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MURRAY R. EDELMAN
VICE PRESIDENT
NUCLEAR

August 20, 1985
PY-CEI/NRR-0302 L

Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Perry Nuclear Power Plant
Docket Nos. 50-440; 50-441
Perry System Vibration and
Thermal Expansion Test Program

Dear Mr. Youngblood:

Attached is a copy of the subject program, originally forwarded by June 2, 1982 letter from Davidson to Schwencer, which has been revised to show the current plan for vibration and thermal expansion testing. The following categories of changes are proposed:

1. Some piping will be visually inspected post-fuel load instead of remotely monitored.
2. Some piping previously identified as being tested remotely, post-fuel load, will now be tested visually, pre-fuel load.
3. Systems having only containment penetrations in their scope were eliminated from testing. Penetrations were eliminated because they are anchored and the effects of thermal expansion and flow induced vibration are negligible.
4. The C85 system (Main Steam Bypass and Pressure Regulation) was removed from the scope due to its location and the lack of effect its failure would have on safety related or Seismic Category 1 plant features.
5. The vibration test scope was enlarged to include portions of the following systems:
 - a. Nuclear Boiler (B21)
 - b. Reactor Water Recirculation (B33)
 - c. Leak Detection (E31)
 - d. Suppression Pool Cleanup (G42)

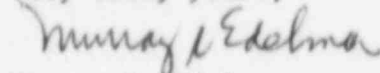
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- e. Control and Computer Room Humidification (M29)
 - f. Main, Reheat, Extraction and Miscellaneous Drains (N22)
 - g. Auxiliary Steam (P61)
 - h. HPCS Diesel Generator Fuel Oil (R45)
 - i. Feedwater/Feedwater Leakage Control (N27)
6. The thermal expansion test scope was enlarged to include portions of the following systems:
- a. Nuclear Boiler (B21)
 - b. Control Rod Drive (C11)
 - c. Fuel Pool Cooling and Cleanup (G41)

Applicable FSAR Text (Section 3.9.2.1 - Piping Vibration, Thermal Expansion, and Dynamic Effects) is consistent with this letter. Please call if you have any questions.

Very truly yours,



Murray R. Edelman
Vice President
Nuclear Group

MRE:njc

cc: Jay Silberg, Esq.
John Stefano (2)
J. Grobe

BOP SYSTEM VIBRATION AND THERMAL TESTING

BOP System Vibration and Thermal Testing is conducted in two phases, System Vibration and Thermal Pre-operational Testing and Post Fuel Load BOP System Vibration and Thermal Testing.

I. SYSTEM VIBRATION AND THERMAL PRE-OPERATIONAL TESTING

System vibration and thermal pre-operational testing of BOP safety related piping designated as ASME Class 1, 2, or 3 will be conducted. In addition, certain non-safety related piping will be tested. This piping includes high energy piping in Seismic Category I structures, high energy portions of systems whose failure could reduce the functioning of Seismic Category I plant features to an unacceptable level, and Seismic Category I portions of moderate energy systems located outside containment. Testing will include a visual observation that steady state and transient induced vibrations during acceptance and pre-operational testing are within acceptable limits in accordance with ASME Code Section III, paragraphs NB-3622.3, NC-3622.3 and ND-3622.3. Thermal testing will ensure that designated piping/piping supports exhibit unobstructed thermal expansion during acceptance, pre-operational and other system testing. Additionally, following the testing, a verification will be performed to ensure that snubber and spring hanger movements (travel) were within the predicted operating limits for the test conditions.

Details of the test (including systems) are included as Attachment 1.

II. POST FUEL LOAD BOP SYSTEM VIBRATION AND THERMAL TESTING

Post fuel load BOP system vibration and thermal testing includes those safety related, and certain nonsafety related, piping systems and components (as previously identified in Section I) which will not be monitored during acceptance and pre-operational tests. Testing will be accomplished by visual observation or by remote monitoring to ensure that steady state and transient induced vibration as well as thermal movements of such piping are within acceptable limits in accordance with ASME Code Section III paragraphs NB-3622.3, NC-3622.3 and ND-3622.3.

Details of the test (including systems) are included as Attachment 2.

