



TECHNICAL REPORT

NUMBER

612-82

TITLE

DBA NUTEC 6/1201, NUTEC 1201/1201 APPLIED OVER SSPC-SP-3
(CLEAN N' STRIP) PREPARED STEEL
FOR

GENERAL USE

CUSTOMER

Submitted by: JERRY ARNOLD *ACA*

Accepted by: ROBERT R. TAYLOR *R.R. Taylor 4/6/82*

Approved: ROBERT R. TAYLOR

Date: June 2, 1982

SOUTHERN IMPERIAL COATINGS CORPORATION, INC.
P. O. Box 29077, • New Orleans, Louisiana 70189
Phone: (504) 254-1433

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PDR FOIA
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PDR

The information contained in this report, based upon our experience, is offered without charge as part of our service to customers. It is intended for use by persons having technical skill at their own discretion and risk. We assume no liability in connection with its use. This information is not intended as a license to operate under, nor a recommendation to infringe, any patent covering any material or use.

FF:

The purpose of this test was to evaluate NUTEC 6 and NUTEC 1201, under DBA test conditions, over steel surfaces prepared in accordance with SSPC-SP-3 with a Clean n' Strip wheel.

BACKGROUND:

For optimum performance of epoxy coating systems, the steel substrate is usually abrasive blasted. However, in some instances, especially during maintenance work, blasting is not feasible. In such cases where blasting can not be performed, power tool cleaning is recommended. This test evaluates one power tool - the Clean n' Strip manufactured by the 3M company.

SUMMARY:

All specimens tested met the acceptance criteria established by ANSI N101.2 for DBA testing.

PROCEDURE:

Steel panels measuring 2 x 4 x 1/4 inch were exposed on a roof top for two weeks to induce rusting. The rusted and pitted panels were then power tool cleaned with a Clean n' Strip wheel to remove loose rust and milscale. The resultant surface appeared as bright metal with the exception of some remaining rust in pits. The panels were then coated as outlined below and as described in the attached panel preparation sheets:

<u>Panel #</u>	<u>System</u>
7927	6/1201
7928	6/1201
7931	6/1201
7932	6/1201
7935	1201/1201
7936	1201/1201

The coated panels were then submitted to ORNL for DBA testing with maximum temperature and pressure of 385°F and 70 PSIG respectively. Refer to the attached ORNL procedures for details.

RESULTS:

Refer to attached ORNL results sheets.

All panels surpassed the acceptance requirements of ANSI N101.2 for DBA testing.

CONCLUSIONS:

The DBA test results indicate that NUTEC 6 and NUTEC 1201 achieve adequate adhesion over a power tool cleaned surface to meet the rigors of design basis accident testing.

It should be noted that these test specimens were not irradiated prior to DBA testing. It was felt that this was an unnecessary step, since NUTEC 6 and NUTEC 1201 have demonstrated on numerous occasions the ability to withstand irradiation to 1×10^9 Rads.

ORNL TEST PROCEDURES

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: January 8, 1981

Report of Irradiation, Decontamination, and DBA Testing

The irradiation, decontamination, and design basis accident (DBA) tests are conducted, respectively, in accordance with Bechtel Corp. *Standard Specification Coatings for Nuclear Power Plants*, specs. CP-951, CP-952, and CP-956 (or with modifications as noted in Table 2, DBA test conditions). The tests are designed also to meet the specifications set in both A.N.S.I. report N 101.2-1972, *Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities*, and N 5.12-1974, *Protective Coatings (Paints) for the Nuclear Industry*. The DBA test spray solution and the test conditions are listed in Tables 1 and 2. After both the DBA and the irradiation tests, the coatings are examined for signs of chalking, blistering, cracking, peeling, delamination, and flaking, according to ASTM standards where applicable. All except the decontamination test panels are returned to the coating manufacturer.

The irradiation tests are run using a spent fuel assembly, removed from the High-Flux Isotope Reactor (HFIR) at ORNL, as the source of radiation. These fuel assemblies are stored under 20 feet of demineralized water. The fuel is 93% enriched U^{235} as U_3O_8 combined with aluminum. The spent fuel assemblies are removed after each 23-megawatt day period. Irradiation is done using the gamma energy from the accumulated mixed fission products. This more readily simulates conditions around a reactor than does a cobalt source. Also, the higher gamma activity affords shorter irradiation time to achieve accumulated doses. The dose rate four days after removal of a fuel assembly from the reactor is 1×10^8 rads/hour.

The fuel assembly is 20 inches high. A 20-foot long, 3-1/2-inch diameter pipe, with one end capped, is used for the air irradiation tests. The capped end is lowered into the four-inch opening of the center of the fuel assembly. The open end, above the water level, is covered with an "O" ring sealed flange to which is attached a steel cable and an air outlet hose. The air inlet is located at the bottom of the pipe. The test specimens are connected to the bottom of the cable and lowered into the

Evaluated

Approved

R. F. Apple
L. T. Cochran

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: January 8, 1981

radiation field. Also at the center of the fuel assembly is a stainless steel clad cadmium tube used as a neutron absorber. This prevents contamination of the test specimens by induced radiation.

The decontamination procedure is as follows: a mixture of fission product nuclides (aged greater than 90 days and less than three years) is neutralized to pH 4 and immediately applied to the test specimens. The specimens are previously degreased in alcohol. After the contaminated spot is air dried, the activities of four of the nuclides are measured by counting with a Ge(Li) detector and a multichannel pulse height analyzer. The specimens are then suspended in a beaker of water at 25°C and washed by stirring for 10 minutes. The specimens are removed, the backs rinsed in water, air dried, and counted as above. The ratios of the activities before, to those after the decontamination are reported as decontamination factors for water. The decontamination and counting steps in 25°C and 80°C acids are repeated, and the respective decontamination factors calculated. The "total overall DF" is calculated as the ratio of the total activity at the beginning of the test to the total activity at the completion of the three washing steps. All activities are corrected for decay between counts. A computer has been programmed to do all the calculations.

Evaluated

Approved

Richard L. Apple
L. T. Cochran

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: January 8, 1981

ORNL Log Book No. A 7562; A12-16-80

Table 1. DBA solution composition, distilled water

	Reagent	Concentration
Solution A:	Boric acid, H_3BO_3	5000 ppm
	Sodium hydroxide, NaOH	Required to adjust pH to 10.2
Solution B:	Boric acid, H_3BO_3	5000 ppm
	Sodium hydroxide, NaOH	Required to adjust pH to 9.0

Table 2. DBA test conditions

Time	Temperature (°F)	Pressure (psig)	Comments
Start	210		Autoclave preheated.
60 s	385	70	Steam injected.
80 s	370	66	
3 min	370-350		Spray solution A added at 300°F.
13 min	350	66	Pressure maintained by relief valve.
23 min	350-275		
33 min	275	35	
53 min	275-250		
63 min	250	30	Spray solution B added.
4 days	250	30	
20 min	250-200		
3 days	200	10	
End of test			

Evaluated

Ralph F. Apple

Approved

L. T. Gilman

PANEL PREPARATION SHEETS

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

PRODUCT TO BE TESTED: Nutec 1201 airless/Nutec 1201

TY SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2 x 4 x 1/4

SURFACE PREPARATION (Describe): Cleaned to an SSPC-SP-3, power tooled, using a
Clean-n-Strip.

