UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

October 2, 1989

Docket Nos. 50-369, 50-370

LICENSEE: Duke Power Company

FACILITY: McGuire Nuclear Station, Units 1 and 2

SUBJECT: MCGUIRE SITE VISIT AND MEETING ON STEEL CONTAINMENT CORROSION

On September 7, 1989, NRC staff (T. A. Reed, K. R. Wichman, C. P. Tan) visited the McGuire Nuclear Station to observe the corrosion on the Unit 1 steel containment vessel and to meet with Duke Power Company (DPC) staff concerning the resolution of the corrosion problem for both McGuire units. Meeting participants are listed in Enclosure 1. The slides presented by DPC are provided in Enclosure 2.

During the morning, NRC and DPC staff entered the McGuire Unit 1 containment annulus region. Corrosion was observed on the outside surface of the one-inch thick steel containment vessel at the containment vessel-concrete floor interface. The current identified maximum corrosion depth is 0.125 inches.

In the afternoon, NRC and DPC staff met to discuss the current status of the containment corrosion problem and DPC's action plan to resolve this issue for the McGuire station. The issues discussed included the location of corrosion areas, accessibility of the steel vessel-concrete interface area, DPC's estimate of the corrosion rate, DPC's determination of the minimum acceptable vessel wall thickness, and the DPC action plan for resolution of the corrosion problem. The minimum required wall thickness is 0.65 inches and the projected corrosion rate is .016 to .020 inches per year. At this rate, the estimated remaining vessel wall thickness projected to the next refueling outage for each McGuire unit (0.824 inches for Unit 1 and 0.848 inches for Unit 2) remains greater than the minimum required wall thickness determined from ASME code allowable stress intensities.

DPC has planned immediate, interim, and long term actions for resolution of the corrosion problem, which are identified in Enclosure 2 (last 3 pages). The present plans are somewhat tentative as they are subject to continuing engineering review and management approval.

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Based upon the current DPC technical approach and identified actions to assess and resolve the corrosion problem for the McGuire station, the staff concludes that the minimum vessel wall thickness will not be violated and that ASME code allowable stress units will not be exceeded.

Timothy A. Reed, Project Manager
Project Directorate II-3
Division of Reactor Projects I/II

Enclosures:
As stated

cc w/enclosures:
See next page

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/s/

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Enclosures:
As stated

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Facility: McGuire Units 1 and 2

Docket File		R. Ingram	14-H-25
NRC PDR		T. Reed	14-H-25
Local PDR		OGC	15-B-18
PDII-3 Reading		E. Jordan	MNBB-3302
T. Murley	12-G-18	B. Grimes	9-A-2
J. Sniezek	12-G-18	NRC Participants	
D. Matthews	14-H-25	ACRS (10)	P-315
B. Borchardt	17-D-19	D. Hood	14-H-25

OFC	:PDII-3	:PDII-3	:PDII-3	:PDII-3	:PDII-3	:	:
NAME	:RIngram	:TReed/cb	:KBarkman	:DHood DSH	:DMatthews	:	:
DATE	: 9/27/89	:9/28/89	:9/28/89	:9/28/89	:9/29/89	:	:

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Document Name: MEETING SUMMARY 9/21

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Enclosure 1

McGuire Nuclear Station
Containment Corrosion Meeting
7 September 1989

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Meeting With NRC
Thursday, September 7,1989
McGuire Containment Corrosion Problem

AGENDA

* Sequence of Events

* Inspection Findings

* Operability Determinations

* Planned Actions

* Questions

SEQUENCE OF EVENTS

Date	Activity/Comments
July 12-13	Performed Unit 2 EOC-5 ILRT Sructural Inspection. 1. Discovered boric acid deposits on first horizontal ring stiffener. 2. Identified ponding water on the concrete annulus floor (Elev. 725'+00") between Azimuths 240° and 253°. Area inaccessible. Need for further inspection identified.
August 3	Inspection team consisting of structural and coatings personnel performed further investigation of area at Elevation 725'+00" between Azimuths 240°-253°. 1. Discovered boric acid deposits on the steel containment vessel (SCV) and at the SCV-concrete floor interface. 2. SCV and concrete floor coating failure was evident. 3. Visual evidence of SCV corrosion. 4. Continued visual inspection at Elevation 725'+00" entire 360°. Due to HVAC duct, the SCV-concrete interface was only accessible between Azimuths 164°-253° and 270°-330°.

August 4 — Developed plan of action for additional investigations.

1. Remove existing coating 9" high on SCV by blasting.
2. Determine acceptable coating for immersed conditions.
3. Determine acceptable sealant.
4. Investigate HVAC duct removal for further inspection of SCV.

August 7-10 — Removed existing coating 9" high on SCV of the accessible areas.

August 11 — Determined HVAC duct was not designed to be removable. Removal of duct would require installation of new duct. Duct material was unavailable. Estimated the removal and reinstallation to be eight weeks. Optimal resolution is to relocate duct. Delay until next outage unless inspection dictates otherwise.

August 12 — Performed ultrasonic examination of previously identified significant isolated pits. UT was determined to be inadequate due to pit size, location, and orientation (transducer too large).

Continued existing coating removal on SCV and concrete floor.

August 14 — Developed SCV pit inspection methodology.

August 15 — Meeting with station QA and DE personnel to discuss inspection implementation. It was determined that DE personnel would perform the SCV pit inspection and documentation. The pit measurement techniques and procedures were observed by QA personnel and approved.

Initiated the following Problem Investigation Reports (PIR):

1. PIR 2-M89-0203: Numerous coating failures on the SCV exterior face near Elev. 725'+00". Corrosion of up to 0.10" observed.

2. PIR 2-M89-0204: The annulus SCV-concrete interface was not sealed.

3. PIR 2-M89-0205: Coating failures and/or lack of coating observed on penetrations M276, M302, and M341.

August 16-17 — Performed pit measurements.

August 17 — Informed DE Management of current inspection findings. Discussed continued course of action.

