Consumers Energy

A CMS Energy Company

Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043

Daniel G. Malone
Acting Director, Licensing

March 8, 2000

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

DOCKET 50-255 - LICENSE DPR-20 - PALISADES PLANT
1999 CONTAINMENT INSERVICE INSPECTION, TESTING AND AGING MANAGEMENT REPORT, ISI SUMMARY - REFOUT 14

The attached report is being submitted to the NRC in accordance with ASME Section XI, 1992 Edition, IWA-6240(b), which states, "The inservice inspection summary report shall be submitted within 90 calendar days of the completion of each refueling outage." The Palisades 1999 Refueling Outage ended December 21, 1999.

This report provides a summary of examinations, inspections and corrective actions related to the 1999 Refueling Outage performance of Containment Liner Plate inservice examinations. All activities were performed in accordance with the rules and requirements specified in ASME Section XI, Subsection IWE and previously approved corrective actions.

In accordance with 10CFR50.55a, Palisades is required to implement ASME Section XI, 1992 Edition, 1992 Addenda, Subsection IWE and IWL by September 9, 2001. This requirement is met by implementation of inspection program B as described in IWE-2412.

SUMMARY OF COMMITMENTS

This letter contains no new commitments and no revisions to existing commitments.

Daniel G. Malone
Acting Director, Licensing

CC Administrator, Region III, USNRC
Project Manager, NRR, USNRC
NRC Resident Inspector - Palisades

Enclosure

A047

ENCLOSURE

CONSUMERS ENERGY COMPANY
PALISADES PLANT
DOCKET 50-255

JANUARY 20, 2000

PALISADES NUCLEAR PLANT CONTAINMENT INSERVICE INSPECTION, TESTING AND AGING MANAGEMENT, ISI SUMMARY - REFOUT 14

40 Pages

PALISADES
NUCLEAR PLANT

PALISADES NUCLEAR PLANT

CONTAINMENT INSERVICE INSPECTION, TESTING AND AGING MANAGEMENT, ISI SUMMARY - REFOUT 14

UTILITY: Consumers Energy

PLANT: Palisades Nuclear Plant

AUTHOR:	GESchrader, PE, Program Sponsor	Date 01.31.00
TECHNICAL REVIEWER	THNewton, System Engineer	Date 12/1/00
MANAGER APPROVAL	JKFord, Engineering, Programs	Date 2/15/00

January 20, 2000

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1999 CONTAINMENT INSERVICE INSPECTION, TESTING AND AGING MANAGEMENT REPORT, ISI SUMMARY - REFOUT 14

Submitted in accordance with ASME Boiler and Pressure Vessel Code, Section XI, Article IWA-6000, 1992 Edition, 92 Addenda

1. Date: October through November 1999

2. Company Headquarters: Consumers Energy Company
   212 West Michigan Avenue
   Jackson, Michigan 49201

3. Plant: Palisades Nuclear Plant
   27780 Blue Star Memorial Highway
   Covert, Michigan 49043

4. Unit No: One

5. Commercial Service Date: December 31, 1971

6. Major Component Inspected:

Component	Manufacturer	Equipment Number
Liner Plate	Bechtel	N-54B
Escape Airlock	Progressive	MZ-50

7. Completion Date of Examination: November 26, 1999

8. Code Inspector: KLBlake

9. Authorized Inspection Agency: FMIC

   Johnston, R.I.

10. Abstract: See attached report

1.0 PURPOSE

In accordance with Code of Federal Regulation 10CFR50.55a, Palisades is required to implement ASME Section XI, 1992 Edition, 1992 Addenda, Subsection IWE and IWL by September 9, 2001. This requirement is met by implementation of inspection program B as described in IWE-2412.

This report provides a summary of examinations, inspections and corrective actions related to the 1999 Refueling Outage performance of Containment Liner Plate, inservice examinations. All activities were performed in accordance with the rules and requirements specified in ASME Section XI, Subsection IWE and previously approved corrective actions.

In accordance with ASME Section XI, 1992 Edition, IWA-6240(b), "The inservice inspection summary report shall be submitted within 90 calendar days of the completion of each refueling outage." The 1999 Refueling Outage ended December 21, 1999.

2.0 EXAMINATION AND INSPECTION SCOPE FOR 1999 REFUELING OUTAGE

The examination and inspection scope for the 1999 Refueling Outage is summarized in the following tables:

Palisades Nuclear Plant
ASME Section XI, IWE and IWL
1999 Outage Plan, Table 1

2.1 Examination Category E-A, Containment Surfaces - Table 1

Examination Category	Item Number	Reference I.D.	Drawing/ Stress Iso.	Examination	Examination Procedure	Data Sheet Number	Date Completed	Comments
E-A	E-1.11	Containment Liner Support Truss #1 through 18	Ref.Dr. C-138 ISO. S-1	General VT	NDT-VT-07	DAC 1	10/24/99	None

2.2 Examination Category E-D, Seals, Gaskets and Moisture Barriers - Table 2

Examination Category	Item Number	Reference I.D.	Drawing/ Stress Iso.	Examination	Examination Procedure	Data Sheet Number	Date Completed	Comments
E-D	E-5.30	Moisture Barrier, Elevation 590' Examination area from 0 to 120 degree	Ref.Dr. C-135, C-136	VT-3	NDT-VT-07	DAC 1	10/23/99	C-PAL-99-2035

2.3 Examination Category E-G, Pressure Retaining Bolting - Table 3

Examination Category	Item Number	Reference I.D.	Drawing/ Stress Iso.	Examination	Examination Procedure	Data Sheet Number	Date Completed	Comments
E-G	E-8.10	Escape Airlock	Ref.Dr. C-135, M-232-1, ISO. P-10	VT-1	NDT-VT-07	DAC 1	11/08/00	None

2.4 Palisades' Condition Report C-PAL-98-1018A, "Containment Liner Plate Corrosion Observed During Containment Coatings Walkdown"

Based on an engineering inspection conducted during the 1998 Refueling Outage, various locations on the containment liner were scheduled for additional inspection during the 1999 Refueling Outage.