III. ACCEPTANCE CRITERIA

Piping steady state and transient vibrations for BOP safety related piping systems and/or other systems as previously identified in Sections I and II; will be tested using acceptance limits which will ensure that the piping stresses, as a result of cyclic vibration in the range of 10^8 - 10^9 cycles will be limited to 1/2 of the fatigue endurance limit, at 10^6 cycles, as defined in the ASME Code Appendix I. For those piping systems for which the plant life cycle vibrations are expected to be 10^6 cycles or less, stress limits of the ASME Code Appendix I will be applied. Acceptance criteria establishing such limits have been developed for the steady state and transient vibration testing conditions.

Spring hanger movement shall be within the cold and hot setpoints for transient vibration testing and snubbers shall exhibit no evidence of damage. For thermal testing, spring hangers shall not become unloaded or bottom out and snubbers shall not become fully extended or retracted.

IV. ADDITIONAL ACTIVITIES

At the completion of testing, actual movement of the piping determined during visual thermal testing will be compared to analyzed values to assure proper design and installation. Any remote or visual indication that piping is binding or that thermal movements do not approximate predicted values during testing will be immediately evaluated. Appropriate action will be taken to prevent damage or overstressing of the piping.

SYSTEM VIBRATION AND THERMAL PRE-OPERATIONAL TESTING

TEST METHOD

1. Steady State Vibration and Thermal Expansion
 - a. The following systems (or designated portions of) will be visually inspected for vibration during acceptance or pre-operational testing. Systems marked with an asterisk (*) have portions which will also receive a thermal expansion test.

SYSTEM

- 1) Standby Liquid Control *
(C41)
- 2) Control Rod Drive Hydraulics*
(C11)
- 3) Residual Heat Removal*
(E12)
- 4) Low Pressure Core Spray*
(E21)
- 5) High Pressure Core Spray*
(E22)
- 6) Reactor Core Isolation Cooling*
(E51)
- 7) Reactor Water Cleanup*
(G33)
- 8) Fuel Pool Cooling and Cleanup*
(G41)
- 9) Suppression Pool Make-up
(G43)
- 10) DELETED (Liquid Radwaste - G50) See Paragraph 1g
- 11) Service Water
(P41)
- 12) Emergency Closed Cooling
(P42)
- 13) Nuclear Closed Cooling*
(P43)
- 14) Emergency Service Water
(P45)

- 15) Safety Related Instrument Air
(P57)
- 16) DELETED (Service Air - P51) See Paragraph 1g.
- 17) DELETED (Instrument Air - P52) See Paragraph 1g.
- 18) Standby Diesel Generator Starting Air
(R44)
- 19) Standby Diesel Generator Fuel Oil
(R45)
- 20) DELETED (Standby Diesel Generator Jacket Water Cooling - R46) See
Paragraph 1g.
- 21) Standby Diesel Generator Lube Oil
(R47)
- 22) Feedwater/Feedwater Leakage Control*
(N27)
- 23) Reactor Water Cleanup Filter/Demineralizer
(G36)
- 24) DELETED (Liquid Radwaste Sump - G61) See Paragraph 1g.
- 25) Condensate Storage & Transfer
(P11)
- 26) DELETED (Mixed Bed Demineralized Water - P22) See Paragraph 1g.
- 27) Control Complex Chilled Water
(P47)
- 28) DELETED (Containment Vessel Chilled Water - P50) See Paragraph 1g.
- 29) DELETED (Fire Service Water - P54) See Paragraph 1g.
- 30) DELETED (Nitrogen Supply - P86) See Paragraph 1g.
- 31) Standby Diesel Generator Exhaust, Intake & Crankcase*
(R48)
- 32) Combustible Gas Control
(M51)
- 33) Emergency Service Water Screen Wash
(P49)
- 34) Nuclear Boiler*
(B21)
- 35) Reactor Water Recirculation*
(B33)
- 36) Leak Detection*
(E31)

