

U.S. NUCLEAR REGULATORY COMMISSION SUMMARY OF THE MARCH 8, 2023,
OBSERVATION PREAPPLICATION PUBLIC MEETING
WITH SMR, LLC (A HOLTEC INTERNATIONAL COMPANY)
TO DISCUSS THE SMR-160 SIMULATOR, OPERATOR LICENSING AND
OPERATING EXPERIENCE REVIEWS

Meeting Summary

The U.S. Nuclear Regulatory Commission (NRC) held an observation public meeting on March 8, 2023, with SMR, LLC (SMR), a Holtec International Company (Holtec), to discuss preapplication information related to the SMR-160 simulator, operator licensing, and operating experience review (OER).¹ Specifically, SMR (Holtec) requested the meeting to discuss and receive NRC staff feedback on its questions related to these topics in its presentation materials.^{2,3} This meeting summary satisfies the SMR (Holtec) request for review and feedback on its preapplication meeting materials.

This virtual observation preapplication meeting had attendees from SMR (Holtec), NRC staff, and members of the public. The NRC staff and SMR (Holtec) discussed proprietary information during the closed session.

Preapplication engagements, including this meeting, provide an opportunity for the NRC staff to engage in early discussions with a prospective applicant to offer licensing guidance and to identify potential licensing issues early in the licensing process. No decisions or commitments were made during the preapplication meeting.

The following summarizes the discussion during the meeting:

- After opening remarks and introductions, SMR (Holtec) described the purpose of the meeting to provide a high-level overview of the SMR-160 simulator development plan and to discuss Human Factor Engineering (HFE) milestone. The desired outcome of the meeting was to obtain NRC staff feedback on the development plan and eventual certification of the SMR-160 simulator for operator training.
- SMR (Holtec) provided an overview of the SMR-160 simulators that will be used for various regulated and non-regulated activities. SMR (Holtec) noted that the engineering simulator currently functions for system performance and has been informing the development of the SMR-160 design.

¹ Letter from J. Hawkins, "SMR, LLC, Submittal of Preapplication Meeting Materials for March 8, 2023," dated March 1, 2023, Agencywide Documents and Access Management System (ADAMS) Accession No. ML23060A009, part of ML23060A008.

² SMR, LLC, "Enclosure 2: Holtec International, NRC Meeting: Simulator Certification and Human Factor Engineering," dated March 1, 2023, ML23060A011 – Public, part of ML23060A008.

³ SMR, LLC, "Enclosure 1: SMR, LLC Meeting Presentation Materials for February 22, 2023 (P)," dated February 14, 2023, ML23060A010 – Proprietary, part of ML23060A008.

- The NRC staff noted that the term “simulator certification” referenced by SMR (Holtec) was used in the past for a simulator assessment process that is no longer used today. The NRC staff clarified that the current process consists of either an applicant making a declaration of a plant-reference simulator (PRS) or obtaining a Commission-Approved Simulator (CAS), and that an NRC inspection would occur thereafter at a point after the simulator is ready but before its use for regulated operator licensing and training activities.
- SMR (Holtec) asked what specific tests or validations are required to achieve a “Plant Referenced-Simulator” given that the SMR-160 simulator will only have plant design analysis for reference. In response, the NRC staff noted that the facility license applicant will determine when a plant-referenced simulator has been established which is referred to a “declaring” a plant-referenced simulator. Under 10 CFR Part 55, the NRC would subsequently conduct an inspection using Inspection Procedure (IP) 41502 to confirm that the simulator is acceptable for the purposes of use within regulated contexts (e.g., reactivity manipulations for licensed operator applicant experience, initial operator licensing exams, etc.).⁴

The NRC staff emphasized the importance of recognizing that the scope of this inspection procedure is closely linked to the performance testing methods described under American National Standards Institute (ANSI)/American Nuclear Society (ANS) Standard ANSI/ANS-3.5-2009, which the agency has endorsed in Regulatory Guide (RG) 1.149.^{5, 6} This standard represents one means of meeting the relevant requirements of 10 CFR 55.46 and a facility license applicant could propose alternatives. In proposing alternatives, the applicant should adequately justify how the proposed alternative represents an acceptable equivalent to following the guidance of RG 1.149.⁷ Thus, completion of the performance testing regimen described under ANSI/ANS-3.5, and resolution of identified discrepancies, presents an appropriate step towards preparing for an IP 41502 inspection. Additional information may be found in an NRC charter project report on the topic.⁸ The NRC staff noted that future preapplication engagements could support an applicant’s confidence that the PRS is on the right track.

