



LABORATORY TEST REPORT

January 14, 1976

SUMMARY REPORT: SR-57
Final Report

SUBJECT: Data Summary of Weathered Carbo Zinc 11 and Carbo Weld 11 primed steel, following topcoating and exposure to Loss of Coolant Accident testing.

REFERENCE: Mr. C. J. Wieggers, Mr. R. J. Tegtmeier; Carboline Testing Report: 4-1180

PURPOSE: To summarize the performance data of primed steel coupons which had received various surface treatments, been recoated and exposed to both ANSI N101.2-1972, BWR-PWR composite and Bechtel #4 PWR test criteria.

CONCLUSION: This selected data indicates that weathered inorganic zinc primers, when properly cleaned and topcoated, may be resistant to stringent Loss of Coolant Accident exposures.

OBSERVATIONS: All systems in this report exhibited an acceptable performance for each of the two test exposures when evaluated per the ANSI N101.2-1972, Section 4.5 criteria.

PROCEDURE:

A. Test Coupons

2" x 5" x 1/8" Sandblasted Steel
(SSPC-SP-5-63 White Metal Substrate)

B. Systems Tested

Dry Film Thickness
Range

- | | | |
|----|--|-------------|
| 1. | 1c Carbo Zinc 11 (Weathered)
Surface Preparation
1c Carbo Zinc 11
1c Phenoline 305 Finish | 9.5-10 mils |
| 2. | 1c Carbo Weld 11 (Weathered)
Surface Preparation
1c Carbo Zinc 11
1c Phenoline 305 Finish | 7-9 mils |

C. Cure Schedule

Carbo Zinc 11 and Carbo Weld 11 (Weathered) - Two and one half months exposure to Gulf Coast Weathering.

Carbo Zinc 11 - Three days laboratory cure.

Phenoline 305 Finish - Extended laboratory cure.

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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PROCEDURE: Continued

D. Exposure

I. ANSI N101.2-1972 PWR-BWR Composite

Water Chemistry - Demineralized Water

<u>Time Lapse</u>	<u>Temperature</u>	<u>Pressure (Saturated) (1)</u>
Initial	70°-90°F	-
1 second	260°F	35 psig
10 seconds	295°F	55 psig
1 minute, 40 seconds	280°F	59 psig
16 minutes, 40 seconds	255°F	58 psig
2 hours, 47 minutes	245°F	30 psig
27 hours, 47 minutes	220°F	19 psig
5 days	130°F	17 psig
11 days, 2 hours, 40 minutes	150°F	16 psig

(1) Test was kept at saturation pressure throughout the complete time-temperature cycle. The values for psig were obtained from the theoretical pressures given in ANSI N101.2-1972.

II. Bechtel #4 PWR Alkaline Borate Spray

Water Chemistry - Demineralized Water

0.28 Molar H_3BO_3 (3000 ppm Boron)
NaOH to pH = 9.5

<u>Time Lapse</u>	<u>Temperature</u>	<u>Pressure (Saturated) (1)</u>
Initial	120°F	
1 second	300°F	70 psig
30 minutes	300°F	70 psig
96 hours *	250°F	30 psig
100 days	200°F	10 psig

*The Bechtel #4 was terminated after 4 days and the coupons were evaluated for development of this report. They were not continued in test at that time.

(1) Saturation pressure was in effect throughout the test. Values for psig were obtained from theoretical pressures given in ANSI N101.2-1972.

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PANEL

PREPARATION: Weathering - All test coupons were primed with either Carbo Zinc 11 or Carbo Weld 11 and allowed to weather for 2 1/2 months on the Gulf Coast. The weathering racks are all at a 45° angle and situated so as to obtain the maximum amount of Ultraviolet (UV) sunlight available.

Side 1: Weathering and U.V. - This is the area of the panel facing the sun, receiving both a moist or wet exposure and an alternate drying of the surface by the intense sunlight.