PRODUCT DATA: SAMPLE NO.(s): 7936

DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: N/A

IT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F) & R.H.	THICKNESS (ins.)	TIME & DATE APPLIED
1	Nutec	1201 Airless	9772 9773	Spray	86° 77%	F .006 - .007 B .0045 - .005	10/17/80
2	Nutec	1201	1958	Spray	74° 78%	F .004 - .0045 B .0065 - .007	10/22/80

CURING CONDITIONS: AMBIENT TEMP. 70-90 °F REL. HUMIDITY 70-80
MINIMUM CURE 78 DAYS

TEST PROCEDURE: DBA

TESTING PERFORMED BY: ORNL DATE SUBMITTED 12/8/80

APPROVED: Sheld C. Arnold

TEST REPORT NO. 465-81

PREPARED BY: Sharon Farney

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

- .. PRODUCT TO BE TESTED: Nutec 1201 airless/Nutec 1201
1. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2' x 4' x 1/4"
2. SURFACE PREPARATION (Describe): Cleaned to an SSPC-SP-3, power tooled, using a
clean-n-strip.
- .. PRODUCT DATA: SAMPLE NO.(s): 7935
- .. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: N/A

OAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS		THICKNESS (ins.)	TIME & DATE APPLIED
					R/M(°F)	R.H.		
1	Nutec	1201 airless	9772	Spray	86°	77%	F .005 - .006	10/17/80
			9773				B .007 - .008	
2	Nutec	1201	1958	Spray	74°	78%	F .005 -	10/22/80
			1959				B .007 - .0075	

CURING CONDITIONS: AMBIENT TEMP. 70-90 °F REL. HUMIDITY 70-80
MINIMUM CURE 72 DAYS

TEST PROCEDURE: DBA

TESTING PERFORMED BY: ORNL DATE SUBMITTED 12/8/80

APPROVED: Arnell E. Arnold
TEST REPORT NO. 465-81
PREPARED BY: Gregory J. Grier

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Nutec 6/Nutec 1201
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2 x 4 x 1/4
3. RFACE PREPARATION (Describe): Clean - n - strip to SSPC-SP-3 power tooled cleaned
4. PRODUCT DATA: SAMPLE NO.(s): 7927
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: 10/17/80

<u>DATE</u>	<u>PRODUCT</u>	<u>PRODUCT CODES</u>	<u>BATCH #</u>	<u>APPLICATION METHOD</u>	<u>CONDITIONS R/M(°F) & R.H.</u>	<u>THICKNESS (ins.)</u>	<u>TIME & DATE APPLIED</u>
1	Nutec	6	1953 8461	Spray	86° 77%	F .0055 - .006 B .006 - .007	10/17/80
2	Nutec	1201	1958 1959	Spray	74° 78%	F .0065 - .007 B .007 - .0075	10/22/80

6. CURING CONDITIONS: AMBIENT TEMP. 70-90 °F REL. HUMIDITY 70-80
MINIMUM CURE 78 DAYS

7. TEST PROCEDURE: DBA

8. TESTING PERFORMED BY: ORNL DATE SUBMITTED 12/8/80

APPROVED: Sheld C. Arnold

TEST REPORT NO. 465-81

PREPARED BY: Sharon Finney

DEA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

- PRODUCT TO BE TESTED: Nutec 6/Nutec 1201
- TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2 x 4 x 1/4
- SURFACE PREPARATION (Describe): Clean-n-strip, to SSPC-SP-3 Power Tool Cleaned.
- PRODUCT DATA: SAMPLE NO.(s): 7928
- DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: 10/17/80

<u>LOT</u>	<u>PRODUCT</u>	<u>PRODUCT CODES</u>	<u>BATCH #</u>	<u>APPLICATION METHOD</u>	<u>CONDITIONS R/M(°F) & R.H.</u>	<u>THICKNESS (ins.)</u>	<u>TIME & DATE APPLIED</u>
1	Nutec	6	1953 8461	Spray	86° - 77%	F .007 - .008 B .006 - .0065	10/17/80
2	Nutec	1201	1958 1959	Spray	74° 78%	F .007 - .0075 F .006 - .0065	10/22/80

CURING CONDITIONS: AMBIENT TEMP. 70-90 °F REL. HUMIDITY 70-80
MINIMUM CURE 78 DAYS

TEST PROCEDURE: DEA

TESTING PERFORMED BY: ORNL DATE SUBMITTED 12/8/80

APPROVED: David C. Arnold
TEST REPORT NO. 465-81
PREPARED BY: James G. Jones

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

.. PRODUCT TO BE TESTED: Nutec 6/Nutec 1201

1. TYPE SUBSTRATE: ASTM A-36 Carbon Steel

SIZE: 2 x 4 x 1/4

1. SURFACE PREPARATION (Describe): Cleaned to SSPC-SP3 power tooled using Clean-n-strip.

.. PRODUCT DATA: SAMPLE NO.(s): -7931

.. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: 10/17/80

<u>QAT</u>	<u>PRODUCT</u>	<u>PRODUCT CODES</u>	<u>BATCH #</u>	<u>APPLICATION METHOD</u>	<u>CONDITIONS R/M(°F) & R.H.</u>	<u>THICKNESS (ins.)</u>	<u>TIME & DATE APPLIED</u>
1	Nutec	6	1958 8461	Spray	86° 77%	F .0055 - .006 B .005 - .0055	10/17/80
2	Nutec	1201	1958 1959	Spray	74° 78%	F .0065 - .007 B .005 - .0055	10/22/80

.. CURING CONDITIONS: AMBIENT TEMP. 70-90 °F REL. HUMIDITY 70-80

MINIMUM CURE 78 DAYS

.. TEST PROCEDURE: DBA

.. TESTING PERFORMED BY: ORNL

DATE SUBMITTED 12/8/80

APPROVED:

TEST REPORT NO. 465-80

PREPARED BY:

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

PRODUCT TO BE TESTED: Nutec 6/Nutec 1201

TYPE SUBSTRATE: ASTM A-36 Carbon Steel

SIZE: 2 x 4 x 1/4

SURFACE PREPARATION (Describe): Cleaned to an SSPC-SP-3 power tooled using clean-n-strip.