1. Continue pit measurements.

2. Remove concrete in worst case location of SCV corrosion (AZ 240°-243°).

3. Remove insulation panel from SCV in the pipe chase to inspect the SCV interior.

August 18	Removed concrete between Azimuths 240° and 243°. Thoroughly documented pitting in this area. Removed two insulation panels from the SCV in the pipe chase to inspect the SCV interior.
August 19	Completed SCV pitting measurements. Documented boric acid deposit locations, instrumentation line locations, deleted instrumentation line locations, ring stiffener hole locations. Inspected SCV interior face at removed insulation panel locations.
August 21	Discussed inspection findings with DE Management.
August 22-23	Determined corrective actions. Initiated tabulation of inspection findings. Reviewed SCV Stress Report and ASME requirements for minimum wall calculations.
August 24	Discussion of inspection findings and corrective actions with DE and Station Management personnel. Degradation of the SCV was determined to be reportable to the NRC. Station received verbal operability notification for Units 1 and 2 from DE. Station received verbal approval from DE to proceed with Unit 2 ILRT.
August 29-30	Preliminary inspection of the Unit 1 SCV exterior surface was performed.

MCGUIRE NUCLEAR STATION
UNITS 1 & 2

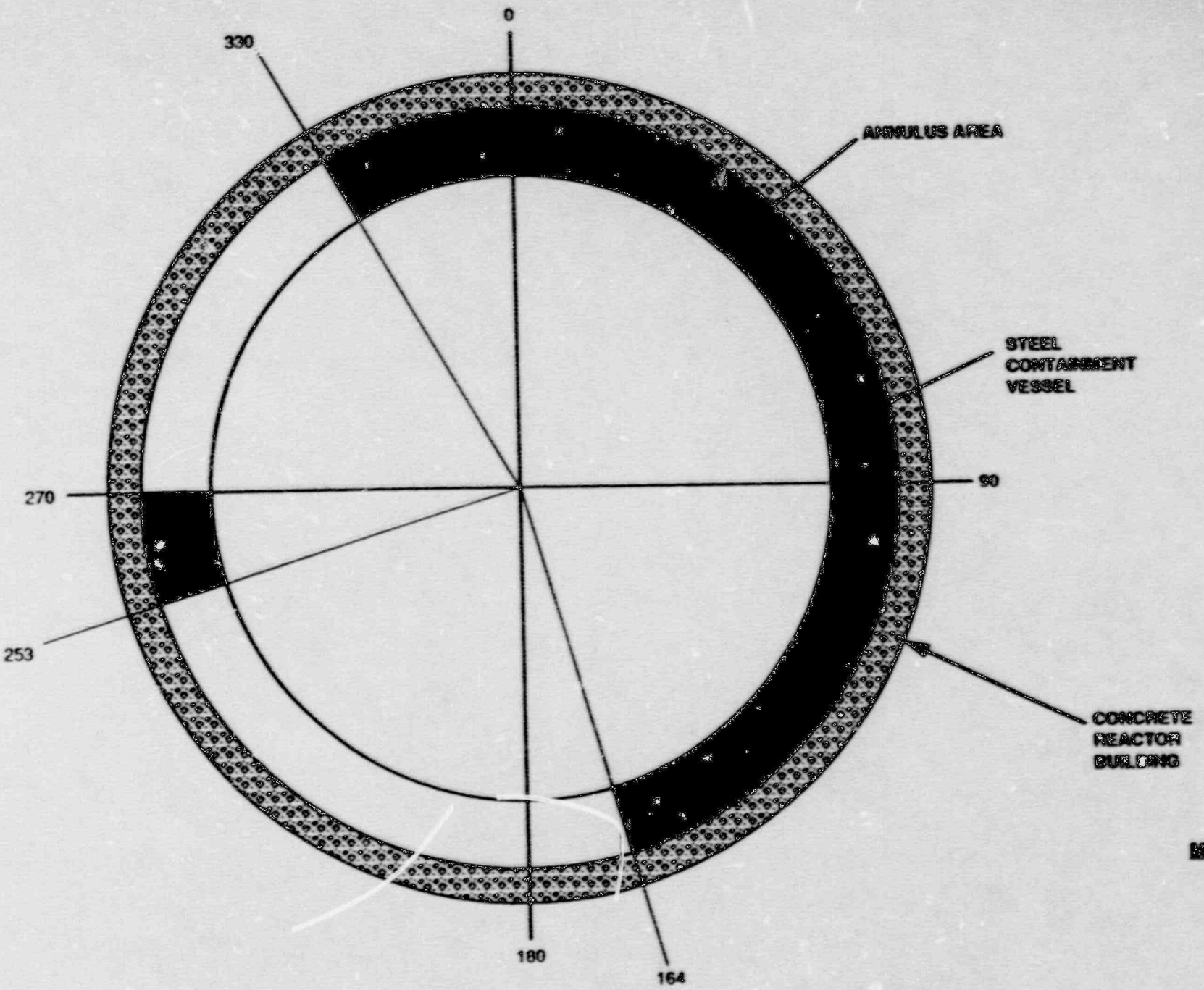
Steel Containment Vessel
Inspection History Summary

UNIT 1

Date	Activity	Comments
July 13, 1979	Pre-operation	No ponding water or coating failures observed.
Feb. 21-25, 1983	ILRT Structural Visual Inspection	At various locations water was ponding on horizontal stiffeners. No corrosion of the SCV surfaces was observed.
Aug. 14-17, 1986	ILRT Structural Visual Inspection	No ponding water or coatings failures noted.

UNIT 2

Date	Activity	Comments
Aug. 26-27, 1982	Pre-operation	No ponding water or coating failures observed.
May 23-26, 1986	ILRT Structural Visual Inspection	Boric acid deposits were identified at AZ 195° Elev 725'+00" (concrete floor and horizontal stiffener). Ponding water observed on horizontal stiffeners between AZ 220° and 235° at Elev. 806'+0". No corrosion on the SCV surfaces were noted.
July 12-13, 1989	ILRT Structural Visual Inspection	Ponding water and coating failures noted. Additional inspections initiated.



