

**Blister Evaluation – Torus Pressure Boundary in Immersion**

The licensee provided the criteria for evaluation and disposition of blisters on the torus immersion coating. The blisters were categorized into three groups as shown in Figure 18.

1. **Intact Blisters:** Blisters indicated by green arrows which, when viewed with the naked eye, are intact, and exhibit no cracking and/or staining due to corrosion of the underlying substrate.
2. **Cracked Blisters:** Blisters indicated by yellow arrows which, when viewed with the naked eye, exhibit cracking and/or light surface staining due to corrosion of the underlying substrate. Although cracked, the cap of a cracked blister remains in place.
3. **Fractured Blisters:** Blisters indicated by red arrows which, when viewed with the naked eye, exhibit disbondment of the blister cap and active corrosion of the underlying substrate.

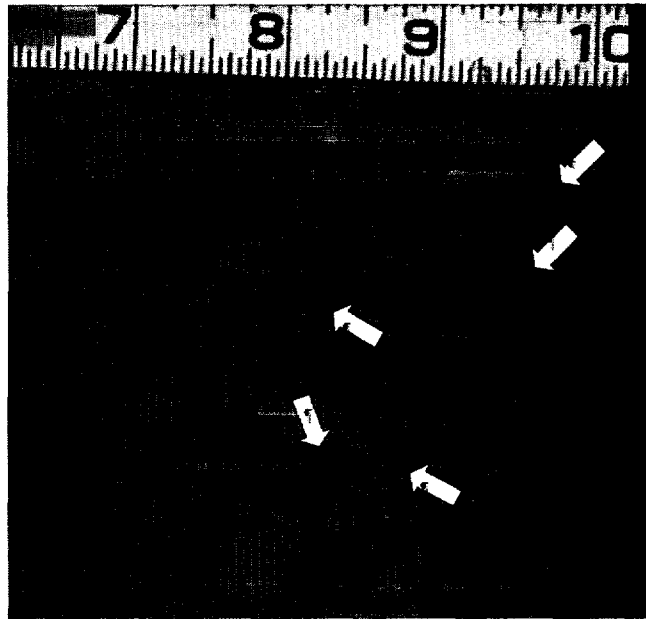


Figure 18 – Categorization of blister conditions on the torus shell.

**Fractured Blisters**

Fractured blisters, by definition, exposed the steel substrate and were designated for coating repair. Figure 19 illustrates the typical condition at fractured blister sites before and after the substrate was cleaned for inspection. Each of the areas was inspected for pitting. With the exception of pits 18-P2-01, 15-P2-01, 05-P1-01, 05-P5-01, and 05-P5-02 (see Table 4), all other pitting was less than 0.040". Approximately \*\*400 fractured blisters were identified. Blister diameters generally range from less than 1/4" to 1-1/2". They represent less than 1% of the total submerged surface area of the torus shell. All fractured blister sites were repaired by the application of underwater coating.

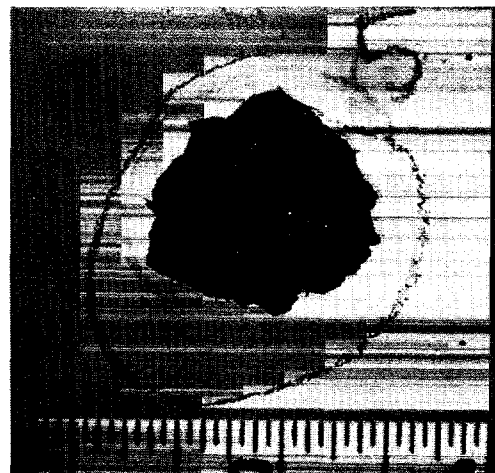
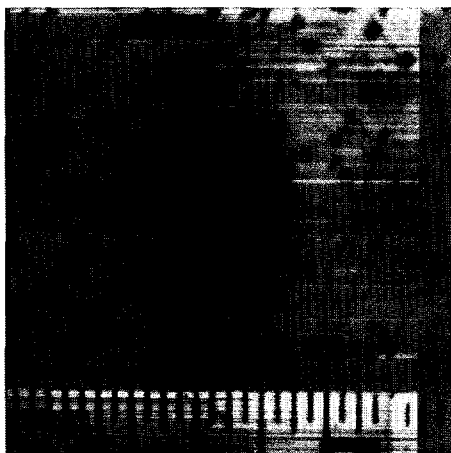


Figure 19 – Typical condition of substrate at site of fractured blisters. Pitting is typically <40 mils.