PRODUCT DATA: SAMPLE NO. (s): 7932

DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: 10/17/80

AT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F) %R.H.	THICKNESS (ins.)	TIME & DATE APPLIED
1	Nutec	6	1953 8461	Spray	86° -77%	F .007 - .0075 B .006 - .0065	10/17/80
2	Nutec	1201	1958 1959	Spray	74° 78%	F .007 - .0075 B .006 - .0065	10/22/80

CURING CONDITIONS: AMBIENT TEMP. 70-90 °F REL. HUMIDITY 70-80
MINIMUM CURE 78 DAYS

TEST PROCEDURE: DBA

TESTING PERFORMED BY: CRNL DATE SUBMITTED 12/8/80

APPROVED: *Donald C. Arnold*

TEST REPORT NO. 465-81

PREPARED BY: *Marion Smoyer*

RESULTS

OAK RIDGE NATIONAL LABORATORY

OPERATED BY
UNION CARBIDE CORPORATION
NUCLEAR DIVISION



POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

January 8, 1981

Mr. Henry L. Lomasney
President
Imperial Professional Coatings
P. O. Box 29077
New Orleans, Louisiana 70189

Dear Henry:

Enclosed are the test results on your recently submitted specimens.

If we can be of further assistance, please feel free to call on us.

Sincerely,

A handwritten signature in dark ink, appearing to read 'L. T. Corbin', written in a cursive style.

L. T. Corbin, Section Head
Analytical Chemistry Division

LTC:dmw

Enclosures

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: January 8, 1981

SYSTEM IDENTIFICATION

x Steel panel

 Concrete block

6/1201 (clean n'strip)

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A 7262; A12-16-80

<u>Sample No.</u>	<u>DBA phase</u>	<u>Test results</u>
7927	spray	Front: Coatings intact, no defects. Rear: Coatings intact, no defects.
7928	spray	Front: Coatings intact, no defects. Rear: Blisters, #6 few.
7931	spray	Front: Coatings intact, no defects. Rear: Coatings intact, no defects.
7932	spray	Front: Coatings intact, no defects. Rear: Coatings intact, no defects.

Evaluated

Approved

Ralph F. Apple
L. T. Lister

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: January 8, 1981

SYSTEM IDENTIFICATION

x Steel panel Concrete block

1201/1201 (clean n'strip)

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A 7262; A12-16-80

<u>Sample No.</u>	<u>DBA phase</u>	<u>Test results</u>
7935	spray	Front: Single blister, #6. Rear: Coatings intact, no defects.
7936	spray	Front: Coatings intact, no defects. Rear: Coatings intact, no defects.

Evaluated

Ralph L. Apple

Approved

L. T. Lister

201 North Berry Street
Post Office Box 1020
Brea, California 92621
(714) 529-1951 Telex: 655342

Allegation 10

Ameron

Protective Coatings
Division

Date: March 7, 1984

RADIATION AND DBA TESTING
OF DIMETCOTE 6 REPAIRED
AND TOUCHED UP WITH
DIMETCOTE 6

NAME: _____

STATEMENT FROM OAK RIDGE
ON PROCEDURES USED IN THEIR EVALUATION

Manufacturer: Bechtel/3M
Saint Paul, Minnesota

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: October 10, 1979

Report of Irradiation and DBA Testing

The irradiation and design basis accident (DBA) tests are conducted, respectively, in accordance with Bechtel Corp. *Standard Specification Coatings for Nuclear Power Plants*, specs. CP-951 and CP-956 (or with modifications as noted in Table 2, DBA test conditions). The tests are designed to meet the specifications set in both A.N.S.I. report N 101.2-1972, *Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities*, and N 5.12-1974, *Protective Coatings (Paints) for the Nuclear Industry*. The DBA test spray solution and the test conditions are listed in Tables 1 and 2. After both the DBA and the irradiation tests, the coatings are examined for signs of chalking, blistering, cracking, peeling, delamination, and flaking, according to ASTM standards where applicable. All test panels are returned to the coating manufacturer.

The irradiation tests are run using a spent fuel assembly, removed from the High-Flux Isotope Reactor (HFIR) at ORNL, as the source of radiation. These fuel assemblies are stored under 20 feet of demineralized water. The fuel is 93% enriched U^{235} as U_3O_8 combined with aluminum. The spent fuel assemblies are removed after each 23-megawatt day period. Irradiation is done using the gamma energy from the accumulated mixed fission products. This more readily simulates conditions around a reactor than does a cobalt source. Also, the higher gamma activity affords shorter irradiation time to achieve accumulated doses. The dose rate four days after removal of a fuel assembly from the reactor is 1×10^8 rads/hr.

The fuel assembly is 20 inches high. A 20-foot long, 3-1/2-inch diameter pipe, with one end capped, is used for the air irradiation tests. The capped end is lowered into the four-inch opening of the center of the fuel assembly. The open end, above the water level, is covered with an "O" ring sealed flange to which is attached a steel cable and an air outlet hose. The air inlet is located at the bottom of the pipe. The test specimens are connected to the bottom of the cable and lowered into the radiation field. Also at the center of the fuel assembly is a stainless steel clad cadmium tube used as a neutron absorber. This prevents contamination of the test specimens by induced radiation.

Evaluated

Ralph L. Apple

Approved

L. T. Cochran

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

PANEL ID# 811

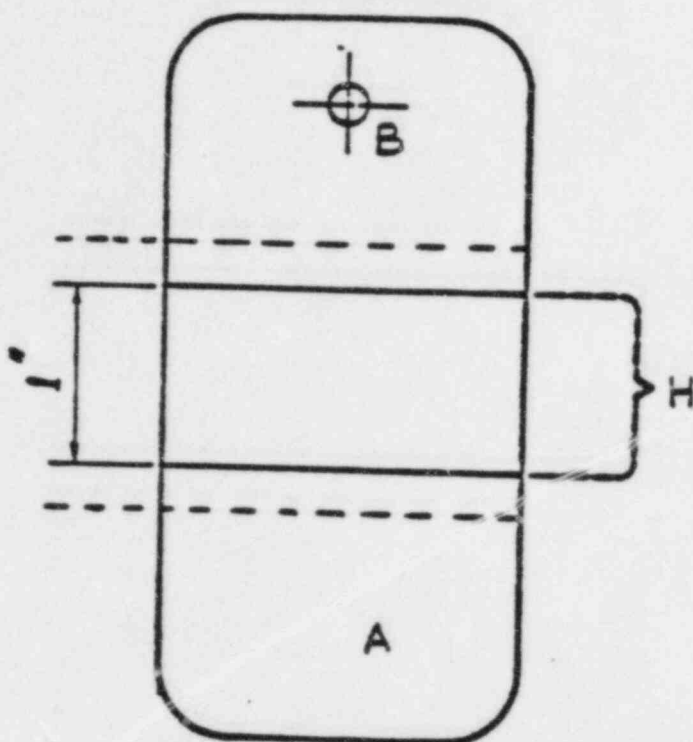
COATING MATERIAL DFT*

A. Ameron
D6N 4.0

B. Ameron
D6N 4.2

T. U. Ameron
D6N 3.1

F. None —



1. ABRASIVE BLAST TO SSPC-SP10 WITH A PROFILE FROM 1.5 TO 3.0 MILS.
2. APPLY THE INDICATED PRIMER TO DESIGNATED AREA OF PANEL. (NO PRIMER IS TO BE APPLIED TO CENTER SECTION H.)
3. ALLOW BARE AREA H TO RUST.
4. PHOTOGRAPH PANEL AT THIS POINT.
5. POWER TOOL CLEAN RUSTED AREA OF PANEL USING THE CLEAN AND STRIP WHEEL AND/OR DISC FOLLOWED BY THE ROTO PEEN WHEEL (MANUFACTURED BY 3M COMPANY.)
6. PHOTOGRAPH PANEL AT THIS POINT.
7. COAT THE PREPARED AREA WITH THE INDICATED TOUCH-UP COATING MATERIAL (TU).
8. PHOTOGRAPH PANEL AT THIS POINT.
9. APPLY INDICATED FINISH COAT ONTO AREAS A, B AND H.
10. PHOTOGRAPH PANEL AT THIS POINT.

