplishes simulator

performance testing scenarios prescribed by ANS 3.5 and ISV test scenarios with sufficient scope and fidelity to the AP1000 to support its use in operator testing and control manipulations for VEGP 3 & 4. These scenarios demonstrate the functionality of the simulation facility for VEGP 3 & 4 under a broad range of operational conditions that address the 13 items in10 CFR 55.45(a).

Similar to the way SBT helps ensure simulator performance testing discrepancies do not challenge the ability of the simulation facility VEGP 3 & 4 to replicate the reference plant with sufficient scope and fidelity, SBT also helps ensure that the design problems and HEDs identified by the ISV do not impact the scope and fidelity of the simulation facility.

Summary and Conclusions for Performance Testing:

In summary, the facility licensee performed the simulator operability testing prescribed by ANS 3.5, and documented where testing revealed aspects of the simulator that did not replicate the plant design. The facility licensee completed an aggregate review that effectively identified simulator discrepancies that could generically challenge the ability of the simulation facility for VEGP 3 & 4 to replicate the reference plant with sufficient scope and fidelity, which is required in order to approve the simulation facility for use in operating tests under 10 CFR 55.45(a), or for control manipulations required by 10 CFR 55.31(a)(5). The facility licensee has taken corrective action to resolve all of the issues that caused these challenges. The simulator discrepancies that remain are limited in scope and have limited impact on the capability of the simulation facility for VEGP 3 & 4 to replicate the reference plant with sufficient scope and fidelity for use in operating tests under 10 CFR 55.45(a) and control manipulations required by 10 CFR 55.31(a)(5). In addition, the required NUREG-1021 examination preparation process will allow the staff or facility licensee to screen out scenarios where simulator discrepancies could affect operator licensing examinations or control manipulations.

The initial configuration of the simulation facility for VEGP 3 & 4, in combination with the facility licensee's corrective actions, have established sufficient scope and fidelity of the simulation facility for VEGP 3 & 4 such that the AP1000 safety functions can be monitored and controlled through a broad range of normal, abnormal, and emergency operating conditions. For example, for reactivity control, test scenarios have demonstrated that the simulation facility for VEGP 3 & 4 models the AP1000 DCD in terms of core physics, the plant thermal hydraulics (including the core, heat removal systems and containment response), the system performance (especially rod control but also systems that affect reactor coolant temperature and pressure), indications, controls and power supplies, and all of these components and systems are functioning as independent entities and in an integrated manner. The simulation facility for VEGP 3 & 4 replicates the AP1000 DCD reference plant's expected performance with sufficient scope and fidelity concerning these components and systems to support operating tests, requalification training and testing, and control manipulations required in 10 CFR Part 55, and activities described in NUREG-1021, including job performance measures that relate to reactivity control, and control manipulations. Similarly, the simulation facility for VEGP 3 & 4 replicates other AP1000 safety functions with sufficient scope and fidelity to support its approval as a Commission-approved simulation facility.

Therefore, based on the above the staff concludes that the simulation facility for VEGP 3 & 4 demonstrates sufficient scope and fidelity with the AP1000 reference plant DCD to support approval of the simulation facility for VEGP 3 & 4 for the equitable and consistent administration of operator licensing examinations and control manipulations.

3.3 Procedures for Maintaining Examination and Test Integrity

10 CFR 55.46(b)(1) states in part:

> *Facility licensees that propose to use a simulation facility, other than a plant-referenced simulator, or the plant in the administration of the operating test under §§ 10 CFR 55.45(b)(1) or 10 CFR 55.45(b)(3), shall request approval from the Commission. This request must include:*
>
> (iii) – A *description of the procedures for maintaining examination and test integrity consistent with the requirements of 10 CFR 55.49.*

**Staff Evaluation**

The CAS request submittal, Enclosure 4, "Summary Description of the Procedures for Maintaining Examination and Test Integrity Consistent with the Requirements of 10 CFR 55.49," the facility licensee stated that its examination security procedure, NMP-TR-423, "Regulatory Exam Development," conforms to NUREG-1021, "Operator Licensing Examination Standards for Power Reactors," which provides guidance for complying with 10 CFR 55.49. The facility licensee stated that the procedure includes controlling physical access to examination material, encrypting electronic files that contain the simulator scenario events, and preventing the recording of simulator events while using the simulator to develop examination materials.