The lowest Containment floor elevation is located at the 590 foot elevation, while the Safety Injection Tank Catwalk is at approximately the 740 foot elevation. All azimuth angles are determined from the zero degree location which is aligned with North. Azimuth degrees increase when proceeding clockwise form North to East. Reference Engineering Drawing C-135, "Containment General Plan, Elevation and Details." Table 4 provides an inspection results summary and is included as follows:

Table 4

Location	Description	Actions Taken
Elevation 659 ft; Azimuth 98 degrees	Two rust spots on liner plate.	Visual Inspection
Elevation 670 ft; Azimuth 340 degrees	Liner plate bulge at hatch.	Visual Inspection
Elevation 658 ft; Azimuth 40 degrees	Discoloration on liner plate, 6 spots.	Visual Inspection
Elevation 634 ft; Azimuth 85 degrees	Blemish on liner plate.	Visual Inspection
Elevation 640 ft; Azimuth 85 degrees	Liner plate rust stain.	Visual VT-3 & UT; Location re-coated.
Elevation 740 ft;	Un-coated, rusted spot on liner plate.	Visual VT-3 & UT; Location re-coated.
Elevation 662 ft; Azimuth 350 degrees	Equipment Hatch support rail and liner plate.	Visual Inspection
Elevation 660 ft; Azimuth 350 degrees	Equipment hatch, looking up.	Visual Inspection
Elevation 740 ft	Blemish on liner plate.	Visual Inspection
Elevation 740 ft; Azimuth 265 degrees	Attachment to liner plate.	Visual Inspection
Elevation 740 ft; Azimuth 174 degrees	Rust bleed through at dome truss support. Blemish on liner plate.	VT-3 and UT; Location re-coated.

3.0 EXAMINATION AND INSPECTION RESULTS AND CORRECTIVE ACTIONS

3.1 Examination Category E-A, Containment Surfaces

Examination Results:

No conditions adverse to quality were discovered during the VT-1 examinations of 100% of the Containment Liner Support Truss population. This is equal to 43% of Exam Category E-A, Item Number E1.11, Supports total.

Corrective Actions:

No conditions requiring the initiation of work order requests were discovered during the VT-1 examinations of Containment Liner Support Trusses.

3.2 Examination Category E-D, Seals, Gaskets and Moisture Barriers

Examination Results:

The moisture barrier was examined by VT-3 method from the 0 to 120 degree location at the 590 foot elevation of containment which represents 33% of the entire circumference. This area failed acceptance criteria, and the examination scope was expanded to include 100% of the Exam Category E-D, Item Number E5.30, Moisture Barrier. Remarks contained on the examination sheet state "the entire 360 degree of the moisture barrier appears to be eroded and broken down or missing entirely. The coating on the liner plate near the moisture barrier appears to be loose or missing in numerous areas."

Corrective Actions:

Due to failure to meet acceptance criteria in the 0 to 120 degree area, Condition Report C-PAL-99-2035 was initiated and the entire circumference at 590 foot elevation of containment was inspected.

Work order 24903053 was written to control assessment activities for the liner plate at the 590 foot elevation of containment. This included areas at and just above the floor level and areas below floor level. Examination by ultrasonic test (UT) was performed at six locations at and just above floor level. These locations were chosen based on amount of broken or peeling paint, observed corrosion or because boric acid or water was found in contact with the liner plate. Examination results indicate all areas meet the nominal 0.250 inch plate thickness described in FSAR 5.8. Minimum measured wall thickness was 0.242. Maximum thickness was nominally 0.280 inches.

If it is assumed that the nominal, as purchased, plate thickness was 0.280 inches, the 0.242 inch measurement would indicate a 0.038 inch degradation from nominal plate thickness. This would exceed the 10% degradation limit specified in IWE-3512.3, "Ultrasonic Examination" of ASME Section XI, 1992 Edition, 1992 Addenda. Palisades Engineering Analysis EA-EAR-98-0443-01, "Basis for ISI Acceptance Criteria for Containment Liner Reduced Thickness" (Attachment 3), documents the basis for accepting thinning up to 0.0625 inch for normal surfaces and 0.125 inch for surfaces which may experience accelerated degradation. In either case, the 0.242 inch dimension is well above minimum thickness requirements determined in the engineering analysys.

Liner plate inspection by boroscope below the containment 590 foot elevation moisture barrier did not discover evidence of corrosion greater than that documented at and above the floor elevation. The liner is 0.500 inch nominal thickness below the floor verses 0.250 nominal thickness above the floor. Visual inspection results indicate less corrosion is taking place below floor level. This observation is supported by industry operating experience (OE) documented in OE 10288 and others.

Work order 24813617 was written to restore the degraded moisture barrier. Initial scope included approximately 30 feet of the 365 feet located on the 590 foot elevation containment circumference. Once the full amount of degradation was understood, the scope was increased to include the entire containment circumference.

Once the moisture barrier is restored, all degradation should stop and no further thinning is expected. To provide assurance of effective measures, the area with the maximum thinning will be re-examined during the 2001 Refueling Outage.

Work order 24710713 was originally written to control recoating of two locations described in C-PAL-98-1018A, which will be discussed later in this report. Recoating at the 590 foot elevation moisture barrier was added to the scope during the refueling outage.

Work order 24010051 will direct the inspection of a sample set of locations below the containment 590 moisture barrier during the 2001 Refueling Outage.

3.3 Examination Category E-G, Pressure Retaining Bolting

Examination Results:

No conditions adverse to quality were discovered during the VT-1 visual examinations of Containment Escape Hatch bolting. The scope completed during the 1999 Refueling Outage represents 100% of the Exam Category E-G, Item Number E8.10, Emergency Airlock total.

Corrective Actions:

No conditions requiring the initiation of corrective actions were discovered during the VT-1 visual examinations of Containment Escape Hatch bolting.

3.4 Palisades' Condition Report C-PAL-98-1018A, " Containment Liner Plate Corrosion Observed During Containment Coatings Walkdown"

Examination and Inspection Results:

No conditions adverse to quality were discovered during the visual inspections, VT-3 examinations or UT examinations of the eleven locations described in the condition report.

Corrective Actions:

Work order 24710713 was written to control "as-found" VT-3 examination, preparation, UT examination, painting and "as-left" VT-3 examination of two locations on the containment liner plate. Based on the results of examination in these areas, a decision to "accept as-is" was made for the remainder of locations. The basis for this decision is documented in the response to C-PAL-98-1018A. In summary, the two locations recoated by this work order met all acceptance criteria for UT and "as-left" VT-3 examination. All other locations remained unchanged in appearance when compared to photographs from the 1998 Refueling Outage.