* ACTUAL - AVERAGE OF TWO OR MORE READINGS

										GECHTEL LOS ANGELES		
												GEORGIA POWER COMPANY MELVIN W. VOSTLE NUCLEAR PLANT
										DEA REPAIRABILITY TEST		
										PANELS		
										SCALE	DRAWING NO.	REV.

SAMPLE IDENTIFICATION
AND
SPECIFIC TEST DESIGNATION

<u>Sample No.</u>	<u>Primer/Touch-Up</u>	<u>Test Designation</u>
811	Dimetcote 6/Dimetcote 6	Radiation & DBA
821	Dimetcote 6/Dimetcote 6	DBA
831	Dimetcote 6/Dimetcote 6	Radiation & DBA
341	Dimetcote 6/Dimetcote 6	DBA

RADIATION TOLERANCE TEST RESULTS

Manufacturer Bechtel/3M
Saint Paul, Minnesota
Report Number TRC-089-03

Analytical Chemistry Division
Oak Ridge National Laboratory
Date October 10, 1979
Page 41 of 48

System Identification^a

x Steel panel Concrete block

GR - Inorganic Zinc D-6
PT - Inorganic Zinc Touch-Up D-6
No finish

Radiation Tolerance Test Results

ORNL Master Analytical Manual Method No. 2 0921, Bechtel Corp. Spec. No. CP-951
ORNL Log Book No. A 7562; A8-23-9

Initial dose rate 1×10^7 rad/h

Test conducted in x air water

Sample No.

Cumulative dose rate 2×10^8 rads: comments

811 Coatings intact, no defects all areas. 40/2.1

831 Coatings intact, no defects all areas. 31/3.2

^aGR = grit blast cleaning; PT = power tool cleaning; SW = solvent wash cleaning.

Evaluated

Ralph L. Rapp

Approved

L.T. Cochran

DBA TEST RESULTS

Manufacturer Bechtel/3M
Saint Paul, Minnesota
ORNL Log Book No. A7562; A8-31-9

Analytical Chemistry Division
Oak Ridge National Laboratory
Date October 10, 1979

Table 1. DBA solution composition, distilled water

Solution A: 0.28 M boric acid (3000 ppm boron)
Adjusted to pH 10.5 with sodium hydroxide
Solution B: 0.28 M boric acid (3000 ppm boron)
Adjusted to pH 8.5 with sodium hydroxide

Table 2. DBA test conditions^a

Time	Temperature (°F)	Pressure (psig)	Comments
Start			Autoclave preheated.
10 seconds	307	60	Steam injected.
2 minutes	307	60	
20 seconds	310	60	Spray solution A added at 310°F.
5-minute recovery	310-307	62-60	
64 minutes	307	60	
20 seconds	282	52	Spray solution B added at 260°F after draining autoclave.
5-minute recovery	282-307	60	
167 minutes	307	60	
15 minutes	307-250	30	Temperature and pressure reduced via cooling coil.
4 days	250	30	Pressure adjusted with N ₂ .
20 seconds	180	-7	Fresh spray solution B added at 75°F after draining autoclave.
15 minutes	180-200	10	Pressure adjusted with N ₂ .
3 days	200	10	
End of test			

^aThe above data are taken from recorder charts on permanent file at ORNL.

Evaluated

Approved

Ruth L. Apple
L. T. G. Collins

Manufacturer Bechtel/3M
Saint Paul, Minnesota
Report Number TRC-089-03

Analytical Chemistry Division
Oak Ridge National Laboratory
Date October 10, 1979
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System Identification^a

x Steel panel Concrete block

GR - Inorganic Zinc
PT - Inorganic Zinc Touch-Up
No finish

DBA Test Results

ORNL Master Analytical Manual Method No. 2 0922
ORNL Log Book No. A 7562; A8-31-9

<u>Sample No.</u>	<u>DBA phase</u>	<u>Comments</u>
811 ^b	spray	Coatings intact, no defects all areas.
821	spray	Coatings intact, no defects all areas.
831 ^b	spray	Coatings intact, no defects all areas.
841	spray	Coatings intact, no defects all areas.

^aGR = grit blast cleaning; PT = power tool cleaning; SW = solvent wash cleaning.

^bIrradiated.

Evaluated

Ralph E. Apple

Approved

L. T. Cochran



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.

carboline

100 HAWLEY HILL, NEWTON, CT. 06459-1000

-----8511060236-----

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 GGH #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:

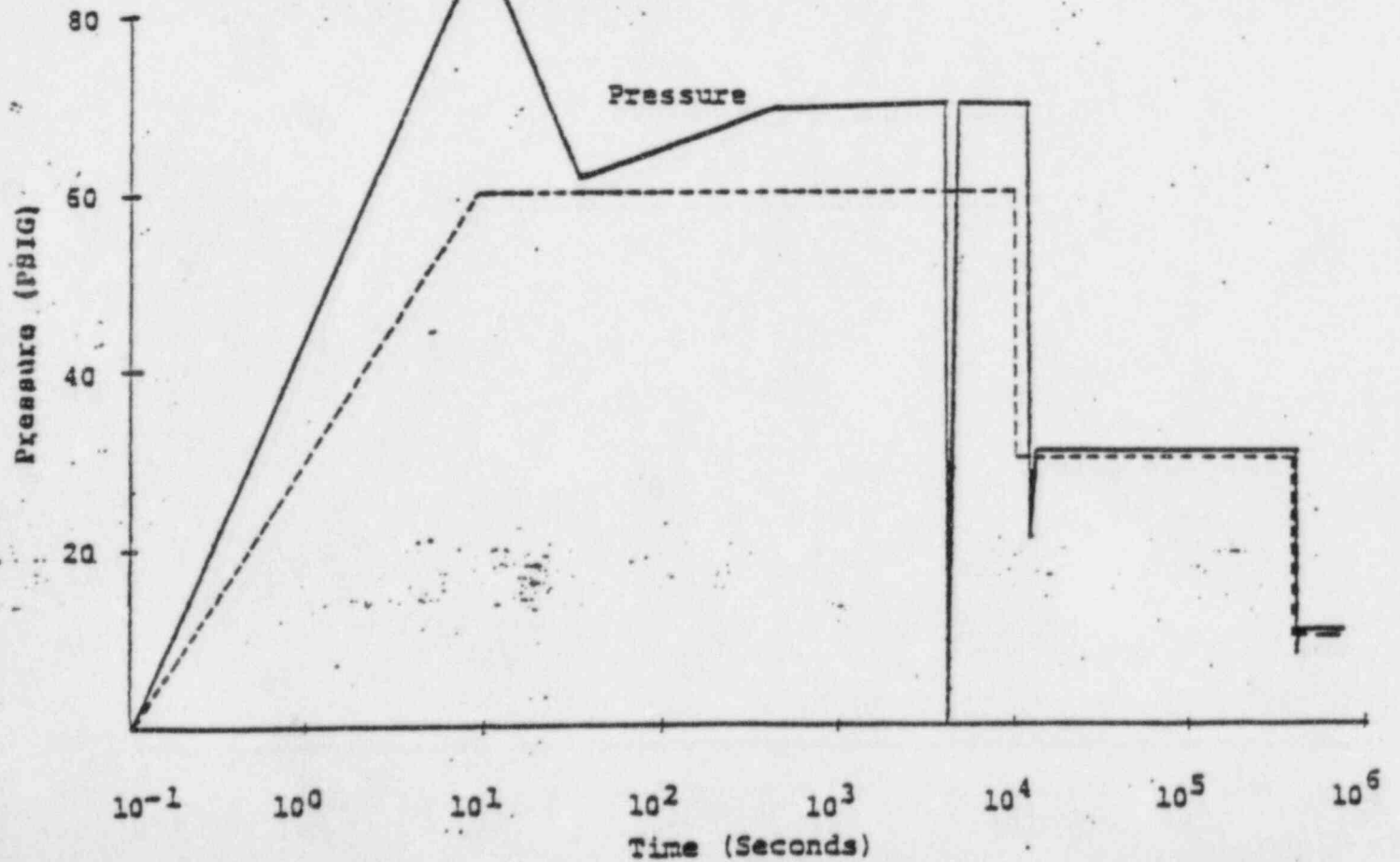
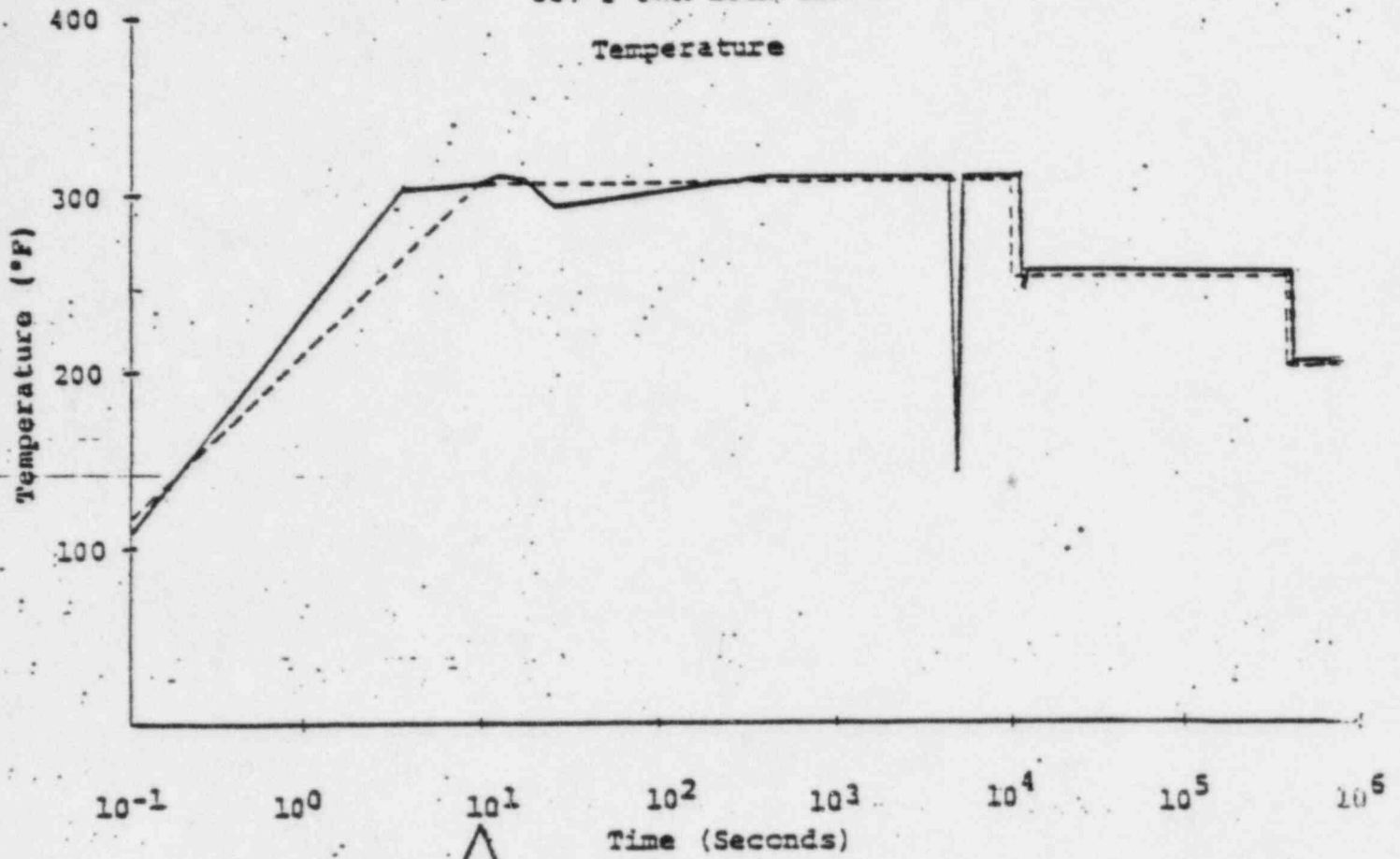
The test coupons were evaluated for performance in the following areas:

- 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:

307°F PWR LOCA CURVE

Temperature



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
Page 5

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	#4V-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

#4V to
#6M to
#8MD

#6 (Moderate)

*Panel suspended in the
vapor phase.

LAB/T-21878-1

TESTING PROJECT: 01931
Final Report: 7 days

February 10, 1981
Page 6

Robert M. Reals

Robert M. Reals
Lab Technician
Testing Department

John J. Ladage Jr.

John J. Ladage, Jr.
Group Leader
Testing Department

John F. Montle

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

carboline

Appendix I

Carboline Specification C31

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

NOT APPLICABLE

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 Specimens:

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".



LABORATORY TEST REPORT

#9

Testing Project Number: 01978.1Date: May 14, 1982Report # Final Time 7 daysDate of Grading: December 22, 1981Total Design Test Duration 7 daysRequested by: Mr. D. W. McBride

Performance of Carbo Zinc 11 Systems Exposed to 340°F Bechtel
TITLE: CP956-2/76 LOCA Curve.

PURPOSE: The purpose of this testing project is to determine how various Carbo Zinc 11 systems will perform in the upcoming 340°F Bechtel CP956-2/76 LOCA Curve tests at Oak Ridge National Laboratory scheduled for early 1982. The systems to be tested are:

1. 1c Carbo Zinc 11 @ 3 mils
2. 1c Carbo Zinc 11 @ 6 mils
3. 2c Carbo Zinc 11 @ 3/2 mils
4. 3c Carbo Zinc 11 @ 5/2/2 mils
5. 3c Carbo Zinc 11 @ 3/2/2 mils
6. 1c Carbo Weld 11/1c Carbo Zinc 11 @ 1.5/3.0 mils

CONCLUSIONS: Please refer to "Results".