Through Region II staff's participation in the accreditation board for the facility licensee's Operations Training Program accreditation by the National Academy for Nuclear Training, the staff reviewed the facility licensee's examination security procedures. In a letter dated October 21, 2015 (ADAMS Accession No. ML15295A200), the Region II staff concluded, based on the review of the procedure, that the facility licensee's exam security procedures conformed to guidance in NUREG-1021 and were therefore adequate to ensure compliance with 10 CFR 55.49. Accordingly, the staff concludes that the facility licensee described an acceptable procedure for maintaining examination security and test integrity, and has complied with 10 CFR 55.46(b)(1)(iii).

3.4 Suitability of the Simulation Facility for VEGP 3 & 4 for Control Manipulations

As described in Section 1.0, this safety evaluation also addresses the use of the simulation facility for VEGP 3 & 4 by applicants for control manipulations which, per 10 CFR 55.31(a)(5), must be done on either the facility itself or on a plant-referenced simulator. RG 1.149, Revision 4, endorses ANSI/ANS-3.5-2009[4] as an acceptable method for complying with the regulations in 10 CFR Part 55, including 10 CFR 55.46(c) and 10 CFR 55.46(d), which list the requirements for a plant-referenced simulator that will be used for control manipulations. These requirements are listed below, in addition to the staff's evaluation of how the simulation facility for VEGP 3 & 4 satisfies the requirements to be used for control manipulations.

[4] RG 1.149, Revision 4, states, "editions of ANSI/ANS-3.5 that were previously endorsed by the NRC remain acceptable methods of meeting the regulations."

Requirements listed in 10 CFR 55.46(c)(1) state,

> A plant-referenced simulator used for the administration of the operating test or to meet experience requirements in § 55.31(a)(5) must demonstrate expected plant response to operator input and to normal, transient, and accident conditions to which the simulator has been designed to respond. The plant-referenced simulator must be designed and implemented so that it:
>
> (i) Is sufficient in scope and fidelity to allow conduct of the evolutions listed in §§ 55.45(a)(1) through (13), and 55.59(c)(3)(i)(A) through (AA), as applicable to the design of the reference plant.
>
> (ii) Allows for the completion of control manipulations for operator license applicants.

**Staff Evaluation**

As discussed in Section 3.1, the staff determined that the simulation facility for VEGP 3 & 4 models the AP1000 plant systems and also contains the alarms, indications, and controls needed to operate the AP1000 plant systems, including those controls that affect reactivity. As discussed in Section 3.2, the staff concludes that the simulation facility for VEGP 3 & 4 is sufficient in scope and fidelity with the reference plant during operating tests that contain the 13 items in 10 CFR 55.45(a). Further, the staff reviewed the list of performance and malfunction tests that the facility licensee performed in accordance with ANS 3.5 and documented in the CAS request submittal, Enclosure 3, "Description of the Performance Tests for the Simulation Facility and Results of the Tests." The staff determined that the tests included evolutions listed in 10 CFR 55.59(c)(3)(i)(A)-(AA) that are applicable to the design of the AP1000 reference plant, including 10 CFR 55.59(c)(3)(i)(A)-(F) and (R), (T), (W), and (X), which are identified in 10 CFR 55.31(a)(5) as appropriate scenarios allowing applicants to perform control manipulations.

Accordingly, the staff concludes that the simulation facility for VEGP 3 & 4 is sufficient in scope and fidelity to allow the conduct of the evolutions listed in 10 CFR 55.45(a)(1) through (13), and 55.59(c)(3)(i)(A) through (AA), and that it also allows for completion of the control manipulations for applicants.

Requirements in 10 CFR 55.46(c)(2) state,

> Facility licensees that propose to use a plant-referenced simulator to meet the control manipulation requirements in § 55.31(a)(5) must ensure that:
>
> (i) The plant-referenced simulator utilizes models relating to nuclear and thermal-hydraulic characteristics that replicate the most recent core load in the nuclear power reference plant for which a license is being sought; and
>
> (ii) Simulator fidelity has been demonstrated so that significant control manipulations are completed without procedural exceptions, simulator performance exceptions, or deviation from the approved training scenario sequence.

**Staff Evaluation**

As discussed in Section 3.2, the staff concluded that the simulation facility for VEGP 3 & 4 provides the necessary reactor physics, thermal hydraulic, and integrated system modeling of the reference plant necessary to perform license examinations. This includes the predicted core performance, not the most recent core load because VEGP 3 & 4 are under construction and the core has not yet been loaded. This is acceptable because ANS 3.5, Section 5.1.1, "Utilization of Baseline Data," lists sources of simulation facility baseline data in order of preference that may be used to ensure simulator fidelity with the reference plant. The most preferred source is data from the reference unit, which is not yet available and will not be available until after fuel load and the completion of plant startup testing. Therefore, the facility licensee must use the second preferred source, which is data generated through engineering analysis with a sound theoretical basis. This is the predicted reference plant core performance as described in the AP1000 DCD. ANSI/ANS-3.5-2009, Section 3.4.3.3, "Simulator Reactor Core Performance Testing," states, "simulator reactor core performance testing shall be conducted to confirm that the simulator nuclear and thermal-hydraulic models replicate the reference unit core response within the scope of simulation." The staff reviewed the CAS request submittal, Enclosure 3, and found that the facility licensee performed core performance testing.