- 37) Suppression Pool Cleanup
(G42)
 - 38) Control and Computer Room Humidification*
(M29)
 - 39) Main, Reheat, Extraction and Miscellaneous Drains*
(N22)
 - 40) Auxiliary Steam*
(P61)
 - 41) HPCS Diesel Generator Fuel Oil
(R45)
- b. If visual inspection detects questionable vibration the portion of testing which produced that vibration will be repeated and the piping vibration will be monitored with a portable vibration monitor.
 - c. During the course of the repeat tests, regular vibration readings will be taken to determine compliance with acceptance criteria. If trends indicate that acceptance criteria may be violated, the frequency at which vibration readings are taken will be increased. The test will be subjected to a hold or terminated, as determined by the Qualified Piping Engineer, if acceptance criteria are violated.
 - d. As soon as possible after establishment of a test hold or termination of the test, the following corrective actions will be taken:
 - 1) Installation Inspection - a walkdown of the piping and suspension will be performed to identify any obstruction or improperly operating suspension components. The source of the excitation must be identified to determine whether it is related to equipment failure. Action will be taken to correct any discrepancies prior to repeating the test.
 - 2) Instrumentation Inspection - the instrument installation and calibration are checked and discrepancies will be corrected. Additional instrumentation will be added as necessary.
 - 3) If items d. 1) and d. 2) above identify discrepancies that could account for failure to satisfy acceptance criteria, the test will be repeated.
 - e. During visual observation of the above test conditions/retests close attention will be given to small attached piping and instrument connections to ensure that they are not in resonance with the major sources of vibration in their respective systems. If excessive vibration is observed and confirmed by portable vibration monitor, then the piping will be reviewed. Action will be taken to alleviate the excessive vibration and the final piping arrangement will be retested.
 - f. For thermal testing, attention shall be given to small attached piping and instrument connections to ensure that the smaller piping is not damaged or distorted. Visual evidence that spring hangers or snubbers did not meet acceptance criteria shall be brought to the immediate attention of

the Qualified Piping Engineer for review. The Qualified Piping Engineer shall determine if a test hold is required. If a test hold is required because of improper piping/support thermal response, the Qualified Piping Engineer shall determine necessary action before any additional system heatup is permitted.

- g. The systems shown as "deleted" were removed from the scope in accordance with the results of a system review. The review was based on the guidelines listed in Section I, System Vibration and Thermal Pre-operational Testing. Generic categories for systems that were deleted include systems having containment or drywell penetrations as their only safety related portion, systems having skid mounted, vendor supplied, piping as the only applicable portion, or systems that have been reclassified as non safety.

2. Transient Vibration

- a. During pre-operational testing designated system piping will be observed for vibration in response to various transients on the following systems:

SYSTEM

- 1) Residual Heat Removal (E12)
- 2) Low Pressure Core Spray (E21)
- 3) High Pressure Core Spray (E22)
- 4) Reactor Core Isolation Cooling (E51)
- 5) Reactor Water Cleanup (G33)
- 6) Fuel Pool Cooling and Cleanup (G41)
- 7) Suppression Pool Make-up (G43)
- 8) DELETED (Liquid Radwaste - G50) See Paragraph 1g.
- 9) Service Water (P41)
- 10) Emergency Closed Cooling (P42)
- 11) Nuclear Closed Cooling (P43)
- 12) Emergency Service Water (P45)
- 13) DELETED (Service Air - P51) See Paragraph 1g.

- 14) DELETED (Instrument Air - P52) See Paragraph 1g.
- 15) Standby Diesel Generator Starting Air
(R44)
- 16) Standby Diesel Generator Fuel Oil
(R45)
- 17) DELETED (Standby Diesel Generator Jacket Water Cooling - R46) See
Paragraph 1g.
- 18) Standby Diesel Generator Lube Oil
(R47)
- 19) Safety Related Instrument Air
(P57)
- 20) Standby Liquid Control
(C41)
- 21) Control Rod Drive Hydraulics
(C11)
- 22) Reactor Water Cleanup Filter/Demineralizer
(G36)
- 23) DELETED (Liquid Radwaste Sump - G61) See Paragraph 1g.
- 24) DELETED (Condensate Storage & Transfer - P11) See Paragraph 1g.
- 25) DELETED (Mixed Bed Demineralized Water - P22) See Paragraph 1g.
- 26) Control Complex Chilled Water
(P47)
- 27) DELETED (Containment Vessel Chilled Water - P50) See Paragraph
1g.
- 28) Standby Diesel Generator Exhaust Intake & Crankcase
(R48)
- 29) Emergency Service Water Screen Wash
(P49)
- 30) Nuclear Boiler
(B21)
- 31) Reactor Water Recirculation
(B33)
- 32) Suppression Pool Cleanup
(G42)
- 33) Combustible Gas Control
(M51)

