



Consumers Power

PALISADES NUCLEAR PLANT

SPECIAL TEST PROCEDURE

PROC NO T-147
PAGE 1 OF 6
REVISION 0
DATE

TITLE; WATER HAMMER TEST

REVIEWED BY
PRC/QC
DATE 11/12/81

TECHNICAL REVIEW PRIOR TO USE:
Ref.: Engineering Manual EM-14

APPROVED BY PLANT GENERAL MANAGER

/ NOV 13 1981 DATE

1.0 PURPOSE

To ascertain whether or not a main feedwater line or auxiliary feedwater line water hammer will result from the covering of the feedwater spargers following their uncover and drainage at various pressures and auxiliary feedwater flow rates. Due to the symmetry of the feedwater lines and the nearness of the containment access to the B steam generator, the feedwater piping connected to the B steam generator will be tested for a water hammer. Test will be conducted at 200 psi and 900 psi on secondary side.

2.0 REFERENCES

- 2.1 Combustion Engineering letter to Consumers dated December 7, 1979 entitled Guideline for Palisades Water Hammer Test.
- 2.2 NUREG 0291 - An Evaluation of PWR Steam Generator Water Hammer.
- 2.3 NSC Report entitles Evaluation of Auxiliary Feedwater Hammer at Palisades Plant 7/9/79.
- 2.4 NSC Report entitles Potential for Auxiliary Feedwater and Main Feedwater Water Hammer at Palisades Plant 2/24/77.
- 2.5 Test and test data from the Feedwater Line Water Hammer Test conducted at Palisades after Core 4 reload.
- 2.6 Operating Procedure GOP 2.
- 2.7 Standard Operation Procedure SOP 12 Feedwater System

3.0 PREREQUISITES

- 3.1 Instrumentation including strain gauges, pressure sensors, amplifiers and recorders have been installed and verified by Test Engineer to be operational. Background information has been recorded on the recorders.

Verified:

Date: 12-10-81
12-14-81

- 3.2 All personnel are cleared from containment.

Shift Supervisor:

J. W. Montan 12/14/81

8407110377 840709
PDR ADOCK 05000255
P PDR



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- 3.3 Communication has been established between personnel in Control Room and North cable penetration area where the instrumentation is located.

Test Engineer: [Signature] 12-14-81
12-10-81

- 3.4 Plant in heatup per GOP 2 with bubble formed in pressurizer and T hot at 382° F. (this corresponds to 200 psi in steam generator).

Test Engineer: [Signature] 12-10-81

- 3.5 Verification of reasonably lowest achievable concentration of non-condensable gases in secondary system (feedwater line, S.G.) shall be made by Test Engineer through consultation with the Chemistry Department.

Verified: [Signature] 12-10-81
12-10-81

- 3.6 Test Engineers are cognizant of all phases of test.

200# Test [Signature]
900# Test [Signature]

Date: 12-10-81

Date: 12-14-81

Date: _____

Date: _____

- 3.7 Notify QC prior to start of test.

QC Inspector: [Signature] 12-15-81
12/18/81

Date: 12/18/81

4.0 PRECAUTIONS AND LIMITATIONS

- 4.1 When adding feedwater during a test, PCS temperature and pressure will drop which will result in a shrinkage of PCS.
- 4.2 If during a test indications of a water hammer are present, remainder of test shall be aborted unless evaluation of test data proves otherwise.
- 4.3 If during a test indications of a water hammer are present, consideration shall be given to EOP 6 main steam line break/main feedwater line break inside containment.
- 4.4 At the discretion of the Test Engineer, steps can be terminated early and reinitialized.
- 4.5 Chart strip recordings must be labeled for each test in matrix with date, time, pressure in S.G. and refill rate.



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- 4.6 Consideration shall be given to actual vs. indicated steam generator level.
- 4.7 Steam Generator level referenced in this procedure shall be from the narrow range indicators.
- 4.8 Pressurizer heaters shall be kept on. Pressure will be controlled through cycling of spray valves.
- 4.9 Pressurizer level control may have to be put in manual at large auxiliary feedwater flow rates.
- 4.10 Operable charging pumps will be put in auto.
- 4.11 Boron concentration shall be at cold shutdown concentration or greater.

