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NRC Meeting:
Simulator Certification and Human Factor Engineering

HOLTEC INTERNATIONAL

Date: 8 March 2023

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Meeting Agenda

- Introductions
- Purpose & Outcome
- Overview of SMR-160 Simulator Development Steps
- Discussion of Simulator Certification Regulatory Process and Staffing
- Discussion of Regulation intended updates
- Discussion on HFE OER Fidelity
- Open Forum

Introductions

- NRC Staff
- Holtec Staff

Purpose and Outcome

- PURPOSE
  - To provide a high-level overview of the SMR-160 simulator development plan and to discuss important Human Factor Engineering (HFE) milestones

- OUTCOME
  - To obtain feedback from the NRC staff on the development plan and eventual certification of the SMR-160 simulator for operator training

Overview of SMR-160 Simulator

- Plant Model incorporating the following high-fidelity computer codes
  - SIMULATE3-Real Time (S3R) models the neutronic behavior of the reactor core. S3R uses the same physics methods found in SIMULATE, the modeling tool used by core design engineers, but runs in real-time.
  - RELAP5-3D is used to model the thermal hydraulic behavior of the RCS and ESFs, including the RPV and primary and secondary side of the Steam Generator.
  - MELCOR may be used to simulate severe accident behavior on the full-scope simulator.
  - WSC 3KeyMaster code suite is used to model the remaining plant systems.
- Integration of MELTAC Emulator for digital control system mimics major I&C systems and Human System Interface (HSI) design
- Development includes three main stages
  - Engineering Simulator (ES)
  - Desktop Scale Simulator (DSS)
  - Full Scale Simulator (FSS)

Overview of SMR-160 Simulator (Continued)

- Engineering Simulator
  - Engineering tool for plant design and development
  - Primary purpose is to analyze and evaluate integrated plant response
  - Secondary purposes are to integrate and test MELTAC emulator interface with the simulator Plant Model and to begin HFE evaluations

- Desktop Scale Simulator
  - Real time simulation using HSI screens that will mimic the Main Control Room design layout to continue ongoing development and HFE work
  - Perform transient testing and initial scenario-based testing

- Full Scale Simulator
  - Simulator room that replicates the Main Control Room layout design with associated hardware.
  - Perform Verification and Validation of HFE process
  - Continue Full Scale Simulator to incorporate full instructor station to certify as a Plant-Referenced Simulator for Operator Training and Licensing

Plant-Referenced Simulator

- From 10 CFR 55.4, "*Plant-referenced simulator* 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's procedures." And *Reference plant* means "the specific nuclear power plant from which a simulation facility's control room configuration, system control arrangement, and design data are derived."

- From NRC Inspection Procedure 41502:

> 01.04 To verify that a simulator facility for a "new reactor" has sufficient fidelity to be designated a 'plant reference simulator' and conforms to objectives 1.01 through 1.03 above. (A 'new reactor' for the purposes of this procedure means as a reactor plant under construction with no core operating history.)

- Question: What specific tests or validations are required to achieve a "Plant Referenced Simulator" given that our simulator will only have plant design analysis for reference?

Simulator Certification Fidelity

- The simulator will be validated through analysis of normal and abnormal operations, malfunctions and surveillance testing based on requirements set forth in ANSI/ANS-3.5-2018. The package provided for simulator certification will also include the records mentioned in Section 5 and Appendix A of ANSI/ANS-3.5-2018.

- Question: What is the expectation for confirming validation testing, specifically in regard to coding used, system design, and information gathered?

Certification Process

- From ANSI/ANS-3.5-2018, "A configuration management program shall be established to provide a means for demonstrating compliance with Sec. 3, "General requirements." The program shall be established to document the adequacy of the design and performance of the simulator at the time the simulator is approved for use in operator training and examination."

- Holtec intends to set development completion at the time the company will submit for NRC certification. After which time the Holtec configuration management control process will be implemented and tracked to account for any discrepancies of the V&V.

- Question: At what point during development is it acceptable to call complete to being deficiency tracking database and official configuration management control process?

Certification Qualification

- Holtec intends to set requirements based on background experience as stated in HPP-160-1014 to perform work associated with HFE V&V and simulator certification.

- Question: Are additional qualification, such as an SMR-160 Operator Certification obtained from an approved training program, required to perform validation of the Simulator for its certification?

Simulator Issue Resolution Process

- From NRC Inspection Procedure 41502

> (e) New reactor inspections should evaluate the areas listed above as well as verify that discrepancies in the Issue Resolution Verification portion of the ITAAC are assessed per the configuration management control process and entered in the licensee's simulator corrective action program. The results from verification and integrated validation activities performed in accordance with the Design Certification and documented is the Licensee's ITAAC closure letter(s) may be cited as the bases for satisfactorily addressing applicable 10 CFR 55.46 requirements.

- Question: How will the process of Issue Resolution Verification be performed for Part 50 application?

Regulation Update

- Regulations were presented to be under revision to include verbiage of new construction plants, including 10 CFR 55.45 and 10 CFR 55.46.

- Question: Are there any updates to the regulation changes?

Operating Experience Review

- Operating Experience Review will be reviewed and documented in accordance with HPP-160-1014.

- Question: What extent of research entails sufficient investigation? What level of detail is required to capture for OER RSR? Holtec intends to capture relates OER items in the OER RSR which will be assigned a tracker within the HFE Issue Tracking System (HITS).

Open Forum

Backup Slides

Path of Commission-Approved Simulator

- From ML1670A301, "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....[since] 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."

- Question: "Can you help describe how and why SNC chose to pursue the Commission-approved simulator path and how do we as an applicant avoid that path."

Certification Qualification

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Simulator Development Timeline

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