Cracked Blisters

The substrate condition beneath cracked blisters was evaluated by sampling a one foot square, area in each bay. Sample areas were selected based on worst case condition of cracked blisters. Blister caps were removed from 10% (or a minimum of 10) of the cracked blisters and the substrate was evaluated for pitting.

Typical worst case conditions (see Figure 20) were chosen for evaluation of substrate beneath cracked blisters (yellow arrows). Intact blisters in the sample area are indicated by green arrows. Blister size and distribution is typical. Coating in the sample areas exhibits medium to dense blistering with a high ratio of cracked blisters. When blister caps are removed from cracked blisters (blue arrows), the substrate typically exhibits light surface rusting with minor (<40 mil) pitting. Coating adjacent to blisters appears to have good adhesion except in areas where epoxy was applied over the 46x16 surfacer.

Three pits exceeding 0.040" were identified and reported. No other pits greater than or equal to 0.040" were found. Sample photographs depicting typical condition of the cracked blisters and underlying substrate are shown in Figure 20. A map of blister locations can be found in Attachment \*.

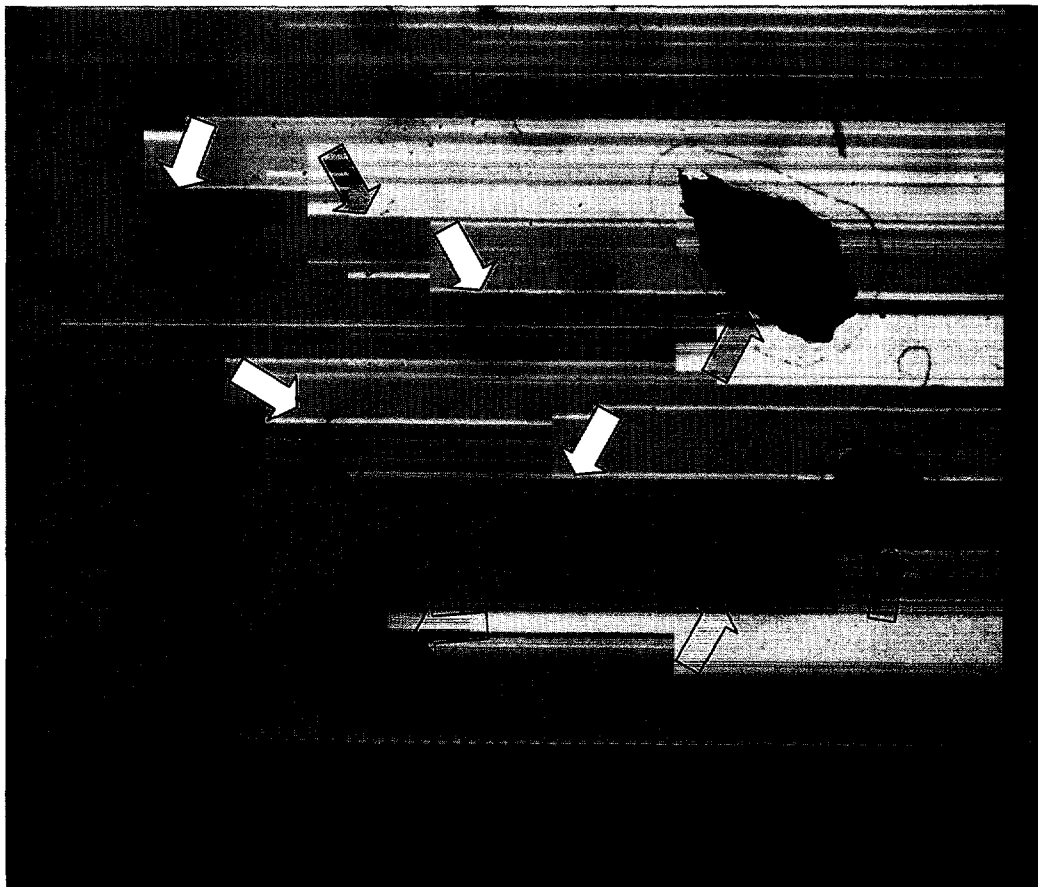


Figure 20 – Typical conditions in cracked blister sample areas.

**Quantitative Corrosion Evaluation – Torus Pressure Boundary in Immersion**

Oyster Creek specification SP-1302-52-120, Revision 3 established guidelines for pitting considered reportable. The majority pitting and general corrosion appeared to fall well inside the guidelines for pits requiring quantitative evaluation.

Localized general corrosion and surface rusting was found in randomly scatter areas on torus internal structures and components below the waterline. Visual assessment and selected confirming measurements show no indication that any significant metal loss has occurred. Minimal corrosion was noted on structures in the vapor area.

Seven reportable pit depth measurements were documented on the immersion area of the torus pressure boundary. Pit depths at these sites are documented in Attachment \*.