McGUIRE UNIT 2
FIGURE 1

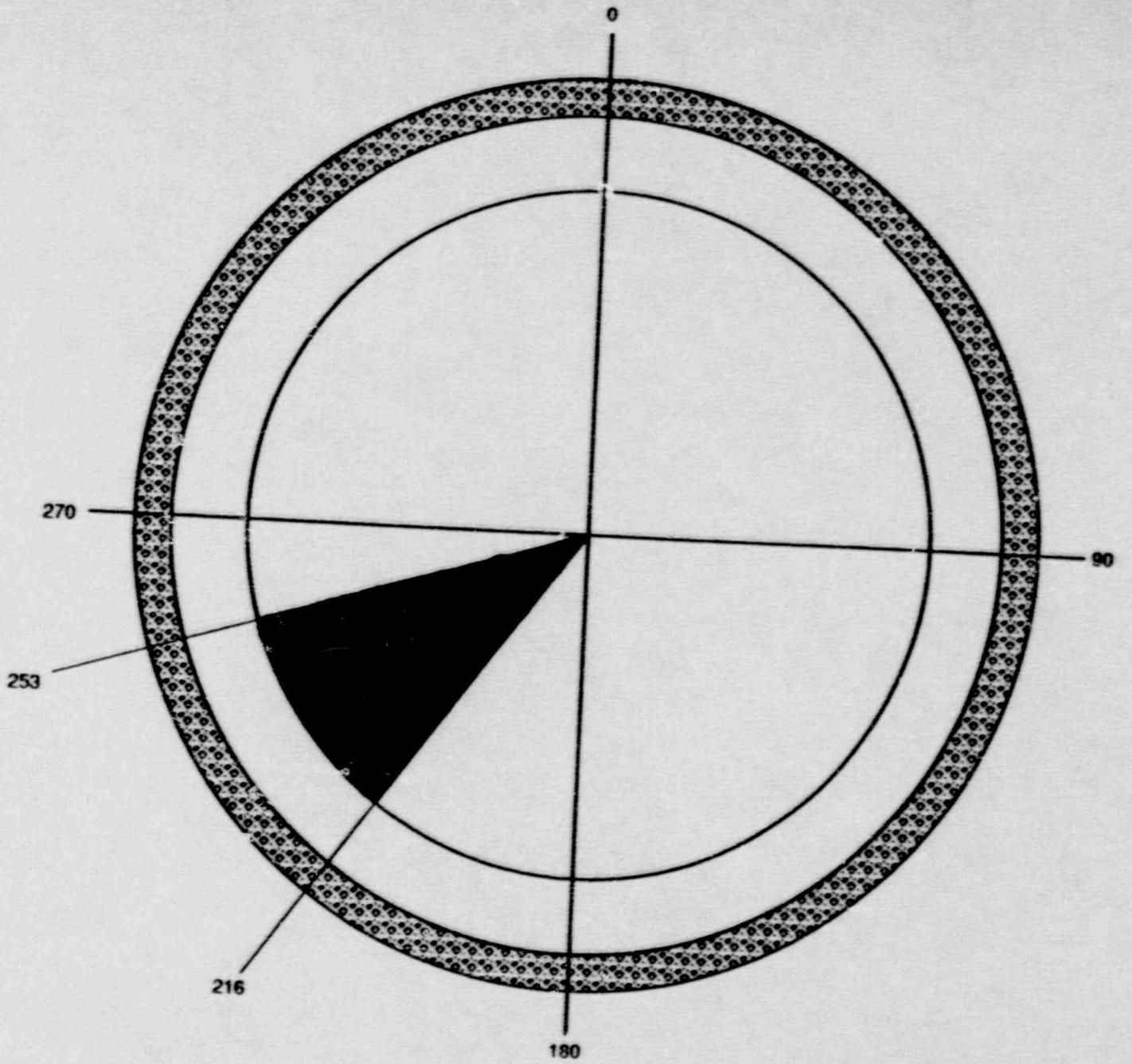


FIGURE 2

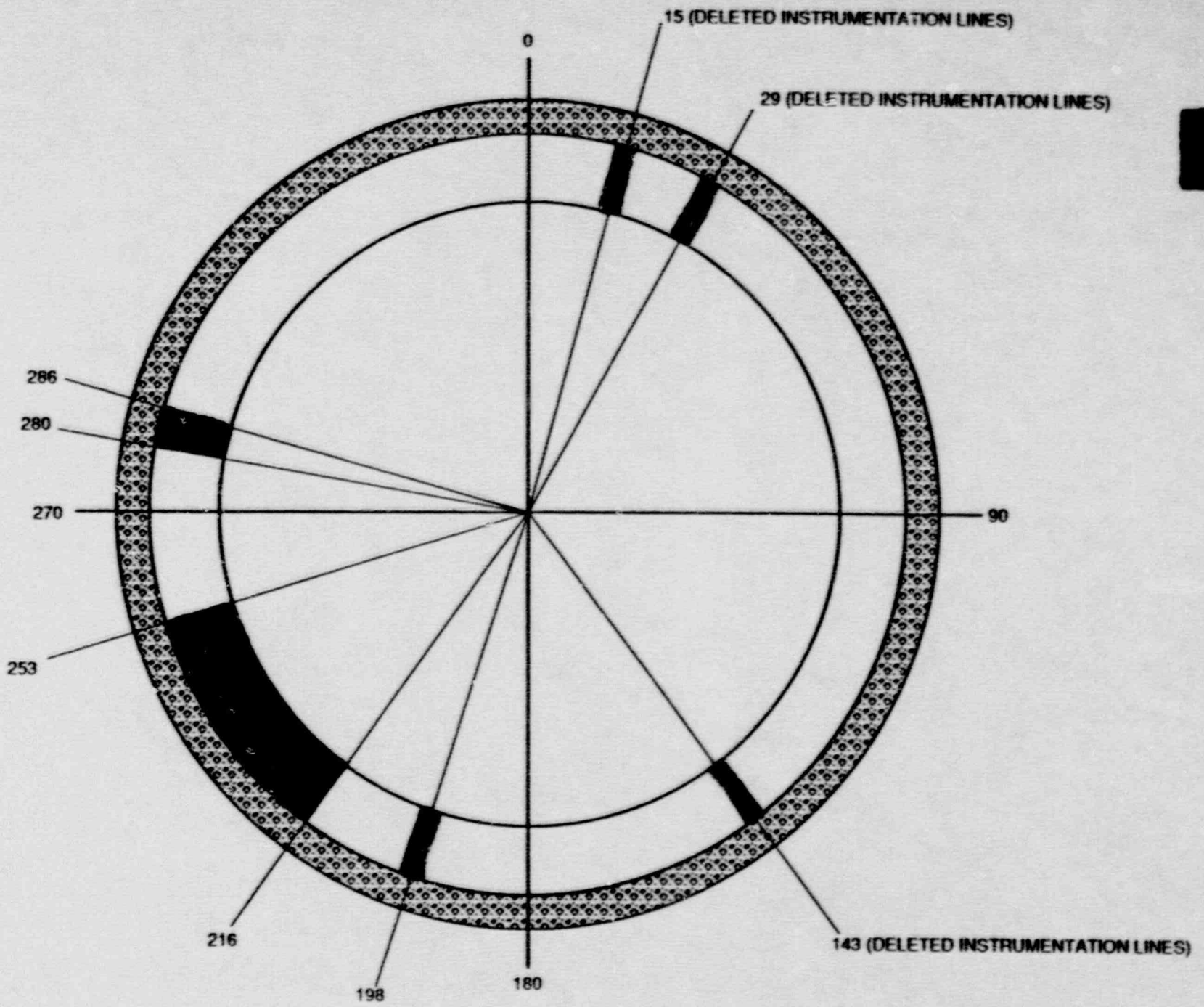


