UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RESPONSE TO SUPPLEMENT NO. 1 TO GENERIC LETTER 87-02

EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-321 AND 50-366

1.0 BACKGROUND

On February 19, 1987, the NRC issued Generic Letter (GL) 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46." In the GL, the NRC staff set forth the process for resolution of USI A-46, and encouraged the affected nuclear power plant licensees to participate in a generic program to resolve the seismic verification issues associated with USI A-46. As a result, the Seismic Qualification Utility Group (SQUG) developed the "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," Revision 2.

On May 22, 1992, the NRC issued Supplement 1 to GL 87-02 including the staff's Supplemental Safety Evaluation Report No. 2 (SSER-2) pursuant to the provisions of Title 10 of the Code of Federal Regulations (10 CFR) Section 50.54(f), which required that all addressees provide either (1) a commitment to use both the SQUG commitments and the implementation guidance described in GIP-2 as supplemented by the staff's SSER-2, or (2) an alternative method for responding to GL 87-02. The supplement also required that those addressees committing to implement GIP-2 provide an implementation schedule, as well as detailed information including the procedures and criteria used to generate the in-structure response spectra (IRS) to be used for USI A-46.

In a letter dated September 16, 1992 (Reference 10), Southern Nuclear Operating Company, Inc. (SNC or the licensee), provided its response to Supplement 1 to GL 87-02 for the Edwin I. Hatch Nuclear Plant (Hatch), Units 1 and 2. In the September 16 letter, the licensee committed to follow the SQUG commitments set forth in GIP-2, including the clarifications, interpretations, and exceptions identified in SSER-2. The staff issued its evaluation of the licensee's response by letter dated November 20, 1992 (Reference 11).

By letter dated May 30, 1995 (Reference 5), the licensee submitted summary reports for both Hatch units summarizing the results of its USI A-46 implementation program. In this letter, the licensee stated that it has successfully verified the seismic adequacy of the electrical and mechanical equipment using GIP-2. However, the licensee took an exception to the GIP-2 criteria by not performing a third-party review of the Unit 2 USI A-46 evaluation. The licensee's justification for omission of the third-party review for Unit 2 was based on the following information.

1. An extensive third-party review was performed on the Unit 1 USI A-46 program. The third-party review verified the expertise of the personnel performing the Unit 1 evaluations.

2. The same personnel who performed the Hatch Unit 1 evaluations also performed the Hatch Unit 2 evaluations.

3. Hatch Unit 2 safe shutdown equipment list (SSEL), with few exceptions, is identical to Hatch Unit 1 SSEL equipment.

4. Hatch Unit 1 and Unit 2 reactor buildings are essentially identical and have the same soil conditions. The control building, diesel generator building, and intake structure are shared by both Units 1 and 2.

In consideration of the above factors, the staff believes that the omission of the third-party review of the USI A-46 implementation at Hatch Unit 2 does not compromise the conclusions concerning its seismic adequacy. The staff reviewed the summary reports for Hatch Units 1 and 2 of the USI A-46 implementation program and issued a request for additional information (RAI) on June 27, 1996 (Reference 12). The licensee provided the response to the RAI in the submittal of August 23, 1996 (Reference 6). The staff's review of the response generated a supplemental request for additional information (SRAI) (Reference 13) and the licensee provided its response to the SRAI in two letters dated April 25, 1997, and February 6, 1998 (References 7 and 14).

This report provides the staff's evaluation of the licensee's USI A-46 implementation program based on the staff's review of the summary report, supplemental information, clarification, and documentation provided by the licensee in response to the staff's RAIs.

2.0 DISCUSSION AND EVALUATION

The staff's review of USI A-46 summary reports for Hatch Unit 1 and Unit 2 was performed in accordance with the USI A-46 Action Plan, dated July 26, 1994. In that regard, this effort consisted of a screening level review of specific sections of the licensee's program, with emphasis placed on identification and resolution of outliers; i.e., equipment items that did not readily pass the GIP-2 screening and evaluation criteria. The summary report describes a safe shutdown path and provides the evaluation of seismic adequacy of tanks and heat exchangers, cable and conduit raceways, relays, and outlier identification and resolution including proposed schedules.