Side 2: Weathering - This side of the coupon is away from the sun. It receives a moist or wet exposure, but does not experience either the direct U.V. sunlight or the washing (rinsing) effect produced by rain.

Results for each coupon are differentiated as to the side receiving the intense U.V. sunlight and the side facing away from the sun.

PERFORMANCE EVALUATION:

Due to the nature of this screening series, edge effects were not considered in performance evaluation. Please note that standard 2" x 5" x 1/8" steel panels were employed, and not the 2" x 5" x 1/4" with rounded corners and edges steel panels that are normally used in LOCA testing. Please refer to "Discussion of Results".

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:

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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 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.

(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

Blister Size

Blister Density

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

#2
#4
#6
#8

None
Few
Medium
Medium-Dense

Chalking ASTM D659 8 (Light)

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GRADING
PROCEDURE: Continued

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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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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RESULTS:

I. ANSI N101.2-1972 PWR-BWR Composite

Coating System and I.D.	Dry Film Thickness (mils)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
1A)							
1c Carbo Zinc 11	3.0	10	None	One, #8, intact	10	-	Side 1
Detergent Rinse	2.5						Acceptable
1c Carbo Zinc 11	4.0/9.5	10	None	10	10	-	Side 2
1c Phenoline 305 Finish							Acceptable
2A)							
1c Carbo Zinc 11	3.5	10	None	Less than #6F	10	-	Side 1
High Pressure Water Rinse	2.5						Acceptable
1c Carbo Zinc 11	3.5/9.5	10	None	10	10	-	Side 2
1c Phenoline 305 Finish							Acceptable
3A)							
1c Carbo Weld 11	1.5	10	None	10	10	-	Side 1
No Preparation	2.5						Acceptable
1c Carbo Zinc 11	4.5/8.5	10	None	10	10	-	Side 2
1c Phenoline 305 Finish							Acceptable
4A)							
1c Carbo Weld 11	1.5	10	None	10	10	-	Side 1
Wire Brush	2.5						Acceptable
1c Carbo Zinc 11	4.5/8.5	10	None	10	10	-	Side 2
1c Phenoline 305 Finish							Acceptable
Perfect Performance ANSI N101.2-1972		10	None	#4F to #8MD	8(Light)		

Side 1 = U.V. and Weathering; Side 2 = Weathering

RESULTS: Continued

I. ANSI N101.2-1972 PWR-BWR Composite

Coating System and I.D.	Dry Film Thickness (mils)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
A) c Carbo Weld 11 team Clean	1.5	10	None	10	10	-	Side 1 Acceptable
c Carbo Zinc 11	2.5						Side 2
c Phenoline 305 Finish	4.5/8.5	10	None	10	10	-	Acceptable
A) c Carbo Weld 11 ater with Brush	1.2	10	None	One or two intact blisters	10	-	Side 1 Acceptable
c Carbo Zinc 11	2.5						Side 2
c Phenoline 305 Finish	3.3/7.0	10	None	10	10	-	Acceptable
A) c Carbo Weld 11 etergent Rinse	1.2	10	None	10	10	-	Side 1 Acceptable
c Carbo Zinc 11	2.5						Side 2
c Phenoline 305 Finish	4.8/8.5	10	None	10	10	-	Acceptable
A) c Carbo Weld 11 igh Pressure Water Rinse	1.2	10	None	10	10	-	Side 1 Acceptable
c Carbo Zinc 11	2.5						Side 2
c Phenoline 305 Finish	4.8/8.5	10	None	One, #4, intact	10	-	Acceptable
Effect Performance NSI N101.2-1972		10	None	#4F to #8MD	8(Light)		