DISCUSSION:

9511070051

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.

carboline

300 HOLLY HILL RD., ST. LOUIS, MO 63114

A. Test Coupons

Description: 2x4x1/4 steel panels conforming to Carboline Specification ST1 (See Appendix 1)

Surface Preparation: Gritblasted to SSPC-SP 10-63 with a 1.0-3.0 mil profile.

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

Note: Before priming, the coupons were vapor degreased.

B. Systems Tested

System Number	Coating System	Color	Batch No.	Dry Film Thinning Thickness		
				Thinner	Ratio	Range
1.	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	10%	3.0-3.3 mils
			B: 1E2388Z	1A2473M		
2.	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	10%	6.2-7.3 mils
			B: 1E2388Z	1A2473M		
3.	1c Carbo Zinc 11	green 0300	A: 0J5543M	#33	12%	3.1-3.4 mils
			B: 9E1683Z	OD3885M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	1.6-2.8 mils
			B: 1E2388Z	1F0964M		
4.	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	10%	6.4-7.0 mils
			B: 1E2388Z	1A2473M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	1.9-2.5 mils
			B: 1E2388Z	1A2473M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	3.5 mils
			B: 1E2388Z	1A2473M		
5.	1c Carbo Zinc 11	green 0300	A: 0J5543M	#33	12%	2.8-3.3 mils
			B: 9E1683Z	OD3885M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	1.6-2.0 mils
			B: 1E2388Z	1F0964M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	1.7-2.0 mils
			B: 1E2388Z	1F0964M		
6.	1c Carbo Weld 11	gray 0700	A: 0M2879M	#33	5%	1.7 mils
			B: 1E2388Z	1A2473M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	3.0-3.5 mils
			B: 1E2388Z	1A2473M		

C. Cure Schedule				
System Number	Coating System	Time	Temperature Range	Humidity Range
1.	1c Carbo Zinc 11	2 months, 2 weeks	22-83°F	21-97%
2.	1c Carbo Zinc 11	2 months, 2 weeks	22-83°F	21-97%
3.	1c Carbo Zinc 11	7 months, 12 days	21-91°F	10-97%
	1c Carbo Zinc 11	2 months, 16 days	22-83°F	21-97%
4.	1c Carbo Zinc 11	1 month	26-86°F	21-97%
	1c Carbo Zinc 11	24 hours	70-76°F	39-41%
	1c Carbo Zinc 11	34 days	22-69°F	28-97%
5.	1c Carbo Zinc 11	7 months, 12 days	21-91°F	10-97%
	1c Carbo Zinc 11	24 hours	75-79°F	55-60%
	1c Carbo Zinc 11	2 months, 15 days	22-83°F	21-97%
6.	1c Carbo Weld 11	2 weeks	28-69°F	29-97%
	1c Carbo Zinc 11	20 days	22-68°F	28-97%

D. Exposure

Bechtel CP956 (2/76) LOCA Curve

1. Time-Temperature-Pressure Curve

Time	Temperature*	Pressure*
Initial	Ambient	Ambient
Initial to 6 hours	3-1°F (171°C)	70 psig
6 hours to 96 hours	257°F (121°C)	30 psig
96 hours to 7 days	213°F (93°C)	10 psig

*These are theoretical values. The next page are graphs of the theoretical and actual LOCA temperature and pressure curves. The data for the actual LOCA curves are from the chart recording for this test, found on page 97, Lab Book #230.

2. Water Chemistry

Deionized water pH = 7.2

Note: All test panels were suspended in the vapor phase of test.