2.1 Seismic Demand Determination

The licensee requested use of one-half of the seismic margin earthquake (SME) ground response spectra (GRS) and IRS, which were developed from the Hatch Unit 1 seismic margin assessment (SMA) program, for the USI A-46 issue resolution of Hatch Unit 1. The SME GRS horizontal components have a peak ground acceleration (PGA) of 0.30g and the corresponding vertical PGA is 0.20g. SNC's request was based on the following: (1) the 5 percent damped Unit 1 design basis earthquake (DBE) GRS, which is a Housner GRS tied to a peak ground acceleration of 0.15g, is enveloped with significant margin by the ½ x 5 percent damped SME

GRS, (2) the Unit 1 GRS of the SMA program were developed by performing a detailed soil-structure interaction (SSI) analysis, (3) the NRC's concerns relating to soil properties, use of deconvolution process, etc., in the SSI analysis were previously resolved, and (4) the method of developing SME GRS and IRS was evaluated and accepted by the NRC (References 1, 2, 3, and 4). SNC also requested to use the one-half x SME GRS and IRS for the USI A-46 issue resolution of Hatch Unit 2 based on the facts that: (1) the 5 percent damped Unit 2 DBE GRS, which is a modified Newmark ground spectra tied to a peak ground acceleration of 0.15g, is approximately equal to the ½ x 5 percent damped SME GRS, and (2) Unit 2 is founded on the same soil and is a sister unit to Unit 1 (e.g., both units share same control building, diesel generator building and intake structure except for the reactor buildings; however, these reactor buildings were designed by the same architect/engineering organization, are nearly identical, and contain nearly identical equipment in the buildings).

The staff reviewed SNC's justifications for using ½ x SME GRS and IRS and concluded that the request was acceptable for the USI A-46 issue resolution for Hatch. SNC then used the one-half x SME GRS and IRS as seismic demands for the USI A-46 resolution.

It should be noted that SNC used the full SME GRS (PGA of 0.30g) and IRS, rather than the one-half x SME GRS and IRS, to determine seismic demand for certain equipment. This was considered conservative for the cases involving a single evaluation that satisfied the resolution of USI A-46 and the seismic aspect in the individual plant examination of externally initiated events (IPEEE).

2.2 Seismic Evaluation Personnel

The licensee has provided the information concerning the qualification and experience of the seismic evaluation personnel. The staff found that the seismic capability engineers who were members of the seismic review team, the system engineers who developed the SSEL and assisted the seismic review team, and the relay evaluation personnel responsible for evaluation of relay chatter and identification of electric SSEL components, possessed considerable experience in design and analysis and met the qualification and experience provisions of GIP-2.

2.3 Safe Shutdown Path

GL 87-02 specifies that licensees should be able to bring the plant to, and maintain in, a hot shutdown condition during the first 72 hours following a safe shutdown earthquake (SSE). To meet this provision, in its submittal of May 30, 1995, SNC addressed the following plant safety functions: reactor reactivity control, pressure control, inventory control, and decay heat removal. A primary and an alternate safe shutdown success path with their support systems and instrumentation were identified for each of these safety functions to ensure that the plant is capable of being brought to, and maintained in, a hot shutdown condition for 72 hours following an SSE. Appendix A of the licensee's submittal provides the safe shutdown equipment list.

Following a seismic event, the reactor decay heat removal function is accomplished by relieving steam from the reactor via the safety/relief valves into the suppression pool. During the early stages, the reactor coolant system inventory is controlled by injecting water into the reactor by the high pressure coolant injection, which takes suction from the suppression pool if the

condensate storage tank is not available. In the later stages, the available loop of CS system can be manually started from the control room to recover any inventory loss following depressurization. The decay heat removal is achieved by placing the residual heat removal (RHR) system in the suppression pool cooling (SPC) mode of operation. During the SPC mode of RHR, the RHR system takes suction from and discharges to the suppression pool via the RHR heat exchangers. The RHR service water system provides the capability to transfer the decay heat from the RHR system to the ultimate heat sink.