5.0 PROCEDURE

- 5.1 Isolate A steam generator by closing MO-0501 and CV-0737A.
- 5.2 Stabilize PCS at 382° F. or 532° F. ($\pm 5^\circ$ F.) depending on whether steam generator 200 psi or 900 psi test is being done through adjustment of MO-0510 and CV-0736A.
- 5.3 Close CV-0736A and adjust MO-0510 to drop steam generator B level to 5% while maintaining primary system temperature at value of Step 5.2.

NOTE: Blowdown can be used in addition to the above to drop level.
- 5.4 When level reaches 5% in steam generator B, adjust CV-0736A and MO-0510 to maintain this level while keeping primary system temperature stable.

NOTE: Isolate blowdown if blowdown used in Step 5.3.
- 5.5 Hold level at 5% in B steam generator for greater than 5 minutes.
- 5.6 Close MO-0510 and establish desired flow rate through adjustment of CV-0736A and use of FI-0736.

NOTE: For test runs with low flow rates, MO-0510 will have to be opened slightly to maintain desired PCS temperature.

For test runs with high flow rates, PCS temperature may drop.

CAUTION: Water hammer event should be anticipated during refill process.



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5.7 When level reaches 72% in steam generator B, adjust CV-0736A and MO-051 to maintain level at 72% and to stabilize PCS temperature.

5.8 Repeat Steps 5.2 through 5.7 for new matrix values upon consent of Test Engineer and Shift Supervisor.

NOTE: Prior to consent, Test Engineer will evaluate data from previous test and compare with acceptance criteria.

5.9 Return to service

1. Adjust steam generator level in both steam generator A and steam generator B to Shift Supervisor's advised level.
2. Disposition charging pumps per Shift Supervisor's advice.
3. Restore blowdown per Shift Supervisor's advice.

6.0 ACCEPTANCE CRITERIA

6.1 200 psi test

1. Pressure from test pressure sensors within ± 100 psi of 200 psi.
2. 565 microstrain (uin/in).

6.2 900 psi test

1. Pressure from test pressure sensors within ± 100 psi of 900 psi.
2. 455 microstrain (uin/in).

7.0 RECORDS AND ATTACHMENTS

7.1 Attachment - Test Matrix

7.2 Records

1. Chart Strip Recordings
2. Calibration information on equipment



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8.0 REVIEW

- 8.1 Test Data Evaluation performed by: *[Signature]* Date: 12-14-81
1-15-82
- 8.2 Technical Review performed by: *[Signature]* Date: 12-18-81
- 8.3 Administrative Review performed by: *[Signature]* Date: 1/15/2
Responsible Dept. Head



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TEST MATRIX

TEST NO.	TEST ENGINEER CONSENT & DATE	SHIFT SUPERVISOR CONSENT & DATE	S/G PSIA	GPM FW FLOW
1	<i>[Signature]</i> 12-10-81	<i>Aaron Brookhouse</i> 12-10-81	200	150
2	<i>[Signature]</i> 12-10-81	<i>Aaron Brookhouse</i> 12-10-81	200	300
3	<i>[Signature]</i> 12-14-81	<i>E. Thompson</i>	900 complete C320	200
4	<i>[Signature]</i> 12-14-81	<i>E. Thompson</i>	900	300
5	<i>[Signature]</i> 12-15-81	<i>[Signature]</i> 12-15-81	900	400

ATTACHMENT II

Steam Generator Refill Rates Using Auxiliary Feedwater Flow

Steam Generator refill rate shall be:

Two operable Steam Generators

- 150 gpm for Steam Generator level $\leq 15\%$
- 100 gpm (or less) for Steam Generator level $>15\%$ and $\leq 25\%$
- unrestricted for Steam Generator level $>25\%$

One operable Steam Generator

- 300 gpm for Steam Generator level $\leq 15\%$
- 100 gpm (or less) for Steam Generator Level $>15\%$ and $\leq 25\%$
- unrestricted for Steam Generator level $>25\%$



PR821020a
UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
750 ROOSEVELT ROAD
GLEN ELLYN, ILLINOIS 60137

RECEIVED
OCT 27 1982
NUCLEAR LICENSING

October 20, 1982

Docket No. 50-255

Consumers Power Company
ATTN: Mr. B. D. Johnson
Staff Licensing Engineer
212 West Michigan Avenue
Jackson, Michigan 49201

Gentlemen:

This is in response to your letter of August 17, 1982, requesting removal of the administrative limit on auxiliary feedwater flow rate to a single steam generator which was a subject of our letter of October 1, 1980.