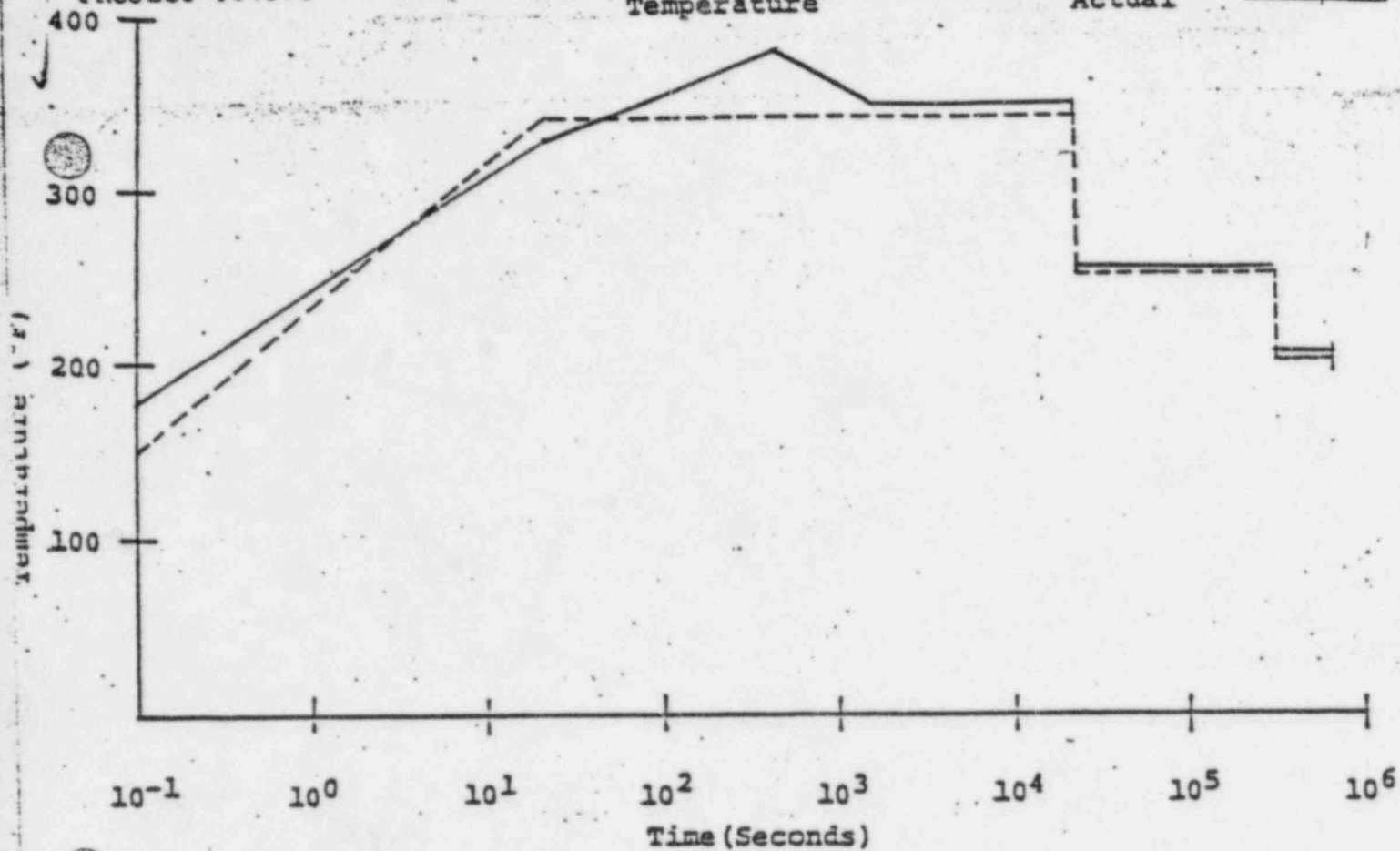
PROJECT #01978.1

SCHEMATIC OF 330 - 4/10 LOCK CURVE

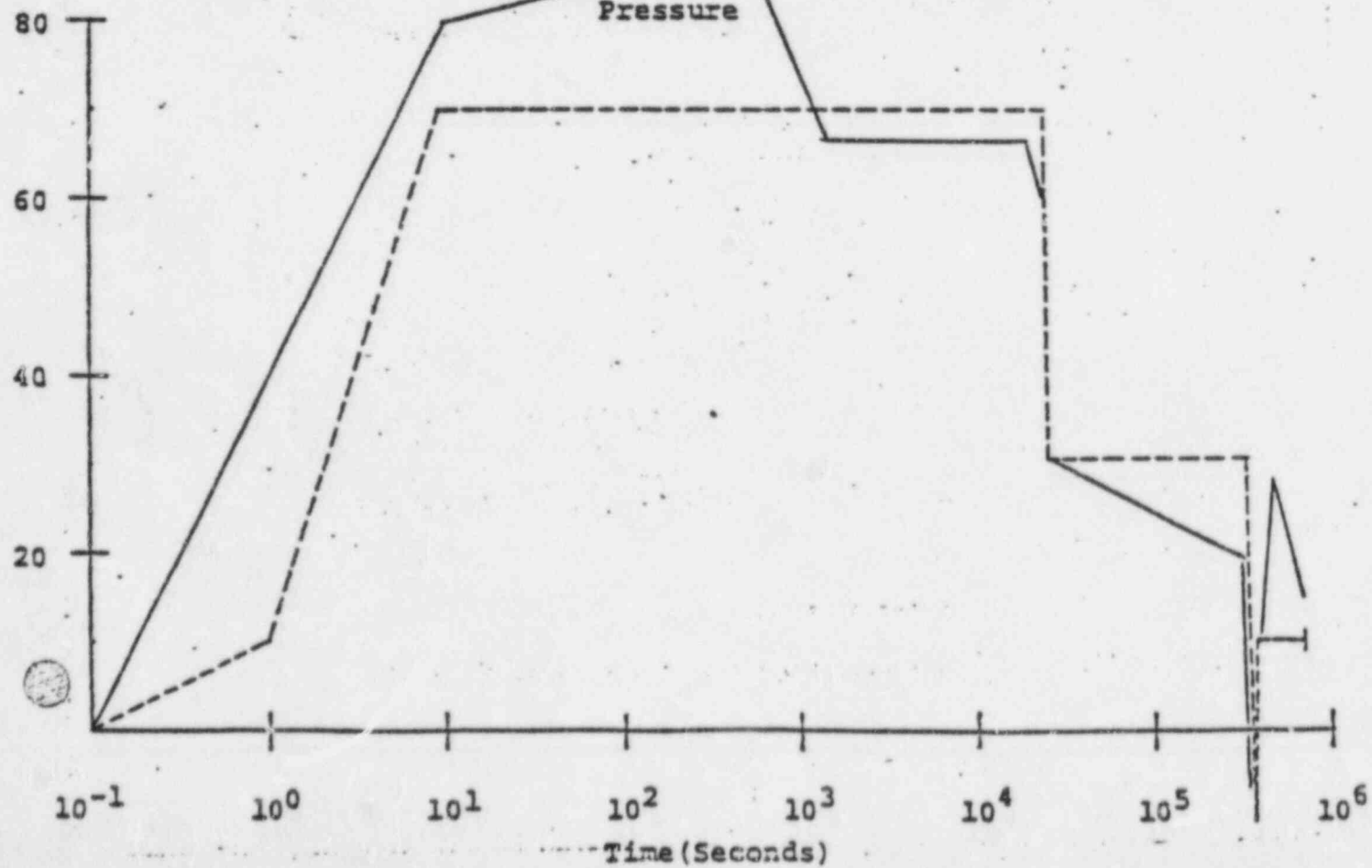
Theoretical

Temperature

Actual



Pressure



LOCA Grading Procedure
(ASTM D3911-80)

The test coupons are examined and evaluated within 4 hours after removal from the test chamber for the following coating defects:

Delamination - report extent
Cracking - report extent
Peeling - report extent
Blistering - report in accordance with ASTM Method D714

Key to Symbols in Results

B-blistering
CD-coating discoloration
F-few

RESULTS:

Panel Identification and Coating System	Dry Film Thickness (mils)	Delamination	Cracking	Peeling	Blistering	Other Performance Characteristics
1A; Side A 1c Carbo Zinc 11	3.0	none	none	none	none	CD
1A; Side B 1c Carbo Zinc 11	3.3	none	none	none	none	CD
2A; Side A 1c Carbo Zinc 11	7.3	none	none	none	none	CD
2A; Side B 1c Carbo Zinc 11	6.2	none	none	none	none	CD
3A; Side A 1c Carbo Zinc 11 1c Carbo Zinc 11	3.4 1.6 5.0	none	none	none	none	CD
3A; Side B 1c Carbo Zinc 11 1c Carbo Zinc 11	3.3 2.6 5.9	none	none	none	none	CD
3B; Side A 1c Carbo Zinc 11 1c Carbo Zinc 11	3.2 2.8 6.0	none	none	none	none	CD
3B; Side B 1c Carbo Zinc 11 1c Carbo Zinc 11	3.1 2.0 5.1	none	none	none	none	CD

RESULTS:

Panel Identification and Coating System	Dry Film Thickness (mils)	Delamination	Cracking	Peeling	Blistering	Other Performance Characteristics
A; Side A						
1c Carbo Zinc 11	6.4	none	none	none	none	CD
1c Carbo Zinc 11	1.9					
1c Carbo Zinc 11	3.5					
	11.8					
A; Side B						
1c Carbo Zinc 11	7.0	From edge	none	none	none	CD
1c Carbo Zinc 11	2.5	spreading 1/2"				
1c Carbo Zinc 11	3.5	onto plane area.				
	13.0					
A; Side A						
1c Carbo Zinc 11	3.0	none	none	none	none	CD
1c Carbo Zinc 11	1.6					
1c Carbo Zinc 11	2.0					
	6.6					
A; Side B						
1c Carbo Zinc 11	3.3	none	none	none	none	CD
1c Carbo Zinc 11	1.7					
1c Carbo Zinc 11	2.0					
	7.0					
B; Side A						
1c Carbo Zinc 11	3.1	none	none	none	none	CD
1c Carbo Zinc 11	2.0					
1c Carbo Zinc 11	1.7					
	6.8					