The plant Operations Department reviewed the safe shutdown success paths and concluded that the plant operating procedures and operator training were adequate to establish and maintain the plant in a safe shutdown condition using the equipment identified in Appendix A of SNC's submittal.

The staff concludes that the approach to achieve and maintain safe shutdown for 72 hours following a seismic event is acceptable.

2.4 Seismic Screening Verification and Walkdown for Mechanical and Electrical Equipment

2.4.1 Equipment Seismic Capacity Compared to Seismic Demand

SNC stated in the Summary Report (Reference 5) that the full SME GRS (PGA of 0.30g) was used as a seismic demand and was compared to the seismic capacities described in the GIP-2 by the "Bounding Spectrum (BS)" for equipment within 40 feet above the effective grade. The full SME GRS is enveloped by the GIP-2 BS. A review of the in-structure response spectra for elevation up to about 40 feet above the plant grade indicates that for frequencies above 8 Hertz, the amplification is less than 1.5.

For equipment located 40 feet above the effective grade, SNC used Method B of GIP-2 to determine the seismic adequacy when subjected to the developed IRS as the seismic demand. The staff considers that the manner by which the seismic capacity to demand was compared, yielded an adequate verification of the seismic capability of equipment for the resolution of USI A-46 at Hatch.

2.4.2 Assessment of Equipment Caveats

"Caveats" are defined as the set of inclusion and exclusion rules that represent specific characteristics and features particularly important for seismic adequacy of a particular class of equipment. The licensee documented specific cases of equipment where the intent of the caveats was considered to be met, rather than the specific wording of the caveat in the Screening Evaluation Work Sheets. The staff did not identify discrepancies with the licensee's assessment of equipment caveats.

2.4.3 Equipment Anchorages

SNC stated in Reference 5 that the seismic adequacy of equipment anchorages was verified in accordance with the GIP-2 guidelines. During the walkdowns, the Seismic Review Team (SRT)

inspected the seismic adequacy of anchorage installation and its connection to the base of the equipment and determined the allowable capacity of the anchorage used to secure the equipment. The inspection utilized plant documentation and drawings and consisted of visual checks and measurements, and anchor bolt tightness and embedment checks for concrete expansion anchors.

The SRT determined the seismic demand imposed on the equipment, and identified outliers for the anchorages that did not have enough capacity compared to the demand. The full SME GRS (PGA of 0.30g) was used as a seismic demand. Appendix H of the Summary Report (Reference 5) shows the anchorage outliers identified during the USI A-46 walkdowns. Those equipment anchorage outliers were related to anchorage deficiencies that included insufficient anchor capacity, unacceptable anchorage edge distance, a corroded anchor bolt, missing anchor bolts, and potential bolt bending concerns. SNC stated (References 5 and 8) that it has resolved all of the anchorage outliers either by modification or replacement. The staff finds the licensee's evaluation of equipment anchorage and resolution of outliers to be acceptable.

2.4.4 Seismic Spatial Interaction Evaluation

Among the aspects to be addressed in the USI A-46 program implementation is the review of the potential spatial interaction of nonseismic structural systems or components with the equipment in the safe shutdown path. In order to verify the seismic adequacy of mechanical and electrical equipment with regard to this consideration, SNC performed walkdowns considering the following concerns: (1) proximity effects, (2) structural failure and falling, (3) flexibility of attached lines and cables, and (4) any other possible interactions. Appendices H and L of the Summary Report (Reference 5) describe the spatial interaction issues identified as outliers by the SRT during the walkdowns. SNC stated that it has resolved all outlier issues by replacing or modifying structural systems to avoid potential interactions (References 5 and 8). The staff finds the licensee's resolution of seismic spatial interaction aspect of the USI A-46 to be acceptable.

