November 8, 2000

Mr. A. Alan Blind
Vice President, Nuclear Power
Consolidated Edison Company
of New York, Inc.
Broadway and Bleakley Avenue
Buchanan, NY 10511

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NO. 2 - PLANT-SPECIFIC SAFETY EVALUATION REPORT FOR UNRESOLVED SAFETY ISSUE A-46 PROGRAM IMPLEMENTATION (TAC NO. M69453)

Dear Mr. Blind:

The staff of the U.S. Nuclear Regulatory Commission (NRC) has completed its review of Consolidated Edison Company of New York, Inc.'s (ConEd's), program to resolve Unreviewed Safety Issue (USI) A-46, "Seismic Qualification of Equipment in Operating Plants," for the Indian Point Nuclear Generating Unit No. 2 (IP2). ConEd's program was provided in a submittal dated December 31, 1996, as supplemented on September 3, and December 13, 1999.

ConEd's USI A-46 Program at IP2 was established in response to Generic Letter 87-02 through a 10 CFR 50.54(f) letter (Title 10 of the *Code of Federal Regulations*, Part 50). The NRC staff has determined that the licensee's corrective actions and proposed physical modifications for resolution of outliers provide sufficient basis to close the USI A-46 review for 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. Licensee activities related to USI A-46 implementation are subject to NRC inspection.

The staff's findings and conclusions are provided in the enclosed safety evaluation. This completes the staff's effort on this issue.

Sincerely,

/RA/

Patrick D. Milano, Senior Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-247

Enclosure: Safety Evaluation

cc w/encl: See next page

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ConEd's USI A-46 Program at IP2 was established in response to Generic Letter 87-02 through a 10 CFR 50.54(f) letter (Title 10 of the *Code of Federal Regulations*, Part 50). The NRC staff has determined that the licensee's corrective actions and proposed physical modifications for resolution of outliers provide sufficient basis to close the USI A-46 review for 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. Licensee activities related to USI A-46 implementation are subject to NRC inspection.

The staff's findings and conclusions are provided in the enclosed safety evaluation. This completes the staffs effort on this issue.

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Docket No. 50-247
Enclosure: Safety Evaluation
cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

USI A-46 PROGRAM IMPLEMENTATION

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 2

DOCKET NO. 50-247

1.0 BACKGROUND

On February 19, 1987, the U.S. Nuclear Regulatory Commission (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." The GL encouraged 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 (GIP-2) (Reference 1).

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) (Reference 2), pursuant to the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) (10 CFR 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.

By letter dated September 21, 1992 (Reference 3) Consolidated Edison Company of New York, Inc. (ConEd), the licensee for Indian Point Nuclear Generating Unit No. 2 (IP2) responded to Supplement 1 of GL 87-02. Its response included a commitment to implement GIP-2 and provided a description of the procedures used to develop IRS to be used for USI A-46 and the implementation schedule for the USI A-46 Program. The staff's evaluation of ConEd's response was issued in a letter dated November 19, 1992 (Reference 4). The staff found the ConEd commitment to implement GIP-2 to be acceptable with the condition that, in addition to using the SQUG guidance for implementing GIP-2, the licensee should refer to the staff's position on the SQUG guidance, which was provided in a staff response to the SQUG dated October 2, 1992 (Reference 5).

ConEd conducted the USI A-46 Program and submitted a summary report (Reference 6) on December 31, 1996. The staff reviewed the summary report and requested additional information (RAI) in a letter dated April 15, 1999 (Reference 7). ConEd responded to the staff's

RAI on September 3, 1999 (Reference 8). ConEd provided additional information regarding the use of GIP-2 Method A.1 on December 13, 1999 (Reference 9).

2.0 DISCUSSION AND EVALUATION

The summary report (Reference 6) provides the licensee's implementation results for the USI A-46 Program at IP2. The report identifies a safe shutdown equipment list (SSEL) and contains a summary of the seismic screening verification and walkdowns of mechanical and electrical equipment and the relay evaluation. The report also contains the evaluation of the seismic adequacy of tanks and heat exchangers, the seismic adequacy of cable and conduit raceways, and outlier identification and resolutions. By a letter dated March 31, 2000 (Reference 10), the licensee stated that the resolution of all the outliers is to be completed by the end of the 2000 refueling outage (RFO).

2.1 Seismic Demand Determination

The design-basis safe shutdown earthquake (SSE) ground response spectra (GRS) for IP2 are Housner response spectra with a peak ground acceleration of 0.15g for the horizontal components and 0.10g for the vertical component. The structures are founded on competent rock. For the design of the plant, the structures were considered to be fixed at the base and the design ground motions were input at their foundation levels. The IRS were developed by the dynamic analyses of multi-degree of freedom elastic models subjected to seismic motions represented by time histories with response spectra that envelope the SSE GRS.

In a letter dated September 21, 1992 (Reference 3), ConEd provided a description of the spectra proposed for use in the USI A-46 Program for IP2 and the methods used to develop them. The proposed spectra are the plant design-basis ground motions and the associated amplified IRS. The NRC staff reviewed this information and, in a letter dated November 19, 1992 (Reference 4), informed the licensee that the IRS were acceptable for the purpose of verifying the adequacy of equipment in the resolution of USI A-46.

2.2 Seismic Evaluation Personnel

As described in Section 4.2 of the summary report (Reference 6) the organization for the resolution of USI A-46 at IP2 consisted of three groups of personnel: the USI A-46 documentation team, the seismic review team (SRT), and the outlier resolution team. The documentation team was responsible for gathering existing documentation, documenting the seismic demand for all areas of the plant, performing the A-46 screening verification and walkdowns of mechanical and electrical equipment and documenting the results of the walkdowns on the screening evaluation worksheets (SEWS). The SRT performed the third party audit as described in Section I.2.2.7 of GIP-2. The outlier resolution team provides direction on the resolution of outliers.