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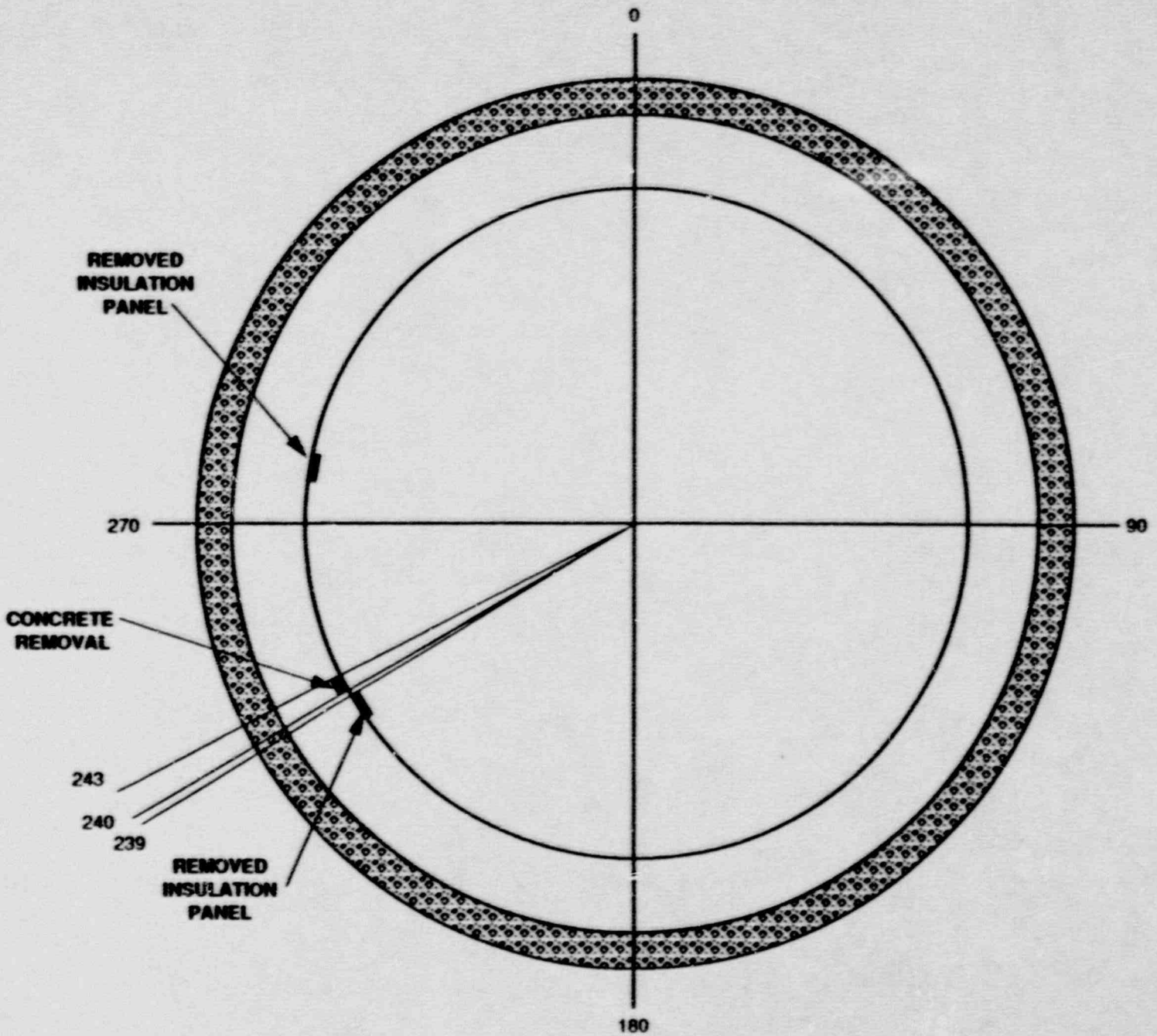
FIGURE 3