2.5 Tanks and Heat Exchangers

SNC evaluated a total of nine tanks and heat exchangers in Unit 1 and seven in Unit 2 by seismic walkdowns. The equipment was evaluated for adequacy of wall thickness, anchorage, connection between anchor bolts and shell, and flexibility of attached piping. SNC stated in the Summary Report (Reference 5) that it determined the capacity of the tanks and heat exchangers in accordance with the GIP-2 allowables. For the seismic demand, SNC used the full SME IRS, rather than the ½ x SME IRS. As mentioned, this was conservatively done so a single evaluation could be performed to satisfy both the resolution of USI A-46 and the seismic evaluation for IPEEE. SNC identified only one tank as an outlier. The cause of the outlier issue was a wooden roof structure that could potentially fall on the tank and the attached piping. SNC resolved this outlier issue by modifying the roof structure to prevent its collapse on the tank. The staff finds the licensee's assessment and corrective action with regard to tanks and heat exchangers to be acceptable for the resolution of USI A-46 at Hatch.

2.6 Cable and Conduit Raceways

The licensee's evaluation of the raceway systems in Hatch Units 1 and 2 was comprised of plant walkdowns of SSEL raceway systems and an analytical review of selected worst-case raceway system supports. The walkdown and the limited analytical review were conducted according to the guidance in GIP-2. The purpose of the walkdown was to verify that the raceway systems are bounded by the earthquake experience and the shake table database. The limited analytical review ensured that the selected worst-case representative samples of raceway support systems were at least as rugged under seismic loadings as those which performed well in the earthquake experience and the shake table test data. The portions of the raceway systems, which did not pass the screening guideline, were classified as outliers and were evaluated separately using alternate methods specified in GIP-2. Based on the walkdown results, SNC identified eleven outliers. The outlier issues were mainly with anchorage support systems. SNC has resolved all outliers by modifying the support systems and performing detailed analytical evaluations to meet the requirements as set forth in Section 8 of GIP-2. The results are shown in Appendix K of the Summary Report (Reference 5). The staff concludes that the licensee has properly evaluated the seismic adequacy of electrical raceway systems.

2.7 Essential Relays

Essential relays (i.e., relays for which chatter must be precluded) affecting the safe shutdown equipment were evaluated for seismic adequacy to demonstrate that chatter will not occur due to an earthquake. The generic equipment ruggedness spectra (GERS) were used to determine the seismic capacity at which electrical contact devices will not chatter. The seismic capacity was compared to the seismic demand for a given relay to determine its acceptability. The basic seismic demand at the point of attachment of the panel or cabinet that housed the relay was one-half the SME IRS. However, the seismic demand for the relay was determined by multiplying an appropriate in-cabinet amplification factor by 1.5 times the one-half SME IRS. The licensee conservatively applied an amplification factor of 7 to most panels containing essential relays, unless a lower, more realistic factor was required for comparison with the GERS.

The licensee evaluated all essential relays required for the shutdown path components for relay chatter since it can potentially result in an unacceptable seal-in. Based on the evaluation results, the essential relays were grouped into one of the following categories:

- Chatter is acceptable
- Relay is seismically acceptable
- Resolved by operator action
- Relay is screened out using GERS
- Relay is screened out using plant-unique seismic test data
- Components are not affected by relays
- Dual status refers to relays with multiple contacts resolved with different methods
- Corrective action (i.e., replacement) is required

The licensee replaced relays where relay chatter was determined to be unacceptable. The staff finds this evaluation and resolution to be acceptable in accordance with the methodology specified in GIP-2.

2.8 Human Factors Aspect

The staff's review focused on verifying that the licensee had used one or more GIP-2 methods for conducting the operations department review of the SSEL, and had considered aspects of human performance in determining what operator actions could be used to achieve and maintain safe shutdown (e.g., resetting relays, manual operation of plant equipment). The licensee provided information which outlined the use of the "desk-top" evaluation method by a senior reactor operator and simulator exercises by a licensed operating crew to verify that existing normal, abnormal, and emergency operating procedures were adequate to mitigate the postulated transient and that operators could place and maintain the plant in a safe shutdown condition. The staff verified that the licensee had considered its operator training programs and verified that its training was sufficient to ensure that those actions specified in the procedures could be accomplished by the operating crews. The licensee stated that, as a result of its review, it was determined that the Hatch procedures and operator actions and training are adequate to direct the plant to the safe shutdown path using only equipment on the SSEL.