The teams were comprised of ConEd employees and engineering consultants from EQE International and ANCO Engineers, Inc. (ANCO). The seismic walkdowns were managed by EQE International project management personnel and performed by teams of seismic capability engineers (SCEs). Seismic walkdowns were performed by two separate walkdown teams each comprised of two SCEs. Section 4.2.2 of the summary report states that all SCEs are degreed

engineers with at least 5 years experience in earthquake engineering and have completed the SQUG training course on seismic adequacy verification of nuclear power plant equipment. The SRT was comprised of Peter L. Yanev of EQE International, Sri K. Sinha of ConEd and Paul Ibanez of ANCO. The resumes of all SCEs and the SRT team members are provided in Appendix C to the summary report (Reference 6).

ConEd's seismic evaluation personnel qualifications meet the provisions of GIP-2 and the NRC staff's SSER-2, and are considered acceptable for use in the resolution of USI A-46 at IP2.

2.3 Safe Shutdown Path

GL 87-02 specifies that the licensee should be able to bring the plant to, and maintain the plant in a hot shutdown condition during the first 72 hours following an SSE. To meet this provision, in its submittal of December 31, 1996 (Reference 6), the licensee addressed the following plant safety functions: reactor reactivity control, pressure control, inventory control, and decay heat removal. Primary and alternate safe shutdown success paths, with associated 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 L of the summary report (Reference 6) contains the SSEL.

The reactor decay heat removal function would be accomplished in two stages by secondary heat removal. The first stage of secondary heat removal would be accomplished by relieving steam from the steam generators (SGs) to the atmosphere through the atmospheric relief valves, which are automatically controlled by the SG pressure control system. In the event of a failure of atmospheric relief valves, steam would be discharged to the atmosphere through the code safety valves which have staggered set points. Makeup water to the SGs would be supplied by the auxiliary feed water system which takes suction from the condensate storage tank (CST). The CST would provide inventory for up to 42 hours to make up water supply to the SGs at hot shutdown conditions. Another non-seismic water source which can be used for makeup water to the SGs is the city water storage tank. The second stage of secondary heat removal would be accomplished by the operation of the residual heat removal (RHR) system when the reactor coolant system pressure and temperature are below the RHR entry limits. In this method, decay heat is removed from the reactor coolant to the component cooling water (CCW) system via the RHR heat exchangers. The heat from the CCW is then rejected to the service water system via the CCW heat exchangers.

The plant operations department reviewed the equipment listed in the SSEL against the plant operating procedures and operator training and concluded that the procedures and training were adequate to establish and maintain the plant in a safe shutdown condition following an SSE.

The staff concludes that the approach to achieve and maintain a safe shutdown for 72 hours following a seismic event is acceptable for resolution of USI A-46 at IP2 since it meets the provisions of GIP-2.

2.4 Seismic Screening Verification and Walkdown of Mechanical and Electrical Equipment

The licensee's evaluation of the seismic adequacy of mechanical and electrical equipment on the IP2 SSEL was performed in accordance with Section II.4 of GIP-2. The equipment screening verification and walkdowns involved the review of 1,006 equipment items in the 20 defined classes of equipment (e.g., Motor Control Centers, Low Voltage Switchgear, etc.) and the "other" equipment class and resulted in 107 components being designated as outliers. The licensee further analyzed a total of 55 cases of these outliers and resolved them as being acceptable without modifications. The licensee performed the majority of the plant walkdowns during the 1993 RFO, from February to April 1993. The licensee documented the results of the walkdowns on the SEWS and summarized them on the seismic verification data sheets (SVDS) provided as Appendix B of the summary report (Reference 6). This is acceptable for the resolution of USI A-46 at IP2 since it meets the provisions of GIP-2.

2.4.1 Equipment Seismic Capacity Compared to Seismic Demand

GIP-2 provides five methods for comparing equipment seismic capacity to the seismic demand. Method A.1 compares the SQUG bounding spectrum to the SSE GRS. Method A.2 compares the generic equipment ruggedness spectrum (GERS) to 1.5^2 (2.25) times the GRS. Method B.1 compares 1.5 times the bounding spectrum (reference spectrum) to the conservative design IRS or to the realistic median-centered IRS. Method B.2 compares the GERS to the conservative design SSE IRS. Method B.3 compares the GERS to 1.5 times the median center IRS. Also, the seismic design of equipment may be compared to the seismic demand as represented by the IRS.

The criteria and limitations for use of Method A.1 are that the equipment should be mounted below about 40-feet above the effective plant grade, the equipment's natural frequency should be greater than 8 Hz, and the amplification factor between free-field GRS and the IRS will not be more than about 1.5. Method B may be used for equipment at any elevation and for equipment with any natural frequency.

IP2 SSEL components are housed primarily in or adjacent to the following structures for which ConEd developed IRS:

- Containment Structure
- Inner Containment Structure
- Control Building
- Fan House
- Intake Structure
- Primary Auxiliary Building
- Shield Wall

The licensee stated in Section 4.1.2 of the summary report (Reference 6) that the seismic input motion for each item of equipment was based on its supporting floor elevation and that seismic capacity was compared with the seismic demand using the methods described in Table 4-1 of GIP-2. Little additional information regarding the comparison of seismic capacity to demand was provided in the summary report (Reference 6). In its response (Reference 8) to RAI Question 1 (Reference 7), ConEd provided a description of the specific methods used to

compare seismic capacity to demand and included a revised SVDS listing, SEWS for selected components, and pertinent references. ConEd stated that it used GIP-2 Method B.1 to compare the seismic capacity to the seismic demand for all components with the following exceptions: (1) Method A.1 was used for 58 SSEL equipment items located at elevation 98 feet in the Primary Auxiliary Building (AB), and (2) reports from shake table tests were used to establish the capacity for two items located at elevation 89 feet in the Fan House. A review of the revised SVDS showed it to be consistent with the response statements with one exception. The exception is that design documentation was also used to establish capacity for one motor control center located at elevation 98 feet in the Primary AB.