Side 1 = U.V. and Weathering; Side 2 = Weathering

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SUITS: Continued

II. Bechtel PWR Alkaline Borate Spray (4 Days)

Coating System and I.D.	Dry Film Thickness (mils)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
A) c Carbo Zinc 11 detergent Rinse	3.5	10	None	10	10	-	Side 1 Acceptable
c Carbo Zinc 11 c Phenoline 305 Finish	2.5 4.0/10.0	10	None	10	10	-	Side 2 Acceptable
B) c Carbo Zinc 11 High Pressure Water Rinse	3.0	10	None	10	10	-	Side 1 Acceptable
c Carbo Zinc 11 c Phenoline 305 Finish	2.5 4.5/10.0	10	None	Three, #4 intact	10	-	Side 2 Acceptable
1B) 1c Carbo Weld 11 40 Preparation	1.5	10	None	10	10	-	Side 1 Acceptable
1c Carbo Zinc 11 1c Phenoline 305 Finish	2.5 4.0/8.0	10	None	10	10	-	Side 2 Acceptable
CNA				10	10	-	Side 1

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RESULTS: Continued

II. Bechtel #4 PWR Alkaline Borate Spray (4 Days)

Coating System and I.D.	Dry Film Thickness (mils)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
(B) 1c Carbo Weld 11 Steam Clean	1.5	10	None	10	10	-	Side 1 Acceptable
2c Carbo Zinc 11 3c Phenoline 305 Finish	2.5 4.0/8.0	10	None	10	10	-	Side 2 Acceptable
(B) 1c Carbo Weld 11 Water with Brush	1.5	10	None	One, #6, intact	10	-	Side 1 Acceptable
2c Carbo Zinc 11 3c Phenoline 305 Finish	2.5 4.5/8.5	10	None	10	10	-	Side 2 Acceptable
(B) 1c Carbo Weld 11 Detergent Rinse	1.0	10	None	One, #4, intact	10	-	Side 1 Acceptable
2c Carbo Zinc 11 3c Phenoline 305 Finish	2.5 4.5/8.0	10	None	10	10	-	Side 2 Acceptable
(B) 1c Carbo Weld 11 High Pressure Water Rinse	1.2	10	None	10	10	-	Side 1 Acceptable
2c Carbo Zinc 11 3c Phenoline 305 Finish	2.5 3.3/7.0	10	None	10	10	0	Side 2 Acceptable
Perfect Performance ASTM N101.2-1972		10	None	#4F to #8MD	8(Light)		

Side 1 = U.V. and Weathering; Side 2 = Weathering



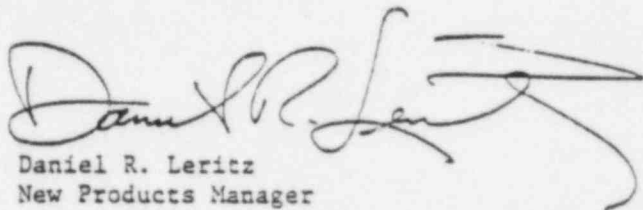
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DISCUSSION
OF RESULTS:

Edge failure was ignored for all performance evaluations in this project. This was necessary since the test coupon was one-half the thickness of that specified for LOCA testing, and each side of a test coupon was being evaluated independently. Edge failure, if it did occur, would be most likely due to the thin, sharp edge and it would be inaccurate to assign the failure to the coating on either or both sides.


Daniel R. Leritz
New Products Manager

DRL:ph

XC: SLL/HDT/JFM/EWS/MJD/CSH/SLS/CJW/RJT/LAB GROUP LEADERS

From the Carbolite 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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REFERENCE: Mr. C. J. Wieggers, Mr. R. J. Tegtmeyer; Carboline Testing Report: 4-1180

PURPOSE: To summarize the performance data of primed steel coupons which had received various surface treatments, been recoated and exposed to both ANSI N101.2-1972, BWR-PWR composite and Bechtel #4 PWR test criteria.

CONCLUSION: This selected data indicates that weathered inorganic zinc primers, when properly cleaned and topcoated, may be resistant to stringent Loss of Coolant Accident exposures.

OBSERVATIONS: All systems in this report exhibited an acceptable performance for each of the two test exposures when evaluated per the ANSI N101.2-1972, Section 4.5 criteria.

