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PERRY NUCLEAR POWER PLANT

Al Kaplan
VICE PRESIDENT
NUCLEAR GROUP

July 11, 1988
PY-CEI/NRR-0879 L

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Perry Nuclear Power Plant
Docket No. 50-440
NRC Bulletin 88-04, Potential
Safety-Related Pump Loss

Gentlemen:

The subject bulletin requested evaluation of the potential for dead-heading safety-related pumps operating in parallel, or accelerating pump wear due to minflow line undersizing. CEI has completed this evaluation for Perry based on configurations described in the Updated Safety Analysis Report, available test data and existing operating procedures.

We have concluded that the potential for pump damage is negligible, and that sufficient redundancy and emergency cooling capacity exists to meet the requirements of 10 CFR 50.46 and GDC 35. The attachment provides detailed backup for these conclusions. Please call if you have further questions.

Very truly yours,

A. Kaplan

Al Kaplan
Vice President
Nuclear Group

AK:cab
Attachment
cc: T. Colburn
K. Connaughton
USNRC Region III

IE11
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Alvin Kaplan who, being duly sworn, deposed and said that (1) he is Vice President, Nuclear Group of The Cleveland Electric Illuminating Company, (2) he is duly authorized to execute and file this report on behalf of The Cleveland Electric Illuminating Company and as duly authorized agent for Duquesne Light Company, Ohio Edison Company, Pennsylvania Power Company and the Toledo Edison Company, and (3) the statements set forth therein are true and correct to the best of his knowledge, information and belief.

Alvin Kaplan

Alvin Kaplan

Sworn to and subscribed before me, this 11th day of July, 1988.

Jane E Mott

JANE E. MOTT
Notary Public, State of Ohio
My Commission Expires February 20, 1990
(Recorded in Lake County)

Evaluation of Perry Susceptibility to Safety Related Pump Degradation

NRC Bulletin 88-04 stipulated the following actions in paragraph 4:

> "Within 60 days of receipt of this bulletin, provide a written response that (a) summarizes the problems and systems affected, (b) identifies the short-term and long-term modifications to plant operating procedures or hardware that have been or are being implemented to ensure safe plant operations, (C) identifies an appropriate schedule for long-term resolution of this and/or other significant problems that are identified as a result of this bulletin, and (d) provides justification for continued operation particularly with regard to General Design Criterion 35 of Appendix A to Title 10 [Part 50] of the Code of Federal Regulations (10 CFR 50), "Emergency Core Cooling" and 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors."

CEI responses to each action item are provided below.

(a) No safety-related pump/piping system alignments exist that would result in pump-to-pump interaction during minimum flow operation and dead-heading one or more of the pumps. This is precluded in all but one case by pump arrangement and piping configuration.

The exception is the arrangement of the Low Pressure Core Spray Pump (E21-C001) and Residual Heat Removal Pump, "A" loop (E12-C002A). A common discharge exists for each pump's minimum flow piping into the RHR test return line to the Suppression Pool (Figure 1).

Pump-to-pump interaction has been minimized by the following design features:

1. Both pump minimum flow lines are orificed prior to the junction with the RHR test return line.

2. The common discharge line is increased in size from the minimum flow line sizes such that the flow resistance in this common line is an insignificant portion of the overall hydraulic resistance.

No actual test data exists for either combination of full test flow/minimum flow when both pumps are in operation. Engineering review of system resistance curves for each pump operating independently, and the respective pump performance curves, indicates that interaction between the systems may result in either pump not being able to meet the manufacturer's minimum flow requirements under the remote circumstance of one of these pumps in full flow to the test return line with the other pump in minimum flow. Corrective action is addressed below under (b).

A review of installed minimum flow capacity of other safety-related pumps and piping configurations was conducted and compared with the manufacturer's requirements. Design calculations based on actual piping configuration and preoperational or surveillance testing were utilized as data sources for flow capacities. In all cases but one, the minimum flow capacities exceeded the values specified by the manufacturer.

The exception is the minimum flow capacity provided for the RCIC Pump (E51-C001). Discussions with the pump vendor indicated that pump operation at the installed minimum flow capacity (approximately 14% of rated) is acceptable only for a time period of less than 20 seconds. Appropriate corrective action is detailed in section (b).

The remainder of the piping system configurations contain full flow or open flow paths in which the pump will operate at or near its design conditions upon startup and, therefore, minimum flow lines are not required for pump operation.