ConEd calculation 42100-C-001, provided in Attachment C to the RAI response (Reference 8), demonstrated that the seismic capacity exceeds the seismic demand for all elevations where GIP-2 Method B.1 was used. In the response to the RAI, ConEd also stated that of the 58 equipment items evaluated with Method A.1, 34 were of classes 0, 7, 8, and 21, where natural frequency criteria are not applicable and the remaining 24 items conformed to the GIP-2 guidelines of 8 Hz for the fundamental frequency.

The NRC staff review of the IRS provided in ConEd's September 21, 1992, submittal (Reference 3), indicated that, for locations where the licensee used GIP-2 Method A.1, the limitation that the amplification factor between the free-field GRS and the IRS will not be more than about 1.5 is not met. In RAI Question 2 (Reference 7), the licensee was requested to justify its application of Method A.1. In its response (Reference 8), ConEd stated that in its interpretation of GIP-2 the statement regarding amplification is a statement of expectation not a restriction. Specifically, the realistic amplification factor of the GRS to be expected within 40 feet of grade in reinforced concrete frame and shear wall structures and heavily braced steel frame structures is 1.5. Since the Primary AB conforms to these structural types and does not have any unusual structural features, ConEd concluded the use of Method A.1 was appropriate. ConEd further stated that the licensing basis IRS for Primary AB elevation 98 feet shows a maximum amplification of 6.3 in the frequency range above 8 Hz. The licensee concluded that this high amplification was unrealistic and due to the conservatisms inherent in the calculation of the IRS, and provided a discussion of these conservatisms in Attachment D to its response (Reference 8). The staff considered these arguments to be too general to address the specific issue for IP2. The licensee provided additional information regarding the use of Method A.1 in a letter dated December 13, 1999 (Reference 9).

The licensee stated that the high amplification factor between the free field GRS and the primary AB IRS for elevation 98 feet is due to conservatism in the analysis of the structure. The licensee stated that the fundamental frequencies of the building response are 13.58 and 13.88 Hz in the east-west and north-south directions, respectively. The east-west and north-south 5 percent of critical damping IRS for Primary AB elevation 98 feet have peak spectral accelerations of 0.85g and 0.95g, respectively. Reference 11 describes how the IRS were calculated, smoothed, and broadened using standard industry techniques and criteria for design IRS generation including time history analysis.

The licensee also provided the 5 percent of critical damping response spectrum of the horizontal component of the free-field time history used in the IRS generation. The spectral acceleration is 0.215g at 13.58 Hz and 0.22g at 13.88 Hz. The amplification factors of the IRS at Primary AB elevation to the actual input ground motion are about 4 for the east-west

component and 4.3 for the north-south component. The licensee stated in Reference 9 that the 1.5 amplification factor referred to in GIP-2 as a limitation on the use of Method A.1 is meant to be the ratio of realistic median-centered IRS to the GRS and that realistic median-centered IRS are not available for IP2. ConEd states it is possible to estimate what realistic median-centered IRS would be using the procedure that was applied to reinforced concrete shear wall structures at the R.E Ginna Nuclear Power Plant as discussed in Reference 12.

Reference 11 presented information developed by the SQUG comparing overall margins between median-centered analysis and design-basis analysis for five reinforced concrete shear wall structures at four nuclear power plants. The ratios of the conservative design spectra to median-centered spectra presented in Reference 11 were 2.53, 5.3, 3.3, 2.3 and 5.4. In Reference 12, the NRC staff considered the wide range of ratios to be due to the different methods and levels of conservatism used in the analyses of the structures rather than differences between structural configurations. The staff then used the mean value of the ratios, 3.77, to estimate the amplification factor for the R. E. Ginna structures. The licensee states that the IP2 Primary AB is also a reinforced concrete shear wall structure so the information in Reference 11 and the discussion in Reference 12 are applicable to the IP2 Primary AB.

Dividing the peak spectral accelerations of the design IRS for elevation 98 feet of the Primary AB by the mean value of the ratios from Reference 12 (i.e., 3.77), results in estimated realistic median-centered peak spectral accelerations of 0.23g and 0.25g for the east-west and north-south directions, respectively. The ratios of these values to the corresponding spectral accelerations of the input free field time history (0.215g and 0.22g) are 1.07 and 1.14, respectively. This indicates that if realistic median-centered IRS were developed for elevation 98 feet of the Primary AB, the amplification would be about 1.5, thus justifying use of Method A.1 at this location for the resolution of USI A-46 at IP2.

The licensee stated that elevation 98 feet in the Primary AB is the only location in the IP2 plant where GIP-2 Method A.1 was used for comparing seismic capacity to seismic demand in the implementation of the USI A-46 Program.

The licensee provided plots of the 5 percent of critical damping Housner design GRS and the 5 percent of critical damping response spectrum of the time history actually used to generate the Primary AB IRS. The response spectrum of the time history envelopes the Housner design GRS. Therefore, it is appropriate to use the response spectrum of the time history to determine the amplification factor as was done to demonstrate the conservatism in the design IRS.

Regarding the evaluation of component cooling surge tank 0021CCST, the licensee stated that the calculation is an analysis of the component anchorage and the platform structure to which it is anchored. GIP-2, Section 7.4.2, Step 10, page 7-57, indicates that determination of the seismic demand was done in accordance with GIP-2, Section 4.4.3. Step 1 of Section 4.4.3 requires use of an appropriate IRS. GIP-2, Table 4-3 lists the three different types of IRS which may be used, along with the factors of conservatism by which they must be multiplied. The first type of IRS listed in the table is 1.5 times the SSE horizontal GRS.