SPECIAL INSPECTION AREAS

FIGURE 4
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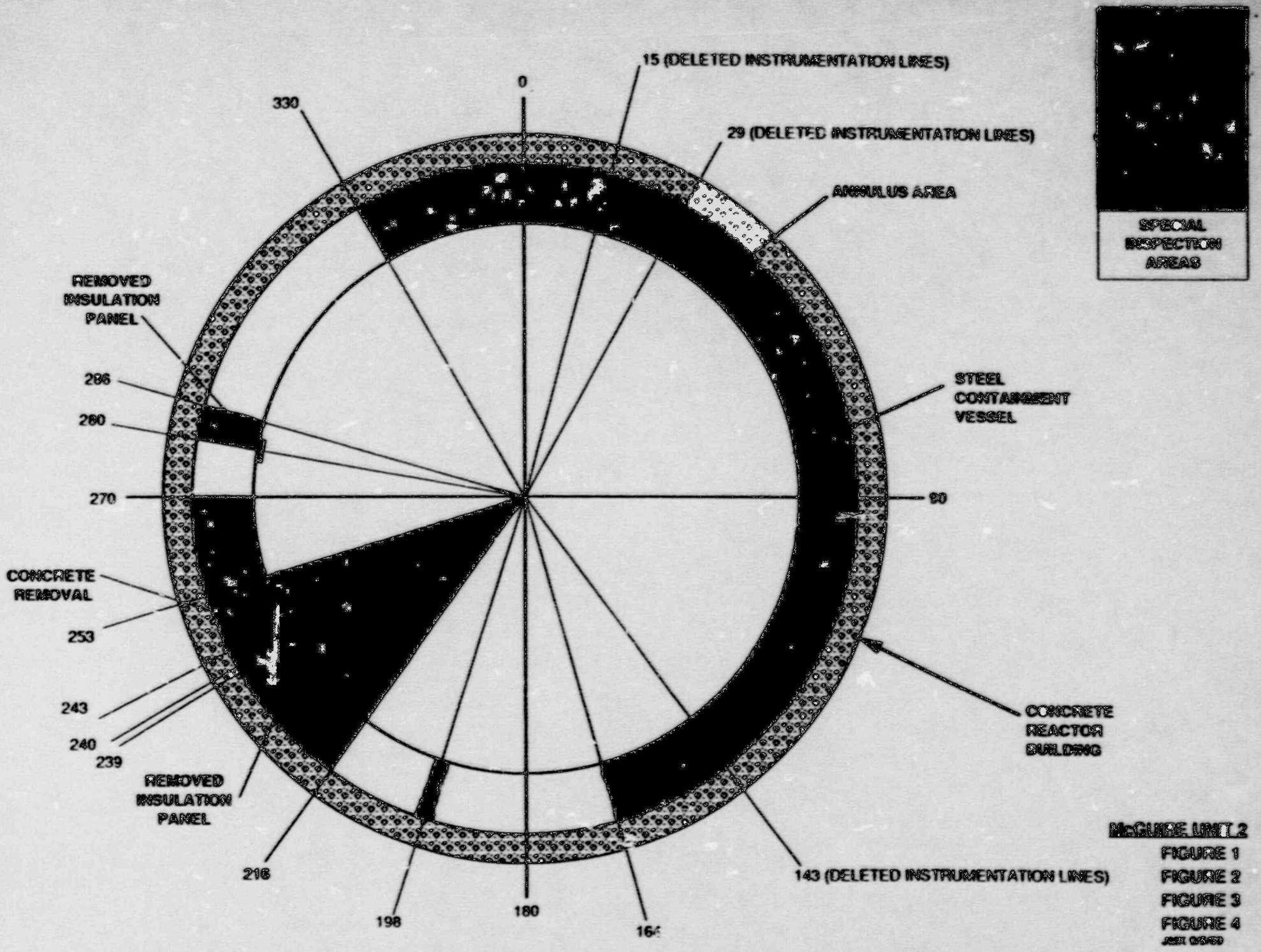


