

MAY 1 - 1978



LABORATORY TEST REPORT

May 9, 1978

Testing Project: #01651
FINAL REPORT

CONFIDENTIAL

SUBJECT: LOCA test of systems topcoated with Phenoline 305 Finish

REFERENCE: Commanche Peak Nuclear Power Station; Mr. P. D. Sullivan, Sr. Smith & lk;
Mr. Dan McBride; L-115-105

PURPOSE: To test the performance of Phenoline 305 Finish on each of the following primers:

- 1) 1c Amercoat D-6 @ 2.0 - 3.0 mils
- 2) 1c Mobil Zinc 7 @ 2.0 - 3.0 mils
- 3) 1c Carbo Zinc 11 @ 11.0 - 12.0 mils

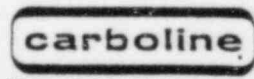
when exposed to the Commanche Peak Steam Electric Station, FSAR LOCA Curve and evaluated according to the criteria of ANSI N101.2 - 1972, Section 4.5 as interpreted by Carboline.

CONCLUSIONS: After completion of the 7 day Commanche Peak FSAR LOCA test, the systems tested exhibited the following performances when evaluated according to ANSI N101.2 - 1972, Section 4.5 as interpreted by Carboline:

<u>Coating System</u>		<u>Performance</u>
1) Amercoat D-6 @ 2-3 mils Phenoline 305 Finish	Vapor Phase	Acceptable
2) Amercoat D-6 @ 2-3 mils Phenoline 305 Finish	Liquid Phase	Unacceptable
3) Mobil Zinc 7 @ 2-3 mils Phenoline 305 Finish	Vapor Phase	Acceptable
4) Mobil Zinc 7 @ 2-3 mils Phenoline 305 Finish	Liquid Phase	Acceptable
5) Carbo Zinc 11 @ 11-12 mils Phenoline 305 Finish	Vapor Phase	Unacceptable
6) Carbo Zinc 11 @ 11-12 mils Phenoline 305 Finish	Liquid Phase	Unacceptable

From the Carboline Research & Development Laboratory

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CONFIDENTIALPROCEDURE:A) Test Coupons

Size: 2" x 4" x 1/4" Certified ASTM A36 Steel.

Surface Prep: Gritblasted to SSPC-SP5-63

Abrasive Media: 6FH #50 grit (Cleveland Metal Abrasives, Inc)

B)

<u>Systems Tested</u>	<u>Batch Numbers</u>	<u>Dry Film Thickness</u>
1) 1c Amercoat D-6	6-705416	2.5 - 3.0 mils
	6-705420	
1c Phenoline 305 Finish	7K2528M	4.8 - 6.2 mils
	7K2500M	7.3 - 8.5 mils
<hr/>		
2) 1c Mobil Zinc 7	FT7K24	2.1 - 2.7 mils
1c Phenoline 305 Finish	7K2528M	5.3 - 6.9 mils
	7K2500M	8.0 - 9.0 mils
<hr/>		
3) 1c Carbo Zinc 11	7K3106M	11.0 -13.0 mils
	7K0966Z	
1c Phenoline 305 Finish	7K2528M	4.0 - 5.5 mils
	7K2500M	16.0 -17.0 mils

C) Cure Schedule

Primers (all systems): 17 days at 65-76°F (18-24°C) and 27-90% R.H.

Topcoat (all systems): 10 days at 72-79°F (22-26°C) and 31-45% R.H.

D) Exposure

Texas Utilities Generating Company, Comanche Peak Steam Electric Station, FSAR Figures 6.2.1-1 and 6.2.1-2

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1. Time/Temperature/Pressure Profile

<u>Time</u>	<u>Temperature</u>	<u>Pressure</u>	<u>Spray Condition</u>
Initial to 10 seconds	240°F (115°C)	44 psig	Static
10 seconds to 15 mins.	270°F (132°C)	58 psig	Dynamic
15 mins. to 1 hour			
15 mins.	215°F (102°C)	34 psig	Dynamic
1 hour 15 mins. to			
7 days	215-130°F (102-51°C)	34-10 psig	Dynamic

Please refer to the recorder chart (L115-105) for exact conditions of LOCA profile.

2. Spray Solution

H₂BO₃ (2000 ppm as Boron) in deionized water.
pH = 8.5 - 10.0 (NaOH added to adjust pH)

GRADING PROCEDURE:

The test coupons were evaluated for performance in the following areas:

- 1) Material flaking off
- 2) Delamination between coats and/or peeling
- 3) Blistering of the topcoat
- 4) Chalking of the coating
- 5) Excessive cracking

Grading procedures specified in Report N101.2 - 1972 of the American National Standards Institute-Protective Coatings for Light Water Nuclear Reactor Containment Facilities:

4.5 Methods of Examining and Evaluating the Exposed Test Specimens

The dynamic and/or static elevated temperature-pressure and irradiation test panels shall be evaluated within 2 hours and again after 2 weeks after removal from the test chamber for the following surface defects: flaking, delamination and/or peeling, blistering, and chalking. Defects listed in Subsections 4.5.1 through 4.5.4 shall be dealt with as follows:

From the Carboline Research & Development Laboratory

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LABORATORY TEST REPORT

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4.5.1 Flaking. ASTM D772, Evaluating Degree of Resistance to Flaking (Scaling) of Exterior Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. Flaking shall not be permitted.

4.5.2 Delamination and/or Peeling. Delamination and/or peeling shall not be permitted.

4.5.3 Blistering. Blistering shall be limited to a few, intact blisters, Size No. 4, ASTM D714, Standard Method of Evaluating Degree of Blistering of Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. The number and the size of blisters shall be recorded.

4.5.4 Chalking. ASTM D659, Standard Method of Evaluating Degree of Resistance to Chalking of Exterior Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. Heavy chalking shall not be permitted.

Any other changes in coating properties which are not also associated with the separation, or the release, of coating from the substrate shall not be a cause for rejection.

ANSI N101.2 - 1972 Criteria
(As interpreted by Carboline)

Maximum Degree of Failure Allowable

Flaking ASTM D772		10 (None)
Delamination or Peeling		None
*Blistering ASTM D714-56	<u>Blister Size</u>	<u>Blister Density</u>
	#2	None
	#4	Few
	#6	Medium
	#8	Medium-Dense
Chalking ASTM D659		8 (Light)

NOTE: Flaking, blistering and chalking are all evaluated according to ASTM Standards, with a rating of 10 indicating that no failure was observed in the specific grading area.