A work order was drafted as a result of visual examination of the containment liner at the 740 foot elevation, Safety Injection Tank Catwalk, Azimuth 174. Corrosion identified during the examination is a result of failure to remove test instruments associated with the preoperational containment structural integrity test (SIT). Other attachments associated with this test remain, and corrosion is noted at some locations. The proposed work order will direct the removal of all SIT equipment and recoating of the liner plate at these locations. Additionally, this work order will direct the recoating of all locations within the scope of ASME Section XI, Subsection IWE.

4.0 EXAMINATION AND INSPECTION SUMMARIES

4.1 Containment Liner Examinations, Preservice to 1999 Refueling Outage

4.1.1 Preservice Examination

Preservice examinations for containment are documented in Palisades FSAR 5.8.8, Containment Structure Testing and 5.8.8.4, "Structural Integrity Test."

4.1.2 An initial Containment Liner Plate and Penetration Surveillance Program is documented in FSAR 5.8.8.5. The liner plate and penetration surveillance program was established to satisfy the requirements of the Plant Technical Specifications. Surveillances were conducted before the pressurization phase of the structural integrity test (PPSIT) on approximately March 22, 1970, after the PPSIT, one year after initial start-up and one-and-one-half years after initial start-up. It was concluded that the liner plate system and penetration assemblies were performing as predicted. Therefore, the surveillance program was terminated.

4.1.3 Steam Generator Replacement Construction Opening

Details pertaining the steam generator construction opening are described in Palisades FSAR 5.8.9.

4.2 Containment Reinforcing Concrete Examinations, Preservice to Present

4.2.1 Preservice

Preservice examinations for containment is documented in Palisades FSAR 5.8.8, Containment Structure Testing.

4.2.2 FSAR 5.8.8.6, "End Anchorage Concrete Surveillance"

The end anchorage concrete surveillance program was established to satisfy the requirements of the Plant Technical Specifications. Observations were made before, during and after the PPSIT. Subsequent observations were made February 12, 1971 and June 7, 1971. It was concluded that the end anchorage concrete was sound and free of significant cracking. Therefore, the surveillance program was terminated.

4.2.3 Steam Generator Replacement Construction Opening

Details pertaining the steam generator construction opening are described in Palisades FSAR 5.8.9.

4.3 Containment Post Tensioning System, Preservice to 25-Year Surveillance

4.3.1 Preservice Examination

Preservice examination for containment post tensioning system is documented in Palisades FSAR 5.8.8.3, "Prestressing System Surveillance."

4.3.2 1, 3 and 5 and 10 through 20-Year Surveillances

Historical summary for containment 1, 3, 5 and 10 through 20-Year Post Tensioning System surveillances are documented in Palisades FSAR 5.8.8.3.5, "Historical Summary."

4.3.3 25-Year Surveillance

Consumers Energy Company submitted the Palisades 25-Year tendon surveillance report on December 18, 1997, with a supplemental submittal on February 23, 1998. Additionally, information was submitted September 25, 1998 in response to the NRC's July 27,1998 request.

5.0 ASSESSMENT OF POTENTIAL DEGRADATION MECHANISMS

5.1 Containment Metal Liner

5.1.1 Pitting Thinning

This degradation has not been found at Palisades to date.

5.1.2 Corrosion Thinning (Atmospheric, Embedment, Crevice, Differential Aeration, Galvanic, Microbiologically Induced, Chemical)

Atmospheric corrosion was discovered during the 1999 Refueling Outage. Minor corrosion was noted at the 590 foot elevation moisture barrier and at various locations where Structural Integrity Test strain gauges remained attached to the liner plate. Corrosion occurred at unprotected carbon steel surfaces. Areas of occurrence were characterized by visual evidence of redish brown discoloration. Corrosion was minor and liner plate nominal wall thickness was not significantly affected.

5.1.3 Mechanical Damage, Wear Erosion or Abrasion

This degradation has not been found at Palisades to date.

5.1.4 Galvanic Corrosion Thinning

This degradation has not been found at Palisades to date.

5.1.5 Cracking (Stress Corrosion, Cyclic Fatigue)

This degradation has not been found at Palisades to date.

5.2 Containment Reinforcing Concrete

5.2.1 Chemical Attack of Concrete

This degradation has not been found at Palisades to date.

5.2.2 Freeze-Thaw

This degradation has not been found at Palisades to date.

5.2.3 Differential Settlement

This degradation has not been found at Palisades to date.

5.2.4 Aggregate Reactions

This degradation has not been found at Palisades to date.

5.2.5 Leaching of Calcium Hydroxide

This degradation has not been found at Palisades to date.

5.2.6 Mechanical Damage, Wear Erosion or Abrasion

This degradation has not been found at Palisades to date.

5.3 Containment Post Tensioning System

5.3.1 Tendon Wire Corrosion

This degradation has not been found at Palisades to date.

5.3.2 Tendon Relaxation

The lift-off forces for tested tendons are reviewed at each surveillance. With some exceptions, lift-off forces are above the lower bound values (i.e, the prescribed lower limits) established for each group. Some tendons have tested below their respective prescribed lower limit, but above 95% of this limit. The force and elongation for affected tendons were analyzed. The analysis indicates that there is some non-linearity in the force/elongation relation. This is caused by a binding of the tendon and would not have any effect on the performance of the tendons.

Subsection 7.1.6 of RG 1.35, Revision 3, implies that the trend of the pre-stress loss should be determined, if the loss is larger than expected. In order to determine the trend, it is necessary to perform a regression analysis of the tendon lift-off forces for all the tendons in a group, from all the surveillances conducted to date after the structural integrity test. Palisades has performed a regression analysis which indicates the average lift-off force curve for each group. The results of the analysis indicate that for each of the groups the pre-stressing forces will not be less than the minimum required before the next scheduled surveillance. It is important that in the analysis for each group of tendons, the individual lift-off forces for each of the tendons should be plotted and average values should not be used for a group.

5.3.3 Tendon Grease Loss

From the data on grease removed and grease replaced there appeared to be some voids in the grease. Most of the grease voids are less than 5%. Large voids in sheathing may indicate that the tendon wires are not fully protected against corrosion. Large voids may also indicate that there may be leakage of grease into concrete, thus potentially reducing concrete strength. From the sheathing filler streaks which exist on the outside of the containment wall at various locations, it appears that there has been some leakage from the sheathing. A number of grease can gaskets have been replaced. Leakage appears to have resulted from an ambient temperature change after greasing operations. Grease leakage was also found scattered along construction joints. Such a situation is not unique to Palisades. Grease voids have not had any impact on the integrity of the tendon and concrete as evidenced by visual examination of the concrete and the lift-off readings of the tendons. During the steam generator replacement in 1990 and 1991, 52 tendons were removed from the containment opening, were examined and found to have adequate grease coverage with no evidence of corrosion. The effects of grease voids on the containment integrity appear to be insignificant.