The following table summarizes the quantitative pit depth measurements.

**Table 4 – Reportable pitting indications**

Pit ID	Pit Group	Metal Loss (in)	Pit Dia (in)	Coordinate X or Azimuth	Units (In or Deg)	Y Coord or Dist. from Pen (In)	Adjacent Pits / Pit Groups
18-P2-01	N/A	0.041	0.250	28" from P3 WS	in	56" from IWS	N/A
15-P2-01	N/A	0.044	0.250	48" from P2/3 WS	in	6" from IWS	N/A
05-P1-01	N/A	0.041	0.038	46" from 4/5 RG	in	50" from IWS	N/A
05-P5-01	N/A	0.076	0.025	27" from P4/5 WS	in	36" from IWS	N/A
05-P5-02	N/A	0.039	0.025	22" from P5/6 WS	in	34" from IWS	N/A
07-P5-01	N/A	0.050	0.025	20" from P4/5 WS	in	52.5" from IWS	N/A
04-P5-01	1	0.041	0.125	10.5" from P4/5 WS	in	67" from IWS	Pit 01-G1
04-P5-02	1	0.044	0.125	10" from P4/5 WS	in	61" from IWS	Pit 02-G1

## ATTACHMENT 1

## QUALITATIVE INSPECTION RECORD

PRESERVICE [ ] INSERVICE [X]  
VT-1 [ ] VT-3 [X] GENERAL VISUAL [ ]  
DIRECT [X] REMOTE [ ]  
ILLUMINATION CHECK (TIME): START NA STOP NA ILLUMINATION CHECK: SAT [X] UNSAT [ ]  
Client: Exelon/AmerGen Facility Location: Oyster Creek Nuclear Gen. Station Project No.: 01-02260.56  
Date: 10/28/06 Description of Vessel: G.E. BWR /Mark I Containment-Torus Location: Bays No. 1 - 20 (Shell)

WORK ORDER NO. R2077340RECORD NO.: 1 Page 1 of 4**INSPECTION INFORMATION: Submerged Torus Shell (Pressure Boundary)**Principal Torus Coating: Mobil 78 + Mobil 46 x 16 Surfacer**Classification of Coating Deficiencies:**

TYPE	DESCRIPTION	Location	Area
Cracking	In Top Coat <u>None</u> To Substrate <u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Delamination	In Top Coat <u>None</u> To Substrate <u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Blistering	Per D714: <u>No. 2 to 6 Med to Dense</u>	<u>Invert &amp; near waterline</u>	<u>1 to 10 sqft typ.</u>
Flaking or Peeling	<u>Frac blisters/low adhesion</u>	<u>Associated with Blistering</u>	<u>1 to 2 sqft typ.</u>
Mech. Damage	<u>Random to med dense</u>	<u>primarily at invert</u>	<u>1 to 2 sqft typ.</u>
Tiger Striping	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Discoloration	<u>Surface staining</u>	<u>primarily at invert</u>	<u>1 to 10 sqft typ.</u>