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Panel Identification and Coating System	Dry Film Thickness (Mils)	Flaking	Delamina- tion or Peeling	Blister- ing	Chalking	Other Performance Characteristics	Performance Evaluation
1A)* 1c Ameron D-6 1c Phenoline 305 Finish	2.5/3.0 4.8/5.0 7.3/8.0	10	None	None	10	Blistering at bottom edge, both sides, larger than #2F-BT-intact	Acceptable
1B 1c Ameron D-6 1c Phenoline 305 Finish	2.3/2.4 6.2/5.4 8.5/7.8	10	None	#2F-BT on side 1 - intact	10	Blistering at bottom edge, both sides, larger than #2F-BT-cracked	Unacceptable
2A)* 1c Mobil Zinc 7 1c Phenoline 305 Finish	2.7/2.6 5.3/5.4 8.0/8.0	10	None	None	10	Blistering at bottom edge, both sides, larger than #2F-BT-intact	Acceptable
2B) 1c Mobil Zinc 7 1c Phenoline 305 Finish	2.4/2.1 6.6/6.9 9.0/9.0	10	None	None	10	Blistering at bottom edge, both sides: #2M-BT. One #2 at top edge, Side 1.	Acceptable
Acceptable Performance ANSI N101.2-1972, Section 4.5, As Interpreted by Carboline		10	None	#4F to #8MD	#8 Light	*Panel suspended in the vapor phase	

LAB/T-1277

Panel Identification and Coating System	Dry Film Thickness (Mils)	Flaking	Delamina- tion or Peeling	Blister- ing	Chalking	Other Performance Characteristics	Performance Evaluation
3A)* 1c Carbo Zinc 11 1c Phenoline 305 Finish	11.0/11.5 5.0/ 5.5 16.0/17.0	10	None	Larger than #2F-BT, Side 1; #6F, 4F- BT, Side 2	10	Blistering at bottom edge; One larger than #2-BT- intact. One larger than #2-B at top edge, Side 2, intact.	Unacceptable
3B) 1c Carbo Zinc 11 1c Phenoline 305 Finish	13.0/12.2 4.0/ 4.8 17.0/17.0	10	See Blistering	Larger than #2F-BT, near edges, Side 2 (peeled)	10	Three hairline cracks 1/4-1/2" on upper edges- coating intact.	Unacceptable
(1) Because blistering is limited to few-moderate, intact blisters occurring at the edges only, panels 1A, 2A and 2B are rated "Acceptable".							
Acceptable Performance ANSI N101.2-1972, Section 4.5, As Interpreted by Carboline		10	None	#4F to #8MD	#8 Light	*Panel suspended in the vapor phase	



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CONFIDENTIALDISCUSSION
OF RESULTS:

Although panels 1A, 2A and 2B do not meet the strict standards of ANSI N101.2, Section 4.5, Carboline interprets the standard as pertaining primarily to the plane areas of a test coupon, and places limited significance on the discontinuous surfaces such as edges, channels, weld spatter, etc. Therefore, the performance of these panels (1A, 2A, 2B) having intact edge blisters, with no other effects to the coating system or substrate, is rated "Acceptable".

Alicia M. Boldt
Acting Group Leader
Testing Department

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Supervisor
Research & Development

John F. Montle
Vice President
Research & Development

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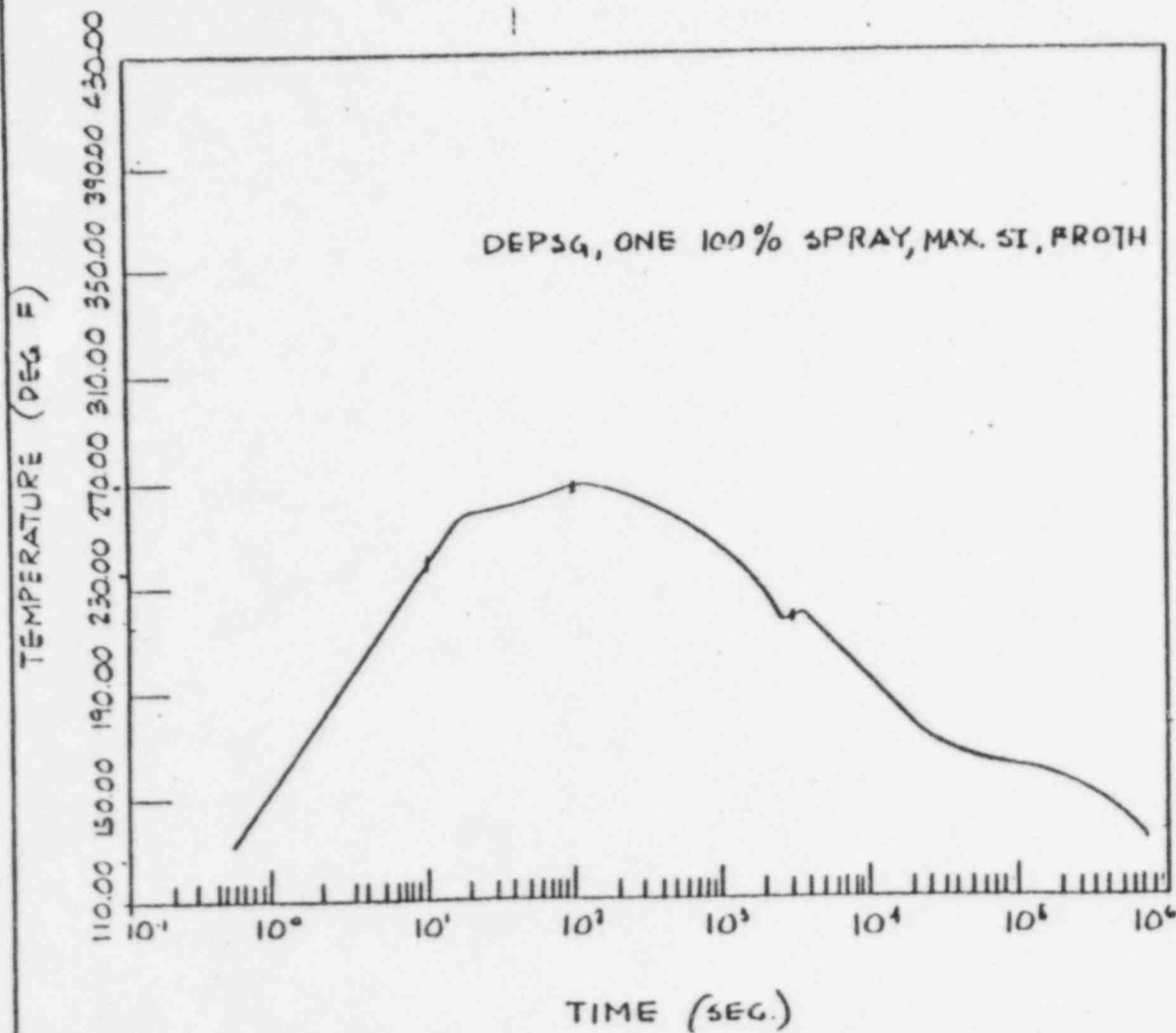
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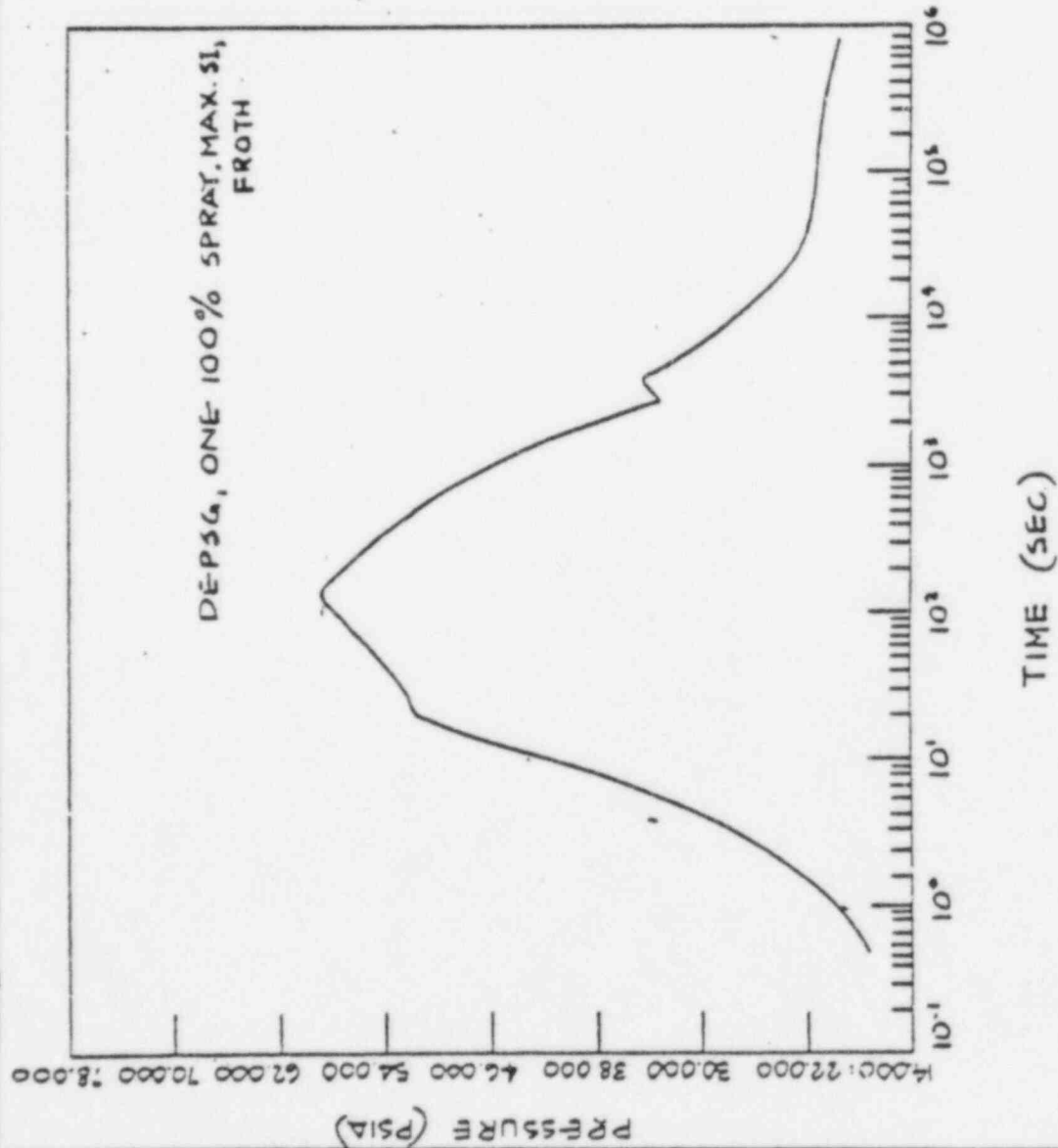
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COMANCHE PEAK S.E.S.
FINAL SAFETY ANALYSIS REPORT
UNITS 1 and 2