5.3.4 Strain Aging

This degradation has not been found at Palisades to date.

5.3.5 Water Infiltration

As documented in Palisades submittal to the NRC entitled, Tendon Surveillance Report (TAC NO. M84017), dated October 28, 1994 water infiltration has been documented at Palisades. The grease in tendons

D2-23 and V-20 had an absorbed water content of 15.5% and 10.2%, respectively. In addition, small quantities of free water were found in three additional grease cans. The concern is that water in contact with the anchorage may cause stress corrosion of the anchor head or tendon wire, or hydrogen embrittlement of the anchorage. However, examinations of the anchorages in the surveillance scope did not show any visible corrosion or cracking of any of the anchorage components. On the basis of this information, it is concluded that the presence of water in the grease is limited to a few tendons, and its effect appears to be insufficient to cause corrosion or cracking of the anchorage components.

6.0 SUMMARY

The Containment Inservice Inspection, Testing and Aging Management Program demonstrates that the Palisades containment continues to be operable and capable of fulfilling all designed operating and accident functions.

7.0 APPENDIX

7.1 Definitions and Acronyms

Condition Report (CR) - Condition Reports (CRs) identify undesirable conditions or conditions adverse to quality at Palisades.

Inspection - As used in this report, an inspection is an observation, other than Code examinations, performed by engineers, operators or maintenance persons.

Operating Experience (OE) - Operating experience is industry information received from the Institute of Nuclear Power Operators (INPO), the NRC, utilities, NSSS suppliers, and international participants in the form of various reports which are disseminated to nuclear power plants via the Nuclear Network system.

Pressurization Phase of the Structural Integrity Test (PPSIT) - The pressurization phase of the structural integrity test (PPSIT) was conducted between March 23 and March 31, 1970.

Structural Integrity Test (SIT) - In accordance with the requirements contained in 10CFR50, Appendix J, Containment Buildings are required to undergo a series of preoperational and postoperational surveillance tests to demonstrate its structural and leaktight integrity and operability. These tests include the structural integrity test (SIT), the integrated leak rate tests (ILRT), and prestressing tendon surveillance. The pre-operational structural integrity test (SIT) for Palisades was performed during the period of March 23, 1970 through March 31, 1970 to monitor the response of the Containment Building to pressurization.

Ultrasonic Test (UT) - In accordance with ASME Section XI, 1992 Edition, IWA-2230, UT examinations are conducted to detect the presence of discontinuities throughout the volume of material and may be conducted from either the inside or outside surface of a component.

Visual Examination VT-1 - In accordance with ASME Section XI, 1992 Edition, IWA-2211, VT-1 examinations are conducted to detect discontinuities and imperfections on the surfaces of components, including such conditions as cracks, wear, corrosion or erosion.

Visual Examination VT-2 - In accordance with ASME Section XI, 1992 Edition, IWA-2212, VT-2 examinations are conducted to detect evidence of leakage from pressure retaining components, with or without leakage collection systems, as required during the conduct of system pressure test. VT-2 examinations are conducted in accordance with IWA-5000. For direct examination, the Table IWA-2210-1 maximum examination distance shall apply to the distance from the eye to the surfaces being examined.

Visual Examination VT-3 - In accordance with ASME Section XI, 1992 Edition, IWA-2213, VT-3 examinations are conducted to determine the general mechanical and structural condition of components and their supports by verifying parameters such as clearances, settings, and physical displacements such as loss of integrity at bolted or welded connections, loose or missing parts, debris, corrosion, wear, or erosion. VT-3 includes examination for conditions that could affect operability or functional adequacy of snubbers and constant load and spring type supports.

8.0 ATTACHMENTS

Attachment 1 , NIS-1 Form, “Owners Data Report for Inservice Inspection”

Attachment 2 , NIS-2 Form, “Owners Report for Repairs and Replacements” None

Attachment 3, Engineering Analysis EA-EAR-98-0443-01, “Basis for ISI Acceptance Criteria for Containment Liner Reduced Thickness”

ATTACHMENT 1

CONSUMERS ENERGY COMPANY
PALISADES PLANT
DOCKET 50-255

FORM NIS-1 OWNER'S REPORT
FOR INSERVICE INSPECTIONS

1 Page

FORM NIS-1 OWNER'S REPORT FOR INSERVICE INSPECTIONS
As required by the Provisions of the ASME Code Rules

1. Owner Consumers Energy Company, 212 W. Michigan Ave., Jackson, MI 49201
(Name and Address of Owner)

2. Plant Palisades Nuclear Plant, 27780 Blue Star Memorial Hwy., Covert, MI 49043
(Name and Address of Plant)

3. Plant Unit 1 4. Owner Certificate of Authorization (if required) n/a

5. Commercial Service Date 12/31/71 6. National Board Number for Unit n/a

7. Components Inspected

Component or Appurtenance	Manufacturer or Installer	Manufacturer or Installer Serial No.	State or Province No.	National Board No.
Containment Liner Plate	Bechtel Group, Inc.	n/a	n/a	n/a
Escape Airlock	Progressive Fabricators, Inc.	K8899	n/a	n/a

Note: Supplemental sheets in form of lists, sketches, or drawings may be used, provided (1) size is 8½ in. x 11 in., (2) information in items 1 through 6 on this report is included on each sheet, and (3) each sheet is numbered and the number of sheets is recorded at the top of this form.

FORM NIS-1 (Back)

8. Examination Dates 6/8/98 to 12/14/99 9. Inspection Interval from 7/17/97 to 02/12/08

10. Abstract of Examinations. Include a list of examinations and a statement concerning status of work required for current interval. SEE "Verification of Section XI Compliance Upon Completion of Refout 14."

11. Abstract of Conditions Noted SEE "Containment Inservice Inspection, Testing and Aging Management, ISI Summary - Refout 14."

12. Abstract of Corrective Measures Recommended and Taken SEE "Containment Inservice Inspection, Testing and Aging Management, ISI Summary - Refout 14."

We certify that the statements made in this report are correct and the examinations and corrective measures taken conform to the rules of the ASME Code, Section XI.