(b) System operation in the minimum flow mode, which includes the potential for dead-head operation, is already minimized for the short periods of pump startup during routine system operation, surveillance testing, and startup upon a LOCA signal.

For all systems with minimum flow lines, the System Operating Instructions (SOI) and Surveillance Instructions (SVI) have been reviewed with respect to the time of pump operation in the minimum flow mode. In some cases, sufficient caution statements are included in existing procedures to limit the time of pump operation in the minimum flow mode.

SOI/SVI procedure revisions will be provided for those systems which do not presently contain adequate caution. These cautions will limit pump minimum flow operation to a maximum of 30 minutes and assure that pump discharge is transferred to the full flow test line whenever possible. Instructions will be provided to prohibit operation in the minimum flow/full flow test combination for the Low Pressure Core Spray and Residual Heat Removal "A" Loop Systems, until such time as additional testing demonstrates that each pump delivers adequate minimum flow under the operating condition described in (a) above. For the RCIC pump a precaution has been added to the RCIC SOI to limit pump operation at minimum flow conditions to time periods less than 20 seconds.

(c) Review and approval of necessary procedure changes will be completed by October 15, 1988.

(d) The justification for continued operation provided by the BWR Owners Group in their letter BWROG-8836 is applicable to Perry:

1. Safety Class 1, 2 and 3 pumps must undergo inservice inspection per ASME Boiler and Pressure Vessel Code Section XI, Article IWP-1000. These quarterly tests are in addition to the Technical Specification surveillance requirements intended to demonstrate conformance with the plant safety analyses. The Section XI tests are intended to detect changes in pump performance; Article IWP-1500 ("Detection of Change") states:

   "The hydraulic and mechanical condition of a pump, relative to a previous condition, can be determined by attempting to duplicate, by test, a set of basic reference parameters. Deviations detected are symptoms of changes and, depending upon the degree of deviation, indicate need for further tests or corrective action."

   The inservice tests measure speed (if variable speed), inlet pressure, differential pressure, flow rate, vibration amplitude, and bearing temperature. Alert ranges and required action ranges are strictly defined, and require either increased frequency of testing or declaring the pump inoperable. Performance outside of the required action range would place the affected system in a Limiting Condition for Operation requiring repair, replacement, or an evaluation.

   Although these tests themselves would not detect pump dead-heading or inadequate minimum flow (since these are intended to be full flow tests), any deleterious effects of operating with inadequate flow would be detected in advance of significant pump performance degradation. Therefore, any changes in pump performance would be detected and corrected by routine pump testing in advance of pump degradation due to cumulative low flow effects during pump surveillance testing and normal system starts.

2. The potential for excessive pump wear attributable to minimum flow operation and/or dead-heading is negligible, since system operation in the minimum flow mode is limited to monthly surveillance testing and during system start on a LOCA signal.

3. BWR operating experience demonstrates that short-term operation in the minimum flow mode and/or dead-heading has little or no impact on pump life. Recent inspections of BWR RHR pumps have indicated no pump impeller excessive wear due to minimum flow. It is estimated that the pumps had been operating for up to 30 hours in the minimum flow mode in the period since the previous inspection.

   There have been occurrences when pumps have operated dead-headed inadvertently (i.e., dead-heading was not caused by minimum flow operation but, for instance, by incorrectly closing a valve). These pumps have continued to function normally.