**Classification of Substrate Deficiencies:**

Pinpoint Rusting	<u>Random</u>	<u>various locations</u>	<u>&lt;1 sqft typ.</u>
Uniform Rusting	<u>Minor</u>	<u>various locations</u>	<u>&lt;1 sqft typ.</u>
Pitting Corrosion (< threshold values)	<u>2 to 39 mils</u>	<u>primarily at invert</u>	<u>&lt;1 sqft typ.</u>
Corrosion with loss of section	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
Other Surface Indications*	<u>None</u>	<u>N/A</u>	<u>N/A</u>

**Note 1:** \*Document surface indications such as discoloration, arc strikes, gouges, dents, pitting, cracks, wear, excessive corrosion, erosion, or other signs of surface irregularities on the part or component.

**Note 2:** Show references to continuation sheets when entering data on this sheet.

**Measuring and Testing Equipment:**Dry Film Thickness Gauge: SN 181771 SN 178919 SN EJ018 SN EJ024NIST Cal. Plates: SN K-84487 SN K-75160Dial Depth Gauge: SN D-24 SN 177857Calibration Flat: SN 05002Go/No-Go Pit Gauge: SN PB-15

1 - Gauges disposed of on site.

Level II Review

**INFORMATION ONLY**

ISI Engineer Review

Date

ANII Review

Date

**ATTACHMENT 1 (CONTINUED)**  
**QUALITATIVE INSPECTION RECORD**

PRESERVICE ☐ INSERVICE ☒WORK ORDER NO. R2077340VT-1 ☐ VT-3 ☒ GENERAL VISUAL ☐RECORD NO.: 1 Page 2 of 4DIRECT ☒ REMOTE ☐Client: Exelon/AmerGen Facility Location: Oyster Creek Nuclear Gen. Station Project No.: 01-02260.56Date: 10/15/02 Description of Vessel: G.E. BWR /Mark I Containment-Torus Location: Bays No. 1 – 20 (Shell)

**GENERAL ASSESSMENT**

**Torus Shell:** 100% of the submerged torus shell (pressure boundary) was inspected in all 20 bays. The surface of the torus shell is coated, however, there are numerous small coating deficiencies that expose base metal. These consist primarily of fractured blisters with minor mechanical damage and spot rusting and typically measure 1/16" to 1/2" in diameter. Pitting of the base metal was qualitatively assessed and typically ranged from 2 to approximately 40 mils.

Blistering of the pressure boundary coating is found in all 20 bays. The heaviest blistering is generally near the invert. Blister size is No. 2 to No. 6. Degree of frequency is medium to medium dense as rated in accordance with ASTM D 714 "Standard Test Method of Evaluating Degree of Blistering of Paints". Fractured blisters appear to expose undercoat or substrate. Blister size in these areas randomly exceeds ASTM rating (1/2" to 1-1/4" diameter).

The balance of the coating in the inspected areas exhibits random moderate to heavy surface straining (not to substrate), mechanical damage, and pinpoint rusting.

**REPORTABLE INDICATIONS**

**Coated Surfaces:** Coating deficiency indications consist primarily of blistering, discoloration, and minor mechanical coating damage in all 20 torus bays. Frequency and distribution of these conditions is as described above. Photographs of typical conditions can be found in the final report. Coating deficiencies exposing base metal were identified and repaired by the application of an underwater coating.

**Uncoated Surfaces:** Reportable Pitting indications are recorded on the attached quantitative data sheets (attachment 2). Photographs of typical pitting conditions can be found in the final report. Other localized areas of exposed base metal exhibit only minor corrosion and surface rusting. There are no indications of discoloration, arc strikes, gouges, dents, pitting, cracks, wear, excessive corrosion, erosion, or other signs of surface irregularities.