The statement in the calculation for 0021CCST derives from the paragraph preceding GIP-2, Table 4-3. The licensee stated that the tank in question met the requirements given in Table 4-3; namely, it was located less than 40 feet above grade and its frequency was greater

than 8 Hz. For horizontal tanks and heat exchangers, the low frequency slosh mode is not significant (as opposed to large flat-bottomed vertical tanks) and is not included in the evaluation procedure of GIP-2, Section 7.4.2. This method was used only at elevation 98 feet of the Primary AB, and only for equipment which met the requirements given in GIP-2, Table 4-3. The licensee demonstrated, as noted above, that if realistic median-centered IRS were developed for elevation 98 feet in the Primary AB, the amplification would be about 1.5, justifying use of Method A.1 at this location. Therefore, the use of 1.5 times the SSE horizontal GRS is acceptable for the analysis of this component anchorage and the platform structure to which it is anchored for the resolution of USI A-46 at IP2.

The procedures used by ConEd to define seismic capacities and demands and to assure that seismic capacities are greater than their demands are considered to be consistent with the provisions of GIP-2, and, therefore, adequate for the resolution of USI A-46 at IP2.

2.4.2 Assessment of Equipment Caveats

In order to apply the experience-based approach and use the equipment seismic capacity defined in GIP-2, the plant-specific equipment must meet some restrictions or caveats described in GIP-2. Caveats are the inclusion and exclusion rules, which represent specific characteristics and features particularly important for seismic adequacy of a specific class of equipment when the equipment seismic capacity is determined based on the experience-based data. The use of “meeting the intent of the caveats” is typically intended to demonstrate seismic adequacy of equipment that did not meet the specific wording in certain caveats, but is deemed seismically adequate based on the judgment of the SCE.

ConEd screened equipment caveats to confirm that the equipment characteristics are similar to the earthquake experience class so that the seismic adequacy of an item of mechanical or electrical equipment could be assessed. The licensee documented the walkdown caveat checks on the SEWS and summarized the results in column 12 of the revised SVDS in Attachment A to the ConEd response (Reference 8) to the RAI.

ConEd included a listing of all equipment class-specific caveats on the SEWS for each class of equipment. The SCEs were required to consider all the caveats for each item reviewed, indicating whether the item met the caveat, did not meet the caveat, or met the intent of the caveat. In the latter case the SCEs listed directly on the SEWS the basis for their judgment. Staff review of the SEWS, provided in the licensee response (Reference 8) to the RAI, found that the caveat checks were made and appropriate explanations provided where the intent option was used for compliance. The licensee classified equipment items that did not meet the caveats or the intent of the caveats as outliers.

ConEd made the judgment that the intent of the caveats are met without meeting the specific wording of the caveat for 156 items of equipment. The licensee found that 59 equipment items did not satisfy caveats and were identified as caveat outliers. The 59 caveat-outlier determinations were based on several considerations including equipment dimensions outside GIP-2 guidelines, pipe and valves being independently supported and anchorage components missing or being questionable. The methods ConEd used to resolve these outliers included performing detailed calculations to demonstrate seismic capacity, improving seismic capacity by the implementation of equipment/anchorage modifications and the replacement of missing

components. ConEd resolved, or will resolve with pending modification work, all equipment caveat outliers by the end of the 2000 RFO.

ConEd's approach for identifying and assessing equipment caveats is reasonable and consistent with the GIP-2 provisions and is acceptable for the resolution of USI A-46 at IP2.

2.4.3 Equipment Anchorage

GIP-2 specifies the following four steps in regard to equipment anchorage verification: (1) anchorage installation inspection, (2) anchorage capacity determination, (3) seismic demand determination, and (4) comparison between capacity and demand.

ConEd assessed the seismic adequacy of equipment anchorage during the walkdowns and documented the results of the evaluations on the SEWS forms and summarized the results in column 13 of the revised SVDS in Attachment A to the ConEd response (Reference 8) to the RAI.

ConEd stated that the majority of the enclosures for electrical and mechanical equipment are anchored at their base using either welds to embedded steel, bolts in the interior of the cabinet, or a combination of welds and bolted structural angle. As anchor bolt tightness tests were not always conducted at the time of the initial walkdown, where they were required, the licensees classified components as outliers for tracking purposes. ConEd later performed the tightness tests in accordance with EQE Engineering Procedure 42100-P-001, "Procedure for USI A-46 Anchor Bolt Tightness Check."

In its response (Reference 8) to RAI Question 3 (Reference 7), ConEd provided the following additional information regarding the assessment of equipment anchorage, and a sample of SEWS to illustrate the evaluation of representative anchorage types. IP2 SSEL equipment anchorage includes concrete expansion anchors, cast-in-place headed bolts and j-bolts, and welds to embedded steel. The capacity reduction factors from Appendix C of GIP-2 were used to account for the effects of concrete strength, minimum spacing and edge distance. A reduction factor of 0.6 was used if the type of concrete expansion anchor could not be determined. A modification factor of 1.25 was applied to the IRS for computing anchorage demand.

The staff reviewed the anchorage calculations in the sample of SEWS provided by ConEd. The sample included an instrument rack anchored with an unknown type of 3/4-inch concrete expansion bolts, a heat exchanger anchored with 3/4-inch cast-in-place j-bolts and a motor control center anchored with fillet welds to an embedded plate. The SEWS anchorage checklists were all completed with sketches and explanations provided as necessary. The calculations were hand calculations using accepted design formulae and strength and reduction factors from appropriate sections of GIP-2. For the horizontal heat exchanger the licensee used the procedure of Section II.7.4.2 of GIP-2. The calculations are considered appropriate and complete.

