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January 14, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Zion Station Units 1 and 2
Environmental Qualification of
Electrical Equipment
NRC Docket Nos. 50-295 and 50-304

Reference (a): December 14, 1982, letter from
S. A. Varga to L. O. DelGeorge.

Dear Mr. Denton:

Reference (a) transmitted the NRC's Safety Evaluation Report (SER) for the Environmental Qualification of Safety-Related Electrical Equipment for Zion Station. This is to the provide information that reaffirms our justification for continued operation regarding the items identified in the SER.

The Attachment to this letter provides information regarding Fisher & Porter transmitters and Marathon terminal blocks. We have identified no items in categories 1B, 2A, and 2B for which justification for continued operation was not previously submitted. Resolution of aging deficiencies will be addressed in our 90-day submittal.

To the best of my knowledge and belief, the statements contained in this letter and the Attachment are true and correct. In some respects, these statements are not based on my personal knowledge but upon information furnished by contractors and other Commonwealth Edison personnel. Such information has been reviewed in accordance with Company practice and I believe it to be reliable.

One (1) signed original and forty (40) copies of this transmittal are provided for your use.

Please address questions regarding this matter to this office.

Very truly yours,

F. G. Lentine

F. G. Lentine
Nuclear Licensing Administrator

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Attachment

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ATTACHMENT

COMMONWEALTH EDISON COMPANY

ZION UNITS 1 and 2

JUSTIFICATION FOR CONTINUED OPERATION FOR

ITEMS IDENTIFIED IN FCR's TEP

5806N

In the recently issued Franklin Institute Technical Evaluation Report, the main item of concern was the short-term operability of the certain safety-related transmitters.

The following are FRC TER item numbers and equipment:

1. FRC Item 36

LT-517	LT-527	LT-537	LT-547
LT-518	LT-528	LT-538	LT-548
LT-519	LT-529	LT-539	LT-549

These are the narrow range steam generator level transmitters which are located in containment.

2. FRC Item 38

PT-455
PT-456
PT-457
PT-458

These are the pressurizer pressure transmitters located in containment.

3. FRC Item 39

FT-512	FT-532
FT-513	FT-533
FT-522	FT-542
FT-523	FT-543

These are the steam line flow transmitters located in containment.

4. FRC Item 40

PT-514	PT-524	PT-534	PT-544
PT-515	PT-525	PT-535	PT-545
PT-516	PT-526	PT-536	PT-546

These are the steam line pressure transmitters located in the lower safety valve room.

The licensee has prepared an accident analysis on the following three accidents: Loss of Coolant Accident (LOCA), Mainsteam Line Break (MSLB) and Fe dwater Line Break (FLB). The licensee has reviewed the line breaks analyzed and determined which transmitter will cause the required safeguards actuation (safety injection and/or reactor trip).

A. LOCA

Section 14.3.1.1 of the Zion FSAR details the LOCA break cases. It states that, should a break occur, depressurization of the Reactor Coolant System causes fluid to flow to it from the pressurizer, resulting in a pressure decrease in the pressurizer. Reactor trip and safety injection occur when the pressurizer low pressure set points are reached (1825 and 1815 psig respectively). Safety injection actuation/reactor trip are also provided by a high containment pressure signal.

Table 14.3.4-3 of the Zion FSAR presents a LOCA event chronology for all cases analyzed. For the event chronology, the safety injection signal is assumed to be generated by pressurizer pressure. Also, a 25 second delay in starting of the ECCS System is assumed in the analysis. The design maximum delay time between SI signal and the time that the Safety Injection System is ready to deliver water is 22 seconds. Note 4 of the same table identifies the delay time in receiving the safety injection signal from the containment pressure as a maximum of 2.0 seconds for a three foot^2 equivalent break. Using the 22 second maximum response time with the two second delay yields 24 seconds, which is still less than the 25 seconds assumed in the analysis for ECCS starting.

Thus, the two acceptable means of safety injection actuation are:

1. Pressurizer Pressure

   PT-455, 456, 457 and 458 located inside containment. These transmitters would provide the safety injection signal on low pressurizer pressure. However, the harsh environment may render these transmitters inoperable.