McGUIRE UNIT 2

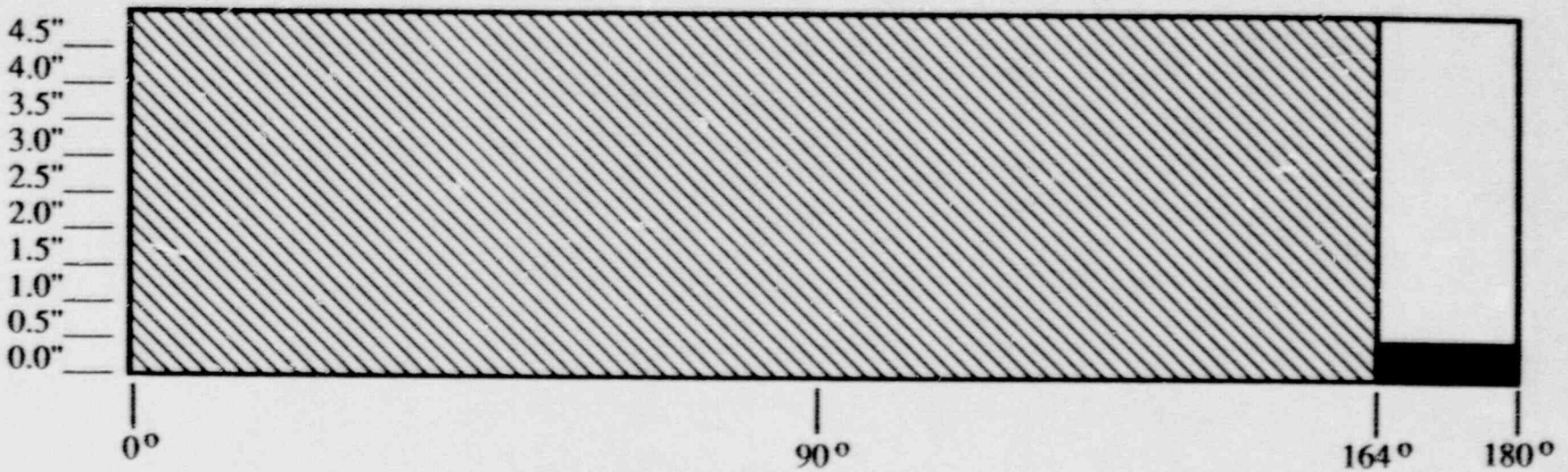
FIGURE 1

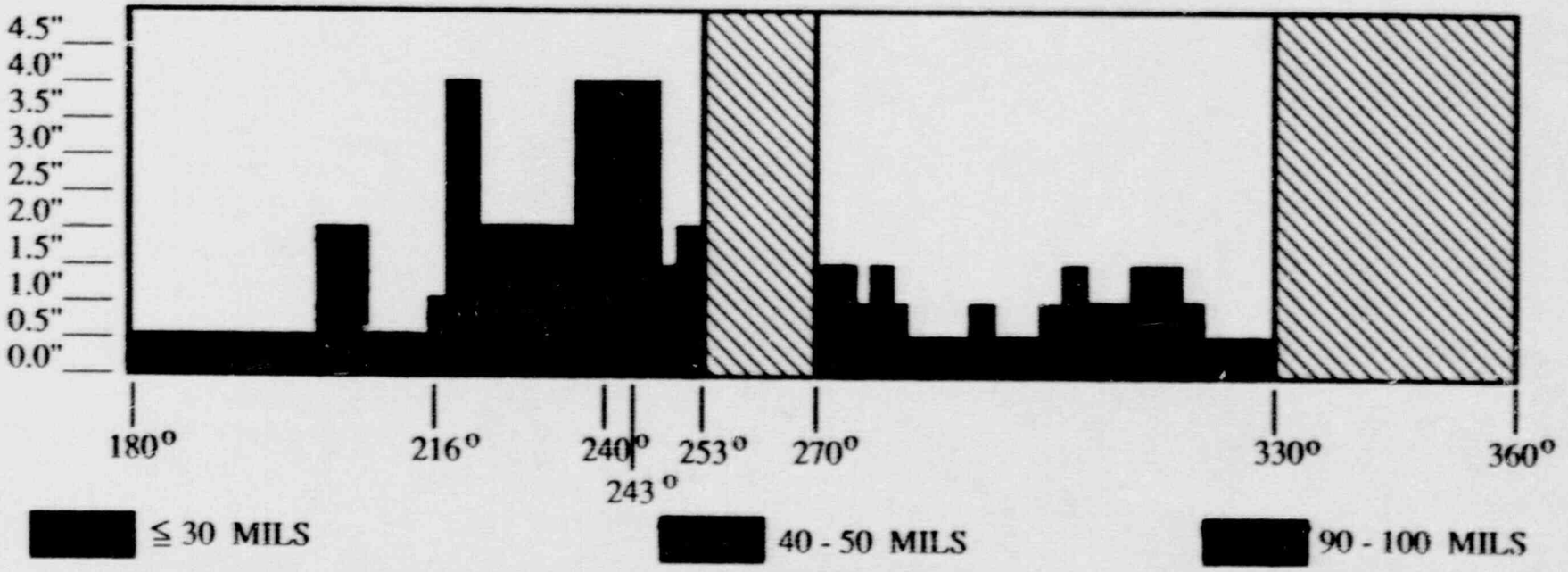
FIGURE 2

FIGURE 3

FIGURE 4

CYLINDER PLATE DEVELOPED VIEW OF IDENTIFIED CORROSION





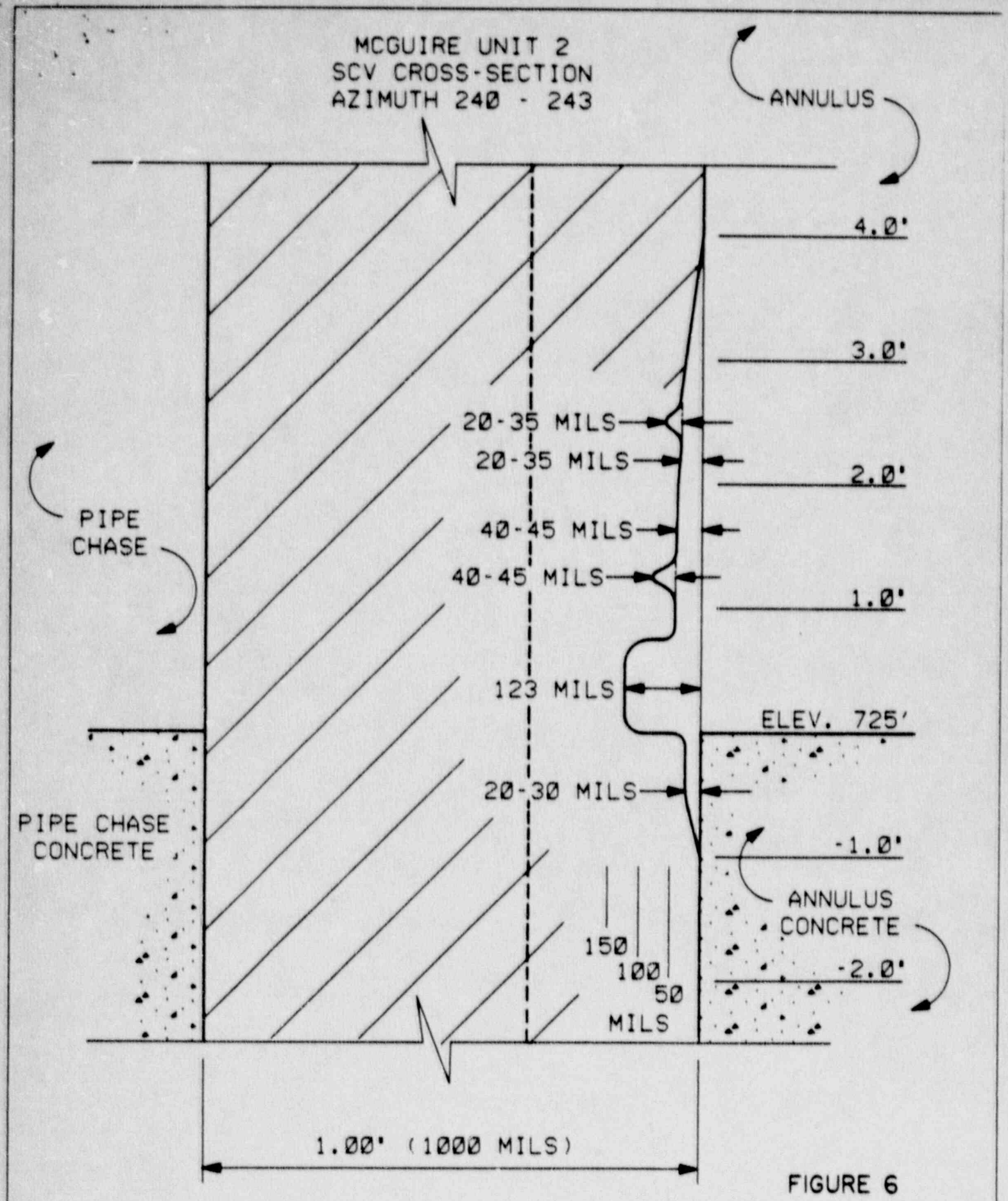

MCGUIRE UNIT 2
SCV CROSS-SECTION
AZIMUTH 240 - 243
ANNULUS
4.0'
3.0'
20-35 MILS
20-35 MILS
2.0'
PIPE
CHASE
40-45 MILS
40-45 MILS
1.0'
123 MILS
ELEV. 725'
20-30 MILS
PIPE CHASE
CONCRETE
-1.0'
ANNULUS
CONCRETE
150
100
50
MILS
-2.0'
1.00' (1000 MILS)

FIGURE 6

UNIT 1 PRELIMINARY INSPECTION FINDINGS

* Similar Coating Failures as Unit 2

* Similar Ponding of Water as Unit 2