The licensee declared any anchorage that it determined to be deficient or not covered in GIP-2 guidelines to be an outlier. The licensee identified 44 equipment items, including nine tanks and heat exchangers, to be anchorage outliers. Outliers were identified for components not

properly restrained, missing fasteners, improper and inadequate installation, inadequate anchorage, and bolts requiring tightness testing. The methods the licensee used to resolve the outliers included strengthening the anchorage or load path, installing new hardware, replacing deficient and missing components, performing anchor bolt tightness testing and modifying the anchorage. All anchorage outliers have been resolved or will be resolved with pending modification work by the end of the 2000 RFO.

ConEd's methods to evaluate equipment anchorage are consistent with the GIP-2 provisions and are considered acceptable for the resolution of USI A-46 at IP2.

2.4.4 Seismic Spatial Interaction Evaluation

The seismic interaction evaluation is another screening criterion which must be satisfied to verify the seismic adequacy of SSEL equipment. ConEd assessed the possibility of seismic interactions during the screening walkdowns. The licensee documented the interaction evaluation findings on the SEWS forms and in column 14 of the revised SVDS in Attachment A of ConEd's response (Reference 8) to the RAI. In Section 4.3.1 of the summary report (Reference 6), ConEd stated that it evaluated the possibility of seismic interactions during the field walkdowns. The effects the licensee evaluated included interaction with items in proximity with the inspected item, the possibility of structural failure or falling and the flexibility of attached lines and cables. ConEd identified conditions that could adversely affect SSEL equipment items based on the SQUG training course examples from actual strong motion earthquakes, and based on the experience and judgment of the SCE. Potential seismic interaction concerns were identified and evaluated in accordance with the guidance provided in GIP-2.

In its response (Reference 8) to RAI Question 6 (Reference 7), ConEd provided the following description of its approach to address SSEL equipment located in proximity to masonry walls, and attached a sample of SEWS to illustrate the approach. The licensee addressed the proximity of SSEL equipment items to masonry walls in accordance with the guidelines provided in Appendix D of GIP-2. Specifically, the licensee reviewed walls; that it found in proximity to SSEL equipment with the documentation of safety-related walls previously evaluated in response to IE Bulletin (IEB) 80-11. The licensee considered walls which had been evaluated under the IEB 80-11 Program to pose no wall collapse interaction concern. The licensee evaluated masonry walls not evaluated under the IEB 80-11 Program for seismic adequacy based on drawing details and masonry work specifications.

In its response to RAI Question 6 (Reference 7) ConEd also discussed the seismic capacity of the turbine building with respect to its posing an interaction concern with safety-related structures, systems and components. ConEd stated that the turbine building is designed to remain intact under the SSE. The seismic analysis of the structure is contained in the IP2 Updated Final Safety Analysis Report, Section 1.11.6.1. With the demonstrated seismic integrity, the turbine building does not pose a potential seismic interaction hazard.

The licensee identified a total of 14 seismic interaction outliers during the walkdowns. Outliers were the result of loose or broken parts, unrestrained extraneous objects and improperly restrained hoist chains. The licensee has or will resolve all seismic interaction outliers by the end of the 2000 RFO.

The evaluations of spatial seismic interactions performed by ConEd are consistent with the provisions of GIP-2 and are considered acceptable for the resolution of USI A-46 at IP2.

2.5 Tanks and Heat Exchangers

ConEd evaluated a total of 51 items of equipment that were classified as part of the tank and heat exchanger class. The licensee documented the results of these evaluations on the SEWS forms and summarized the results on the revised SVDS in Attachment A to the ConEd response (Reference 8) to the RAI and Section 4.3.2 of the summary report (Reference 6).

ConEd stated in Section 4.3.2 of the summary report that it walked down and screened the tanks and heat exchangers on the IP2 SSEL for features vulnerable to seismic loading in accordance with Section II.7 of GIP-2. This included verification of the load path and the seismic adequacy of the anchorage. The equipment class consisted of horizontal and vertical, buried, freestanding and suspended tanks and heat exchangers, and included three large flat-bottom vertical tanks and eight vertical tanks on legs. Supports included legs, steel-base skirts, frames/racks, and saddles.

Appendix B to the summary report (Reference 6) indicated that the seismic capacity of many fluid containing tanks had been resolved using Method A.1 of GIP-2. RAI Question 5 (Reference 7) requested the licensee to explain its approach for fluid-filled tanks and to provide SEWS to substantiate the conclusions reached. In its response (Reference 8), ConEd stated that 16 fluid containing tanks were evaluated for the features which can be vulnerable to seismic loadings, as described in Section II.7 of GIP-2. In the revised SVDS the capacity-vs.-demand column entry for all tanks and heat exchangers is “N/A,” indicating the capacity was determined by methods other than those defined in Table 4-1 in GIP-2, i.e., Method A.1 was not used. For the three large flat-bottomed vertical tanks the analytical steps of Section II.7.3 of GIP-2 were followed. The licensee found the three buried and six small rigid tanks to be adequate based on the small tank size and light weight in comparison to the anchorage strength. The licensee checked two of the remaining four tanks by analysis and two were judged acceptable based on engineering judgment. ConEd provided SEWS, showing examples of the evaluations, for a sample of the tanks.

The licensee’s analyses for the two flat-bottomed vertical tanks, 0021RWST and 0021PWST, followed the GIP-2, Section II.7.3, analytical method and the tanks were determined to have adequate seismic capacity. For the Volume Control Tank 0021VCT, a vertical tank on legs, hand calculations were used with a ConEd document referenced as the basis for the allowables for the cast-in-place J-bolts. The licensee found the tank anchorage to be inadequate and the tank was identified as an outlier.