\_\_\_\_\_  
Level II NDE Inspector\_\_\_\_\_  
Date\_\_\_\_\_  
Level II NDE Inspector\_\_\_\_\_  
Date\_\_\_\_\_  
Level II NDE Inspector\_\_\_\_\_  
Date\_\_\_\_\_  
Level II NDE Inspector**INFORMATION ONLY**\_\_\_\_\_  
Level II NDE Inspector\_\_\_\_\_  
Date\_\_\_\_\_  
Level II NDE Inspector\_\_\_\_\_  
Date\_\_\_\_\_  
Level III NDE Inspector\_\_\_\_\_  
Date\_\_\_\_\_  
ISI Engineer Review\_\_\_\_\_  
Date\_\_\_\_\_  
ANII Review\_\_\_\_\_  
Date

UNDERWATER CONSTRUCTION CORPORATION	PROCEDURE: QP10.09 – OCNGS1R21	REVISION: 1
-------------------------------------	--------------------------------	-------------

## ATTACHMENT 2

### QUANTITATIVE EVALUATION OF METAL LOSS RECORD

PRESERVICE <input type="checkbox"/> INSERVICE <input checked="" type="checkbox"/> VT-1 <input checked="" type="checkbox"/> VT-3 <input type="checkbox"/> GENERAL VISUAL <input type="checkbox"/> DIRECT <input checked="" type="checkbox"/> REMOTE <input type="checkbox"/> ILLUMINATION CHECK (TIME): START <u>NA</u> STOP <u>NA</u> ILLUMINATION CHECK: SAT <input checked="" type="checkbox"/> UNSAT <input type="checkbox"/> Client <u>Exelon/AmerGen</u> Date: <u>10/28/06</u> Description of Vessel: <u>G.E. BWR Four/Mark I Containment - Torus</u>		WORK ORDER NO: <u>R2077340</u> RECORD NO.: <u>1</u> Page <u>3</u> of <u>4</u> Project No.: <u>01-02260.56</u>	
Facility Location: <u>Oyster Creek Nuclear Generating Station</u> Location: Bay No. <u>4, 5, 7, &amp; 15</u>			
<b>Measure and Test Equipment:</b> Dry Film Thickness Gauge: SN <u>181771</u> SN <u>178919</u> SN <u>EJ0181</u> SN <u>EJ0241</u> NIST Cal. Plates: SN <u>K-84487</u> SN <u>K-75160</u> Dial Depth Gauge: SN <u>D-24</u> SN <u>177857</u> Calibration Flat: SN <u>05002</u> Go/No-Go Pit Gauge: SN <u>PB-15</u> 1 – Gauges disposed of on site.			
<div style="border: 2px solid black; padding: 10px; font-size: 2em; font-weight: bold; background-color: #f0f0f0;">         INFORMATION ONLY       </div>			
<b>Procedure for Determining Metal Loss:</b> Metal loss values have a higher degree of accuracy when the protective coating is removed. Since it is not practical to remove the coating at all measured sites, it is generally performed when the metal loss values (obtained with coating in place) approach or exceed the maximum value (MAV) established by the Owner. Metal loss values (MLV) are obtained by subtracting the sum of the average dry film thickness (ADFT) value and the dial depth gauge adjusted to zero value (AZV) from the pit depth value (PDV). Thus, $MLV = PDV - (ADFT + AZV)$			
<b>LEGEND FOR METAL LOSS RECORD</b>			
<b>Pit ID</b> = Bay#, Plate(P)#, Pit# <i>Examples:</i> 16-2P-023 = Bay 16, shell plate 2, pit # 023	<b>Pit Group</b> = N/A if not present	<b>Isolated Pit (ISO)</b> = N/A if not present	<b>Pit Depth</b> = Uncorrected for surface roughness or DFT
	<b>Adj. Zero</b> = Surface roughness measured near pit		<b>Avg DFT</b> = Average dry film thickness near pit
<b>Metal Loss</b> = Pit Depth – (Adj. Zero + Avg. DFT)	<b>Pit Diameter</b> = Diameter of pit or pit group across longest dimension	<b>Coordinate</b> = Location measured as an X / Y distance from a structural feature (such as a Ring Girder) or azimuth & distance from a penetration.	
<b>Pit Coordinate</b> = X / Y coordinate or azimuth & distance.	<b>Adjacent Pits</b> = Enter Pit ID#'s of adjacent pits or pit groups	<b>Video Ref.</b> = reference from VCR counter	<b>UT Thickness</b> = Wall thickness per Owner
<b>Rep. Eng.</b> = Report to Owner's Engineer (Yes / No)			
<b>Note: Record all measurements in mils. 1 mil = one thousandths of an inch (0.001)</b>			