In addition, the staff requested verification that the licensee had adequately evaluated potential challenges to operators, such as lost or diminished lighting, harsh environmental conditions, potential for damaged equipment interfering with the operator's tasks, and the potential for placing an operator in unfamiliar or inhospitable surroundings. The licensee provided information regarding the simulator and "desk-top" evaluations to substantiate that operator actions could be accomplished in a time frame required to mitigate the transient. Specifically, the licensee provided assurance that ample time existed for operators to take the required actions to safely shut down the plant. The licensee verified that existing procedures, availability of lighting equipment, and operator training were adequate to ensure that the operators could perform the required actions credited in the submittal. The licensee verified that all required actions were grouped in easily accessible and familiar areas of the plant (i.e., the main control room, switchgear room, and diesel generator building). The licensee further stated that earthquake experience has shown that typical industrial grade equipment and structures are inherently rugged and not susceptible to damage at USI A-46 plant SSE levels. Therefore the potential for physical barriers resulting from equipment or structural earthquake damage that could inhibit operator ability to access plant equipment is not considered to be a significant hazard.

The licensee has provided the staff with sufficient information to demonstrate conformance with the NRC-approved review methodology outlined in GIP-2 and is, therefore, acceptable.

2.9 Outlier Identification and Resolution

The licensee classified items of identified safe shutdown equipment as outliers if the screening guidelines of GIP-2 were not met. If an item of equipment was identified as an outlier during the screening evaluation, the reason for failing to satisfy the screening guidelines was documented in the Screening Verification Data Sheet. Appendix L to the Summary Report

(Reference 5) contains a summary of equipment outliers and provides information pertaining to the equipment, description of the outlier, method and status of resolution. The staff noted that in Unit 1 there were 59 outliers relating to components in SSEL, 12 outliers involving conduits and raceways, and 3 relay outliers. In Unit 2, there were 46 outliers relating to components in SSEL, 5 outliers involving conduits and raceways, and 2 relay outliers. The licensee resolved the outliers by analysis or modification. All outliers were resolved by the end of December 1995. The staff determined that the licensee's process for identification and resolution of outliers was, in general, consistent with the guidelines of GIP-2 and the staff's SSER No. 2, and is, therefore, acceptable.

3.0 SUMMARY OF MAJOR STAFF FINDINGS

The staff's review of the licensee's USI A-46 implementation program, as provided for each area discussed above, did not find any significant or programmatic deviation from GIP-2 regarding the walkdown and the seismic adequacy evaluation at Hatch.

4.0 CONCLUSIONS

The licensee's USI A-46 program at Hatch was established in response to Supplement 1 to GL 87-02 through a 10 CFR 50.54(f) letter. The licensee conducted the USI A-46 implementation in accordance with GIP-2 and the staff's SSER No. 2. The licensee's submittal on the USI A-46 implementation indicated that in both units of Hatch, 777 SSEL components, including tanks and heat exchangers and conduits, raceways and electrical relays, were evaluated. The evaluation identified 105 component outliers, 17 outliers in conduits and raceways, and 5 outliers in relays. All the identified outliers have been resolved. The licensee's implementation report did not identify any instance where the operability of a particular system or component was questionable. As described in Section 3.0 of this SE, the staff's review did not identify any areas where the licensee's program deviated from GIP-2 and the staff's SSER No. 2 on SQUG/GIP-2 issued in 1992.

The staff concludes that the licensee's USI A-46 implementation program has, in general, met the purpose and intent of the criteria in GIP-2 and the staff's SSER No. 2 for the resolution of USI A-46. The staff has determined that the licensee's already completed actions will result in safety enhancements, in certain aspects, that are beyond the original licensing basis. As a result, the licensee's actions provide sufficient basis to close the USI A-46 review at the facility. The staff also concludes that the licensee's implementation program to resolve USI A-46 at the facility has adequately addressed the purpose of the 10 CFR 50.54(f) request. The licensee's activities related to the USI A-46 implementation may be subject to NRC inspection.