Component cooling surge tank 0021CCST is a horizontal tank supported on four legs, which are in turn supported on a frame structure. For this tank detailed evaluations were made using the Super Sap finite element code and American Institute of Steel Construction methods to assess members and fasteners. To define the demand, an acceleration of 1.5 x GRS amplified by 1.25 was used. This definition of demand is consistent with GIP-2, where the 1.5 factor represents the amplification factor between the GRS and the floor response spectra for elevations within 40 feet of grade, and the 1.25 factor accounts for uncertainties in median centered spectra.

As discussed in Section 2.4.1 of this evaluation, ConEd provided an acceptable basis for the definition of demand used for the evaluation of component cooling surge tank 0021CCST.

Nine tank and heat exchanger components were identified as outliers. The outliers were the result of missing anchor bolts and nuts, inadequate anchorage installation, inadequate anchorage, and the need for bolt tightness testing. All of the outliers have been resolved by correcting installations, performing tightness tests, and completing anchorage modifications.

ConEd's evaluations of tanks and heat exchangers is consistent with the GIP-2 provisions and are considered to be acceptable for the resolution of USI A-46 at IP2.

2.6 Cable and Conduit Raceway Supports

ConEd assessed the seismic adequacy of cable tray and conduit raceways and documented the inspections and evaluations on the Plant Area Summary Sheets (PASS), calculations performed for the Limited Analytical Reviews (LAR), and the revised SVDS in Attachment A to the ConEd response (Reference 8) to the RAI. ConEd provided a description of the review effort in the Executive Summary and Section 4.3.3 of the summary report (Reference 6).

As stated in Section 4.3.3 of the summary report, the licensee reviewed raceways with respect to the GIP-2 inclusion rules to determine whether the as-installed raceway systems are within the envelope of the earthquake experience and shake table data bases, and to screen for other performance concerns. The licensee also reviewed raceways for potential seismic interactions with adjacent equipment and structures. The licensee selected representative worst-case samples of supports and LAR were performed for those supports. ConEd conducted raceway walkdowns in all areas of the plant containing cable and conduit raceways which carry wiring for SSEL items. The results of the walkdowns are documented on PASS similar to Exhibit 8-1 in GIP-2. They completed separate PASSs for each room or area where evaluations were conducted.

ConEd stated that cable tray and conduit spans are generally 8 feet or less; the trays are tied to their supports with standard friction type hardware; cast iron inserts were not used and rigid boot connection details were not observed in any plant areas. Anchorage types included welded connections to structural steel, embedded unistrut members, and unistrut members attached with expansion anchors to the floor, wall or ceiling.

The majority of the cable tray and conduit supports were members manufactured by the Kindorf Corporation. ConEd classified these as a generic outlier in accordance with GIP-2, because the Kindorf strut nuts lack the required serrations on the edge of the channel nut in contact with the members. They resolved this outlier by performing a dynamic shake table test to qualitatively determine realistic dynamic and pullout load capacities.

In its response (Reference 8) to RAI Question 7 (Reference 7), ConEd provided a description of the shake table tests and the final report for the test program. The tests were performed at the ANCO facility in Culver City, CA, and included static pull tests to determine the ultimate load capacity of the Kindorf strut nuts and dynamic tests to verify that the strut would not "walk" out of the connections, or lose capacity, under cyclic loading. ANCO conducted the dynamic tests on a full-scale tray system mock-up representative of the most heavily loaded IP2 raceway tray

system. It consisted of a four-tier trapeze system of 4-inch by 24-inch ladder type trays with single strut supports suspended on ungusseted angle connections. They shook the mock-up at progressively greater loads culminating in a 30-second duration test with excitation in both the horizontal and vertical directions with accelerations consistent with a response spectrum that had a peak spectral acceleration of 3.0g and a zero period acceleration of 1.0g. The mock-up was stated to have survived the dynamic tests which developed peak connection loads comparable to the loads achieved in the static pull tests. Using the static pull test results, with a safety factor of 2, ConEd developed realistic capacities of the non-serrated strut nuts and used them for the three times dead load and lateral load capacity checks in the LAR.

ConEd selected three supports for analytical review as a result of the plant walkdowns. These supports were judged by ConEd to be representative bounding samples of the support configurations in the plant which were not represented by the shake table test configuration. In its response (Reference 8) to RAI Question 8 (Reference 7), ConEd provided the three LAR, samples of the PASS, and a discussion of the basis for the selection of the LAR. By design, the shake table test configuration enveloped the majority of the raceway systems in the plant and served as the basis for their acceptance. All other configurations were enveloped by the three LAR configurations which served as the basis for their acceptance. The NRC staff's review of the LAR showed them to be comprehensive and consistent with the GIP-2 guidelines. LAR 1 was a unique configuration and was qualified for its true tray fill loadings. LAR 2 and 3 were evaluated for tray loadings consistent with the GIP-2 guidelines. LAR 1 and 2 passed all the analytical checks and were determined to be seismically adequate. LAR 3, representing many supports in the cable spread room, failed the dead load check and was identified as an outlier.

As noted above, ConEd identified two outliers in the assessment of raceway systems at IP2. The first was the generic outlier regarding the non-serrated nuts. This was resolved with the shake table tests performed at ANCO. The second was the dead load deficiency for the LAR 3 configuration. This affects many supports in the cable spread room and its resolution will be completed by the end of the 2000 RFO.

ConEd’s evaluation of cable and conduit raceway supports is consistent with the GIP-2 provisions and is considered acceptable for the resolution of USI A-46 at IP2.

2.7 Essential Relays

ConEd contracted with Atometrics, Inc. (Atometrics), to evaluate essential relays at IP2. Atometrics prepared a list of all relays affecting equipment on the SSEL and completed evaluations for them. The Atometrics review is documented in Appendices G through J to the summary report (Reference 6) with the relay review list presented in Appendix H. The relay walkdown and evaluation results are documented on the relay screening and evaluation forms and summarized on the relay review list.

