UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

# SAFETY EVALUATION REPORT

# EVALUATION OF LPCI SWING BUS TRANSFER SCHEME

# REGARDING SINGLE FAILURE VULNERABILITY

# BOSTON EDISON COMPANY

# PILGRIM NUCLEAR POWER STATION

# DOCKET NO. 50-293

## BACKGROUND

By letter dated March 2, 1990, the Boston Edison Company (BECO), on staff's request, submitted additional information on the low pressure coolant injection (LPCI) swing bus transfer scheme regarding its single failure vulnerability at Pilgrim Nuclear Power Station. Pilgrim was identified as one of the BWRs which uses the LPCI swing bus transfer scheme to meet the ECCS criteria of 10 CFR 50.46. The staff was concerned that the LPCI swing bus transfer scheme at Pilgrim could be vulnerable to a single failure of dc control power, as experienced at FERMI-2. A single failure of dc control power at FERMI-2 resulted in the loss of one train of core spray and a total loss of LPCI system leaving one core spray pump to perform the ECCS function during an accident.

## LPCI SYSTEM DESCRIPTION

FERMI-2 and other BWRs use an ac swing bus to accommodate the design of the ECCS/LPCI system. In contrast, Pilgrim incorporates a swing bus design on ac as well as on dc system to achieve their LPCI function. The design of swing buses at Pilgrim is as follows:

1. 480v ac swing bus B6

   The LPCI swing bus B6 receives power from either 480v bus B1 or B2 through two series connected circuit breakers 102 and 601, or through 202 and 602 (see Figure 1). One set of breakers is closed while the other set is open. Upon a loss of normal supply voltage, an automatic transfer signal causes both closed circuit breakers to trip after a time delay and the open circuit breakers are then closed by two independent closing signals.

2. 125v dc swing bus D6

   The control power for the breakers feeding the above ac swing bus B6 and their LPCI related load breakers is supplied from dc swing bus D6 in distribution panel C. The dc swing bus D6 receives power from the A train battery through an automatically controlled switch in panel D32 in series with the normally closed portion of an automatic transfer switch (ATS) in panel Y10. The alternate power supply to the dc swing bus D6 is from the B train battery though an automatically controlled switch in panel D33 and an ATS in panel Y10 which are normally kept open (See Figure 1.)

EVALUATION

The licensee has stated that the single failure concerns at FERMI-2 and other BWR plants are not applicable to Pilgrim because a single failure of dc or ac swing bus causing loss of both one train of core spray and LPCI is not possible. The basis for this conclusion is as follows:

1. In the event of a single failure resulting in the loss of LPCI, low pressure injection can be achieved by the core spray system which remains operable. Pilgrim has two 100% capacity core spray subsystems which are powered from separate 4160v safety trains. The control power for each safety train is also supplied from the battery on the same train. Since the core spray system function does not depend on power supply from the 480v ac swing bus B6, or the 125v dc swing bus D6, a single failure of either B6 or D6 transfer scheme would only affect the operation of LPCI function. Thus, the core spray system would be available to perform the ECCS function during an accident.

2. Two pairs of series connected power supply breakers are used to feed ac power to bus B6 from either the 480V B1 or B2 bus. This design differs from FERMI-2 where magnetic contactors are used. The magnetic contactors at Fermi-2 are powered from a dc bus and are normally energized to remain closed. Upon loss of dc control power, the contactors are de-energized interrupting the ac power supply to the LPCI swing bus. Although, at Pilgrim, a single breaker (No. 14) on dc bus D6 provides control power to all the breakers required for LPCI function on bus B6, a loss of dc control power to this breaker would not interrupt the power supply to bus B6 and their LPCI loads since they are normally closed and will remain closed upon loss of dc control power. Thus, during a postulated loss of dc control power event, both LPCI and two core spray pumps would be available to perform ECCS functions at Pilgrim.

3. Because the dc swing bus D6, which provides control power for all the breakers on the ac swing bus B6 can be powered from either of the two battery trains, a single dc control power failure in one train would not result in a loss of the ac swing bus B6. When undervoltage occurs in one train, (for example D16, as shown in Figure 1) the logic causes one auto controlled switch (D32) to open and send a signal for the other auto controlled switch (D33) to close. Also, the ATS in panel Y10 senses that power is now coming from D33 instead of D32, and transfers to D33 to re-energize the switch bus D6. The operating current for the transfer switch is taken from the side to which the load is being transferred. Thus, a second source of control power to operate the ac breakers would be available through the dc swing bus D6 during a postulated event similar to the Fermi-2 event.

4. All supply breakers on bus B6 are coordinated with all the LPCI load breakers such that a fault on any of those load breakers will cause the breaker to trip before any of the supply breakers. This will confine a fault on the load side of bus B6. Under the worst fault condition, it would simply isolate bus B6 by containing a fault within bus B6 (i.e., no LPCI function) while making two core spray pumps available to perform ECCS function.

Based on the above, a single failure of dc control power does not cause the loss of both one core spray subsystem and a total LPCI function.