CONTAINMENT VAPOR
TEMPERATURE TRANSIENT -
DEPSG

FRAME 6.2.1-2



COMANCHE PEAK S.E.S.
FINAL SAFETY ANALYSIS REPORT
UNITS 1 and 2

CONTAINMENT PRESSURE
TRANSIENT - DEPSG

FIGURE 6.2.1-1



LABORATORY TEST REPORT

September 12, 1975

TESTING PROJECT: 01377
Interim Report: 96 Hours

SUBJECT: Loss of Coolant Accident testing of Carbo Zinc 11 at various thicknesses, untopcoated and topcoated with Phenoline 305.

REFERENCE: Carboline Master BWR Curve; Mr. Chris Kjaer-olsen, Mr. Jim Neese, Mr. W. R. Shelton, General Electric; Mr. C. J. Wieggers, Carboline.

PURPOSE: Evaluate Carbo Zinc 11 at film thicknesses of 1.4 through 15 mils, both untopcoated and topcoated with 1 mil of Phenoline 305 Finish, when subjected to the Carboline Master BWR/1975 test exposure.

OBSERVATIONS: After the initial four days exposure, all systems are exhibiting an acceptable to excellent performance per the ANSI N101.2-1972, Section 4.5 evaluation criteria.

PROCEDURE: A. Test Coupons

2" x 5" x 1/4" Sandblasted Steel

B. Systems Tested

Dry Film Thickness*

1. Carbo Zinc 11	1 mil
2. Carbo Zinc 11	3 mils
3. Carbo Zinc 11	5 mils
4. Carbo Zinc 11	7 mils
5. Carbo Zinc 11	9 mils
6. Carbo Zinc 11	11 mils
7. Carbo Zinc 11	15 mils
8. Carbo Zinc 11	1 mil
Phenoline 305	1 mil
9. Carbo Zinc 11	3 mils
Phenoline 305	1 mils
10. Carbo Zinc 11	5 mils
Phenoline 305	1 mil
11. Carbo Zinc 11	7 mils
Phenoline 305	1 mil

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LABORATORY TEST REPORT

September 12, 1975/Page 2

TESTING PROJECT: 01377
Interim Report: 96 Hours

PROCEDURE: (Continued)

B. Systems Tested

Dry Film Thickness*

12.	Carbo Zinc 11	9 mils
	Phenoline 305	1 mil
13.	Carbo Zinc 11	11 mils
	Phenoline 305	1 mil
14.	Carbo Zinc 11	13 mils
	Phenoline 305	1 mil

*All dry film thicknesses are given as reported by the Application Department. For measured dry film thicknesses, please refer to "Results".

C. Cure Schedule

Carbo Zinc 11 (no topcoat), 24 hours at 100% Humidity plus 3 days at 75°F.

Carbo Zinc 11, 24 hours at high humidity, Phenoline 305 Finish, 3 days at 75°F plus 1 day at 120°F.

D. Exposure

Carboline Master LOCA Curve, BWR Testing 1/75

1. Water Chemistry

Deionized Water

2. Time-Temperature-Pressure Profile

This test was begun at atmospheric pressure and kept at saturation pressure throughout the complete cycle.

<u>Total Time Lapse</u>	<u>Temperature*</u>	<u>Test Environment</u>
0-10 seconds	(Steam Blast) 332°F	Static
10 seconds-7 minutes	250°F	Static
7 minutes-4 hours	200°F	Static
4 hours-96 hours**	180°F	Static
4 days-100 days	160°F	Static

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LABORATORY TEST REPORT

September 12, 1975/Page 4

TESTING PROJECT: 01377
Interim Report: 96 Hours

GRADING
PROCEDURE: (Continued)

Grading procedures specified in Report N101.2-1972 of the American National Standards Institute-Protective Coatings for Light Water Nuclear Reactor Containment Facilities:

4.5 Methods of Examining and Evaluating the Exposed Test Specimens

The dynamic and/or static elevated temperature-pressure and irradiation test panels shall be evaluated within 2 hours and again after 2 weeks after removal from the test chamber for the following surface defects: flaking, delamination and/or peeling, blistering, and chalking. Defects listed in Subsections 4.5.1 through 4.5.4 shall be dealt with as follows:

4.5.1 Flaking. ASTM D772, Evaluating Degree of Resistance to Flaking (Scaling) of Exterior Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. Flaking shall not be permitted.

4.5.2 Delamination and/or Peeling. Delamination and/or peeling shall not be permitted.

4.5.3 Blistering. Blistering shall be limited to a few, intact blisters, Size No. 4, ASTM D714, Standard Method of Evaluating Degree of Blistering of Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. The number and the size of blisters shall be recorded.

4.5.4 Chalking. ASTM D659, Standard Method of Evaluating Degree of Resistance to Chalking of Exterior Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. Heavy chalking shall not be permitted.

Any other changes in coating properties which are not also associated with the separation, or the release, of coating from the substrate shall not be a cause for rejection.