Also as discussed in Section 3.2, the staff concluded that the simulation facility for VEGP 3 & 4 has demonstrated sufficient fidelity with the reference plant by conducting the performance testing required by ANS 3.5 and following the process described in ANS 3.5 for identifying, documenting, and correcting simulator discrepancies. Additionally, SBT, which the facility licensee performs for training scenarios that allow applicants to perform the control manipulations required by 10 CFR 55.31(a)(5), will ensure that any simulator discrepancies are screened from the scenario, and SBT also validates that the simulation facility is capable of producing the expected reference unit response without significant performance discrepancies, or deviation from an approved scenario sequence or the applicable plant procedures.

Accordingly, the staff concludes that the simulation facility for VEGP 3 & 4 uses models relating to nuclear and thermal-hydraulic characteristics that replicate the predicted core load for the reference plant for which a license is being sought, and simulator fidelity has been demonstrated so that significant control manipulations are completed without procedural exceptions, simulator performance exceptions, or deviation from the approved training scenario sequence.

Requirements in 10 CFR 55.46(d) address continued assurance of simulator fidelity. As described in RG 1.149, Revision 4,

> ANSI/ANS-3.5-2009 provides methods acceptable to the NRC staff for a facility licensee to demonstrate that, through meeting the criteria of the standard, a plant-referenced simulator will be sufficiently complete and accurate to meet the requirements of 10 CFR 55.46. Although the scope statement of ANSI/ANS-3.5-2009 is limited to the use of full-scope nuclear power plant simulators in operator training and examination, the staff has concluded that simulators meeting this standard should also be satisfactory for meeting the applicant experience requirements described in 10 CFR 55.31(a)(5).

RG 1.149 also states, “Editions of ANSI/ANS-3.5 that were previously endorsed by the NRC remain acceptable methods of meeting the regulations.” ANS 3.5 requires performance testing to be conducted on a periodic basis to demonstrate continued assurance of simulation facility fidelity. On April 8, 2015, the staff completed an inspection at VEGP 3 & 4 in accordance with Inspection Procedure 41502, Nuclear Power Plant Simulation Facilities (ADAMS Accession No. ML12233A564). The inspection report is available at ADAMS Accession No. ML15113A028. The staff reviewed a list of open and closed simulator discrepancies that the facility licensee identified to determine the types of issues that were being identified and included, and also compared the list of simulator discrepancies with a sample of simulator performance testing records to verify that the facility licensee correctly identified all simulator discrepancies that resulted from any testing. The staff also found that the licensee had a very low (i.e., conservative) threshold for documenting simulator discrepancies and that the facility licensee conducted a training needs analysis if a discrepancy could not be corrected, which is required by ANS 3.5, Section 4.2.1.4, “Assessment of Deviations.” The staff also reviewed the licensee’s database of open simulator discrepancies to ensure that they were being tracked adequately. The staff observed that the facility licensee maintains a spreadsheet of all identified simulator discrepancies. This spreadsheet includes an identification number, the test or procedure in which it was identified, a brief status of the discrepancy, and the status of the training needs analysis, if required. The staff determined that the spreadsheet is an effective tool to track simulator discrepancies. Ultimately, the staff concluded in the inspection report that it found the facility licensee’s program to assure continued simulator fidelity to comply with ANS 3.5 and to be adequate.

Accordingly, the staff concludes that the simulation facilities for VEGP 3 & 4 are suitable for the conduct of control manipulations required by 10 CFR 55.31(a).

## 4.0 SAFETY EVALUATION LIMITATIONS

The simulation facility for VEGP 3 & 4 is approved for the conduct of operating tests until a plant-referenced simulator that meets all of the requirements in 10 CFR 55.45(c) and (d) is established, after which all operating tests will be performed on the plant-referenced simulator. In no case will use of the CAS be permitted beyond the finding made by the Commission in accordance with 10 CFR 52.103(g), which is required prior to the facility licensee loading fuel. Additionally, use of the simulator for any of these purposes necessarily remains contingent on the simulation facility’s continued demonstration of fidelity with the reference plant.