**ATTACHMENT 2 (CONTINUED) – DATA SHEET**  
**QUANTITATIVE EVALUATION OF METAL LOSS RECORD**

Work Order No.: R2077340

Project No.: 01-02260.56

Record No.: 1 Page 4 of 4

Pit ID	Pit Group	ISO	Pit Depth (in)	Adj. Zero (in)	Avg. DFT (in)	Metal Loss (in)	Pit Dia (in)	Coordinate X or Azimuth	Units (in or Deg)	Y Coord or Dist. from Pen (in)	Adjacent Pits / Pit Groups	Video Ref.	Rep Eng.	UT Thickness	Comments
18-P2-01	N/A	X	0.052	0.006	0.011	0.041	0.250	28" from P3 WS	in	56" from IWS	N/A	N/A	X	N/A	Adj Zero not used in metal loss calc
15-P2-01	N/A	X	0.073	0.026	0.029	0.044	0.250	48" from P2/3 WS	in	6" from IWS	N/A	N/A	X	N/A	Adj Zero not used in metal loss calc
05-P1-01	N/A	X	0.062	0.010	0.021	0.041	0.038	46" from 4/5 RG	in	50" from IWS	N/A	N/A	X	N/A	Adj Zero not used in metal loss calc
05-P5-01	N/A	X	0.090	0.006	0.014	0.076	0.025	27" from P4/5 WS	in	36" from IWS	N/A	N/A	X	N/A	Adj Zero not used in metal loss calc
05-P5-02	N/A	X	0.055	0.000	0.016	0.039	0.025	22" from P5/6 WS	in	34" from IWS	N/A	N/A	X	N/A	Adj Zero not used in metal loss calc
07-P5-01	N/A	X	0.070	0.000	0.020	0.050	0.025	20" from P4/5 WS	in	52.5" from IWS	N/A	N/A	X	N/A	Adj Zero not used in metal loss calc
04-P5-01	1	NA	0.058	0.000	0.018	0.041	0.125	10.5" from P4/5 WS	in	67" from IWS	Pit 01-G1	N/A	X	N/A	Adj Zero not used in metal loss calc
04-P5-02	1	NA	0.062	0.000	0.018	0.044	0.125	10" from P4/5 WS	in	61" from IWS	Pit 02-G1	N/A	X	N/A	Adj Zero not used in metal loss calc
<div style="display: flex; justify-content: space-between;"> <div>Level II NDE Inspector</div> <div>Date</div> <div>Level II NDE Inspector</div> <div>Date</div> <div>Level II NDE Inspector</div> <div>Date</div> <div>Level II NDE Inspector</div> <div>Date</div> </div>															
<div style="border: 2px solid black; padding: 5px; display: inline-block; font-weight: bold; font-size: 1.5em;">INFORMATION ONLY</div>															
<div style="display: flex; justify-content: space-between;"> <div>Level II NDE Inspector</div> <div>Date</div> <div>Level III NDE Inspector</div> <div>Date</div> <div>ISI Engineer Review</div> <div>Date</div> </div>															
<div style="display: flex; justify-content: space-between;"> <div>ANII Review</div> <div>Date</div> </div>															