PROCEDURE: A. Test Coupons
2" x 5" x 1/8" Sandblasted Steel
(SSPC-SP-5-63 White Metal Substrate)

B. <u>Systems Tested</u>	<u>Dry Film Thickness</u>	
	<u>Range</u>	
1. 1c Carbo Zinc 11 (Weathered) Surface Preparation 1c Carbo Zinc 11 1c Phenoline 305 Finish	9.5-10 mils	
2. 1c Carbo Weld 11 (Weathered) Surface Preparation 1c Carbo Zinc 11 1c Phenoline 305 Finish	7-9 mils	

C. Cure Schedule
Carbo Zinc 11 and Carbo Weld 11 (Weathered) - Two and one half months exposure to Gulf Coast Weathering.
Carbo Zinc 11 - Three days laboratory cure.
Phenoline 305 Finish - Extended laboratory cure.

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PROCEDURE: Continued

D. Exposure

I. ANSI N101.2-1972 PWR-BWR Composit

Water Chemistry - Demineralized Water

<u>Time Lapse</u>	<u>Temperature</u>	<u>Pressure (Saturated) (1)</u>
Initial	70°-90°F	-
1 second	260°F	35 psig
10 seconds	295°F	33 psig
1 minute, 40 seconds	280°F	39 psig
16 minutes, 40 seconds	255°F	38 psig
2 hours, 47 minutes	245°F	30 psig
27 hours, 47 minutes	220°F	19 psig
3 days	180°F	17 psig
11 days, 2 hours, 40 minutes	150°F	16 psig

(1) Test was kept at saturation pressure throughout the complete time-temperature cycle. The values for psig were obtained from the theoretical pressures given in ANSI N101.2-1972.

II. Bechtel #4 PWR Alkaline Borate Spray

Water Chemistry - Demineralized Water

0.28 Molar H_2SO_4 (3000 ppm Boron)
NaOH to pH = 9.5

<u>Time Lapse</u>	<u>Temperature</u>	<u>Pressure (Saturated) (1)</u>
Initial	120°F	
1 second	300°F	70 psig
30 minutes	300°F	70 psig
96 hours *	250°F	30 psig
100 days	200°F	10 psig

*The Bechtel #4 was terminated after 4 days and the coupons were evaluated for development of this report. They were not continued in test at that time.

(1) Saturation pressure was in effect throughout the test. Values for psig were obtained from theoretical pressures given in ANSI N101.2-1972.

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PANEL

PREPARATION: Weathering - All test coupons were primed with either Carbo Zinc 11 or Carbo Weld 11 and allowed to weather for 2 1/2 months on the Gulf Coast. The weathering racks are all at a 45° angle and situated so as to obtain the maximum amount of Ultraviolet (UV) sunlight available.

Side 1: Weathering and U.V. - This is the area of the panel facing the sun, receiving both a moist or wet exposure and an alternate drying of the surface by the intense sunlight.

Side 2: Weathering - This side of the coupon is away from the sun. It receives a moist or wet exposure, but does not experience either the direct U.V. sunlight or the washing (rinsing) effect produced by rain.

Results for each coupon are differentiated as to the side receiving the intense U.V. sunlight and the side facing away from the sun.

PERFORMANCE EVALUATION:

Due to the nature of this screening series, edge effects were not considered in performance evaluation. Please note that standard 2" x 5" x 1/8" steel panels were employed, and not the 2" x 5" x 1/4" with rounded corners and edges steel panels that are normally used in LOCA testing. Please refer to "Discussion of Results".

GRADING PROCEDURE:

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

1. Material flaking off
2. Delamination between coats and/or peeling
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5. Excessive cracking

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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 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.