The NRC staff noted the three purposes of a PRS: operator licensing training, administration of operating tests (for both initial license and annual requalification examinations), and reactivity manipulations for operator license application experience requirements. The NRC staff is proposing changes to address simulators for new reactor constructions in the proposed rule to align the requirements in 10 CFR Part 50 and 52.⁹ The NRC staff noted that both Southern Company and SCANA requested exemptions in

⁴ U.S. NRC, Inspection Procedure (IP) 41502, “Nuclear Power Plant Simulation Facilities,” Issued October 16, 2012. (ML12233A564)

⁵ ANSI/ANS-3.5-2009, “Nuclear Power Plant Simulators for Use in Operator Training and Examination.”

⁶ U.S. NRC, Regulatory Guide, 1.149, “Nuclear Power Plant Simulation Facilities for Use in Operator Training, License Examinations, and Applicant Experience Requirements,” Revision 4, dated April 2011. (ML110420119)

⁷ Title 10 of the *Code of Federal Regulations* (10 CFR) 55.46, “Simulation Facilities.”

⁸ U.S. NRC, “Charter: Declaration of Plant-Referenced Simulators and Qualification of Commission-Approved Simulation Facilities to Support the Cold Licensing Process - Tasks & Recommendations: Task 2,” November 13, 2019. (ML19317E689)

⁹ U.S. NRC, SECY-22-0052: Proposed Rule: Alignment of Licensing Processes and Lessons Learned from New Reactor Licensing (RIN 3150 AI66),” dated June 22, 2022. (ML21159A055)

their combined license (COL) applications related to the requirements for a PRS and that the proposed rule is intended to alleviate the need for such exemptions.

- With respect to the development of operator testing, the NRC staff discussed that NUREG-1021 and its associated knowledge and abilities catalogs provide guidance for operator licensing examination format, content, and scope.¹⁰ However, the NRC staff cautioned that certain technology-specific aspects of this framework may not be applicable to new reactor designs and a listing of the operator knowledge and abilities for SMR-160 will need to be developed in support of establishing an operator licensing program. The NRC staff noted that a draft guidance document developed for the non-light-water reactor community, Advanced Reactor Content of Application Project (ARCAP), Chapter 11, may provide additional insights on the process; however, caution should be taken when reviewing this information because the licensing framework is based on the licensing modernization project framework described Nuclear Energy Institute (NEI) document, NEI-18-04, Revision 1.^{11, 12}
- SMR (Holtec) asked what the NRC expectations are for confirming validation testing with respect to the coding used, system design and information gathered. The NRC staff noted that there is an overlap in the requirements for simulator performance testing and simulator testing (HFE) requirements. The simulator performance testing is covered by ANSI/ANS-3.5-2009 and the simulator testing (HFE) is covered in Chapter 10, "Training Program Development," and Chapter 11, "Human Factors Verification and Validation," of NUREG-0711, Revision 3.¹³

SMR (Holtec) requested additional information on how the data is captured for the NRC review. The NRC staff encouraged a future engagement on HFE to include implementation plans and results summary reports (RSR). Additional insights may be found in Chapter 11 of NUREG-0711, Revision 3.

- SMR (Holtec) asked at what point during the simulator development process would the simulator be considered complete such that a configuration management control process could be implemented. The NRC staff responded that it depends on where the design is in the process and noted that simulator issues occurring during the licensing process fall into categories of simulator performance discrepancies and Human Engineering Discrepancies (HED). The NRC staff referred to Figure 1-1, "Elements of the HFE program's review model," in NUREG-0711, Revision 3, and noted that the elements described on this table are often completed in parallel and that there is no expectation by the NRC staff that the activities be conducted in a serial nature. The NRC staff also noted that Figure 7-1, "The role of important human actions in the HFE program" illustrates an approach where design activities happen in a more realistic

¹⁰ U.S.NRC, NUREG-1021, "Operator Licensing Examination Standards for Power Reactors - Final Report," Revision 12, dated September 2021. (ML21256A276)

¹¹ U.S. NRC, Advanced Reactor Content of Applications Project (ARCAP), draft Chapter 11, "Organization," dated February 21, 2021. (ML21049A277)

¹² Nuclear Energy Institute (NEI), NEI-18-04, "Risk-Informed Performance-Based Technology-Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," Revision 1, August 29, 2019. (ML19241A336)

¹³ U.S. NRC, NUREG-0711, "Human Factors Engineering Program Review Model," Revision 3, dated November 2012. (ML12324A013)

manner. Figure 11-1, "Overview of verification and validation activities" may be helpful to put the HED resolution process within the context of other validation activities.