2. Containment Pressure

   PT-CS19, 20, 21 and 22 located outside containment in Zone A7 (a nonharsh environment throughout any accident). These transmitters would cause a safety injection on high containment pressure. Figure 14.3.4-2 presents the results of the pressure transients for the four break sizes analyzed. The containment pressure set point of 4.5 psig is reached in less than two seconds for all cases.

A. LOCA (cont'd)

Although the pressurizer pressure transmitters are located in containment and are subjected to a harsh environment following a LOCA, the secondary means of providing the safety injection and reactor trip (high containment pressure) is located in a nonharsh environment of the plant and would be available. The response time delay between the pressurizer pressure and containment high pressure signals is less than two seconds and results in ECCS flow being delivered within the time assumed in the analysis.

Justification for Continued Operation:

The analysis presented indicates that there will always be at least one means available for detecting a LOCA and initiating the safety injection. This means is provided by the containment pressure transmitters located in a nonharsh environment of the plant. Qualification of this equipment is by experience.

B. MSLB

The Zion FSAR, Section 14.2, details the action and safeguards protection following a MSLB both in and outside containment. A safety injection signal is received from any of the following:

1. Two out of three low pressurizer pressure transmitters. PT-455, 56, 57 located in Zone Cl.

2. Two out of three differential pressure signals between a steam line and remaining steam lines PT-514, 24, 34, 44, PT-515, 25, 35, 45, PT-516, 26, 36, 46 located in Zone T3.

3. High steam flow in two out of four main steam lines in coincidence with either low low reactor coolant system average temperature or low main steam line pressure.

FT-512, 22, 32, 42	Zone Cl
FT-513, 23, 33, 43	Zone Cl
PT-516, 26, 36, 46	Zone T3
TE-411A&B, 421A&B,	Zone Cl
TE-431A&B, 441A&B	Zone Cl

4. Two out of four high containment pressure transmitters PT-CS19, 20, 21, 22 located in Zone A7.

B. MSLB (cont'd)

Steam Line Break In Containment:

The worst case evaluated is the complete severance of a pipe inside containment at the outlet of a steam generator at no-load conditions and all reactor coolant pumps running. For this case of a steam line break in containment, Figure 14.2.5-9 of the Zion FSAR shows the containment pressure as a function of time following the accident. From the curve it is evident that the containment pressure exceeds the safety injection set point of 4.5 psig in less than one second. Thus, the indication which produces the primary safety injection signal is containment pressure. As discussed previously in the LOCA analysis, the containment pressure transmitters are located outside containment in a nonharsh zone.

One of the available backup actuations, which also provides the necessary safety injection, is the differential pressure signal between one steam line and the remaining steam lines. These transmitters are also located outside containment and for a MSLB in containment, this plant zone is nonharsh.

Justification for Continued Operation:

For a MSLB in containment, the primary means of initiating a safety injection is the containment pressure transmitters located in a nonharsh environment of the plant. These transmitters will be unaffected by the accident and will provide their necessary function.

Steam Line Break Outside Containment:

The Zion FSAR analysis of a MSLB outside containment was conducted on a transient arising as a result of a break equivalent to a steam flow in two out of four main steam lines in coicidence with low low Reactor Coolant System average temperature. These instruments are located in containment and are unaffected by the break. Thus, the primary means of detecting a line break outside containment as analyzed in the FSAR, will be unaffected by the accident and will provide its necessary function.

B. MSLB (cont'd)

Justification for Continued Operation:

For the MSLB outside containment, the primary means of initiating the safety injection signal, as analyzed in the Zion FSAR, are transmitters located in a nonharsh zone of the plant following the accident. These transmitters being unaffected by the accident will be capable of providing their necessary safety function.

C. FLB

A loss of the normal feedwater results in a reduction in capability of the secondary system to remove the heat generated in the reactor core. Of primary importance following this accident is a reactor trip which, if not initiated, could result in primary plant damage from increasing temperature and pressure. Since there is no inventory loss from the reactor coolant system, or positive reactivity inserted, safety injection actuation is not required to mitigate this accident. However, a safety injection would provide the necessary reactor trip.