Regarding future use of GIP-2 in licensing activities, the licensee may revise its licensing basis in accordance with the guidance in Section 1.2.3 of the staff's SSER No. 2 on SQUG/GIP-2, and the staff's letter to SQUG's Chairman, Mr. Neil Smith on June 19, 1998. Where plants have specific commitments in the licensing basis with respect to seismic qualification, these commitments should be carefully considered. The overall cumulative effect of the incorporation of the GIP-2 methodology, considered as a whole, should be assessed in making a determination under 10 CFR 50.59. An overall conclusion that no unreviewed safety question (USQ) is involved is acceptable so long as any changes in specific commitments in the

licensing basis have been thoroughly evaluated in reaching the overall conclusion. If the overall cumulative assessment leads a licensee to conclude a USQ is involved, incorporation of the GIP-2 methodology into the licensing basis would require the licensee to seek an amendment under the provisions of 10 CFR 50.90.

5.0 REFERENCES

1. Letter, dated May 3, 1990, from P. Davis of the PRD Consulting Company to USNRC, "Hatch SMA Peer Review Group Final Report: Evaluation of the Application of the NRC and EPRI Seismic Margins Methodologies."

2. Letter, dated April 16, 1991, from USNRC to W. Hairston of the Alabama Power Company, "Seismic Design Issues - Edwin I. Hatch Nuclear Plant, Units 1 and 2."

3. "Seismic Margin Assessment of Edwin I. Hatch Nuclear Plant, Unit 1," EPRI NR-7217-SL, EPRI, Palo Alto, CA, June 1991.

4. Letter, dated July 5, 1991, from M. Bohn of the Sandia National Laboratories to USNRC, "Independent Evaluation of the Hatch Seismic Margin Assessment - Seismic Building Response and Floor Spectra."

5. Letter dated May 30, 1995 from J. T. Beckham, Jr. to NRC "USI A-46 Summary Report Edwin I. Hatch Nuclear Plant Units 1 and 2" in response to Supplement 1 to GL 87-02.

6. Letter, dated August 23, 1996, from J. Beckham of the Georgia Power Company to USNRC, "Edwin I. Hatch Nuclear Plant: Response to Request for Additional Information: Unresolved Safety Issue A-46."

7. Letter, dated February 6, 1998, from H. Sumner of the Southern Nuclear Operating Company to USNRC, "Edwin I. Hatch Nuclear Plant: Response to Request for Additional Information: Unresolved Safety Issue A-46."

8. Letter, dated July 23, 1998, from D. McCombs of the Southern Nuclear Operating Company to USNRC, "USI A-46 Information Request."

9. NEDO-24372, "Minimum Systems Required for Safe Shutdown During a Fire in Edwin I. Hatch Nuclear Plant Units 1 and 2," dated October 1981.

10. Letter from J. T. Beckham, Jr., to NRC "Response to Supplement 1 to Generic Letter 87-02 on SQUG Resolution of USI A-46," dated September 16, 1992.

11. Letter from NRC to W. G. Hairston, III "Evaluation of Plant Hatch Units 1 and 2, 120-day response to Supplement No. 1 to GL 87-02," dated November 20, 1992.

12. Letter from K. N. Jabbour, NRC to J. T. Beckham, Jr. "Request for Additional Information Regarding the Resolution of Unresolved Safety Issue A-46- Edwin I. Hatch Nuclear Plant" dated June 27, 1996.

13. Letter from K. N. Jabbour, NRC to J. T. Woodard "Supplemental Request for Additional Information on the Resolution of USI A-46" dated January 30, 1997.

14. Letter from H. L. Sumner, Jr. to NRC "Response to Supplemental Request for Additional Information on the Resolution of USI A-46" dated April 25, 1997.

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