We have reviewed the modifications to the auxiliary feedwater system, witnessed the water hammer testing on the modified system and reviewed the test results. We agree that the administrative limits discussed in our October 1, 1980 letter are no longer appropriate and that new maximum flow rates should be established and administratively controlled based on those flow rates attained during the performance of the water hammer tests.

Accordingly, the conditions of our October 1, 1980, Immediate Action Letter are considered satisfied.

Should you have any further questions concerning this matter, please contact this office.

James G. Keppler
James G. Keppler
Regional Administrator

cc:
D. J. Vande Walle, Nuclear
Licensing Administrator
R. W. Montross, General Manager
DMB/Document Control Desk (RIDS)
Resident Inspector, RIII
Ronald Callen, Michigan
Public Service Commission

RECEIVED
OCT 27 1982

DOCUMENT CONTROL CENTER
PALISADES

~~8210260179~~ PDR
1P

DCC: 02320/13370
42X05X15



Consumers
Power
Company

CARB Review Required
after evaluation 4/30/84
JSR/KHG/PWR/REMC

EVENT REPORT

Date

6/18/84 000995

EVENT REPORT NO E-PAL-84-024	
TIME OF OCCURRENCE Date 4/29/84	Hour 0800
SAFETY RELATED Yes XX No	

IDENTIFICATION AND DESCRIPTION

PART 1

TITLE: Steam Generator E-50A Auxiliary Feedwater Nozzle Cracking.

B PLANT SYSTEM(UFI) EQUIPMENT - CLASS(UFI) EQUIPMENT NUMBER

C DESCRIPTION OF OCCURRENCE OR CONDITION: Tear-like cracking located on the auxiliary feedwater nozzle radius. Multiple cracking exists in two locations on the nozzle radius. Facing the nozzle, the areas are from the 11 o'clock to the 1 o'clock position and from the 5 o'clock to the 7 o'clock position. All cracking starts at the end of the nozzle bore and extends axially out over the radius. Maximum length of any single crack is 2"; width of cracks are an average of 1/16"; depth is estimated to be .03 maximum.

D IMMEDIATE ACTION: Combustion Engineering field engineers contacted Combustion Engineering design engineers to prepare a recommendation for corrective action.

E REFERENCES: D-PAL-84-123.

F PREPARED BY: DW Rogers DATE: 4-30-84

DEPT/PLANT: PA SECTION: TE

G NONCONFORMING ITEM: YES ☒ NO ☐ IDENTIFY: Outage activity
DETERMINED BY: P-CARB DATE: 4-30-84 APPROVED BY: P-CARB DATE: 4/30/84

H ER FORWARDED TO: DEPT/PLANT: SECTION:

REVIEW AND NOTIFICATION

PART 2

A REPORTABLE TO NRC: YES ☒ NO ☐ R REPORTING REQUIREMENTS: ANNUAL ☒ 30-DAY 20-DAY

C PROMPT PRE: YES ☐ NO ☒ MEETING # 14-DAY 24-HOUR OTHER SPECIFY NONE SARB PRC

D FACILITY STATUS: Refueling S/O F METHOD OF DISCOVERY: S/G Inspection

F 24-HOUR NOTIFICATION
NRC (PERSON CONTACTED) DATE: 4/30/84 HOUR: 1155 BY WHOM: DW Rogers
OFFSITE (PERSON CONTACTED) Power Control DATE: 4/30/84 HOUR: 1150 BY WHOM: Shift Supervisor
TWX (PERSON CONTACTED) N/A

G EVALUATOR: JATerpstra DOE 6/18/84 PLANT: PA SECTION: PT ASSIGNED BY: P-CARB
EVALUATION DUE DATE: 5-10-84 PRIORITY: 8 7 6 5 4 X DATE ASSIGNED: 4-30-84

EVALUATION AND DISPOSITION

PART 3

A PROXIMATE CAUSE: Tear like cracking located on the auxiliary feedwater nozzle was primarily due to differential thermal stresses that arose when the relatively cool (50°F) auxiliary feedwater, spewed out of the cracked pipe and it contacted the hot (506°F) vessel wall and nozzle.