Certificate of Authorization No. (if applicable) n/a Expiration Date n/a

Date February 10 2000 Signed Consumers Energy By [signature]
Owner

CERTIFICATE OF INSERVICE INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and the State or Province of Michigan and employed by FMIC of Johnston, RI have inspected the components described in this Owner's Report during the period 6/8/98 to 12/14/99, and state that to the best of my knowledge and belief, the Owner has performed examinations and taken corrective measures described in this Owner's Report in accordance with the requirements of the ASME Code, Section XI.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the examinations and corrective measures described in this Owner's Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

K. Blake
Inspector's Signature

Commissions Mi. 762 A,B,N,I,S,IS
National Board, State, Province, and Endorsements

Date Feb. 11 2000

(12/82)

ATTACHMENT 2

CONSUMERS ENERGY COMPANY
PALISADES PLANT
DOCKET 50-255

FORM NIS-2 OWNER'S REPORT
FOR REPAIRS AND REPLACEMENTS - THERE WERE
NO REPAIRS OR REPLACEMENTS
FOR THIS REPORT

0 Pages

ATTACHMENT 3

CONSUMERS ENERGY COMPANY
PALISADES PLANT
DOCKET 50-255

ENGINEERING ANALYSIS EA-EAR-98-0443-01, "BASIS FOR ISI ACCEPTANCE CRITIERA FOR CONTAINMENT LINER REDUCED THICKNESS"

21 Pages

CONSUMERS ENERGY

PALISADES NUCLEAR PLANT ENGINEERING ANALYSIS COVER SHEET

EA-EAR-98-0443-01

Total Number of Sheets 21

Title Basis for ISI Acceptance Criteria for Containment Liner Reduced Thickness

INITIATION AND REVIEW

Calculation Status	Preliminary	Pending	Final	Superseded
			X	

Rev #	Description	Initiated		Init Appd By	Review Method			Technically Reviewed		Rev'r Appd By	S/D App
		By	Date		Alt Calc	Detail Rev'w	Qual Test	By	Date		
0	Original Issue	CNK Krishnaswamy	7/21/99	SRR Raupp		X		BAE Erler	7/26/99	SRR Raupp	
0	Resolve S/DR Comments	CNK Krishnaswamy	9/29/99	SRR Raupp		X		BAE Erler	9/30/99	SRR Raupp	RBG

Reference/Comment

1.0 OBJECTIVE

1.1 Background

10 CFR 50.55a requires that inservice inspection (ISI) of the containment pressure boundary steel liner be performed in accordance with the requirements of ASME Boiler & Pressure Vessel Code, Section XI, Subsection IWE (Analysis Input 2.1). Consumers Energy's IWE ISI Plan (Analysis Input 2.2) defines the requirements for surface examination of the containment liner in accordance with Code Table IWE-2500-1, as modified by 10 CFR 50.55a.

The liner surface examination consists of general and detailed visual examinations. Consumers Energy's IWE ISI plan states that results of the containment liner surface examinations that reveal indications of liner surface areas with material loss exceeding 10% of the nominal thickness of the liner prior to the next examination shall be documented. Acceptance of such areas for service requires an engineering evaluation or correction by repair/replacement.

The industry has experienced indications of some reduced thickness of containment liners. A similar experience may be encountered during the ensuing ISI of the Palisades containment liner. Establishing the acceptable minimum thickness of the containment liner prior to the ISI will help minimize the potential for an extended outage resulting from dispositioning such indications of reduced liner thickness during the ISI.

1.2 Purpose

This Engineering Analysis (EA) is prepared to proactively establish that a reduced liner thickness does not degrade the design basis of the liner. A reasonable minimum thickness of

Reference/Comment

the containment liner will be established for use by the ISI team to disposition ISI results that indicate a reduced liner thickness.

1.3 Scope

The scope of this EA is to determine the minimum acceptable thickness of the containment pressure boundary liner backed by concrete to meet design basis requirements. Discussion of the potential causes of inservice reduction in liner thickness, measurement of liner thickness, rate of thickness loss, etc. are not within the scope of this EA.

2.0 ANALYSIS INPUT

2.1 ASME B&PV Code, Section XI, Subsection IWE, "Requirements for Class MC and Metallic Liners of Class CC Components of Light-Water Cooled Plants," 1992 Edition with 1992 Addenda.

2.2 Palisades Nuclear Plant Engineering Procedure Manual, Proc. No. EM-09-12, "Containment Inservice Inspection, Testing, and Aging Management," Section 6.0, Revision 2.

2.3 UFSAR

2.4 Containment Design Basis Document, Palisades Nuclear Plant DBD-2.09, Revision 0.

2.5 Drawing No. C-135, "Containment Liner General Plant, Elevation, and Details," Revision 11.

2.6 Horschel, D. S., "Synopsis of the Results of a Test of a Reinforced Concrete Containment," Proceedings of Fourth Workshop on Containment Integrity, June 14-17, 1988, Arlington, Virginia, NUREG/CP-0095, November 1988.

Reference/Comment

2.7 Cherry, J. L., "Analysis of Containment Structures with Corrosion Damage," Sandia National Laboratories, Albuquerque, N.M., December 1997.

2.8 Timoshenko, S. P., and Gere, J. M., "Theory of Elastic Stability," McGraw-Hill, Second Edition, 1961, Page-28.

2.9 ASME B&PV Code, Section III, Division 2, Subsection CC, "Concrete Containments (Prestressed or Reinforced)," 1998.

3.0 ASSUMPTIONS

None

4.0 ANALYSIS

4.1 Methodology

This EA will be developed in the following steps:

1. Discuss the design basis safety function of the liner.
2. Discuss the source and nature of liner strains.
3. Discuss the basis for the liner thickness selection.
4. Review the design basis and design margins for the liner and the liner anchors.
5. Discuss the effects of corrosion and show that an inservice reduction in liner thickness will not degrade the design margins for the liner and liner anchors, based on the results of Sandia National Laboratories (SNL) tests on corroded liner plate coupons.

Reference/Comment

6. Review results of recent SNL test of 1/6-scale model steel-lined concrete containment to establish an acceptable minimum thickness for the liner.

7. Based on the results of this EA, industry experience, and recent SNL tests, develop criteria for the acceptable minimum thickness of the containment liner, for use by Palisades ISI team.

4.2 Engineering Analysis

4.2.1. Design Basis Safety Function of the Liner

The sole safety function of the Palisades containment liner plate is to act as a leaktight pressure boundary membrane to minimize the release of radioactive effluents into the environment in the event of postulated accidents.

