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Docket No. 50-245
A01157

Director of Nuclear Reactor Regulation
Attn: Mr. D. M. Crutchfield, Chief
Operating Reactors Branch #5
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

References: (1) D. M. Crutchfield letter to W. G. Counsil dated July 1, 1980 Fowarding SEP Technical Evaluation, Topic VIII-4.
(2) W. G. Counsil letter to D. L. Ziemann dated March 14, 1979.
(3) Industrial Power Systems Handbook, D. Beeman P. 180.

Gentlemen:

Millstone Nuclear Power Station Unit No. 1
SEP Topic VIII-4, Electrical Penetrations

Reference (1) provided the NRC Staff evaluation of Systematic Evaluation Program Topic VIII-4, Electrical Penetrations of Reactor Containment, for Millstone Unit No. 1. Reference (1) concluded that at LOCA temperature, two of the three representative electrical penetrations do not meet current requirements of Regulatory Guide 1.63 and IEEE Std. 317 for any fault current with a failure of the primary protective device. Northeast Nuclear Energy Company (NNECO) has reviewed Reference (1) and has determined that several errors were made in the Reference (1) SEP evaluation. The purpose of this submittal is to identify these discrepancies and to inform the Staff of differences between Millstone Unit No. 1 and the licensing basis used in the SEP Topic VIII-4 assessment.

Paragraph 2 on page 3 of the attachment to Reference (1) states that NNECO submitted the Oyster Creek FDSA Amendment 62 in addition to Reference (2) on typical penetrations. NNECO has no record of docketing the Oyster Creek FDSA Amendment 62 to the Staff. NNECO's only identified previous submittal regarding this SEP topic was Reference (2), which does not mention Oyster Creek or any data pertinent thereto.

It is noted that the NRC's acceptance criteria is predicated upon the results of data contained in Amendment 62 of the Oyster Creek FDSA. The second paragraph on page 3 of the attachment to Reference (1) indicates, "A temperature limit of 352°F (177°C) before seal failure for the three penetrations has been established based on testing done by Oyster Creek Nuclear Station for identical type connectors".

NNECO has reviewed Amendment 62 and determined that although it does mention the 352°F figure, it does not indicate there were seal failures or excessive leakage rates at that temperature.

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Amendment 62 states: "These tests show that the penetration seals perform satisfactorily under these test conditions, exhibiting no leaks." NNECO also has possession of proprietary General Electric data that shows that penetration seals showed no detectable leakage (minimum detectable leakage rate 1 X 10^{-3} cc/sec.) when exposed to 352°F for 30 minutes and followed by twenty-three and a half hours at 309°F.

Reference (1) notes that General Design Criterion 50, Containment Design Basis, of Appendix A of 10 CFR 50 requires that penetrations be designed so that the containment structure can, without exceeding the design leakage rate, accommodate the calculated pressure, temperature, and other environmental conditions resulting from any loss-of-coolant accident (LOCA). There is explicit recognition that some leakage from containment is acceptable. NNECO has concluded that, although not explicitly stated in Reference (1), the NRC Staff concerns center on containment integrity, since the last paragraph of page 2 of the attachment to Reference (1) acknowledges that for backup protective devices, electrical integrity may be lost. On formulating conclusions, NRC Staff made no reference to leak rates before and after a short circuit cleared by either primary or backup protective devices or fusing of a conductor. The Staff also did not address leakage induced by a short circuit vis-a-vis the Technical Specification limitations. Neither was leakage addressed in Amendment 62 of the Oyster Creek FDSA, which in part forms the basis of the NRC Staff acceptance criteria.

In Reference (1), the Staff did not precisely identify the failure mechanism. Clarification is required as to whether the circuit conductors, the conductor insulation, or the epoxy sealing material around the conductors is the problem area alleged in Reference (1). The use of a formula intended to provide protection for cable insulation as an acceptance criterion in penetration protection implies that breakdown of conductor insulation is the item of concern. Similarly, if the circuit protective devices are as inadequate as the Staff has determined, then it appears that the primary concern is fusing of the conductor itself over a portion of the penetration assembly.

Another aspect which requires clarification is the method by which the penetrations were tested. Early tests on penetrations consisted of pressurizing the canister and monitoring leakage. In such a test, a single seal failure will indicate leakage. However, the Millstone Unit No. 1 penetrations utilize double aperture seals and thus leakage from the drywell to the secondary containment will occur only if two sets of seals fail.

Short circuit currents, conductor cross sections, and the circuit protective devices interrupting time need to be coordinated to avoid severe permanent damage to cable insulation during an interval of short circuit current flow. In this respect NNECO concurs that Formula 1 of Reference (1) can be used to calculate the time frame that primary and backup protective devices must function within to protect cables, including those within a penetration assembly, for a given value of fault current and a given conductor size. This same formula was utilized by NNECO in Reference (2). NNECO questions the validity of using Formula 1 of Reference (1), which is intended to provide protection for electrical cables, to predict breaches in the containment boundary.

The use of Formula 1 in Reference (1) requires the selection of two temperatures as inputs for the calculation. The first is the initial temperature T_1 of the copper conductor. The second temperature is defined in Reference (3) as the final copper temperature T_2 consistent with protecting various conductor insulating materials. Reference (1) on the other hand defines T_2 as the maximum penetration temperature before failure. NNECO disagrees with this Reference (1) assumption. In Reference (2), 90°C, which is the rated conductor temperature, was utilized for T_1 and 250°C, which IPC&A Publication P-32-382, Short Circuit Characteristics of Insulated Cable, indicates is an acceptable figure for short time use of cross-linked polyethylene, was used for T_2. NNECO's assumptions are consistent with industry wide application of the subject formula.