The licensee stated, in Section 1.4 of the summary report (Reference 6), that the relay review consisted of identifying the relays to be evaluated, evaluating the consequences of relay malfunction on safe shutdown functions, identifying the essential relays, assessing the seismic adequacy of the essential relays, and performing field walkdowns. The licensee performed relay functionality reviews in accordance with Section II.6 of GIP-2. Relays whose contact

chatter could cause an SSEL system or component to be placed in an undesired state were identified as essential relays. All cabinets and panels that contained SSEL relays were opened during the walkdowns and relay types, locations, and mountings spot checked. ConEd selected equipment classes based on the guidance provided in GIP-2 and in the Electric Power Research Institute's (EPRI) Reports NP-7147-SL and NP-7148-SL. It evaluated all of the relay population using the GIP-2 Screening Level 1 GERS for relays, Motor Control Center, and switchgear GERS and test results. The necessary GERS data was obtained from EPRI NP-7147-SL, for relays, or GIP-2 and EPRI NP-5223-SL, for equipment. The staff reviewed examples of the relay screening evaluation forms provided in the ConEd response (Reference 8) to RAI Question 10 (Reference 7) and found them to be complete. The forms provided the bases to conclude that the relays are chatter acceptable or not vulnerable.

In its response (Reference 8) to RAI Questions 14 and 16 (Reference 7), ConEd addressed various concerns regarding “bad actor relays.” ConEd stated that IP2 does not use “bad actor relays” in any control or power supply circuits associated with the SSEL and consequently no local operator actions are required to reposition such relays. With respect to spurious earthquake-induced alarms in “bad actor relays,” ConEd referred to an August 3, 1988, meeting between the staff and SQUG representatives at which it was concluded that: there appear to be no reasonable basis or evidence which would suggest that spurious alarms resulting from earthquakes may lead to abnormal operator responses. ConEd further observed that the NRC staff accepted the relay functionality review procedures, which are summarized in GIP-2, and since ConEd had conformed to those procedures it does not consider it necessary to perform additional reviews of the effects of spurious alarms caused by relays.

A review of the relay review list showed operator action required for six relays. In RAI Question 15 (Reference 7), the licensee was requested to describe which of the operator actions associated with resetting SSEL equipment affected by relay chatter are considered routine and consistent with the skill of the craft, and which, if any, required training or operational aids. ConEd responded (Reference 8) that all the relays listed as requiring operator action are covered by the Station’s current procedures for normal, abnormal or emergency conditions and do not affect the safe shutdown of the plant. ConEd concluded, therefore, that the actions required to reset the relays are consistent with the skill of the operators.

A review of the list of relays/contact evaluations for relays affecting safe shutdown equipment for IP2 indicated that the licensee evaluated 2,700 relays in the A-46 Program for IP2. Of these, ConEd determined that approximately 1,700 are chatter acceptable, not vulnerable or not applicable in the evaluation process. The licensee evaluated the remainder and determined them to 1) be adequate based on relay GERS, equipment GERS or tests, 2) require operator action, or 3) require corrective action. The last category consisted of three relays of one model type. These the licensee identified as relay outliers. The outliers will be resolved by replacing the three units with models verified to be acceptable. The licensee stated that the resolution of all the outliers will be completed by the end of the 2000 RFO.

ConEd’s assessment of essential relays was consistent with the GIP-2 provisions and is considered acceptable for the resolution of USI A-46 at IP2.

2.8 Human Factors Aspect

GIP-2 describes the use of operator action as a means of accomplishing those activities required to achieve safe shutdown. Section 3.2.7, "Operator Action Permitted," states, in part, that timely operator action is permitted as a means of achieving and maintaining a safe shutdown condition provided procedures are available and the operators are trained in their use. Additionally, Section 3.2.6, "Single Equipment Failure," states that manual operator action of equipment, which is normally power operated, is permitted as a backup operation provided that sufficient manpower, time, and procedures are available. Section 3.2.8, "Procedures," states, in part, that procedures should be in place for operating the selected equipment for safe shutdown and operators should be trained in their use. It is not necessary to develop new procedures specifically for compliance with the USI A-46 Program.

In Section 3.7, "Operations Department Review of SSEL," of GIP-2, the SQUG described three methods for accomplishing the operations department reviews of the SSEL with respect to the plant operating procedures. Licensees were to decide which method or combination of methods were to be used for their plant-specific reviews. These methods included a "desk-top" review of applicable normal and emergency operating procedures, use of a simulator to model the expected transient, and performing a limited control room and local in-plant walkdown of actions required by plant procedures.

The NRC staff's review focused on verifying that the licensee had used one or more of 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" and simulator methods by the operations department 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 licensee determined that the systems and equipment selected for seismic review in the USI A-46 Program are those for which normal, abnormal, and emergency operating procedures are available to bring the plant from a normal operating mode to a hot standby condition. The shutdown paths selected were reviewed by the IP2 operations staff which determined that the procedures would provide adequate guidance to the operators in response to a seismic event. The licensee provided assurance that ample time would exist for operators to take the required actions to safely shut down the plant. This had been accomplished during validation of the pertinent plant operating procedures related to the USI A-46 Program review and as a result of a previous validation of the loss of offsite power (LOOP) accident analysis strategy.

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 operations department verified that all actions necessary to safely shut down the plant were included in existing normal, abnormal, and emergency operating procedures. Additionally, two simulator scenarios containing a seismic event and concurrent LOOP were conducted to verify the safe shutdown paths selected.

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 operators' tasks, and the potential for placing an operator in unfamiliar or inhospitable surroundings. The licensee did not identify any such challenges to operator performance. Additionally the licensee evaluated the potential for interference due to local failure of architectural features and adverse spatial interactions in the vicinity of safe shutdown equipment as part of the GIP-2 process. As a result of the review, no control room interaction sources were identified which could impair the operators' ability to mitigate a seismic event.

