NORTHEAST UTILITIES

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WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
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September 6, 1985

Docket No. 50-245
B11682

Director of Nuclear Reactor Regulation
Attn: Mr. Christopher I. Grimes, Chief
Systematic Evaluation Program Branch
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Millstone Nuclear Power Station, Unit No. 1
Integrated Safety Assessment Program
Summaries of Public Safety Impact Model Project Analyses

In a letter dated July 31, 1985,(1) Northeast Nuclear Energy Company was requested to provide the Staff with summaries of the public safety risk oriented analyses of a selected number of projects we are evaluating in the Integrated Safety Assessment Program (ISAP).

In response to this request, and in accordance with our understanding of the ISAP process, we are providing the Staff with a summary of the following project we have evaluated for public safety impacts:

1) ISAP Topic No. 1.21 - "Fault Transfers"

It is noted that since we have not completed our analyses of the entire set of ISAP projects, the public safety impact scores are to be considered preliminary at this time. Upon completion of our analyses of the entire ISAP project set, including all five attributes, we will review our analyses and revise our public safety impact results, if necessary, to assure consistency in the ranking of the ISAP projects.

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(1) H. L. Thompson letter to J. F. Opeka, "Integrated Safety Assessment Program," July 31, 1985.

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As further public safety impact analyses are completed, we will promptly forward summaries to the Staff for review.

If you have any questions on this material, please feel free to contact my staff.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

J. F. Opeka
J. F. Opeka
Senior Vice President

cc: J. A. Zwolinski

ISAP #1.21 Fault Transfers

Safety Issue

The current Millstone Unit 1 design utilizes Automatic Bus Transfer switches (ABT's) to assure that certain vital electrical loads receive power from redundant sources. Because of this design, concerns have been expressed that the parallel operation of redundant power sources could result in their common mode failure under faulted modes of operation. In particular, if a fault were present on any of the loads which are connected to one source of power and this resulted in a low voltage condition, the ABT could potentially transfer the same fault to the second power source. Such a transfer would cause the failure of both sources due to the subsequent protective breaker isolation function. The worst case that could occur is when each of the redundant supply buses was powered separately by one of the two sources of site emergency power, i.e. the gas turbine and diesel generators. For Millstone Unit 1, there are 7 ABT's that fall into this category:

- 480 VAC MCC EF-7, Diesel generator motor control center
  (Powers 1-SW-9, the non-vital cooling loop isolation valve in the Service Water System.)
- 120/240 VAC VAC-1, Vital AC switchboard
  (Provides 120V AC power to the Feedwater/F.W.C.I., and a number of control board instruments including level indicators.)
- 120/240 VAC IAC-1, Instrument AC switchboard
- 480 VAC MCC EF-3, LPCI MOV's 1-LP-10B & 9B
  (Powers the L.P.C.I. injection MOV and normally open globe stop check valve.)
- 480 VAC MCC FE-3, LPCI MOV's 1-LP-10A, 9A and 8A
  (Powers the L.P.C.I. injection MOV, normally open globe stop check valve, and normally open L.P.C.I. loop cross-tie MOV.)
- 125VDC MCC EF-3, MCC control power
- 125VDC MCC FE-3, MCC control power

Proposed Project

At the present time, there is no formal project to further investigate the fault transfer issue, or to modify the present AC power system to eliminate the ABT's.

Analysis of Public Safety Impact

Currently, 1 of the 7 ABT's is disarmed and is not available to automatically transfer the loads of one load group to the power source of another. The emergency feeder breaker has been racked out so that the ABT cannot auto-transfer to the second source of power, following failure of the normal source. This was modeled in the Millstone Unit 1 P.S.S. by not taking credit for automatic functioning of the ABT, although operator manual recovery of MCC EF-7 was considered at 1/2 hour and 2 hour time intervals for loss of normal power events. Emergency procedures allow the operator to recover the MCC by first opening the breaker to the normal source and then racking in and subsequently closing the breaker to the emergency source. This action ensures that the two redundant sources are not tied together. The ABT on 480VAC MCC EF-7 is the only one that is disarmed from automatic operation.
The 6 remaining ABT's that are presently not disarmed were analyzed using Method A, as described below.