The NRC Staff review utilized the LOCA temperature of 138°C as the initial conductor temperature, (280°F) and 177°C (352°F) as the maximum temperature before failure. Using these figures, there is considerably less time to isolate faults. Unless it can be clearly demonstrated that this is a requirement for maintaining containment integrity, this places undue burdens on the selection and application of circuit protective devices. Furthermore, the penetrations are of the double aperture seal type and even if it is postulated that the conductor and seal at the inboard end is at the LOCA temperature, the outboard end would be at a lower temperature much closer to the normal ambient of the secondary containment. Therefore, while it may be conservative to use the LOCA temperature for T_1 at the inboard end, it is artificially high when considering the outboard end of the penetrations. In addition, the maximum LOCA temperature does not appear instantaneously or persist that long. Thus, the probability of a fault during this time period is small. Some loads, like the primary containment inboard isolation valves would isolate the drywell and be de-energized before their conductors reached the LOCA temperature. In fact, few electrical loads in the drywell remain energized under LOCA conditions. It is also important to recognize that neither Formula 1 of Reference (1) nor the use of the LOCA temperature for T_1 in that formula is implicitly or explicitly sanctioned by IEEE Std. 317 or Regulatory Guide 1.63.

In the case of the low voltage penetration examined in Reference (1), the Staff failed to consider that there are two #8 A.W.G. conductors in parallel in the penetration. The fact that the conductors are in parallel was clearly indicated in Reference (2). This error means there is four times more time to clear a fault than the Staff indicated even if the Staff values of T_1 and T_2 are used. This additional time assures that the primary protective device (i.e., a molded case breaker) would protect the penetration. While it is true that the backup low voltage metal clad switchgear breaker is too slow to protect the penetration or its feeder cable, this does not mean the penetration is not protected. The feeder cable to the subject penetration is a #10 A.W.G. which connects to two #8 A.W.G.'s in the penetration assembly. Figure 3.24 of Reference (3) indicates that a #10 conductor will fuse with 1,600 amps in about 1 second. Similarly, it indicates a #8 conductor carrying 800 amps (half the fault current in each of the two conductors) will fuse in approximately 9 seconds. Thus, the penetration will be protected by its field wiring external to the penetration itself. IEEE Std. 317 recognizes that electrical integrity may be lost when backup protective devices clear a fault. The fact that the field wiring has a smaller cross sectional area was also indicated in Reference (2). Beyond this it is reasonable to believe that the motor starter might successfully function as a backup protective device due to its thermal overloads or the voltage at the control power transformer dropping to near zero due to the fault. Recognize that the 1600 amps stated, in Reference (2) as the fault current is for a three phase fault which is the type of fault least probable to occur. The type of fault most probable is a single line to ground fault, and since the 480 volt system at Millstone Unit No. 1 is ungrounded there will be essentially zero fault current and the fault would be annunciated.

In the case of the medium voltage penetration, the Staff failed to consider that the two 500 KCM conductors are in parallel in each phase, not withstanding the fact that Reference (2) clearly indicated these conductors were in parallel. Thus, even if the Staff assumptions are used for T_1 and T_2, there is still four times the amount of time indicated in Reference (1) to clear a fault. The fourth paragraph of page 5 of Reference (1) indicates that "For a three phase short circuit condition, it cannot be assumed that sufficient current differences will exist to cause the differential relay to operate...". This seems to imply that the three phase currents all have the same fault magnitude, which may well be the case for a three phase fault, but it does not mean the magnitudes will be the same at the current transformers at both boundaries of the protective zone. NNECO concurs with the Staff that it will take 156 or more amps of primary current difference to actuate these relays, (one per phase), but for a three phase or similar type of fault between the motor-generator set and the pump motor, these relays would be actuated. It is also noted that the pairs of current transformers inputting these differential relays are at the wye neutrals of both the generator and the pump motor. Also, the 156 or more amps the Staff used for one per unit pickup of the relay is small compared to normal full load current, about 500 amps, and the 1700 amps of three phase fault current available as indicated in Reference (2).

NNECO concurs with the Staff statement on page 6 of Reference (1) that, for fault currents less than 780 amps, the backup PJC11 relays will not operate to clear the fault. However, this is of no consequence because the two 500 KCM conductors each have a capacity of 550 amps for a total capacity of 1100 amps. Therefore, when required because of 1100 amps or more, the penetrations will be protected. It is also noted that the 1700 amp figure provided in Reference (2) was based on the subtransient reactance of the motor generator and on the fact that both the primary and backup PJC relays would operate fast with this level of fault current. In reality, the sustained three phase fault current available from this generator is only about 300 amps due to the high synchronous reactance of the generator and the de-magnetizing effect of the short circuit current on the air gap flux. This is less than full load current.

The motor generator and recirculation pump motors are part of a high resistance grounded electrical system. Therefore, for the most probable type of fault, a single line to ground, the fault current will be about one-half of one ampere which is minimal. In addition, there is a ground fault relay, which was not previously identified to the Staff, but which would trip both the drive motor for the MG set and trip the field breaker of the generator.

Based upon the above, NNECO does not agree with the NRC Staff evaluation presented in Reference (1). The Staff has not demonstrated that containment integrity will be comprised by the occurrence of a short circuit in the subject reactor containment penetrations. NNECO has concluded that the subject penetrations meet current requirements of Reg. Guide 1.63 and IEEE Std. 317 for any fault current with a failure of the primary protective device. Therefore, no changes to the electrical penetration design are planned. We trust you will find this submittal responsive to your request.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil

W. G. Counsil
Senior Vice President

W. F. Fee

By: W. F. Fee
Executive Vice President