(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 D714-66	Blister Size	Blister Density
	#2	None
	#4	Few
*NOTE: A blister is not intact when it has resulted in coating being separated from the test coupon.	#6	Medium
	#8	Medium-Dense

Chalking ASTM D659 8 (Light)

From the Carboline Research & Development Laboratory



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GRADING
PROCEDURE: Continued

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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RESULTS:

I. ANSI N101.2-1972 PWR-BWR Composite

Coating System and I.D.	Dry Film Thickness (mils)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
1A) 1c Carbo Zinc 11 Detergent Rinse	3.0	10	None	One, #8, intact	10	-	Side 1 Acceptable
1c Carbo Zinc 11 1c Phenoline 305 Finish	2.5 4.0/9.5	10	None	10	10	-	Side 2 Acceptable
2A) 1c Carbo Zinc 11 High Pressure Water Rinse	3.5	10	None	less than #6F	10	-	Side 1 Acceptable
1c Carbo Zinc 11 1c Phenoline 305 Finish	2.5 3.5/9.5	10	None	10	10	-	Side 2 Acceptable
3A) 1c Carbo Weld 11 No Preparation	1.5	10	None	10	10	-	Side 1 Acceptable
1c Carbo Zinc 11 1c Phenoline 305 Finish	2.5 4.5/8.5	10	None	10	10	-	Side 2 Acceptable
4A) 1c Carbo Weld 11 Wire Brush	1.5	10	None	10	10	-	Side 1 Acceptable
1c Carbo Zinc 11 1c Phenoline 305 Finish	2.5 4.5/8.5	10	None	10	10	-	Side 2 Acceptable
Perfect Performance ANSI N101.2-1972		10	None	#4F to #8MD	8(Light)		

Side 1 - D.V. and Weathering; Side 2 - Weathering

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RESULTS: Continued

I. ANST N101.2-1972 PWR-BWR Composite

Coating System and T.D.	Dry Film Thickness (mils)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
A) c Carbo Weld 11 Team Clean	1.5	10	None	10	10	-	Side 1 Acceptable
c Carbo Zinc 11 c Phenoline 305 Finish	2.5 4.5/8.5	10	None	10	10	-	Side 2 Acceptable
A) c Carbo Weld 11 ater with Brush	1.2	10	None	One or two intact blisters	10	-	Side 1 Acceptable
c Carbo Zinc 11 c Phenoline 305 Finish	2.5 3.3/7.0	10	None	10	10	-	Side 2 Acceptable
A) c Carbo Weld 11 etergent Rinse	1.2	10	None	10	10	-	Side 1 Acceptable
c Carbo Zinc 11 c Phenoline 305 Finish	2.5 4.8/8.5	10	None	10	10	-	Side 2 Acceptable
A) c Carbo Weld 11 igh Pressure Water Rinse	1.2	10	None	10	10	-	Side 1 Acceptable
c Carbo Zinc 11 c Phenoline 305 Finish	2.5 4.8/8.5	10	None	One, #4, intact	10	-	Side 2 Acceptable
Effect Performance ANST N101.2-1972		10	None	#4F to #8HD	8(Light)		

Side 1 - U.V. and Weathering; Side 2 - Weathering

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SUBTS: Continued

11. Bechtel #4 PRR Alkaline Borate Spray (4 Days)

Painting System and T.D.	Dry Film Thickness (mils)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
a) Carbo Zinc 11 Tergent Rinse Carbo Zinc 11 Phenoline 30% Finish	3.5	10	None	10	10	-	Side 1 Acceptable
	2.5 4.0/10.0	10	None	10	10	-	Side 2 Acceptable
	3.0	10	None	10	10	-	Side 1 Acceptable
b) Carbo Zinc 11 High Pressure Water Rinse Carbo Zinc 11 Phenoline 30% Finish	2.5 4.5/10.0	10	None	Three, #4 Intact	10	-	Side 2 Acceptable
	1.5	10	None	10	10	-	Side 1 Acceptable
	2.5 4.0/8.0	10	None	10	10	-	Side 2 Acceptable
c) Carbo Zinc 11 Preparation Carbo Zinc 11 Phenoline 30% Finish							
d) Carbo Zinc 11 Preparation Carbo Zinc 11 Phenoline 30% Finish							