The containment liner plate is not relied upon for containment load carrying capability. The prestressed concrete containment structure is designed to carry all the design basis containment loads.

4.2.2 Source and Nature of Liner Strains

The liner is anchored to the containment concrete by means of angles welded to the liner plate and embedded in the containment concrete such that strain compatibility with the concrete containment and restrained thermal expansion of the liner impose strains on the liner.

The types of strains experienced by the liner and their sources are summarized below. The dominant source of each type of liner strain is highlighted in bold.

Reference/Comment

Liner Strain Component	Source
Membrane Compressive Strain	Dead Load Concrete Prestress Concrete Creep & Shrinkage Seismic Overturning **Restrained Thermal Expansion**
Membrane Tensile Strain	Seismic Overturning **Accident Pressure**
Bending Strains (in a liner panel with initial inward curvature)	**Liner Anchor Movement**

The design basis for the Palisades containment liner uses the industry-wide strain-based acceptance criterion as the measure of leaktightness of the liner. Therefore, the nature and characteristics of the liner strains is briefly summarized below to help understand the role of liner thickness on the liner strains.

- **Membrane Strains**

  In a reinforced concrete containment, the concrete shell confines the steel liner plate. When the design basis loads are applied to the containment, the liner is globally constrained to move compatible with the concrete shell. The global membrane strain in the liner, as opposed to the local, due to containment dead load, concrete creep and shrinkage, seismic overturning, restrained thermal expansion, and internal pressure is only a function of a change in the shell displacement. Therefore, the global membrane strain in the liner is independent of the thickness of the liner.

  There would be local areas of membrane strain concentrations, such as at joints in the liner where the liner thickness is not uniform. Such local areas form a

Reference/Comment

relatively small fraction of the global area of the containment liner with uniform liner thickness. The design provides additional anchors at these locations to accommodate the larger force differential and to minimize the local membrane stress/strain concentration in the liner.

- **Bending Strains**

Bending strains are induced in a liner panel (with initial inward curvature) due to inward bending initiated by membrane compressive strains imposed on the liner. The inward bending of a liner panel leads to differential membrane strain in the liner panels adjacent to the one undergoing inward bending. The differential membrane strain in the liner panels, in turn, introduces differential force on the liner anchors and initiates movement or displacement of the anchors toward the inward bending panel. The differential force causing anchor displacement and bending strain in the liner are directly proportional to the thickness of the liner.

Therefore, a thinner liner will contribute to a smaller anchor force and a smaller bending strain in the liner.

It should also be noted that in contrast to buckling under a mechanical load which results in a state of unstable equilibrium, thermal buckling of a liner panel (with initial inward curvature) results in a state of stable equilibrium as soon as the deflected length of the liner panel accommodates the thermally induced displacement of the anchors of the buckling liner panel. Because of this, it is more appropriate to call this bulging of a liner panel as inward bending or inward deflection, rather than buckling - which connotes instability.

Reference/Comment

Conclusion

Based on the above discussion, it can be concluded that an increase in liner thickness will not improve the leaktightness of the containment and that the liner plate should be as thin as practical.

4.2.3 Liner Thickness Selection Basis

Thermal expansion of the liner is restrained by the concrete containment, imposing membrane compression on the liner and equilibrating membrane tension on the concrete containment shell. Therefore, it is advantageous to make the liner as thin as possible to minimize the stresses in the concrete containment shell.

The selection of steel liner thickness is not dictated by the strain-based acceptance criterion for assuring the leaktight function of the liner, but by optimal constructability considerations related to:

- The use of liner as formwork during the construction of the concrete containment shell
- Steel plate handling, welding, and weld repair
- Resistance to damage during construction
- Liner erection tolerance requirements
- Corrosion allowance

A 1/4 inch steel liner thickness is the typical industry practice for prestressed concrete containments, regardless of the containment design pressure, size, or allowable leakage rate.

Reference/Comment

4.2.4 Review of Design Basis

The design basis for Palisades containment liner and liner anchorage system is detailed in the containment design basis document DBD-2.09, Revision 0 (Analysis Input 2.4). Provided below is a summary of the design basis.

General Requirements

The following requirements are imposed in the design of the containment liner system to ensure that the integrity of the liner plate is maintained under all loading conditions.

1. The liner plate shall be protected from loss of function due to damage inflicted by internally generated missiles caused by a postulated accident.

2. The liner plate strains shall be limited to allowable values that have been shown to result in leak tight pressure vessels or high-pressure piping.

3. The liner anchors shall have sufficient strength and ductility to prevent the liner plate from developing significant distortion.

4. Except during concrete pouring, the liner plate is not relied upon to assist the concrete in maintaining the integrity of the structure.

4.4.4.1 Liner Plate Design

Allowable Liner Strain

The following sections of the ASME B&PV Code, Section III, Article 4, 1965, applicable for pressure vessels, were adopted as guides in establishing allowable strain limits:

	Reference/Comment

1. Paragraph N-412(m) Thermal Stress, Subparagraph 2

2. Paragraph N-412(n) Operational cycle

3. Paragraph N-414.5 Peak Stress Intensity Table N-413, Figures N-414 and N-415(a)

4. Paragraph N-415.1 Vessels Not Requiring Analysis for Cyclic Operation

The allowable strain in the liner plate was obtained from the allowable stress of Figure N-415(a). The critical load combination for the liner plate includes the DBA temperature. Since DBA fatigue considerations require only one cycle, one cycle was to have been used in selecting the allowable stress from Figure N-415(a). However, this figure does not extend below 10 cycles. Therefore, the allowable stress corresponding to 10 cycles was conservatively used.

The allowable strain for 10 cycles is approximately 0.02 in/in. This allowable strain in the liner was further reduced to a very conservative value of 0.005 in/in.

Design Basis Liner Strains

The effects of dead load, prestress, concrete creep and shrinkage, operating and DBA thermal gradients, DBA pressure, and seismic loads were considered in the design of the liner.

The 1/4-inch liner plate yields in membrane compression when subjected to the combined effects of concrete creep and shrinkage, prestressing, and DBA temperature. For this loading condition, the maximum membrane compressive strain in the liner is 0.0025 in/in, 50% of the allowable liner strain.

The maximum membrane+bending strain (compressive) due to inward bending of a liner panel with initial inward curvature occurs shortly after the DBA when the pressure has dropped off

	Reference/Comment

but the temperature is still high, and is equal to 0.0045 in/in, 90% of the allowable liner strain.