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LABORATORY TEST REPORT

September 12, 1975/Page 5

TESTING PROJECT: 01377
Interim Report: 96 Hours

GRADING
PROCEDURE: (Continued)
(December, 1973)

ANSI N101.7-1972 Criteria
(As interpreted by Carboline)

Maximum Degree of Failure Allowable

Flaking ASTM D772 10 (None)

Delamination or Peeling None

*Blistering ASTM D714-56

Blister Size

Blister Density

*NOTE: A blister is not
intact when it has resulted
in coating being separated
from the test coupon.

#2

None

#4

Few

#6

Medium

#8

Medium-Dense

Chalking ASTM D659

8 (Light)

NOTE: Flaking, blistering and chalking are all evaluated according to ASTM Standards, with a rating of 10 indicating that no failure was observed in the specific grading area.

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TESTING PROJECT: 01377
Interim Report: 96 Hours

RESULTS:

Coating System and I.D.	Measured Dry Film Thickness	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
1A. Carbo Zinc 11 (1)	1.5 mils	10	None	10	10	Slight salt deposits	Excellent
1B. Carbo Zinc 11 (2)	1.4 mils	10	None	10	10	Slight salt deposits	Excellent
2A. Carbo Zinc 11 (1)	2.8 mils	10	None	10	10	Slight salt deposits; Cracking at vapor-liquid interface (intact)	Very Good
2B. Carbo Zinc 11 (2)	2.7 mils	10	None	10	10	Very slight salt deposits	Excellent
3A. Carbo Zinc 11 (1)	5.0 mils	10	None	10	10	Slight salt deposits	Excellent
3B. Carbo Zinc 11 (2)	5.0 mils	10	None	10	10	Very slight salt deposits	Excellent
Perfect Performance		10	None	#4F to #8MD	#8 (Light)		

- (1) Panels suspended in chamber
(2) Panels set on bottom of chamber

TESTING OBJECT: 01377
Interim Report: 96 Hours

September 12, 1975/Page 7

RESULTS: (Continued)

Coating System and I.D.	Measured Dry Film Thickness	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
4A. Carbo Zinc 11 (1)	6.5 mils	10	None	10	10	Slight salt deposits; Slight cracking at interface (intact)	Very Good
4B. Carbo Zinc 11 (2)	7.0 mils	10	None	10	10	Very slight salt deposits	Excellent
5A. Carbo Zinc 11 (1)	9.0 mils	10	None	10	10	Moderate "Mud- cracking" (intact); Slight salt deposits	Very Good
5B. Carbo Zinc 11 (2)	9.0 mils	10	None	10	10	Moderate "Mud- cracking" (intact); Slight salt deposits	Very Good
6A. Carbo Zinc 11 (1)	12.5 mils	10	None	10	10	Moderate "Mud- cracking" (intact); Slight salt deposits	Very Good
6B. Carbo Zinc 11 (2)	13.5 mils	10	None	10	10	Slight surface cracking (intact); Slight salt deposits	Very Good
Perfect Performance		10	None	#4F to #8MD	#8 (Light)		

- (1) Panels suspended in chamber
(2) Panels set on bottom of chamber

RESULTS: (Continued)

Coating System and I.D.	Measured Dry Film Thickness	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
7A. Carbo Zinc 11 (1)	15.0 mils	10	None	10	10	Slight salt deposits	Excellent
7B. Carbo Zinc 11 (2)	15.0 mils	10	None	10	10	Slight "Mud-cracking" (intact); Slight salt deposits	Excellent
8A. Carbo Zinc 11 (1) Phenoline 305	2.2 mils	10	None	Smaller than #8F-B at bottom edge, (3) one side	10	Slight coating discoloration	Excellent
8B. Carbo Zinc 11 (2) Phenoline 305	2.1 mils	10	None	10	10	Slight coating discoloration	Excellent
9A. Carbo Zinc 11 (1) Phenoline 305	4.0 mils	10	None	10	10	Chipping on corners and 1 edge due to mechanical damage (4)	Excellent
9B. Carbo Zinc 11 (2) Phenoline 305	3.6 mils	10	None	10	10	Slight coating discoloration (4)	Excellent
Perfect Performance		10	None	#4F to #8MD	#8 (Light)		

- (1) Panels suspended in chamber
- (2) Panels set on bottom of chamber
- (3) Due to edge effect
- (4) Pin-holes in topcoat from application

TESTING PROJECT: 01377
Interim Report: 96 Hours

RESULTS: (Continued)

Coating System and I.D.	Measured Dry Film Thickness	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
10A. Carbo Zinc 11 (1) Phenoline 305	6.7 mils	10	None	10	10	Slight coating discoloration (3)	Excellent
10B. Carbo Zinc 11 (2) Phenoline 305	5.6 mils	10	None	#8F-B at 1 edge and corner, one side (4)	10	Slight coating discoloration (3)	Excellent
11A. Carbo Zinc 11 (1) Phenoline 305	8.0 mils	10	None	10	10	Slight coating discoloration (3)	Excellent
11B. Carbo Zinc 11 (2) Phenoline 305	7.8 mils	10	None	10	10	Slight coating discoloration (3)	Excellent
12A. Carbo Zinc 11 (1) Phenoline 305	9.5 mils	10	None	10	10	Rough topcoat surface and coating discoloration	Excellent
12B. Carbo Zinc 11 (2) Phenoline 305	10.2 mils	10	None	10	10	Slight "Mud-cracking" and coating discoloration (3)	Excellent
Perfect Performance		10	None	#4F to #8MD	#8 (Light)		

- (1) Panels suspended in chamber
- (2) Panels set on bottom of chamber
- (3) Pin-holes in topcoat from application
- (4) Due to edge effect

TESTING PROJECT: 01377
Interim Report: 96 Hours

RESULTS: (Continued)

Coating System and I.D.	Measured Dry Film Thickness	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
13A. Carbo Zinc 11 (1) Phenoline 305	11.5 mils	10	None	10	10	Slight wrinkling and coating discoloration (3)	Excellent
13B. Carbo Zinc 11 (2) Phenoline 305	12.0 mils	10	None	10	10	Coating discoloration (3) (4)	Excellent
14A. Carbo Zinc 11 (1) Phenoline 305	15 mils	10	None	10	10	Slight coating discoloration (3)	Excellent
14B. Carbo Zinc 11 (2) Phenoline 305	15 mils	10	None	10	10	Slight coating discoloration; Slight "Mud- cracking" (3) (4)	Excellent
Perfect Performance		10	None	#4F to #8MD	#8 (Light)		

- (1) Panels suspended in chamber
(2) Panels set on bottom of chamber
(3) Topcoat is mirroring the heavy CZ11 prime coat
(4) Pin-holes in topcoat from application



LABORATORY TEST REPORT

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TESTING PROJECT: 01377
Interim Report: 96 Hours

DISCUSSION
OF RESULTS:

All panels were evaluated after 96 hours for development of this interim report. The panels have been returned to test and will be re-graded after 100 days.

John F. Montle
Vice President
Research & Development

Patrick D. Fisher
Developmental Engineer
Testing Department

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7750/8391/252/3083/8852/8675/5689/

5377/6665/9517/5470/5471/7197/7196

OR: Testing Department

XC: SLL/HDT/JFM/EWS/JDB/GHD/SLS/DRL/JRL/RJT/CJW/LAB GROUP LEADERS

From the Carboline Research & Development Laboratory

The technical data furnished is true and accurate to the best of our knowledge. However, no guarantee of accuracy is given or implied.

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LABORATORY TEST REPORT

TESTING PROJECT: 01377
FINAL REPORT - 100 DAYS

December 23, 1975

SUBJECT: LOCA testing of Carbo Zinc 11 at various thicknesses alone and topcoated with Phenoline 305.