120/240 VAC Instrument A.C. (IAC-1) and Vital A.C. (VAC-1) Switchboards

The transformers that provide normal and emergency power feeds to the IAC-1 and VAC-1 switchboards are being replaced with regulating transformers during the upcoming outage. The transformers will provide isolation between the redundant feeds by limiting the fault current to 150% of normal full load. The transformer load side feeder breakers will be fitted with ground detection that will trip long before the 480 VAC breaker is tripped thermally. This eliminates the concern of a fault being transmitted between the redundant power sources, tripping the redundant MCC feeder breakers. The frequency of challenge to these MCC breakers due to a bus fault and combined failure of the ground detection trip is calculated by:

λ(breaker challenge) = λ(bus fault) x Q(trip fails)   where:

λ(bus fault) = 8.8×10^{-4}/yr.

and, Q(trip fails) = 6.14×10^{-4}/D

Substituting these values:

$$\lambda(\text{breaker challenge}) = (8.81 \times 10^{-4}/\text{yr.}) \times (6.14 \times 10^{-4}/\text{D})$$
$$= 5.4 \times 10^{-7}/\text{yr.}$$

due to each bus having a transferred fault. Since there are two buses (i.e. IAC-1 and VAC-1 as shown in Figure 1), the total frequency of breaker challenge is 1.1×10^{-6}. It should be noted that this frequency is only related to the challenge imposed on the redundant MCC breakers and is not the frequency of station blackout (SBO) where all AC is lost. Using the split fractions for loss of onsite AC and the frequency of loss of normal offsite power (LNP) from the Millstone Unit 1 P.S.S. model, the frequency of SBO is calculated as:

$$\lambda_{SBO} = \lambda_{LNP} \times Q(\text{loss of onsite})$$

Substituting λ_{LNP} = 0.12/yr. and Q(loss of onsite) = 1.77×10^{-2}

$$\lambda_{SBO} = 2.1 \times 10^{-3}/\text{yr.}$$

The frequency of challenge to the MCC breakers due to transferred bus faults is more than 3 orders of magnitude less than the frequency of having a station blackout. Accordingly, it is judged that the use of ABT's in conjunction with the regulating transformer trip protection, will not significantly impact the probability of losing both redundant sources of power.

480VAC MCC's EF-3 and FE-3

The ABT's that are presently installed on MCC's EF-3 and FE-3 provide redundant motive and control power sources for the motor operated injection valves on each L.P.C.I. loop. These ABT's are as follows:

- 480 VAC MCC EF-3 provides motive power for the 'B' LPCI injection valves
- 125 VDC EF-3 provides control power for the 480 VAC MCC
- 480 VAC MCC FE-3 provides motive power for the 'A' LPCI injection valves and the cross-tie valve
- 125 VDC FE-3 provides control power for the 480 VAC MCC

If the ABT's were disarmed, then some other method for providing redundant power to the valves would have to be developed. One way to accomplish this and avoid electrical fault transfers would be to provide redundant injection pathways on each L.P.C.I. loop. Redundancy would consist of parallel piping for injection, with independent valves powered from separate electrical sources on each of the parallel pipe sections.

As noted earlier there are no formal plans for a project, so that an equivalent substitute for the ABT's is unknown at this time. However, in order to show the importance of the present ABT's, the Millstone Unit 1 P.S.S. model was requantified with the assumption that they would be removed and not replaced.

The Millstone Unit 1 P.S.S. L.P.C.I. fault tree model in Section 3.2.20 was requantified for those support states where ABT's had to function by assuming an ABT unavailability of 1.0. The results of quantification, using a "new" unavailability for L.P.C.I., show a 0.4% increase in core melt frequency. Almost all of the change is due to plant damage states that have early melt times associated with them. The corresponding increase in public risk is calculated, using a multiplier of 0.5, as follows:

$$R = (3 \times 10^{-6}/\text{yr.})(0.5)(3 \times 10^{6} \text{ Man-Rem})(25 \text{ yr.})$$

$$= 113 \text{ Man-Rem}$$

Results

If the ABT's on the Vital and Instrument AC Switchboards are disarmed there is a minor reduction in reliability and no significant improvement in avoiding the loss of multiple electrical buses. Accordingly this would result in a score of 0 out of 10. If the ABT's on the L.P.C.I. motor operated valve power supplies are disarmed without providing some equivalent means of assuring L.P.C.I. injection, risk increases by 113 Man-Rem. This particular change is given a score of -0.25 on a scale of -10 to 10.