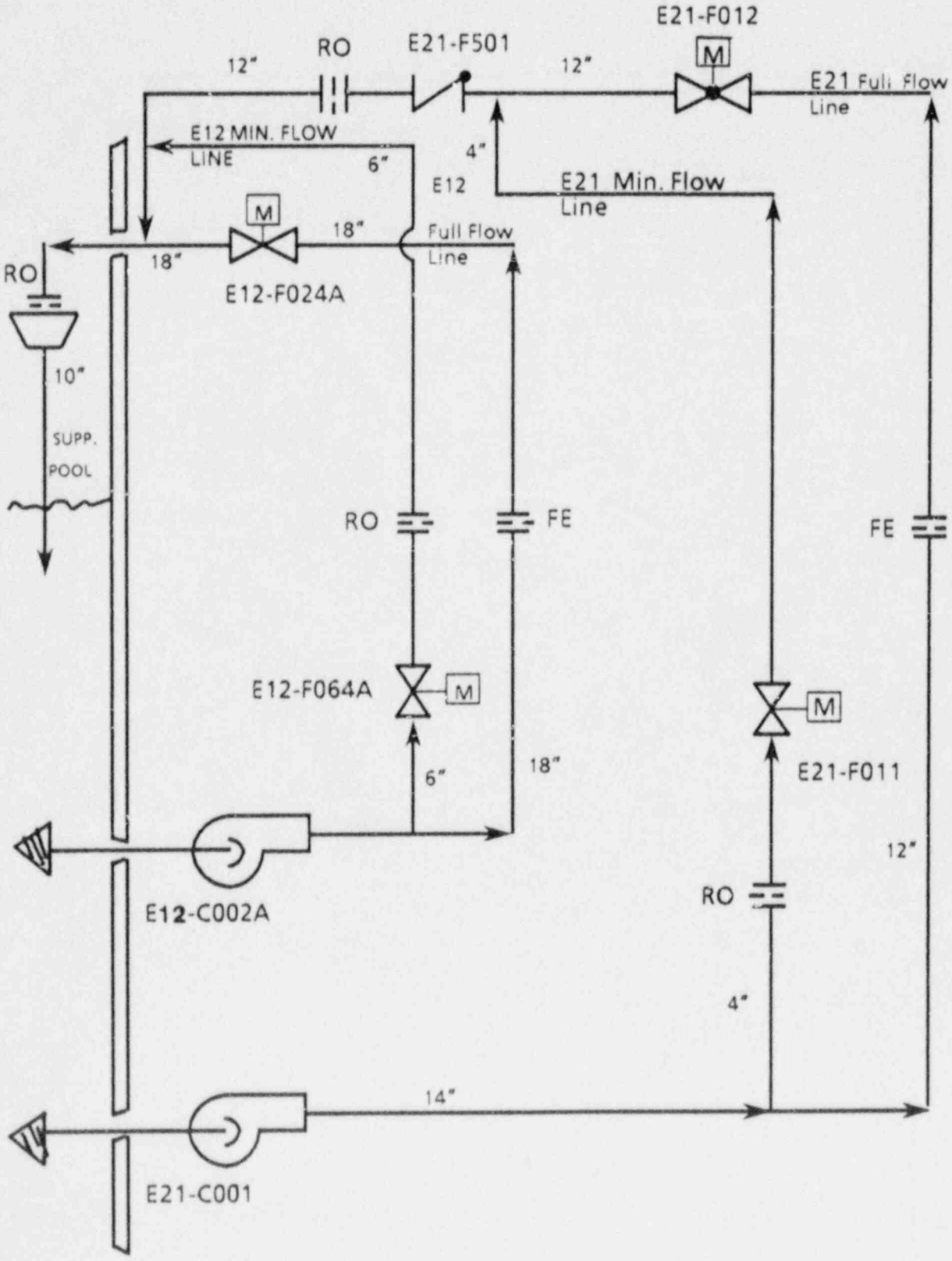
4. Pump wear attributable to minimum flow and/or dead-heading is not a significant contributor to total system unavailability. Other factors (such as loss of emergency power, loss of cooling, etc.) are more significant. BWR operating history indicates no occurrences of system unavailability due to excessive pump wear attributable to low flow operation.

5. For the RHR and core spray pumps, the only design basis events that would lead to pumps running in the minimum flow mode and/ or dead-heading are events that result in an emergency core cooling system (ECCS) initiation signal while the reactor is at high pressure (above the pump shutoff head). These are drywell isolation events caused by false LOCA signals, or actual small break events. Of these, only certain small break LOCA's actually require ECCS injection for LPCI or core spray where the pumps may be operated in the minimum flow mode. However, because of the excess ECCS capacity that is available, limiting LOCA scenarios do not depend on both of a pair of parallel pumps to operate in order to satisfy 10 CFR 50.46 requirements and General Design Criteria 35 of 10 CFR 50 Appendix A. There is no impact expected on the USAR Chapter 15 LOCA analyses.

   Once initiated, the maximum duration that a LPCI or core spray pump may operate in the minimum flow mode for the spectrum of hypothetical LOCA's is less than 30 minutes. This is derived from postulated small break LOCA's, wherein reactor depressurization to below the shut-off head of these pumps is delayed. For large break LOCA's, where the full complement of emergency cooling systems is more fully utilized, the reactor inherently depressurizes through the break. The present minimum flow bypass line is expected to provide adequate protection for these pumps for the short duration postulated during both the small and large break LOCA's.

   For other scenarios, there is adequate time to secure the RHR and core spray pumps, and restart them as necessary, precluding extended operation in the minimum flow mode.

Figure 1
Perry RHR/LPCS
Parallel Flow Paths



Key: RO = Restricting Orifice
FE = Flow Element