REFERENCE: Mr. Chris Kjaer - Olsen, General Electric; Mr. Charles J. Wieggers, Carboline Master BWR Curve.

PURPOSE: To evaluate the performance of Carbo Zinc 11 at film thicknesses from 1 to 15 mils, both untopcoated and topcoated with Phenoline 305, when exposed to the Carboline Master BWR Curve.

CONCLUSIONS: After the 100 days of the Carboline Master BWR Curve, the following conclusions have been reached:

- 1) Carbo Zinc 11 is acceptable according to ANSI N101.2-1972 Section 4.5 as interpreted by Carboline at dry film thicknesses up to 12.5 mils.
- 2) The 1c Carbo Zinc/1c Phenoline 305 is acceptable according to ANSI N101.2-1972 Section 4.5 as interpreted by Carboline at dry film thicknesses up to 11.5 mils.
- 3) At dry film thicknesses in excess of those mentioned above, Carbo Zinc 11 and Carbo Zinc/Phenoline 305 are not acceptable. (Please refer to "Results")

PROCEDURE:

A) Test Coupons
2" x 5" x 1/8" sandblasted steel panels
(blast profile of 1 to 2 mils)

B) Systems Tested Dry Film Thickness

1) Carbo Zinc 11 (various thicknesses)	Please Refer
2) Carbo Zinc 11 (various thicknesses) Phenoline 305	to "Results"

C) Cure Schedule

Carbo Zinc 11:	24 hours at 100% humidity, between coats; 3 days at 75°F, final cure (untopcoated Carbo Zinc 11 only).
Phenoline 305:	3 days at 75°F, 24 hours at 120°F, final cure.

From the Carboline Research & Development Laboratory

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LABORATORY TEST REPORT

TESTING PROJECT: 01377
FINAL REPORT - 100 DAYS

December 23, 1975
Page 2

PROCEDURE: (Continued)

D) Exposure

Carboline Master BWR Curve

(Reference: UNWCC Draft #1; G.E. Mark III, Dry Well)

1) Water Chemistry

Deionized Water

2) Time-Temperature-Pressure Curve

<u>Time</u>	<u>Temperature</u>	<u>Pressure*</u>
Initial	Ambient	Ambient
Initial - 10 Seconds	332°F	106 psig
10 Seconds - 7 Minutes	250°F	30 psig
7 Minutes - 4 Hours	200°F	11.5 psig
4 Hours - 96 Hours**	180°F (Hot Soak)	7.5 psig
96 Hours - 100 Days	160°F (Hot Soak)	4.7 psig

*System was held at saturation pressure throughout the test cycle; the maximum temperature and pressure experienced by the panels was 332°F and 106 psig.

**The panels were removed from test at this time for grading and development of an interim report. They were then returned for the completion of the 100 day test cycle.

GRADING

PROCEDURE: The test coupons were evaluated for performance in the following areas:

- 1) Material flaking off
- 2) Delamination between coats and/or peeling
- 3) Blistering of the topcoat
- 4) Chalking of the coating
- 5) Excessive cracking

Grading procedures specified in Report N101.2-1972 of the American National Standards Institute-Protective Coatings for Light Water Nuclear Reactor Containment Facilities:

4.5 Methods of Examining and Evaluating the Exposed Test Specimens

The dynamic and/or static elevated temperature-pressure and irradiation test panels shall be evaluated within 2 hours and again after 2 weeks after removal from the test chamber for the following surface defects: flaking, delamination, and/or peeling, blistering, and chalking. Defects listed in Subsections 4.5.1 through 4.5.4 shall be dealt with as follows:

From the Carboline Research & Development Laboratory

The technical data furnished is true and accurate to the best of our knowledge. However, no guarantee of accuracy is given or implied.

carboline

300 HANLEY INDUSTRIAL CT, ST LOUIS, MO 63104



LABORATORY TEST REPORT

TESTING PROJECT: 01377
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Page 3

GRADING PROCEDURE: (Continued)

4.5.1 Flaking. ASTM D772, Evaluating Degree of Resistance to Flaking (Scaling) of Exterior Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. Flaking shall not be permitted.

4.5.2 Delamination and/or Peeling. Delamination and/or peeling shall not be permitted.

4.5.3 Blistering. Blistering shall be limited to a few, intact blisters, Size No. 4, ASTM D714, Standard Method of Evaluating Degree of Blistering of Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. The number and the size of blisters shall be recorded.

4.5.4 Chalking. ASTM D659, Standard Method of Evaluating Degree of Resistance to Chalking of Exterior Paints, Part 21, American Society for Testing and Materials, Philadelphia, Pa. 19103. Heavy chalking shall not be permitted.

Any other changes in coating properties which are not also associated with the separation, or the release, of coating from the substrate shall not be a cause for rejection.

(December, 1973)

ANSI N101.2-1972 Criteria
(As interpreted by Carboline)

Maximum Degree of Failure Allowable

Flaking ASTM D772	10 (None)										
Delamination or Peeling	None										
*Blistering ASTM D714-56											
	<table><tr><th>Blister Size</th><th>Blister Density</th></tr><tr><td>#2</td><td>None</td></tr><tr><td>#4</td><td>Few</td></tr><tr><td>#6</td><td>Medium</td></tr><tr><td>#8</td><td>Medium-Dense</td></tr></table>	Blister Size	Blister Density	#2	None	#4	Few	#6	Medium	#8	Medium-Dense
Blister Size	Blister Density										
#2	None										
#4	Few										
#6	Medium										
#8	Medium-Dense										
*NOTE: A blister is <u>not</u> <u>intact</u> when it has resulted in coating being separated from the test coupon.											
Chalking ASTM D659	8 (Light)										

NOTE: Flaking, blistering and chalking are all evaluated according to ASTM Standards, with a rating of 10 indicating that no failure was observed in the specific grading area.

From the Carboline Research & Development Laboratory

The technical data furnished is true and accurate to the best of our knowledge. However, no guarantee of accuracy is given or implied.



Coating System	Dry Film Thickness (Actual Thickness)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
1A) Carbo Zinc 11	1 mil (1.5 mils)	10	None	10	10	Moderate salt deposits	Very good
1B) Carbo Zinc 11	1 mil (1.4 mils)	10	None	10	10	Moderate salt deposits	Very good
2A) Carbo Zinc 11	3 mils (2.8 mils)	10	None	10	10	Moderate salt deposits	Very good
2B) Carbo Zinc 11	3 mils (2.7 mils)	10	None	10	10	Moderate salt deposits	Very good
3A) Carbo Zinc 11	5 mils (5.0 mils)	10	None	10	10	Moderate salt deposits	Very good
3B) Carbo Zinc 11	5 mils (5.0 mils)	10	None	10	10	Moderate salt deposits	Very good
4A) Carbo Zinc 11	7 mils (6.5 mils)	10	None	10	10	Salt deposits	Very good
4B) Carbo Zinc 11	7 mils (7.0 mils)	10	None	10	10	Salt deposits	Very good
5A) Carbo Zinc 11	9 mils (9.0 mils)	10	None	10	10	Slight salt deposits; slight "mudcracking" of surface	Good
Perfect Performance per ANSI N101.2-1975		10	None	#4F to #8MD	#8 (Light)		