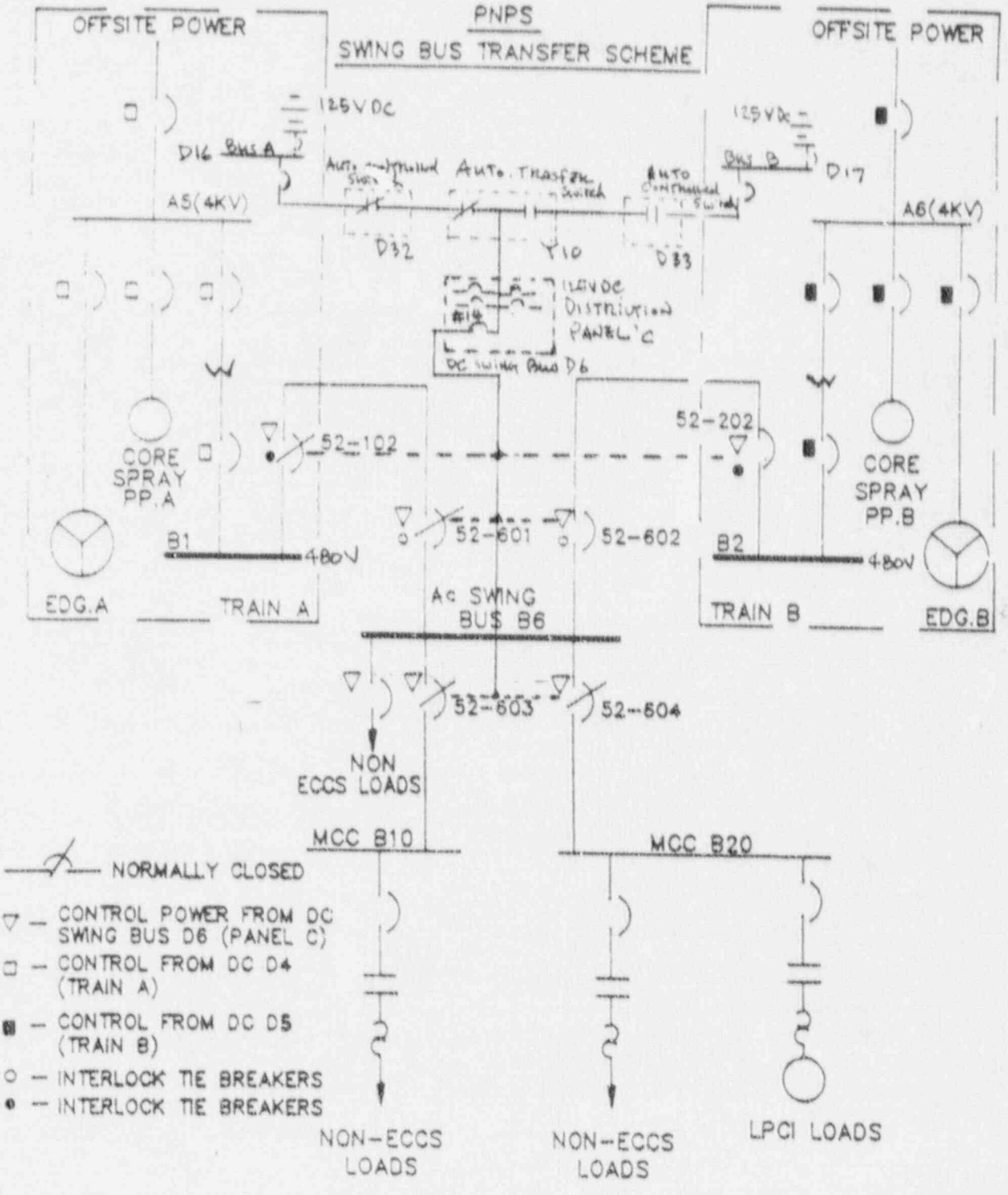
The licensee has also reviewed whether their ac or dc trains could be tied together through a swing bus by a single failure and they found no single failure which could tie both trains together through either of their swing buses.

CONCLUSION

Based on our review of the licensee's evaluation of their swing bus transfer scheme, we concur with the licensee's finding that there is no single failure related to a dc control power that would cause the loss of both one core spray subsystem and a total LPCI function or that could tie both trains together through their ac swing bus. Therefore, we conclude that the single failure concerns experienced at FERMI-2 are not applicable to Pilgrim.

Prepared by: P. Kang

# FIGURE 1


PNPS
SWING BUS TRANSFER SCHEME
OFFSITE POWER
OFFSITE POWER
125VDC
125VDC
D16 BUS A
BUS B D17
AUTO. TRANSFER SWITCH
AUTO CONTROLLED SWITCH
A5(4KV)
A6(4KV)
D32
Y10
D33
125VDC DISTRIBUTION PANEL 'C'
#14
DC SWING BUS D6
52-102
52-202
CORE SPRAY PP.A
CORE SPRAY PP.B
52-601
52-602
B1
480V
B2
480V
EDG.A
TRAIN A
AC SWING BUS B6
TRAIN B
EDG.B
52-603
52-604
NON ECCS LOADS
MCC B10
MCC B20
NORMALLY CLOSED
CONTROL POWER FROM DC SWING BUS D6 (PANEL C)
CONTROL FROM DC D4 (TRAIN A)
CONTROL FROM DC D5 (TRAIN B)
INTERLOCK TIE BREAKERS
INTERLOCK TIE BREAKERS
NON-ECCS LOADS
NON-ECCS LOADS
LPCI LOADS

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