B ROOT CAUSE: Failure of the auxiliary feedwater sparger in close proximity to the radius of the emergency feedwater nozzle allowed auxiliary feedwater to come in contact with the heel of the nozzle to cause thermal cracking, raise the pitting potential and accelerate the pitting found there.
Determined By: JTerpstra Date: 6/16/84

C CONSIDERED TO BE REPORTABLE UNDER 10CFR21: YES ☐ NO ☒ DETERMINED BY: JTerpstra DATE: 6/16/84
(IF YES, NOTIFY NLA FOR FINAL DETERMINATION)

COMPLETION

PART 4

APPROVED BY DATE

COMPLETION REVIEW

PART 5

REVIEWED BY QUALITY ASSURANCE REPRESENTATIVE DATE

- (Gold) - COPY 5 - FORWARD TO QA UPON COMPLETION OF PART 2.
- (Pink) - COPY 4 - FORWARD TO NUCLEAR LICENSING ADMINISTRATOR UPON COMPLETION OF PART 3.
- (Canary) - COPY 3 - FORWARD TO QA UPON COMPLETION OF PART 3.
- (Green) - COPY 2 - FORWARD TO ORIGINATING DEPARTMENT UPON COMPLETION OF PART 5.
- (White) - COPY 1 - FILED IN DOCUMENT CONTROL CENTER UPON COMPLETION OF PART 5.

FORWARD ALL CORRECTIVE ACTION DOCUMENTS THROUGH YOUR CORRECTIVE ACTION COORDINATOR!

CORRECTIVE ACTION SHEET

PAGE OF

REPORT NO.	E- PA -84-024
TIME OF OCCURRENCE	11 Date HOUR
SAFETY RELATED	111 YES NO

EVALUATION	PART 3	COMPLETION	PART 4
------------	--------	------------	--------

PROPOSED REMEDIAL CORRECTIVE ACTION: Surface
ground the radius of the
emergency feedwater nozzle
until the tear-like
indications are removed.
Perform a dye penetrant
examination (PT) on the
nozzle radius when the
indications are no longer
visible to verify that
cracking no longer exists.
Verify that the "as left"
condition of the emergency
feedwater nozzle still meets
minimum structural requirements.

PRC: YES NO ☒ X
MEETING
PRIOR TO PLACING RELIANCE
YES ☒ X NO
ASSIGNED TO JAT
DEPT/PLANT PAL
SECTION PCH
APPROVED BY PLK
DATE APPROVED 6/18/84
REQD COMPLETION DATE 6/18/84
PRIORITY: 8 7 6 5
4 X 3 2 1

REMEDIAL ACTION TAKEN: Combustion Engineering
ground the radius of the nozzle
until the tear-like indications
were gone. Grinding was performed
in such a manner as to minimize
the total amount of metal removed
and was done to maintain the
general contour as closely as
possible, i.e. maintain a radius
concentric with the existing radius.
Combustion Engineering took "as
found" and "as left" contour
measurements of the cross

sectional areas where grinding was
performed. A maximum depth of
7/16" was ground from the 6
o'clock position on the radius of the
nozzle. An average depth of 1/4"
was ground from all other positions
on the radius of the nozzle.

A successful dye penetrant examination
of the radius of the nozzle was performed
when the grinding was completed. A
copy of the PT examination report is
(continued)

COMPLETED BY J. Terpsino DATE 6/16/84
APPROVED BY CLOO DATE 6/18/84

DETERMINED BY J. Terpsino DATE 6/16/84

PROPOSED CORRECTIVE ACTION TO PREVENT RECURRENCE:
Remove the broken auxiliary
feedwater sparger / thermal
liner assembly from the
steam generators. Install
a new thermal liner in
the emergency feedwater
nozzle of the steam
generators. The new thermal
liner assembly shall be
welded to the safe end
of the emergency feedwater
nozzle via a machined
transition piece.