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SUBJECT: Cont Inued

11. Bechtel #4 PWR Alkaline Borate Spray (4 Days)

Catlog System and I.D.	Dry Film Thickness (mils)	Flaking	Delamination or Peeling	Blistering	Chalking	Other Performance Characteristics	Performance Evaluation
(B) 1c Carbo Weld 11 Steam Clean c Carbo Zinc 11 c Phenoline 30% Finish	1.5 2.5 4.0/8.0	10	None	10	10	-	Side 1 Acceptal Side 2 Acceptable
(B) 1c Carbo Weld 11 Water with Brush c Carbo Zinc 11 c Phenoline 30% Finish	1.5 2.5 4.5/8.5	10	None	One, #6, Intact	10	-	Side 1 Acceptable Side 2 Acceptable
(B) 1c Carbo Weld 11 Detergent Rinse c Carbo Zinc 11 c Phenoline 30% Finish	1.0 2.5 4.5/8.0	10	None	One, #4, Intact	10	-	Side 1 Acceptable Side 2 Acceptable
(B) 1c Carbo Weld 11 High Pressure Water Rinse c Carbo Zinc 11 c Phenoline 30% Finish	1.2 2.5 3.3/7.0	10	None	10	10	-	Side 1 Acceptable Side 2 Acceptable
Perfect Performance AST M101, 2-1972		10	None	#4F to #8HD	5 (Light)	0	

Side 1 - B.V., and Weathering; Side 2 - Weathering



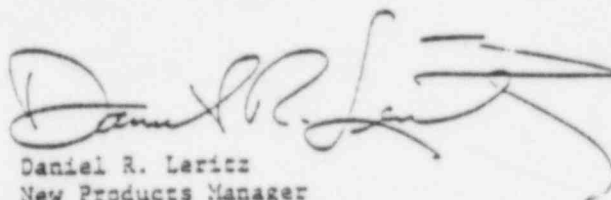
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DISCUSSION
OF RESULTS:

Edge failure was ignored for all performance evaluations in this project. This was necessary since the test coupon was one-half the thickness of that specified for LOCA testing, and each side of a test coupon was being evaluated independently. Edge failure, if it did occur, would be most likely due to the thin, sharp edge and it would be inaccurate to assign the failure to the coating on either or both sides.



Daniel R. Laritz
New Products Manager

DRL:ph
XC: SLL/HDT/JTM/ENS/MJD/CSR/SLS/CJW/RJT/LAB GROUP LEADERS

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LABORATORY TEST REPORT

May 9, 1978

Testing Project: #01651
FINAL REPORT

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SUBJECT: LOCA test of systems topcoated with Phenoline 305 Finish.

REFERENCE: Commanche Peak Nuclear Power Station; Mr. Don Sutton, Mr. Keith Falk;
Mr. Dan McBride; L-115-105

PURPOSE: To test the performance of Phenoline 305 Finish over 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

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PROCEDURE:

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
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
3)	1c Carbo Zinc 11	7K5106M	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, Commanche 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

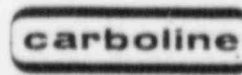
Grading procedures specified in Report N101.2 - 1972 of the American National Standards Institute-Protective Coatings for Light Water Nuclear Reactor Containment Facilities:

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:

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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

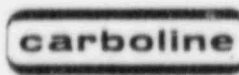
Flaking ASTM D772		10 (None)
Delamination or Peeling		None
*Blistering ASTM D714-56	<u>Blister Size</u>	<u>Blister Density</u>
	#2	None
	#4	Few
	#6	Medium
	#8	Medium-Dense
Chalking ASTM D659		8 (Light)

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

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	(1)
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	(1)
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	(1)
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-12777-

Panel Identification and Coating System	Dry Film Thickness (Mils)	Flaking	Delamination or Peeling	Blistering	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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DISCUSSION 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".

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C: CJW / DWM / PDL / MDT

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