  1. Azimuth 218° to 253°

* More Extensive Boric Acid Deposits Than Unit 2

  1. Azimuth 121° to 198°
  2. Azimuth 206° to 253°
  3. Azimuth 284° to 330°

* Comparable Corrosion Depths as Unit 2

Azimuth (deg)	Pit Height Above Elev. 725 (inches)	Maximum Pit Depth (mils)
216	0 to .5	103
218	0 to .5	60
221	0 to .5	55
228	0 to .5	73
245	0 to .5	82
316	0 to .5	125

Form 01163

PROJECT McGUIRE NUCLEAR STATION ITEM CONTAINMENT VESSEL ANALYSIS PAGE 2-3a

ORIGINATED BY A.G. Quindalla DATE 11-19-74 3-1-79 CHECKED BY [illegible] DATE

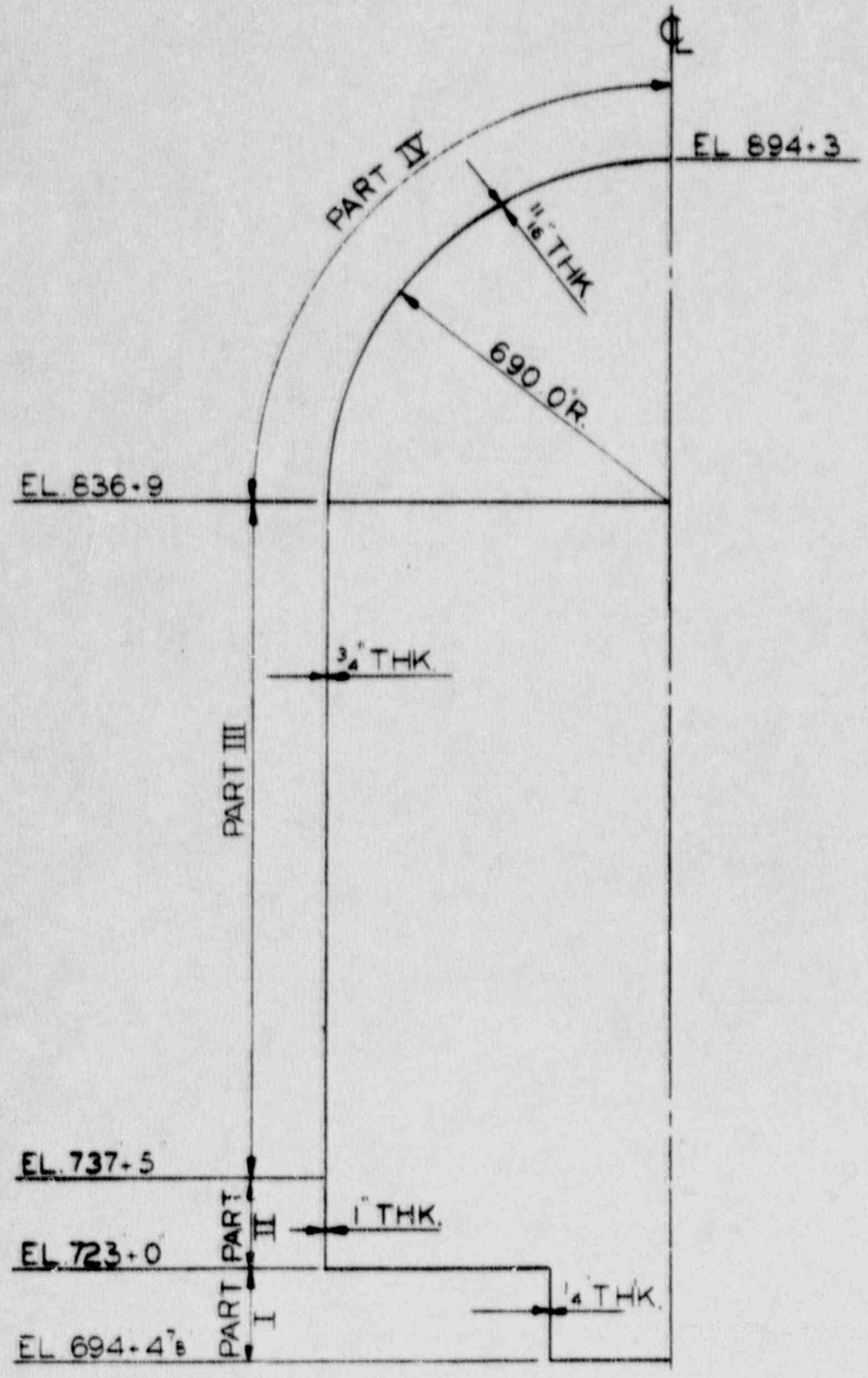


FIGURE 2-1 — THE PLATE THICKNESS OF CONTAINMENT VESSEL.