PRC: YES ☒ X NO
MEETING
PRIOR TO PLACING RELIANCE
YES ☒ X NO
ASSIGNED TO JAT
DEPT/PLANT PAL
SECTION Pch
APPROVED BY PLK
DATE APPROVED 6/18/84
REQD COMPLETION DATE 6/18/84
PRIORITY: 8 7 6 5
4 X 3 2 1

ACTION TAKEN TO PREVENT RECURRENCE: The broken
auxiliary feedwater sparger / thermal
liner assembly was removed
from the steam generator by
Combustion Engineering. A
thermal liner assembly with
an inverted T-tube at the
nozzle discharge was installed
within the steam generator. The
purpose of the inverted T-tube
at the nozzle discharge is
to keep auxiliary feedwater
spray from contacting the

nozzle region. The thermal liner
assembly is equipped with a transition
piece which was welded to the safe
end of the emergency feedwater nozzle
on the steam generator. The inner
diameter of the auxiliary feedwater
nozzle is approximately 0.25 inches.
The inner diameter of the auxiliary
feedwater nozzle thermal liner
assembly is 3 inches. This design
was conceived by Westinghouse and
was installed under facility change
FC-613.

COMPLETED BY J. Terpsino DATE 6/16/84
APPROVED BY CLOO DATE 6/18/84

DETERMINED BY J. Terpsino DATE 6/16/84

- (Gold) - COPY 4 - (FOR ERS) FORWARD TO NUCLEAR LICENSING ADMINISTRATOR UPON COMPLETION OF PART 3; (FOR DRS AND NRS - DISCARD).
(Pink) - COPY 3 - FORWARD TO QA UPON COMPLETION OF PART 3.
(Canary) - COPY 2 - FORWARD TO ORIGINATING DEPARTMENT UPON COMPLETION OF PART 5.
(White) - COPY 1 - FILED IN DOCUMENT CONTROL CENTER UPON COMPLETION OF PART 5.

FORWARD ALL CORRECTIVE ACTION DOCUMENTS THROUGH YOUR CORRECTIVE ACTION COORDINATOR!

CONTINUATION SHEET

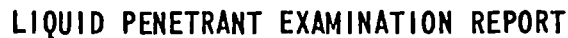
(NOTE SECTION TO WHICH ADDITIONAL INFORMATION APPLIES)

PAGE ____ OF ____

REPORT NO. ____

attached. No crack-like indications were noted in the region where grinding was performed.

Combustion Engineering has performed an analysis on the nozzle radius after grinding was completed. The results of this analysis conclude that upon completion of the grinding by Combustion Engineering the minimum reinforcement requirements for the radius of the nozzle are still met and no additional reinforcement is required. The analysis performed by Combustion Engineering was documented on Combustion Engineering calculation SS-31 dated May 24, 1984 and has been attached to this corrective action document.



EXAMINER STEVEN R. WELLMAN LEVEL II DATE 5-5-84 SHEET NO SW-1
EXAMINER N/A LEVEL N/A NDT COMPANY CONSUMERS POWER CO.
PROJECT NO 238415223080 REQUESTING DEPT TECHNICAL
JOB LOCATION PALISADES TOTAL HOURS WORKED N/A

NDT PROCEDURE NDT-PT-01 REV 2

METHOD/TECHNIQUE COLOR CONTRAST/SOLVENT REMOVABLE

CLEANER MANUFACTURER MAGNAFLUX TYPE SKC-S BATCH NO 83D021

PENETRANT MANUFACTURER MAGNAFLUX TYPE SK1-HF/S BATCH NO 83D038

EMULSIFIER MANUFACTURER N/A TYPE N/A BATCH NO N/A

DEVELOPER MANUFACTURER MAGNAFLUX TYPE SKD-S BATCH NO 83E026

PRECLEANING DRYING TIME 5 MIN METHOD OF APPLYING PENETRANTS SPRAY DWELL TIME 10 MIN

METHOD OF REMOVING EXCESS PENETRANT UTILITY WIPES WATER PRESSURE N/A WATER TEMPERATURE N/A

DRYING TIME AFTER EXCESS PENETRANT REMOVAL 5 MIN METHOD OF APPLYING DEVELOPER SPRAY DEVELOPING TIME 10 MIN

LIGHT INTENSITY 156 FT/CAVITIES LIGHT METER SERIAL NO 3743-10740

SURFACE TEMPERATURE 68° THERMOMETER SERIAL NO 3743-00807

WELD TYPE FORGING

DIRECTION OF FLOW

REV 2 /83