Public Service
Electric and Gas
Company

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Gentlemen:

10CFR21 NOTIFICATION
DEGRADED GRID TRIP AND
BUS TRANSFER SCHEME
HOPE CREEK GENERATING STATION
DOCKET NO. 50-354

Pursuant to the notification requirements of 10 CFR Part 21, Public Service Electric and Gas (PSE&G) hereby provides a report of a design defect in the degraded grid trip and bus transfer scheme for the Class 1E vital busses supplied by Bechtel Power Corporation during the construction of the Hope Creek Generating Station. This design defect could prevent the plant from mitigating the effects of a design basis Loss of Coolant Accident (LOCA).

A design change was implemented during the Hope Creek maintenance outage (March 7 to March 14, 1992) correcting this design defect. Attachment 1 more fully describes the particulars of this design defect which was reported to the NRC Operations Center on May 8, 1992.

Please contact us if you have any questions with regard to this transmittal.

Sincerely,

S LaBruna

Attachments

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On May 8, 1992, PSE&G reported a design deficiency in the degraded grid trip and bus transfer scheme supplied by Bechtel Power Corporation during construction of the Hope Creek Generating Station (HCGS).

Background Information

HCGS has four class 1E vital busses that are supplied by two 13.8/4.16 kV transformers (1AX501 and 1BX501). Each transformer supplies two vital busses during normal operation (see Attachment 6). Transformers 1AX501 and 1BX501 are equipped with automatic load tap changers (LTC) that adjust the voltage on the vital busses depending on the voltage level of the offsite power grid. These LTCs are non-class 1E. Each class 1E vital bus is equipped with a degraded voltage relay set at 92% of nominal infeed voltage and a undervoltage relay set at 70% bus voltage.

Scenario

The following scenario is hypothesized to illustrate the issue of concern.

During the course of the operating cycle, one of the non-class 1E LTCs on either the 1AX501 or 1BX501 transformers is assumed to fail with no indication of failure. Additionally, the LTC is assumed to fail in a "low" tap position. Following the LTC failure, the plant experiences a design basis Loss-of-Coolant Accident (LOCA) while the offsite power grid is experiencing a slightly degraded condition (but not degraded to the point to activate the degraded grid relays).

Since one of the LTCs (on either the 1AX501 or 1BX501 transformers) has failed in a "low" tap position, it is possible to have one transformer supplying its respective busses with near nominal bus voltage while the other transformer is supplying its respective busses with below nominal voltage.

When the LOCA loads sequence on to the bus, the two vital busses with below nominal voltage level degrade below the 92% setpoint of the degraded grid relays. At this point, a degraded voltage timer starts. The busses have 20 seconds to recover from the degraded voltage condition to the reset voltage level of the degraded grid relay before the normally closed infeed breaker opens. Since the two vital busses will not recover to reset voltage of the degraded grid relays within 20 seconds, the degraded grid relay will then generate a signal to trip the normally closed infeed breaker. From initiation of the trip signal (time = 0, Attachment 5), the normally closed infeed breaker will open in 7.6 cycles.

When the infeed breakers open, this will cause the two vital busses to drop below 70% bus voltage (the pick up point of the undervoltage relays) in 3 to 5 cycles. The dead bus transfer logic (see Attachment 2) is then designed to check the alternate infeed voltage level (the second transformer) for a voltage level >92% nominal voltage. Since the alternate infeed voltage was near the nominal infeed voltage level at the beginning of the LOCA loading, the alternate infeed voltage does not drop below 92% nominal voltage thus completing the final step in the dead bus transfer logic. At this point a signal is sent to close the alternate infeed breaker. The time from 70% bus undervoltage to alternate infeed breaker closure ranges from 8 to 17 cycles due to the timing tolerances in the logic and relays.

Since the motor breakers are equipped with 0.25 second time delays and are activated when the 70% undervoltage relays pick-up, the bus transfer will occur before the motor breakers trip. This means that the motors will be transferred to the alternate infeed with "residual" voltage and resultant starting torque at a level that could damage safety related equipment.

PSE&G has tabulated the expected transient values (see Attachment 3) for the range of bus transfer times (8 to 17 cycles). The resultant volts/Hz values, as calculated in accordance with current industry guides (ANSI C50.41-1982), range from 0.64 through 1.83 where 1.33 is considered an acceptable value. It is important to understand that since the formula used for these results is so significantly biased by the phase angle of the bus, as it decays, relative to the normally open infeed, there exists an "array" of acceptable values where cosines are positive and even slightly negative. This corresponds, as shown in Attachment 4, to any vector in the 0° to 90° and 0° to 270° quadrants. The point of the range is that at our expected <u>nominal</u> transfer time with worst case loading, we in fact have an <u>acceptable</u> transfer because the phase angle has swung past full circle to 397° (or 37°). However since there exists other possibilities for exact and actual transfer times (as shown in Attachment 3), there also exists the possibility of reaching unacceptable volts/Hz and incurring resultant equipment damage. Although PSE&G does not consider the potential damage range "probable", it cannot be assured that Hope Creek will not experience this equipment damage range.

The resultant equipment damage would lead to the loss of two Safety Auxiliary Cooling System (SACS) pumps, two Service Water (SW) Pumps, two Residual Heat Removal (RHR) Pumps, two Core Spray Pumps and a Control Room Water Chiller. Since three core spray pumps are taken credit for in the accident analysis for mitigating a LOCA, loss of two of the four core spray pumps could prevent the unit from mitigating the effects of a LOCA.

Corrective Actions

Upon initial discovery of this design deficiency on March 2, 1992, PSE&G initiated the following immediate compensatory actions:

1. Continually monitor the Class 1E 4.16 kV bus voltage to ensure that the bus voltage level does not go below 4160 volts.

2. Channel checks will be performed to assure that the Class 1E busses are within 100 volts of one another.

3. Tap changer position of 1AX501 and 1BX501 will be monitored with respect to each other.

These compensatory measures where kept in place until design change package (DCP) 4EC-3341 was issued and implemented during the Hope Creek maintenance outage, beginning on March 7 and ending on March 14, 1992. This DCP provides a 0.7 second time delay, allowing the motor breakers to trip before the busses are transferred to alternate infeed eliminating the possibility of safety related motor damage.