34) Feedwater/Feedwater Leakage Control
(N27)

- b. During observation of each transient close attention will be given to small attached piping and instrument connections to ensure that they are not in resonance with the major sources of vibration, and to verify that they do not exceed transient vibration limits. If excessive vibration is observed and confirmed by portable vibration monitor, then the piping will be reviewed. Action will be taken to alleviate the excessive vibrations and the final piping arrangement will be retested.
- c. During piping system transient tests the suspension components will be observed. Verification will be made that spring hangers remain between their hot and cold setpoints, and that snubbers exhibit no evidence of damage.
- d. When visual inspection detects unacceptable vibration, the transient which produced that vibration will be repeated and the piping response will be monitored with a portable vibration monitor.
- e. During the course of the repeat tests if vibration readings exceed acceptance criteria, the test will be subjected to a hold or terminated at the direction of the Qualified Piping Engineer.
- f. As soon as possible after establishment of a test hold or termination of the test, the following corrective actions will be taken:
 - 1) Installation Inspection - a walkdown of the piping and suspension will be performed to identify any obstruction or improperly operating suspension components. The source of the excitation must be identified to determine whether it is related to equipment failure. Action will be taken to correct any discrepancies prior to repeating the test.
 - 2) Instrumentation Inspection - the instrument installation and calibration will be checked and discrepancies corrected. Additional instrumentation will be added as necessary.
 - 3) If items f.1) and f.2) above identify discrepancies that could account for failure to comply with acceptance criteria, the test will be repeated.

POST FUEL LOAD BOP SYSTEM VIBRATION AND THERMAL TESTING

1. Thermal Expansion Monitoring Only

Designated piping in the following systems will be remotely monitored for thermal expansion during various test conditions. Monitoring equipment used are transducers and a data acquisition system.

SYSTEM

- 1) TRANSFERRED to item 2 below (Residual Heat Removal - E12).
- 2) DELETED (Low Pressure Core Spray - E21) See Paragraph 2d below.
- 3) DELETED (High Pressure Core Spray - E22) See Paragraph 2d below.
- 4) TRANSFERRED to item 2 below (RCIC - E51).
- 5) DELETED (RWCU - G33) See Paragraph 2d below.
- 6) DELETED (Standby Liquid Control - C41) See Paragraph 2d below.

2. Thermal Expansion Monitoring and Vibration Testing

- a. Designated piping in the following systems will be either remotely or visually monitored for thermal expansion and steady state vibration during various test conditions. Equipment used for remote monitoring are transducers, accelerometers and a data acquisition system. Visual inspection (in low radiation areas) will be done in accordance with the criteria of Attachment 1, items 1b, 1c, 1d, 1e and 1f.

SYSTEM

- 1) Main Steam
(N11)
- 2) Main Reheat, Extraction and Miscellaneous Drains
(N22)
- 3) Feedwater/Feedwater Leakage Control (Vibration Only)
(N27)
- 4) MSIV Leakage Control
(E32)
- 5) DELETED (Main Steam Bypass and Pressure Regulation - C85) See Paragraph 2c below
- 6) Nuclear Boiler
(B21)
- 7) Control Rod Drive Hydraulics (Thermal Only)
(C11)

- 8) Residual Heat Removal
(E12)
- 9) Reactor Core Isolation Cooling
(E51)
- 10) Fuel Pool Cooling and Cleanup
(G41)

- b. Systems as listed in part 2.a of this attachment will also be either remotely or visually monitored for transient vibration during various transients. Equipment used for remote monitoring are accelerometers and a data acquisition system. Visual inspection (in low radiation areas) will be done in accordance with the criteria of Attachment 1, items 2b, 2c, 2d, 2e, and 2f.
- c. The C85 system was removed from the scope, since it is classified non-safety, it is outside of Seismic Category I structures, and a pipe break will not affect safety related or Seismic Category I plant features.
- d. The E21, E22, G33, and C41 systems have been deleted from post fuel load thermal testing since they are tested during the pre-operational test phase.

3. Remote Monitoring Equipment Details

- a. Piping movement is obtained by use of lanyard potentiometers.
- b. Piping vibration is obtained by use of accelerometers.
- c. A computerized data acquisition system is used to collect lanyard potentiometer and accelerometer data.