## 5.0 CONCLUSION

The staff concludes that the facility licensee has adequately addressed the regulatory requirements in 10 CFR 55.46(b), “Commission-approved Simulation Facility.” This includes:

- Demonstration that the current control room simulator configuration for the simulation facility for VEGP 3 & 4 includes the necessary components and systems needed to support operator exams.
- An adequate description of simulator tests and the test results.
- Acceptable control of the testing process, and the process for identification, correction and retesting of simulator discrepancies deviations.
- Acceptable procedures for maintaining examination and test integrity consistent with the requirements of 10 CFR 55.49.

The staff concludes the facility licensee has effectively implemented the simulator qualification process outlined in ANS 3.5. Individual discrepancies were evaluated and corrective action taken for those that were determined to impact operator performance. In addition to the actions identified in ANS 3.5, the facility licensee initiated an evaluation of the discrepancies to identify conditions where similar, insignificant discrepancies might together have an aggregate impact. The facility licensee also initiated corrective actions for those areas where an aggregate impact was identified. The staff reviewed the methodology the facility licensee used, the results and the retest procedures and found these areas to be acceptable. The staff also performed an independent evaluation of the factory and site acceptance testing discrepancies from both an individual and aggregate perspective. The staff's results confirm the facility licensee's results.

The staff reviewed the test scenarios the facility licensee used for both simulator and ISV testing and found them to conform to regulatory guidance. The staff determined that the combination of scenarios used represents a diverse set of scenarios addressing or supporting all 13 items in 10 CFR 55.45(a). The aggregate impact evaluations completed by the facility licensee demonstrate that there are no individual or collective discrepancies that would prevent the simulation facility for VEGP 3 & 4 from addressing any of the 13 items in 10 CFR 55.45(a) or from being used for scenarios that allow applicants to perform the control manipulations required by 10 CFR 55.31(a)(5). The diversity of tests performed between the ISV and the simulator tests also demonstrates that sufficient numbers of scenarios can be generated for any one of the 13 items in 10 CFR 55.45(a) such that there should be no predictability in the content of operator licensing examinations.

Additionally, ANS 3.5 and NUREG-1021 provide a screening process for exam scenarios that allow the facility licensee and the staff to screen out scenarios that could contain simulator discrepancies or HEDs and prevent them from being used in an operating test scenario; ANS provides for the same screening process using SBT performed in accordance with NEI 09-09, for simulator scenarios used for control manipulations. This process is an additional measure that ensures the simulation facility and the operator exam scenarios are properly integrated in a manner that provides for the equitable and consistent administration of the examination.

The staff finds the proposed use of the simulation facility for VEGP 3&4, which is to administer operating tests that are part of the licensing examination, is acceptable because the facility licensee and the staff examiners use the method for preparing and evaluating these examinations that is prescribed by NUREG-1021.

Additionally, the staff finds that the simulation facility for VEGP 3 & 4 replicates the AP1000 DCD in terms of the predicted core model, and sufficient fidelity has been demonstrated such that significant control manipulations required by 10 CFR 55.31(a)(5) can be completed without procedural exceptions, simulator performance exceptions, or deviation from approved training scenario sequence.

For the above reasons, the simulation facility for VEGP 3 & 4 the staff finds that the simulation facility for VEGP 3 & 4 and its proposed use are suitable for the conduct of operating tests for the facility licensee's reference plant under 10 CFR 55.45(a).

## 6.0 REFERENCES


1. 10 CFR 55, “Operators’ Licenses”
2. ANSI/ANS 3.5-1998, “American National Standard for Nuclear Power Plant Simulators for use in Operator Training and Examination,” April 1998
3. ANSI/ANS 3.5-2009, “American National Standard for Nuclear Power Plant Simulators for use in Operator Training and Examination,” September 2009
4. Regulatory Guide 1.149, “Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations,” Revision 3, October 2001
5. Regulatory Guide 1.149, “Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations,” Revision 4, April 2011
6. NUREG-1021, “Operator Licensing Examination Standards for Power Reactors,” Revision 10, December 2014
7. NUREG-0700, “Human-System Interface Design Review Guidelines,” Revision 2, May 2002
8. NUREG-0711, “Human Factors Engineering Program Review Model,” Revision 2, February 2004
9. NEI 06-13A, “Template for an Industry Training Program Description,” Revision 2, March 2009
10. NEI 09-09, “Nuclear Power Plant-Referenced Simulator Scenario Based Testing Methodology,” Revision 1, December 2009
11. VEGP 3 & 4 Updated Final Safety Analysis Report, Revision 4, July 2015