The following provides the necessary protection against a loss of normal feedwater:

1. Reactor trip on any of the following:

    a. Two out of four high pressurizer pressure PT-455, 56, 57, 58 located in Zone C1.

    b. Two out of four over temperature Δ T signals TE-411A&B, 421A&B, 431A&B, 441A&B located in Zone C1.

    c. Two out of three low low steam generator water level transmitters in any steam generator
    LT-517A, 27C, 37D, 47B
    LT-518A, 28C, 38D, 48B
    LT-519A, 29C, 39D, 49B
    located in Zone C1

    d. Steam flow/feedwater flow mismatch with coincident low steam generator level.

    Feedwater flow transmitters are in the steam tunnel, steam flow transmitters and steam generator level transmitters are located in containment.

C. FLB (cont'd)

OR

2. Safety injection signal from any of the following:

   a. Two out of three differential pressure signals between a steam line and remaining steam lines

PT-514	PT-524	PT-534	PT-544
PT-515	PT-525	PT-535	PT-545
PT-516	PT-526	PT-536	PT-546

   located in Zone T3

   b. Two out of four high containment pressure transmitters PT-CS19, 20, 21, 22 located in Zone A7.

In Containment:

Should a FLB occur in containment, the primary means of providing a reactor trip as identified in the FSAR is the low low steam generator level transmitters. This occurs at 27 seconds as determined by the analysis. These transmitters are located in containment and would thus be subjected to the harsh environment. However, the FSAR analysis did not take into account the potential for providing the necessary safeguards actuation caused by high containment pressure transmitters, which would provide safety injection as well as the required reactor trip.

The licensee has made an assessment of the Zion containment's short-term pressure response due to a break of the main feedwater line. The results indicate that the time required for the containment pressure to reach the 4.5 psig set point is conservatively estimated to be less than 20 seconds. This response in containment pressure indicates that the required reactor trip would first be initiated by the high containment pressure transmitters which are located outside containment in a nonharsh zone of the plant. Therefore, reactor trip is provided by transmitters which will be unaffected by the accident and will be capable of providing the necessary function.

Out of Containment:

In the event of a loss of feedwater accident out of containment, the primary means of providing the reactor trip and subsequent auxiliary feedwater flow initiation is available and will be in a nonharsh environment (low low steam generator level transmitters).

C. FLB (cont'd)

Justification for Continued Operation:

The licensee has concluded that for each of the FLB locations, transmitters are available in nonharsh environments of the plant to provide the necessary safeguards actuation. Therefore, the licensee concludes that justification for continued operation has been provided.

FRC Item 37

LT-501
LT-502
LT-503
LT-504

These are the wide range steam generator level transmitters which are being replaced with qualified transmitters. These are located in containment.

FRC Item 42

FT-FW03

This is the auxiliary feedwater flow transmitter located in the Auxiliary Building. This transmitter is being replaced with a qualified transmitter.

Justification for Continued Operation:

These transmitters are required to operate following a High Energy Line Break (HELB) for maintenance of auxiliary feedwater flow to restore and maintain normal steam generator level. For a HELB inside containment, the feedwater flow transmitters will be in a nonharsh environment and can be used as a guide for maintaining long-term steam generator level. For a HELB outside containment, both the narrow range and wide range steam generator level transmitters will be available and will be in a nonharsh environment of the plant. Also, if a HELB occurs in the Auxiliary Building, only FW03 will be in a harsh environment. The three other auxiliary feedwater transmitters remain in nonharsh areas of the plant.

Terminal Blocks

Items 55, 66, 68, 69, 70, 71, 72, 86

FRC Identified Concern of Licensee's Response: Qualification Not Established.

Wyle Test Report 45611-1 documents testing performed on Marathon fixed Barrier terminal blocks, Series 6000 and 1600, both horizontally and vertically mounted in enclosures. The 6000 series blocks were furnished from the Zion Station stock, the enclosures were standard terminal boxes, manufactured per CECo Std. EM47150, thus, duplicating those in use at the Zion Station. Both insulated and uninsulated barrel ring-tongue, terminal lugs were installed on the terminals with Okonite cable forming two separate series circuits on alternate terminals utilizing all terminals on each block. Curcuit resistance (continuity) was tested throughout the test program. The total circuit resistance through a single terminal block was well below the 10 OHM criteria. Insulation resistance between circuits and between each circuit and ground was tested at 500 vdc for one minute with a $1x10^6$ OHM minimum requirement. The terminal block assemblies were irradiated for 448 hours at a dose rate of $4.6x10^5$ rads/hour for a total integrated dose of $2.06x10^8$ rads. The reported minimum dose is $2.0x10^8$ rads.