ConEd's evaluation of human factors is consistent with the GIP-2 provisions and is considered acceptable for the resolution of USI A-46 at IP2.

2.9 Outlier Identification and Resolutions

The licensee indicated on the SVDS in Appendix B to the summary report (Reference 6) that a total of 144 outlier issues affecting 107 mechanical and electrical equipment items were identified in the USI A-46 Program for IP2. Of these, 23 were for class "0" equipment, 4 were for capacity-vs.-demand, 59 were for bounding spectrum caveats, 44 were for anchorage and 14 were for seismic interaction concerns. To these totals must be added two outliers for cable tray and conduit raceways, affecting many components, and three outliers for relays, affecting three relays. As ConEd stated in Section 4.4.3 and Appendix H of the summary report, the unresolved outliers affect one motor control center and cable tray supports in the cable spread room. ConEd presented a description of the equipment and cable raceway outliers and the methods used or proposed to resolve them in Appendix E to the summary report, and a description of the relay outliers and their method of resolution in Appendix H to the summary report.

Based on the staff's review of Appendix E to the summary report (Reference 6), the licensee was requested to clarify some entries in the tabulation of resolutions and to provide greater detail regarding the resolution for some outliers. In its response (Reference 8), ConEd corrected the tabulation entries and provided descriptions of the methods of resolution for motor-control centers MCC-24 and MCC-26AA. For MCC-24, EQE developed a bounding spectrum for shallow panels (less than the GIP-2 minimum of 18 inches) similar to MCC-24 based on experience data from the Sylmar, Coolwater, and Glendale seismic recordings. For MCC-26AA, ConEd provided a summary description of the seismic qualification shake tests which demonstrated the adequacy of the unit. Regarding the outstanding outliers, the proposed method of resolution for MCC-26 is to perform in-situ tests coupled with revised analyses to demonstrate adequacy. For the relay outliers, the deficient relays will be replaced with qualified units. For the cable tray supports, the method of resolution is still pending. The resolution of these outliers will be completed by the end of the 2000 RFO.

The majority of identified outliers have been resolved and the remainder are in the process of being resolved by analysis or corrective actions. As stated, all outliers will be resolved by the end of the 2000 RFO. The methods used and proposed to resolve outliers are considered to be consistent with the GIP-2 methodology and recommendations, and are acceptable. The licensee's actions are considered reasonable for the resolution of USI A-46 at IP2.

3.0 SUMMARY OF MAJOR FINDINGS

The review of ConEd's USI A-46 Program as provided in the summary report (Reference 6) and the responses to RAIs for each area discussed above, did not find any significant or programmatic deviation from GIP-2 regarding the walkdown and the verification of the seismic adequacy of SSEL items at IP2.

4.0 CONCLUSION

ConEd's USI A-46 Program at IP2 was established in response to Supplement 1 to GL 87-02. ConEd conducted the USI A-46 Program in accordance with GIP-2 and the NRC's SSER-2. ConEd identified approximately 149 outlier issues. ConEd's summary report (Reference 6) did not report any instances where the operability of a particular system or component was questionable. In Reference 10, ConEd stated that all outliers will be resolved by the end of the 2000 RFO.

The NRC staff concludes that ConEd's USI A-46 Program has, in general, met the purpose and intent of the criteria in GIP-2 and NRC SSER-2 on GIP-2 for the resolution of USI A-46. The NRC staff has determined that the licensee's corrective actions and completed modifications for resolution of outliers will result in safety enhancements which, in certain aspects, 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 activities related to the USI A-46 Program 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-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. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Power Plant Equipment," Revision 2, Corrected February 14, 1992, Seismic Qualification Utility Group.

2. "Supplemental Safety Evaluation Report No. 2 on Seismic Qualification Utility Group's Generic Implementation Procedure, Revision 2, Corrected February 14, 1992," dated May 22, 1992.

3. Letter, ConEd to NRC, dated September 21, 1992, “Indian Point Nuclear Generating Station, Unit 2, Response to Supplement 1 to GL 87-02 on SQUG Resolution of USI A-46."

4. Letter, NRC to ConEd, dated November 19, 1992, “Evaluation of Indian Point Nuclear Generating Station, Unit 2, 120-Day Response to Supplement 1 to GL 87-02.”

5. Letter, J. Partlow, NRR, to N. Smith, EPRI, dated October 2, 1992, “NRC Response to Seismic Qualification Utility Group (SQUG).”

6. Letter, ConEd to NRC, dated December 31, 1996, “Summary Report for Resolution of USI A-46, Seismic Qualification.”

7. Letter, NRC to ConEd, dated April 15, 1999, “Request for Additional Information.”

8. Letter, ConEd to NRC, dated September 3, 1999, “Response to Request for Additional Information - Resolution of Unresolved Safety Issue A-46 (TAC No. M69453)."

9. Letter, ConEd to NRC, dated December 13, 1999, "Supplemental Information Regarding Resolution of Unresolved Safety Issue A-46, 'Seismic Qualification of Equipment in Operating Plants', (TAC No. M69453)."

10. Letter, ConEd to NRC, dated March 31, 2000, “Outlier Resolution Completion Date Change Regarding USI A-46, Seismic Qualification of Equipment in Operating Plants.”

11. Letter, Rochester Gas and Electric (RG&E) to NRC, dated May 25, 1999, "Additional Information on Use of GIP Method A, R. E. Ginna Nuclear Power Plant, Docket No. 50-244."

12. Letter, NRC to RG&E, dated June 17, 1999, “Plant-Specific Safety Evaluation Report for USI A-46 Program Implementation at the R. E. Ginna Nuclear Power Plant (TAC No. M69449)."

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