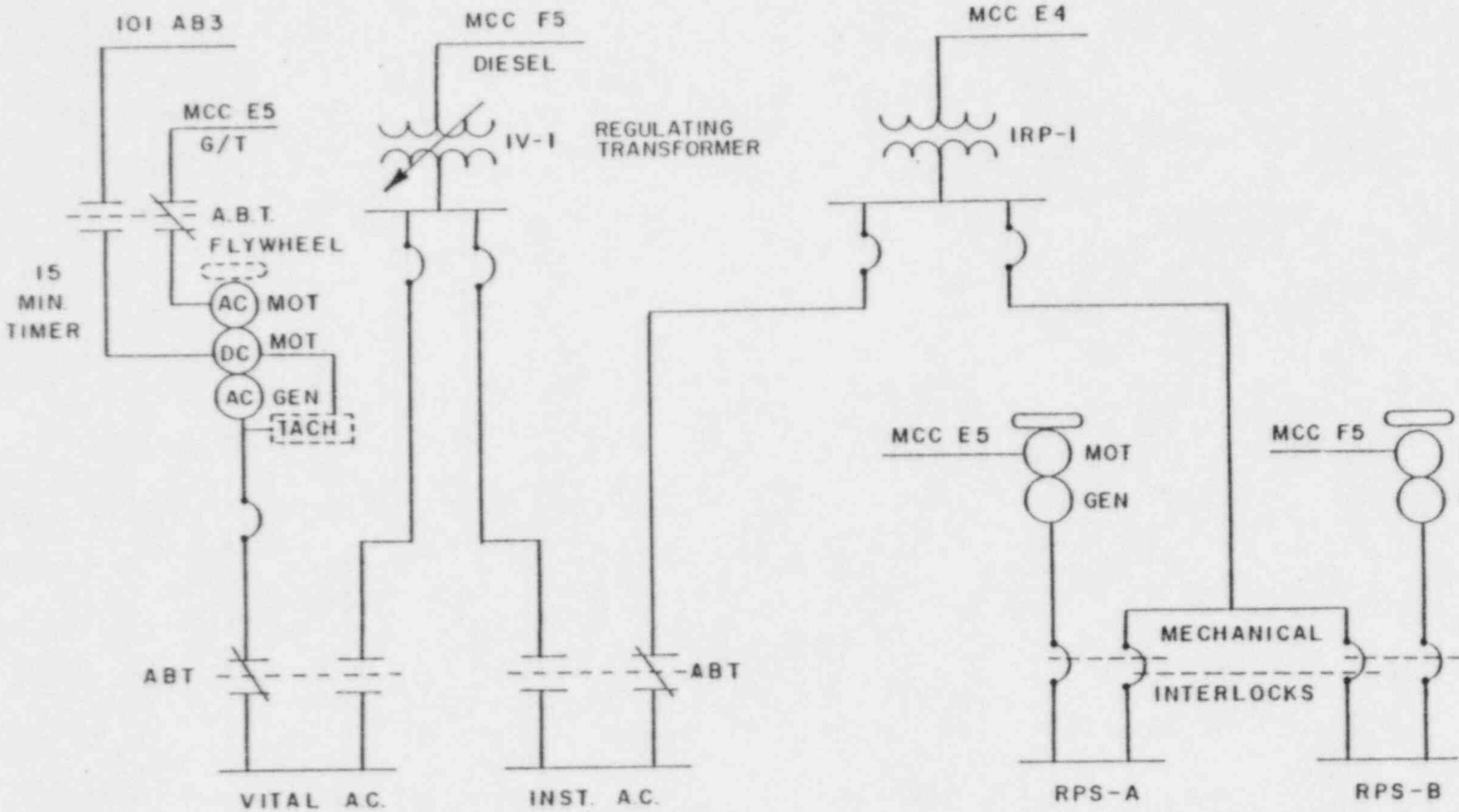

FIGURE I VITAL AC – INSTRUMENT AC REACTOR PROTECTION BUSES