- SMR (Holtec) asked whether additional qualifications, such as an SMR-160 Operator Certification obtained from an approved training program, are required to perform validation of the simulator. The NRC staff responded that, in general, simulator validation activities are conducted by either the operators who are licensed on the reference plant or by instructors who are certified on the reference plant. It should be noted that while the NRC regulates training programs, the agency does not confer certifications. While the needed sequencing of activities precludes licensed operators from being available prior to the establishment of either a plant-referenced or Commission-approved simulator, it is still feasible to train staff to a degree adequate for vendor certification on the design. Validation activities should be implemented by adequately trained staff to ensure that the validators possess the knowledge, skills, and abilities needed to implement procedures, operate the human-system interfaces, and identify both simulator performance and HFE design issues. The NRC staff also referred to Chapter 11 of NUREG-0711, Revision 3, regarding validation testing. The NRC staff noted that through validation testing, an applicant could find that issues were caused by one of the following: design, procedure, or training. By eliminating any training issues, it may be easier for an applicant to address other considerations.
- In response to the SMR (Holtec) question on how the NRC would conduct the Issue Resolution Verification under 10 CFR Part 50, the NRC staff noted that at the Operating License (OL) application stage, a complete and accurate application with HFE Implementation Plans would be expected and that the final HFE Results Summary Reports would need to be submitted before the licensing review for the OL could be completed. Confidence in the review schedule could be achieved if the validation testing plan is available to audit and the RSRs are incorporated into the evaluations.

The NRC staff elaborated that basic information is provided at the construction permit (CP) stage and that topical reports may be used to address discrete issues between the CP and OL stages. Operator licensing follows its own timeline driven by the ability to load fuel. Additional insights on this process can be found in the draft Chapter 11 of the ARCAP document.

- SMR (Holtec) noted that the document referred to on Slide 13, HPP-160-1014, is an internal instrumentation and control document to comply with the regulatory processes for HFE in the SMR-160 design and has not been submitted to the NRC. In response to the SMR (Holtec) question on the level of detail needed for the OER, the NRC referred to the information in Chapter 3, "Operating Experience Review," of NUREG-0711, Revision 3, including information on the Three Mile Island Lessons Learned. The NRC staff noted that the experience need not be limited to nuclear experience and could include experience in other industries such as aviation, medical, process control, and military. The NRC staff cautioned that the more innovative the design, the more experience would be expected.

The NRC staff identified two documents other HFE-related documents with relevance to small modular reactors, NUREG/CR-7126 and NUREG/CR-7202, that SMR (Holtec) may want to consider as its design progresses.^{14, 15, 16}

The open session ended at 2:50 PM.

The following provides a non-proprietary discussion of the closed session of the meeting:

- The NRC staff noted that the discussed information was useful towards meeting the verification and validation timeline. The NRC staff encouraged SMR (Holtec) to continue coordination through preapplication engagements to maintain awareness of the timeline and any limitations that could occur.
- The NRC staff described the audit process of reviewing information in the electronic reading room setup for the preapplication activities when there is sufficient information available to support the audit.
- SMR (Holtec) asked for information on how and why Southern Nuclear (SNC) chose to pursue a CAS path and how an applicant can avoid that path. In response, the NRC staff provided a reference to the CAS evaluation for the Vogtle plant and described how the use of design acceptance criteria (DAC) under the 10 CFR Part 52 process related to the ongoing design of the control room after the license had been issued.¹⁷

The NRC staff discussed that the 10 CFR Part 52 COL application for Vogtle 3 & 4 included the use of DAC under which a completed control room design was not required for the COL to be issued. The control room design had not yet been completed when SNC requested that the Commission approve the Vogtle 3 & 4 simulation facility. SNC requested approval to use a Commission-approved simulation facility for conducting operator licensing examinations until such time as the simulator was accepted as a plant-referenced simulator. The simulation facility for Vogtle 3 & 4 did not yet meet the NRC's requirements for plant-referenced simulators because the design activities required by the AP1000 design certification to establish the HFE design for the main control room were in progress but had not yet been completed.

The NRC staff noted the importance to distinguish between simulators used for HFE testing and simulators used for operator training and licensing, as well as the various requirements for both simulator purposes. The NRC staff also noted that the simulator used for operator licensing exams should be derived from the main control room design that results from HFE testing and issue resolution.

¹⁴ U.S. NRC, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 18, "Human Factors Engineering."
<https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/ch18/index.html>

¹⁵ U.S. NRC, NUREG/CR-7126, "Human-Performance Issues Related to the Design and Operation of Small Modular Reactors," dated June 2012. (ML12179A170)

¹⁶ U.S. NRC, NUREG/CR-7202, "NRC Reviewer Aid for Evaluating the Human-Performance Aspects Related to the Design and Operation of Small Modular Reactors," dated June 2015. (ML15182A199)

¹⁷ U.S. NRC, "Vogtle Electric Generating Plant, Units 3 and 4 Submittal of a Request for a Commission-Approved Simulation Facility, Safety Evaluation," dated March 29, 2016. (ML16070A301)

- The NRC staff ended the close session noting the value of quality preapplication engagements to facilitate a smooth review of the application when it is submitted.

The meeting was adjourned at 3:20 PM.