Coating System	Dry Film Thickness (Actual Thickness)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
8A) Carbo Zinc 11 Phenoline 305	1 mil 1 mil (2.2 mils)	10	None	#8F-B near edges, both sides	10	Slight coating discoloration	Very good
8B) Carbo Zinc 11 Phenoline 305	1 mil 1 mil (2.1 mils)	10	None	#8M-B at one corner, one side	10	Slight coating discoloration	Good
9A) Carbo Zinc 11 Phenoline 305	3 mils 1 mil (4.0 mils)	10	None	10	10	Very slight coating discoloration	Excellent
9B) Carbo Zinc 11 Phenoline 305	3 mils 1 mil (3.6 mils)	10	None	10	9 (Very Light)	Very slight coating discoloration	Very Good
10A) Carbo Zinc 11 Phenoline 305	5 mils 1 mil (6.7 mils)	10	None	10	10	Very slight coating discoloration	Excellent
10B) Carbo Zinc 11 Phenoline 305	5 mils 1 mil (5.6 mils)	10	None	10	10	Very slight coating discoloration	Excellent
Perfect Performance per ANSI N101.2-1975		10	None	#4F to #8MD	#8 (Light)		

Coating System	Dry Film Thickness (Actual Thickness)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
5B) Carbo Zinc 11	9 mils (9.0 mils)	10	None	10	10	Slight salt deposits; slight "mudcracking" of surface	Good
6A) Carbo Zinc 11	11 mils (12.5 mils)	10	None	One > #2 blister, cracked but intact	10	Slight salt deposits; slight "mudcracking" of surface	Unacceptable
6B) Carbo Zinc 11	11 mils (13.5 mils)	10	None	10	10	Slight salt deposits; very slight "mudcracking"	Very good
7A) Carbo Zinc 11	15.0 mils (15.0 mils)	10	None	One #2 blister, one 1-inch blister, one side	10	One blister is cracked but intact; slight "mudcracking"	Unacceptable
7B) Carbo Zinc 11	15.0 mils (15.0 mils)	10	None	10	10	Slight salt deposits; moderate "mudcracking"	Good
Perfect Performance per ANSI N101.2-1975		10	None	#4F to #8MD	#8 (Light)		

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Coating System	Dry Film Thickness (Actual Thickness)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
11A) Carbo Zinc 11 Phenoline 305	7 mils 1 mil (8.0 mils)	10	None	One #4 blister, one side	10	Very slight coating discoloration	Good
11B) Carbo Zinc 11 Phenoline 305	7 mils 1 mil (7.8 mils)	10	None	10	10	Slight coating discoloration	Very good
12A) Carbo Zinc 11 Phenoline 305	9 mils 1 mil (9.5 mils)	10	None	10	10	Slight coating discoloration; surface has rough texture	Good
12B) Carbo Zinc 11 Phenoline 305	9 mils 1 mil (10.2 mils)	10	None	10	10	Slight coating discoloration	Very good
13A) Carbo Zinc 11 Phenoline 305	11 mils 1 mil (11.5 mils)	10	None	One >#2 blister, one side; #2F-B one side	10	Some blisters are cracked, but intact. Very slight coating discoloration	Unacceptable
Perfect Performance per ANSI N101.2-1975		10	None	#4F to #8MD	#8 (Light)		

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Coating System	Dry Film Thickness (Actual Thickness)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
13B) Carbo Zinc 11 Phenoline 305	11 mils 1 mil (12.0 mils)	10	None	#4 to #6F-B, one side	10	Slight coating discoloration	Good
14A) Carbo Zinc 11 Phenoline 305	13 mils 1 mil (15.0 mils)	10	None	#2F-B, one side; #6 to #8F-B, one side	10	Very slight coating discoloration	Unacceptable
14B) Carbo Zinc 11 Phenoline 305	13 mils 1 mil (15.0 mils)	10	None	10	10	Slight coating discoloration	Very good
Perfect Performance per ANSI N101.2-1975		10	None	#4F to #8MD	#8 (Light)		

Patrick D. Fisher
Patrick D. Fisher
Developmental Engineer
Testing Department

John F. Montle
John F. Montle
Vice President
Research & Development

PDF:sh
XC: SLL/HDT/JFM/EWS/JDP/CJW/JDB/SLS/DRL/LAB GROUP LEADERS



LABORATORY TEST REPORT

Testing Project Number: 01931

Date: February 10, 1981

Report # Final Time 7 days

Date of Grading: 2-3-81

Total Design Test Duration 7 days

Requested by: Mr. D. W. McBride

TITLE: LOCA Testing of Carbo Zinc 11/Phenoline 305 Finish repairability

PURPOSE: To determine the performance of 1c Carboline 191 Primer/1c Phenoline 305 Finish as a repair system for Carbo Zinc 11/Phenoline 305 Finish over a surface preparation of 3M "Clean 'n Strip" and 3M "Rotapeen" when exposed to the PWR 307°F. LOCA Curve and evaluated according to ANSI N101.2-1972, Section 4.5, as interpreted by Carboline. This is a proposed repair procedure for the Waterford Nuclear Station Unit #3 which is being engineered by Ebasco Services, Inc.

CONCLUSIONS: After 7 days of the LOCA Curve, the 1c Carboline 191 Primer/1c Phenoline 305 Finish system over a surface preparation of 3M "Clean 'n Strip" and 3M "Rotapeen" exhibits an acceptable performance when evaluated according to ANSI N101.2-1972, Section, 4.5, as interpreted by Carboline.

DISCUSSION:

From the Carboline Research & Development Laboratory

The technical data furnished are true and accurate to the best of our knowledge. However, no guarantee of accuracy is given or implied.

TEST 010/80.1



9511060236

PROCEDURE:

A. Test Coupons

Description: 2"x4"x1/4" steel certified Carboline ST1 (See Appendix 1)

Surface Preparation: Gritblasted to SSPC-SP5-63 with a 2.0-3.0 mil blast profile.

Abrasive Medium: 50/50 mix of GFH #40 grit and S230 shot.

B. Systems Tested

System	Batch Number	Color	Thinner	Thinning Ratio	DFT Range
1c Carbo Zinc 11	A) OE5477M	Green	#33		
	B) OE1981Z	0300	9L1818M	12%	3.0-3.5 mils
1c Phenoline 305 Finish	A) OH1395M	Gray	Phenoline		
	B) OH1491M	C705	9M2285M	10%	4.0-4.5 mils

Carbo Zinc 11/Phenoline 305 Finish was removed by SSPC-SP3-63, power tool cleaning method. Detailed procedure is outlined in Section C; Repair Procedure.

1c Carboline 191 Primer	A) OC3362M	Red	#15		
	B) OC3361M	0500	9L0859M	15%	4.0-4.5 mils
1c Phenoline 305 Finish	A) OH1395M	Gray	Phenoline		
	B) OH1491M	C705	9M2285M	10%	3.0-3.5 mils

C. Repair Procedure

1. Remove Carbo Zinc 11/Phenoline 305 Finish with 3M's "Clean 'n Strip" wheel
 - a. A residual amount of Carbo Zinc 11 is left on substrate.
2. Restore surface profile with 3M's "Rotapeen"
 - a. Operate power tool in two directions over substrate.
3. Solvent wipe substrate to remove grease and oil which may be present from power tool cleaning.

D. Cure Schedule

Carbo Zinc 11: Seven days at 100°F and 100% RH. Phenoline 305 Finish: 48 hours at 72-76°F and 27-32% RH. Carboline 191 Primer: 24 hours at 73-77°F and 29-32% RH. Phenoline 305 Finish: 72 hours at 72-78°F and 28-34% RH and a final cure at 150°F for 24 hours.