TABLE 1-2

FSAR TABLE 3.8.2-2

Containment Materials

Material Location	Material Specification
Base Liners	SA 516, Grade 60
Base Liner Embedments	SA 516, Grade 60 and/or ASTM A36
Knuckle Plate	SA 516, Grade 60
Shell and Dome Plate	SA 516, Grade 60
Penetrations (Piping and Electrical)	SA 333, Grade B and/or SA 516, Grade 60
Personnel Locks	SA 516, Grade 60 and/or Grade 70
Stiffeners	SA 516, Grade 60
Equipment Hatch	SA 516, Grade 60 and/or Grade 70
Anchor Bolts	SA 320-L43
Anchor Bolt Anchor Plates	SA 516, Grade 60

Form 01163

PROJECT McGUIRE NUCLEAR STATION ITEM _____ PAGE 1-13

ORIGINATED BY MMB DATE 3-1-79 CHECKED BY [illegible] DATE 3/1/79

Table 1-1

FSAR Table 3.8.2-1

Containment Vessel
Loading Combination and Code Requirements

Loading Combination	Code Reference
DL + CL	ASME - Normal Condition
DL + OL + DBA	ASME - Normal Condition
DL + OL + OBE	ASME - Normal Condition
DL + OL + OBE + P'	ASME - Normal Condition
DL + OL + SSE	ASME - Emergency Condition
DL + OL + SSE + DBA	ASME - Emergency Condition
DL + OL + SSE + P'	ASME - Emergency Condition

ASME = ASME Boiler and Pressure Vessel Code, Section III, Subsection B, 1968, including all addenda through Summer of 1970.

DL = Own weight of the Containment Vessel and all the permanent attachments to the Containment.

CL = Construction Loads.

DBA = Design Basis Accident which includes temperature and pressure effects.

OBE = Operating Basis Earthquake, 8 percent G.

SSE = Safe Shutdown Earthquake, 15 percent G.

OL = Normal Operating Loads of the Containment Vessel, including Live Loads, thermal loads and operating pipe reactions.

P' = External pressure due to the internal vacuum created by accidental trip of the Containment Spray System.

Stress limits of the Containment Vessel are as prescribed in Figure N-414 of the ASME, Section III, Nuclear Vessels, 1968, including all the addenda up to the Summer of 1970. Buckling is considered in all loading combinations.

MINIMUM WALL DETERMINATION

- Review all load combinations for actual stresses at base.
- Back-calculate required thicknesses based on ASME code allowable stress intensities.
- Controlling combination equivalent "Level B" (OBE + LOCA) excluding thermal effects.
- Minimum wall established at 0.65 inches.

PROJECTED CORROSION RATES*

5 to 20 mils per year

* Based on assumed uniform rate since Initial Fuel Load for measured data.

ESTIMATED REMAINING SHELL THICKNESS AT BASE

	Average	Worst Case
Unit 1	0.852 inches	0.824 inches
Unit 2	0.872 inches	0.848 inches

Values shown include projection to next outage.

ACTUAL MATERIAL PROPERTIES OF BASE SHELL COURSE

	Yield		Tensile	
	Min.	Mean	Min.	Mean
Unit 1	42.8	45.4	63.0	65.9
Unit 2	43.5	46.6	63.7	67.0
Code	32.0		60.0	

CONTRIBUTING FACTORS TO CORROSION

- Ponding Water
- Drain Operation
- Boric Acid Deposits
- Coating Failures
- Lack of Sealant

IMMEDIATE ACTION

1. Properly coat SCV interior face exposed areas where insulation panels have been removed.

   Action: Implementation per MEVN-2005.

   Coat exposed steel with Service Level I Coating System 106-I and reinstall stainless steel cover

2. Recoat concrete floor in accordance with Coating Specification 305. Recoat at least the first nine inches of the steel containment vessel in accordance with Coating Specification 303. Seal joint between containment vessel (including vertical stiffeners) and concrete floor with Sealant Specification 7004.

   Action: Implementation per MEVN-1951

   Clarification: Recoat accessible concrete floor and entire containment vessel between Azimuth 270° - 330° and 164° - 253°.

3. Repair concrete at ~ 240° - 243°.

4. Conduct preliminary inspection of the Unit 1 containment vessel pitting in the annulus.

   Action: Completed preliminary inspection of the SCV exterior face August 29-30, 1989.

5. Take immediate temporary measures to contain water/acid leaks.

INTERIM PERIOD UNTIL NEXT OUTAGE

1. Annulus surveillance to identify and remove ponding water and/or boric acid deposits located on the first ring stiffener or near the containment vessel/concrete floor interface. Surveillance frequency should be once a week. Origin of water/acid leakage should be identified and corrective actions formulated for next outage.

2. Determine permanent fix for annulus drains and faulty "Annulus Loop Seal Switch".

3. NSM for HVAC duct relocation.

4. Develop "Acceptance Criteria" for weld repair.

NEXT OUTAGE

1. Relocate HVAC duct.

2. Reinstall insulation panels and seal all around.

3. Remove coatings a minimum of 9" on the containment vessel from the concrete floor (0° - 360°).

   Note: All of Unit 1. Remainder of Unit 2.

4. Remove concrete floor coatings (0° - 360°).

   Note: All of Unit 1. Remainder of Unit 2.

5. Conduct inspection of the steel containment vessel pitting to include annulus and pipe chase. (Remove and replace insulation panels in pipe chase as required)

   Note: All of Unit 1. Remainder of Unit 2.

6. Identify weld repair locations in accordance with acceptance criteria to be developed.

   Note: All of Units 1 and 2.

7. Implement corrective actions to minimize/control acid/water leakage.

8. Implement modifications/corrective actions for annulus drain system.

9. Install flood barrier to protect containment-concrete interface, if warranted by weekly inspection results and leakage containment measures (following outage).

10. Recoat containment vessel and concrete floor.

    Note: All of Unit 1. Remainder of Unit 2.

11. Re-evaluate future periodic surveillance requirements.

12. Begin consecutive outage containment vessel inspections for coating and sealant degradation.