The terminal block assemblies were aged for 20 and 40 years. One terminal block assembly consisting of sheet steel enclosure and four terminal blocks, was aged for 466 hours at 120°C for an equivalent life of 20 years. The other identical assembly was aged for 932 hours at 120°C for an equivalent life of 40 years. The aging times and temperatures are based on a normal operating ambient of 122°F (50°C) which exceeds the worst case normal ambient at the Zion Station.

Post radiation and thermal aging functional tests equalled or bettered the results of the baseline functional tests in reagrd to insulation resistance with the continuity test howing a slight increase in circuit resistance after thermal aging but still a factor of 1000 below the allowable 10 OHM's.

The seismic qualification tests consisted of biaxial resonance search and random multifrequency tests in each of two test orientations; vertical and horizontal. The seismic tests demonstrated that the terminal block assemblies possessed sufficient integrity to withstand, without compromise of structures or electrical functions, the simulated seismic environment.

For the LOCA test the terminal block assemblies were vertically mounted within the test chamber simulating field conditions. A voltage potential of 175 Vac and a current of 15 amperes was applied to each terminal block assembly to monitor current leakage between the circuits and ground. Arrhenius methodology was used to compress the one year accident period to 34 hours. From initial conditions of 135°F and atmospheric pressure the chamber temperature and pressure was increased to 270°F and 30 psig in 20 seconds which was maintained for approximately four minutes. The chamber was allowed to cool to 140°F and a second transient was begun; raising the temperature and pressure to 380°F at 50 psig maintaining this for approximately 20 seconds. The temperature was dropped to 345°F and maintained for the remainder of the test; the pressure was decreased to 25 psig 10 hours into the test and at 25 hours dropped to 22 psig for the remainder of the test. During the first six hours of the accident exposure, a chemical spray of 0.04 $g/min/ft^2$ and a ph of 8.5 to 10 was maintained, for the next three hours the spray rate was increased to 0.5 $g/min/ft^2$.

Approximately one hour and 50 minutes into the LOCA test a 6000 series terminal block (#2) arranged horizontally in assembly #1, which was preaged for 20 years, shorted to ground. This was attributed to a random failure of the wiring rather than the terminal block itself. All other terminal blocks successfully met the requirements. Post LOCA functional tests showed a slight increase in resistance during the continuity test, although still only 0.1% of the maximum allowed. The insulation resistance tests showed a slight decrease in resistance, but were above the minimum requirements. Worthy of note is the fact that the terminal block that apparently shorted to ground during the LOCA test passed the post LOCA functional tests.

Based upon the results of this test and operating experience, we conclude that the terminal block assemblies in use at the Zion Station are fully qualified for their 40 year design life plus accident conditions.

The licensee maintained a copy of the proprietary test report in their files should the staff wish to review the particulars of the test.

The NRC has asked that the licensee resolve the aging deficiencies identified in the Franklin Technical Evaluation Report (TER). The licensee has been compiling aging information on all equipment identified in the TER. This work has been completed; however, due to the magnitude of the aging concerns identified, the licensee felt that this issue was better responsed to on a case-by-case basis rather than in general terms. Because of this, the licensee will provide a resolution to all aging concerns when it resubmits the Zion Environmental Qualification to the NRC. This is scheduled to be provided within 90 days of issuance of 10CFR50.49, "Environmental Qualification of Safety-Related Electrical Equipment for Nuclear Power Plants."

Finally, the licensee has reviewed the items in NRC Categories 1B, 2A and 2B and concluded that no additional items (other than those previously discussed), exist for which justification for continued operation was not previously submitted. Although the terminal blocks did not contain justification for continued operation in the licensee's 90 day submittal, the qualification which the licensee has now provided shows full qualification of this item. Justification for continued operation for the short-term safety-related transmitters was originally provided for in the licensee's 90 day submittal; however, the licensee has provided an expanded discussion on their operation to ensure that justification for continued operation can be ensured.