Fatigue

The liner plate is capable of withstanding the effects of the following load cycles without fatigue. Fatigue distress in the liner for these load cycles is insignificant.

1. 40 thermal cycles due to annual outdoor temperature variation for the plant life of 40 years.

2. 500 thermal cycles due to containment interior temperature variation between start-up and shutdown.

3. One thermal cycle due to DBA.

4.2.4.2 Liner Plate Anchors

The liner anchors were designed to withstand the effects of dead load, prestress, concrete creep and shrinkage, operating and DBA thermal gradients, DBA pressure, seismic loads.

Design Parameters

The following factors were considered in the design of the liner anchorage system in order to maximize the design basis anchor force, anchor displacement, and strains in the liner:

1. Initial inward curvature of the liner plate between anchors due to fabrication and erection inaccuracies

2. Variation of anchor spacing including spacing to reflect the possibility of a missing or failed anchor

3. Misalignment of liner plate seams

4. Variation of plate thickness

Reference/Comment

5. Variation of liner plate material yield stress

6. Variation of Poisson's ratio for the liner plate material

7. Cracking of concrete in the anchor zone

8. Variation of the anchor stiffness

Liner Anchor Design Cases

Many of the preceding factors were considered in the design cases detailed below. Factors 3 and 6 were found to be significant.

An initial inward displacement of 0.125 inch was considered for Cases I through IV and 0.25 inch for Case V.

Case I — Simulates a plate with a yield stress of 32 ksi and no variation in any other parameters.

Case II — Simulates a 25% increase in yield stress and no variation in any other parameters.

Case III — Simulates a 25% increase in yield stress, a 16% increase in plate thickness, and an 8% increase for all other parameters.

Case IV — Simulates the maximum reasonable variation that could exist in the liner plate thickness, concrete modulus of elasticity, etc., by considering an 88% increase in yield stress with no variation of any other parameters.

Case V — Same as Case III except the anchor spacing and initial inward displacement have been doubled to simulate a missing or failed anchor.

Reference/Comment

Ultimate Deformation Capacity of Liner Anchors

The ultimate deformation capacity of the anchorage system determined by tests is approximately 0.15 inch.

The parametric variation of Cases I through V is summarized in Table 4-1 below along with the resulting factor of safety for the critical anchor located adjacent to the panel with the initial inward curvature.

Table 4-1 Liner Anchor Factor of Safety

Case	Initial Inward Deformation of Liner (in)	Anchor Spacing for Buckling Panel (in)	Anchor Spacing for Adjacent Panels (in)	Factor of Safety Against Failure
I	0.125	15	15	37.0
II	0.125	15	15	19.4
III	0.125	15	15	9.9
IV	0.125	15	15	6.28
V	0.25	30	15	4.25

4.2.5 Inservice Corrosion of Liner Plate

The industry has experienced inservice reduction of liner plate thickness in some containments due to corrosion caused by the degradation of moisture barrier seal leading to moisture intrusion. The effect of corrosion on the properties and design basis of the liner plate are discussed in this section.

Reference/Comment

4.2.5.1 Effects of Corrosion on Liner Plate Material

Mechanical Properties of Corroded Liner Plate

In a corroded liner, the metal loss is typically very irregular in both depth and distribution.

A Sandia National Laboratory investigation was performed recently to evaluate the effects of geneanl corrosion and pitting on the mechanical properties of a 1/16-inch thick containment liner material. Analysis Input 2.7 contains the details of this investigation.

In this study, several samples of 1/16" thick ASTM A 516 steel plates, similar to the low carbon, low strength normalized fine grained A-442 steel used in the Palisades Nuclear Plant containment liner, were intentionally corroded and then tensile-tested to failure. The corrosion damage inflicted on the plates included general corrosion and pitting corrosion. The test results obtained from the corroded specimens were compared with those from uncorroded control specimens. Provided below is a summary of these test results.

The results of this investigation showed that:

1, The ultimate load carried by the corroded plate was proportional to its average thickness.

2. The yield stress, ultimate tensile stress, and Young's Modulus based on average thickness of the corroded plate were not affected by the presence of corrosion.

3. The stress-strain curves were about the same for both the corroded and uncorroded test specimens, except for a reduction in the effective ultimate tensile strain of the corroded plate material to approximately 14%.

4. Stress/strain concentration in a corroded plate is very localized in the 'micro' regions around the pits and rough

Reference/Comment

uneven surfaces (as opposed to through the thickness), affecting only the ultimate tensile strain of the corroded plate, but not the plate stress/strain based on average thickness.

Physical Condition of Corroded Liner Material

The primary physical change due to corrosion is a reduction in thickness. Corrosion also causes an unevenness of the plate surface. This secondary effect results in potential strain concentrations at and near the corroded surface (as opposed to through the thickness) which could account for the reduction in the effective ultimate strain discussed above.

4.2.5.2 Impact of Corrosion Effects on Design Basis

Effect of Mechanical Properties of Corroded Plate

The design basis calculations for liner strain and liner anchor deflection will not be affected by the mechanical properties of a corroded liner plate because the stress-strain curve of a corroded plate remains unchanged, with the exception of a reduction in the ultimate strain.

Although the ultimate strain of a corroded liner pate was reduced to 14%, it is still 28 times the allowable strain in the liner of 0.5% and, therefore, not a concern.

Effect of Thickness Loss

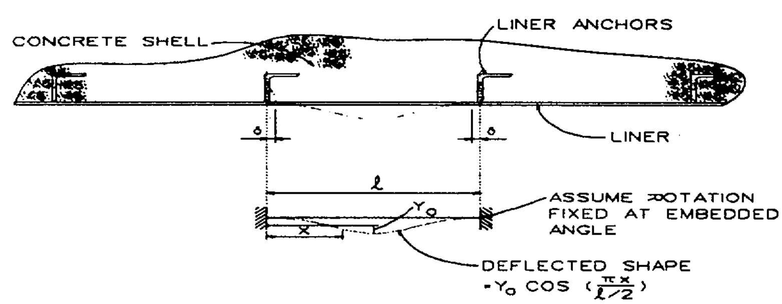
Design basis membrane strains in the liner will not change by a reduction in the liner thickness due to corrosion, as explained below.