E. Exposure

PWR 307°F LOCA Curve

1. Time-Temperature-Pressure Curve

<u>Time</u>	<u>Temperature**</u>	<u>Pressure**</u>
Initial	Ambient	Ambient
Initial to 2 hours, 47 minutes	307°F (153°C)	60 psig
2 hours, 47 minutes to 96 hours*	250°F (121°C)	30 psig
96 hours to 7 days	200°F (93°C)	10 psig

2. Water Chemistry

0.28 Molar H_3BO_3 (3000 ppm Boron)

0.064 Molar $Na_2S_2O_3$

NaOH added to adjust to a pH of 9.5 at 77°F (25°C) in deionized water

*After 2 hours and 47 minutes of exposure, temperature of the test environment was reduced by spraying test solution at 200°F (93°C) into the test chamber which was at 307°F (153°C), giving a final temperature of 250°F (121°C).

**These are theoretical values. The next page contains graphs of the theoretical and actual LOCA temperature and pressure curves. The data for the actual LOCA curves are taken from the chart recording for this test, which is stored in lab book #230, page 57

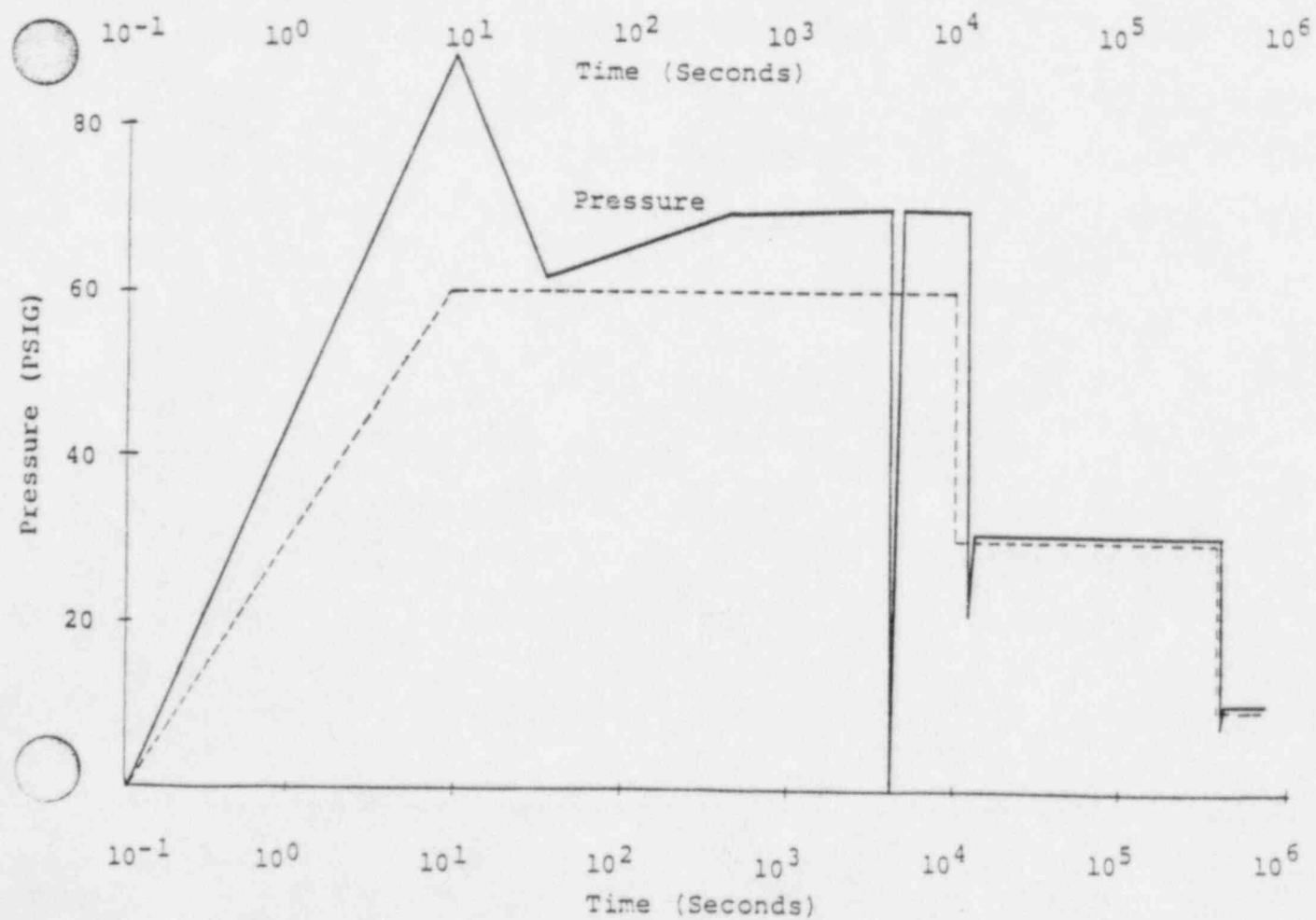
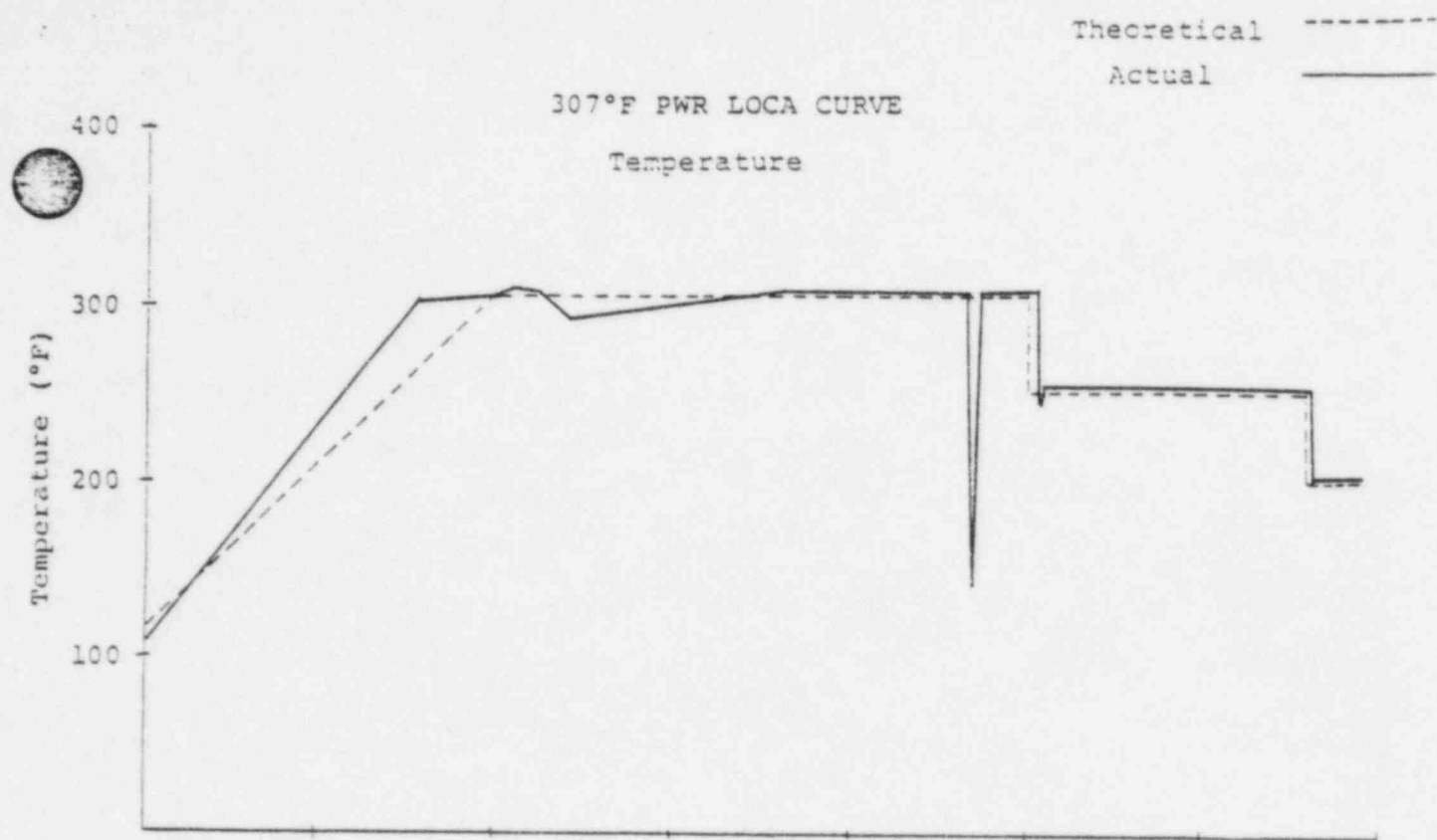
Note: Test was interrupted to place spray nozzle in LOCA chamber. Time was added to test to make up for interruption.