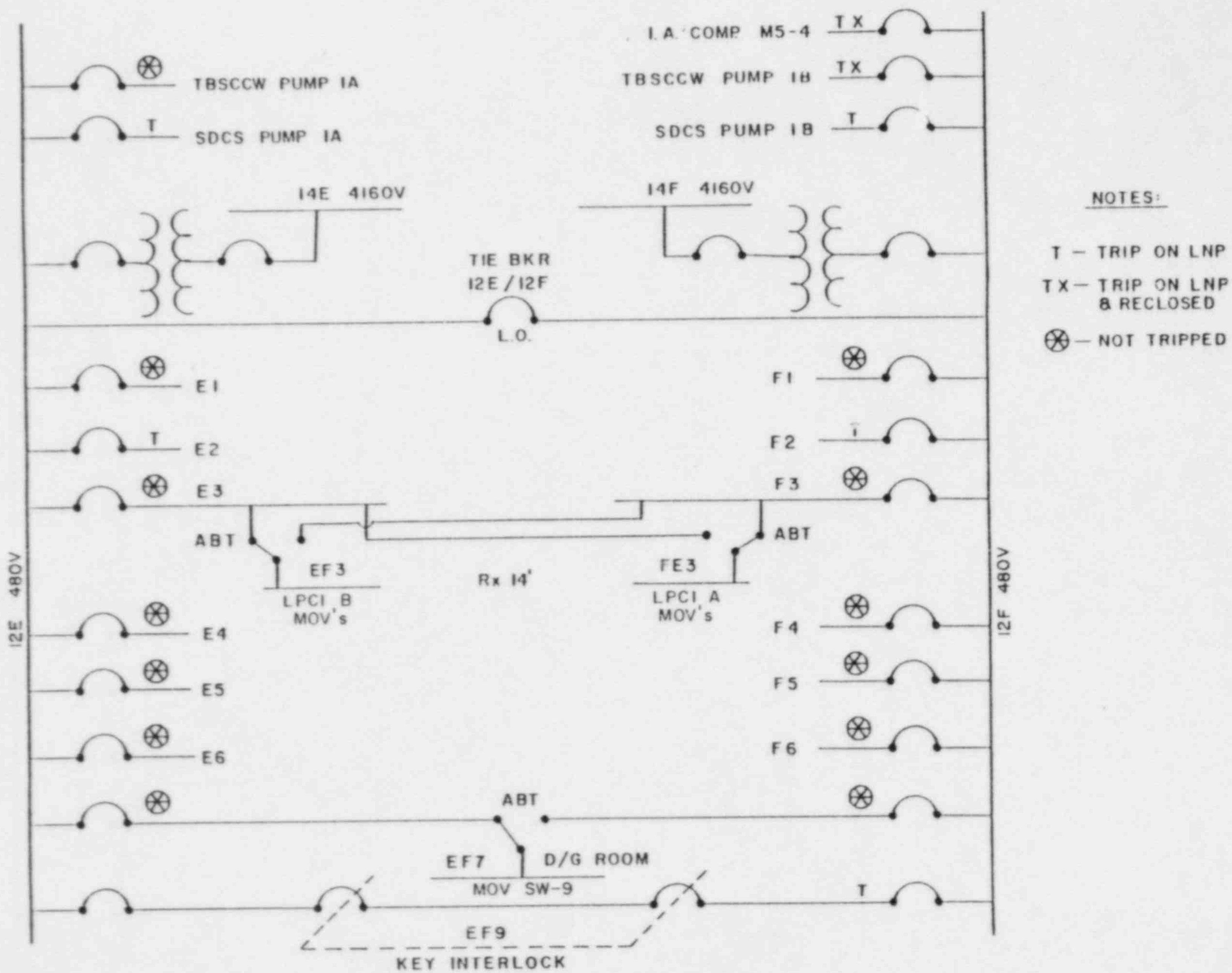

FIGURE 2 480 VOLT DISTRIBUTION 12E – 12F BUS