In a prestressed or reinforced concrete containment, the concrete shell confines the steel liner plate. In addition, the liner plate is not relied upon to assist the concrete containment in carrying its design basis loads. When the design basis loads

Reference/Comment

are applied to the containment, the liner is globally constrained to move compatible with the concrete shell. Therefore, the membrane strain in the liner, which is only a function of a change in the shell displacement, is independent of the thickness of the liner.

Design basis bending strains (in a liner panel with initial inward curvature) are directly proportional to the liner plate thickness and, therefore, will not be adversely affected by a reduction in the liner thickness due to corrosion, as discussed in Section 4.2.2 of this EA. Derivation below provides an analytical confirmation.



Assume deflected shape: $y = y_o \cos[(\pi x)/(\ell/2)]$

Let Δ = Imposed deformation on the plate = 2δ

= Length difference between the deflected and undeflected liner plate.

From Analysis Input 2.8,

$$\Delta = \tfrac{1}{2}\int_0^{\ell}\left(\frac{dy}{dx}\right)^2 dx$$

Reference/Comment

$$= \tfrac{1}{2}\int_0^{\ell}\left[\frac{-2\pi}{\ell}y_o\sin\frac{\pi x}{\ell/2}\right]^2 dx$$

$$= \frac{2\pi^2}{\ell^2}y_o^2\int_0^{\ell}\sin^2\frac{\pi x}{\ell/2}\,dx$$

$$= \frac{2\pi^2}{\ell^2}y_o^2\int_0^{\ell}\tfrac{1}{2}\left[1-\cos2\left(\frac{\pi x}{\ell/2}\right)\right]dx$$

$$= \frac{\pi^2}{\ell^2}y_o^2\left[x-\frac{\ell}{4\pi}\sin2\left(\frac{\pi x}{\ell/2}\right)\right]_o^{\ell}$$

$$= \frac{\pi^2}{\ell^2}y_o^2\,[\ell] = \frac{\pi^2}{\ell}y_o^2$$

Therefore,

$$y_o = \frac{\sqrt{\Delta\ \ell}}{\pi} \quad ----(\text{Eq.}-1)$$

Reference/Comment

Bending strain in extreme fiber = (curvature) . (distance from centroid)

$$\varepsilon_b = \left(\frac{d^2y}{dx^2}\right)\cdot h \text{ at } x = \ell/2,$$

where h = 1/2 plate thickness

$$= -y_o \cdot \frac{4\pi^2}{\ell^2} \cdot \cos\frac{\pi(\ell/2)}{\ell/2} \cdot h$$

$$= h \cdot y_o \cdot \frac{4\pi^2}{\ell^2}$$

$$\varepsilon_b = h \cdot \frac{\sqrt{\Delta \ell}}{\pi} \cdot \frac{4\pi^2}{\ell^2} = 4\pi h\sqrt{\frac{\Delta}{\ell^3}} \quad \text{-------- (Eq.-2)}$$

From Eq.-2, it can be seen that the bending strain in the deflected liner is directly proportional to the liner plate thickness. Therefore, design basis bending strains will not be adversely affected by a reduction in liner thickness due to corrosion.

Liner Anchor Force and Displacement

The force on the liner anchor and the consequent displacement of anchors and bending strain in a liner panel with initial curvature are directly proportional to the thickness of the liner plate. Therefore, a reduction in the thickness of the liner due to corrosion will not adversely impact the design basis anchor displacement.

Reference/Comment

Conclusion

Based on the above discussion, it can be concluded that a reduction in liner thickness due to corrosion will not degrade the design basis for the liner and the liner anchorage system.

4.2.6 Leaktightness of 1/16-inch Thick Liner Plate

Results of recent Sandia National Laboratories test of a 1/6-Scale model of a reinforced concrete containment with a 1/16-inch liner plate show that there was no measurable leakage at nearly 2.5 times the design pressure, with very high global strain levels in the liner (approximately seven times the yield strain of the liner plate). Details of the test are presented in Analysis Input 2.6.

Ultimate functional failure of the containment model occurred at approximately three times the design pressure due to a tear in the liner (at approximately 17% strain in the liner) resulting in gross leakage. The tear in the liner occurred at the welded joint between the 1/16-inch thick liner plate and the thickened embedment plate around a large penetration.

These test results provide a proven basis to conclude that a 1/16-inch thickness of the steel liner is adequate to assure the safety function of the liner as a leaktight barrier.

4.2.7 Acceptance Criteria for Minimum Thickness of Liner

Criteria for the acceptable minimum thickness of the containment liner plate are derived in this section based on the following considerations:

1. Classify containment liner surface subject to examination into global area experiencing nominal inservice degradation, and local areas susceptible to accelerated degradation experienced by the industry or

Reference/Comment

tearing under ultimate pressure evidenced in the 1/6-Scale model test of a steel-lined containment.

2. For the global area, specify an acceptable thickness of 1/16-inch based on the results of the 1/6-Scale model test discussed in Section 4.2.6 of this EA.

3. For local areas susceptible to accelerated degradation or liner tear under ultimate pressure, specify an additional 1/16-inch as margin for potential continued degradation and to account for metal loss due to repair of defects.

4. The specified minimum thickness of sound liner plate shall be available or projected to be available at least until the next examination.

Classification of Liner Surface Areas

1. Category E-A Surface

   Liner plate surfaces identified under Examination Category E-A in Table IWE-2500-1 of ASME Code Section XI IWE (Analysis Input 2.1)

2. Category E-C Surface

   Areas of liner likely to experience accelerated degradation requiring augmented examination identified under Examination Category E-C in Table IWE-2500-1 of ASME Code Section XI, Subsection IWE (Analysis Input 2.1).

Reference/Comment

Acceptable Minimum Thickness

The acceptable minimum thickness of containment liner plate for Category E-A and Category E-C surfaces is summarized in Table 4-2 below. The required minimum thickness of sound liner
plate shall be available or projected to be available at least until the next examination.

Table 4-2 ISI Acceptance Criteria for Liner Thickness

Liner Examination Area	Acceptable Minimum Thickness of Liner
Category E-A	
• Global Area with Nominal Degradation	1/16 inch
• Areas susceptible to accelerated degradation	1/8 inch
• Around thickened embedment plates	1/8 inch
Category E-C	
• Areas susceptible to accelerated degradation	1/8 inch
• Around thickened embedment plates	1/8 inch

5.0 CONCLUSION

1. Inservice reduction in liner thickness will not degrade the design basis of the liner.

2. Acceptance criteria for the minimum required liner thickness have been established.