GRADING
PROCEDURE:

The test coupons were evaluated for performance in the following areas:

- 1) Material flaking off.
- 2) Delamination between coats and/or peeling.
- 3) Blistering of the topcoat.
- 4) Chalking of the topcoat.
- 5) Excessive cracking.

Grading procedures specified in Report N101.2-1972 of the American National Standards Institute - Protective Coatings for Light Water Nuclear Reactor Containment Facilities:



GRADING
PROCEDURE: (continued)

4.5 Methods of Examining and Evaluating the Exposed Test Specimens

The dynamic and/or static elevated temperature-pressure and irradiation test panels shall be evaluated within 2 hours and again after two weeks after removal from the test chamber for the following surface defects: flaking, delamination and/or peeling, blistering and chalking. Defects listed in Subsection 4.5.1 through 4.5.4 shall be dealt with as follows:

4.5.1 Flaking. ASTM D772, Evaluating Degree of Resistance to Flaking (Sealing) of Exterior Paints, Part 21, American Society for Testing and Materials, Philadelphia, PA 19103. Flaking shall not be permitted.

4.5.2 Delamination and/or Peeling. Delamination and/or peeling shall not be permitted.

4.5.3 Blistering. Blistering shall be limited to a few, intact blisters, Size No. 4, ASTM D714, Standard Method of Evaluating Degree of Blistering of Paints, Part 21, American Society for Testing and Materials, Philadelphia, PA 19103. The number and the size of blisters shall be recorded.

4.5.4 Chalking. ASTM D659, Standard Method of Evaluating Degree of Resistance to Chalking of Exterior Paints, Part 21, American Society for Testing and Materials, Philadelphia, PA 19103. Heavy chalking shall not be permitted.

Any other changes in coating properties which are not also associated with the separation, or the release, of coating from the substrate shall not be a cause for rejection.

ANSI N101.2-1972 Criteria
(As interpreted by Carboline)

Maximum Degree of Failure Allowable

Flaking ASTM D772		10 (None)
Delamination or Peeling		None
*Blistering ASTM D714-56	<u>Blister Size</u>	<u>Blister Density</u>
	#2	None
	#4	Few
	#6	Medium
	#8	Medium-Dense
Chalking ASTM D659		6 (Moderate)

Note: Flaking, blistering and chalking are all evaluated according to ASTM Standards, with a rating of 10 indicating that no failure was observed in the specific grading area.

TESTING PROJECT: 01931
Final Report: 7 days

February 10, 1981
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RESULTS: PWR 307°F LOCA Curve

Panel Identification and Coating System	Dry Film Thickness	Flaking	Delamina- tion or Peeling	Blister- ing	Chalking	Other Performance Characteristics	Performance Evaluation
1A)* Carboline 191 Primer Phenoline 305 Finish	4.5 mils 3.5 mils 8.0 mils	10	None	#4F-B	None	--	Acceptable
2A) Carboline 191 Primer Phenoline 305 Finish	4.5 mils 3.5 mils 8.0 mils	10	None	#6M-B	None	--	Acceptable

Acceptable Performance
 ANSI N101.2-1972, Section 4.5,
 As Interpreted By Carboline

10

None

#4F to
 #6M to
 #8MD

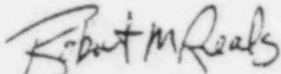
#6 (Moderate)

*Panel suspended in the
 vapor phase.

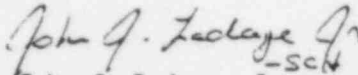
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TESTING PROJECT: 01931
Final Report: 7 days

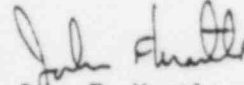
February 10, 1981
Page 6



Robert M. Reals
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John J. Ladage, Jr.
Group Leader
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John F. Montle
Vice President
Research and Development

jag/t.p. 01931

cc: S. Lopata/D. Porthouse/J. Montle/E. Skiles/S. Steinberg/P. Litzsinger/
M. Dugan/Group Leaders

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Appendix 1

Carboline Specification CBl

Preparation of Concrete Specimens:

Concrete Composition

Cement, ASTM C150, Type II. Low alkali
Gravel, ASTM C33, size 3/8 inch
Sand, ASTM C33
Water reducing admixture, ASTM C494
Air entraining admixture, ASTM C260
Pozzolans, ASTM C618
Water - Demineralized or distilled water

Concrete Proportions

Cement, 7 sacks per cubic yard
Sand-Gravel ratio, 55 sand, 45 gravel by volume
Pozzolans, to 15 percent replacement of cement
Air entraining admixture, 4-7 percent
Water reducing admixture, as per manufacturer's instructions
Water, to produce a 3 inch slump

Preparation of Test Specimen:

Make and cure the specimen according to ASTM C192, except that no form oils may be used. The face to be tested shall be composed to the form to simulate poured walls and the wood troweled surfaces: Broom finish top surface to simulate floors. No test face shall be saw cut. When applicable, concrete curing agents compatible with the coating system shall be used.

Panels:

The size for concrete panels shall be 2 by 4 inches by 2 inches thick \pm 0.2 inches.

Curing Time:

Before concrete specimens are coated, they shall be cured a minimum of 28 days in accordance with ACI 301, "Specifications for Structural Concrete for Buildings." If a concrete curing primer is used, it shall be applied on the concrete within 24 hours after removal of the forms.

Carboline Specification ST1

Steel Test Specimens

Panels: The size for carbon steel panels shall be 2 by 4 inches by 1/4 inch thick \pm 0.1 inches with rounded edges and corners. The steel for each specimen shall meet the requirements of ASTM A36, "Standard Specifications for Structural Steel".

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644-1000

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CABLE-CARBOCO-STLOUIS
TELEX 44-7332

PROTECTIVE COATINGS

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August 26, 1983

Mr. Mark Wells
Civil Engineering
Comanche Peak Station
P.O. Box 1001
Glenrose, TX 76043

Dear Mr. Wells:

Please find enclosed a copy of test report 01931 sent to a Mr. Tom Kelly of Ebasco. Mr. Kelly requested I forward a copy to you. If you have any questions, please don't hesitate to call.

Sincerely,

Steve Harrison /hf

Steve Harrison
Power Industry Specialist

SJH/bgf

cc: Charles Rushing