Testing Project: 1978.1
Final Report: 7 days

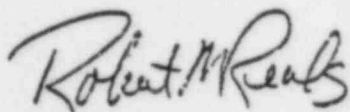
May 14, 1982
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RESULTS:

Panel Identification Coating System	Dry Film Thickness (mils)	Delamination	Cracking	Peeling	Blistering	Other Performance Characteristics
Side B						
1c Carbo Zinc 11	2.8	none	none	none	#2F-B	CD
1c Carbo Zinc 11	2.0					
1c Carbo Zinc 11	2.0					
	6.8					
Side A						
1c Carbo Weld 11	1.7	none	none	none	none	CD
1c Carbo Zinc 11	3.0					
	4.7					
Side B						
1c Carbo Weld 11	1.7	From edge	none	none	none	CD
1c Carbo Zinc 11	3.5	spreading 1/2"				
	5.2	onto plane				

Testing Project: 01978.1
Final Report: 7 Days

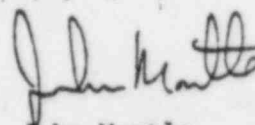
May 14, 1982
Page 9



Robert M. Reals
Lab Technician
Testing Department



Yuly Korobov
Supervisor
Testing Department



John Montle
Vice President
Technology

bic/T.P. 01978.1/
052682

cc: S. Lopata/D. Porthouse/J. Montle/E. Skiles/
S. Steinberg/C. Henson/D. McBride/
M. Dugan/Group Leaders

APPENDIX 1

Carboline Specification CB1

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 ± 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 $\frac{1}{4}$ inch thick ± 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".

Manufacturer: CarbolineSt. Louis, MOAnalytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

REPORT OF IRRADIATION AND DBA TESTING

The irradiation test is conducted in accordance with American Society for Testing and Materials (ASTM) Standard Method D4082-83. The design basis accident (DBA) test is performed in accordance with ASTM Standard Method D3911-80. The tests are designed to meet specifications set in both ANSI report N101.2-1972, Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities, and N5.12-1974, Protective Coatings (Paints) for the Nuclear Industry. The DBA test spray solution was distilled water. The test conditions are listed in Table 1. After both the DBA and irradiation tests, coatings are examined for signs of chalking, blistering, cracking, peeling, delamination, and flaking, according to ASTM standards where applicable. All test panels are returned to the coating manufacturer.

The irradiation tests are run using a spent fuel assembly, removed from the High-Flux Isotope Reactor at ORNL, as the source of radiation. These fuel assemblies are stored under 20 ft of demineralized water. The fuel is 93% enriched U-235 as U_3O_8 combined with aluminum. The spent fuel assemblies are removed after each 23-megawatt-day period. Irradiation is done using the gamma energy from accumulated mixed fission products. This more readily simulates conditions around a reactor than does a cobalt source. Also, the higher gamma activity affords shorter irradiation time to achieve accumulated doses. The dose rate four days after removal of a fuel assembly from the reactor is 1×10^8 rad/h.

The fuel assembly is 20 in. high. A 20-ft-long, 3-1/2-in.-diameter pipe, with one end capped, is used for air irradiation tests. The capped end is lowered into a 4-in. opening at the center of the fuel assembly. The open end, above water level, is covered with an O-ring-sealed flange to which is attached a steel cable and an air outlet hose. The air inlet is located at the bottom of the pipe. Test specimens are connected to the bottom of the cable and lowered into the radiation field. Also at the center of the fuel assembly is a stainless steel-clad cadmium tube used as a neutron absorber. This prevents contamination of the test specimens by induced radiation.

Evaluated R.D. BurdickApproved W.R. Loring

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/23/83

ORNL Log Book No. A9675, A10/20/3

Table 1. DBA test conditions

Time	Temperature (°F)	Pressure (psig)	Comments
Start	170		Autoclave preheated.
20 s	340	70 (10 s)	Steam injected.
5 min 50 s	340	70	Steam turned off.
6 h	340	70	Pressure maintained by relief valve.
20 s	220	30	Spray solution added at 75°F.
15 min	220-250	30	Pressure adjusted with N ₂ .
4 d	250	30	
20 s	180	-15	Fresh spray solution added at 75°F after draining autoclave.
10 min	180-200	10	
3 d	200	10	
End of test			

Evaluated *P. B. Smith*

Approved *W. R. Loring*

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

Carboline Testing Project #02182

SYSTEM IDENTIFICATION

x Steel panel Concrete block

1c Carbo Zinc 11

RADIATION TOLERANCE TEST

ORNL Master Analytical Manual Method No. 2 0921; ASTM Standard Method D4082-83; ORNL Log Book No. A9675, A10-13-3.

Initial dose rate: 1.35×10^7 rad/h

Test conducted in: x air water

<u>Sample No.</u>	<u>Dry Film thickness (mils)*</u>	<u>Cumulative dose</u>	<u>Test results</u>
1	2.5	1.0×10^9 rads	Coating intact, no defects.
2	2.6	1.0×10^9 rads	Coating intact, no defects.
3	2.8	1.0×10^9 rads	Coating intact, no defects.
4	2.8	1.0×10^9 rads	Coating intact, no defects.
9	3.8	1.0×10^9 rads	Coating intact, no defects.
10	4.3	1.0×10^9 rads	Coating intact, no defects.
11	4.5	1.0×10^9 rads	Coating intact, no defects.
12	3.3	1.0×10^9 rads	Coating intact, no defects.

*Dry film thickness values provided by Carboline

Evaluated *[Signature]*

Approved *[Signature]*

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

Carboline Testing Project #02182

SYSTEM IDENTIFICATION

x Steel panel Concrete block

1c Carbo Zinc 11

RADIATION TOLERANCE TEST

ORNL Master Analytical Manual Method No. 2 0921; ASTM Standard Method D4082-83; ORNL Log Book No. A9675, A10-13-3.

Initial dose rate: 1.35×10^7 rad/h

Test conducted in: x air water

<u>Sample No.</u>	<u>Dry Film thickness (mils)*</u>	<u>Cumulative dose</u>	<u>Test results</u>
17	5.8	1.0×10^9 rads	Coating intact, no defects.
18	5.5	1.0×10^9 rads	Coating intact, no defects.
19	6.0	1.0×10^9 rads	Coating intact, no defects.
20	5.8	1.0×10^9 rads	Coating intact, no defects.

*Dry film thickness values provided by Carboline

Evaluated *[Signature]*

Approved *[Signature]*

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

Carboline Testing Project #02182

SYSTEM IDENTIFICATION

x Steel panel Concrete block

2c Carbo Zinc 11

RADIATION TOLERANCE TEST

ORNL Master Analytical Manual Method No. 2 0921; ASTM Standard Method D4082-83; ORNL Log Book No. A9675, A10-13-3.

Initial dose rate: 1.35×10^7 rad/h

Test conducted in: x air water

<u>Sample No.</u>	<u>Dry Film thickness (mils)*</u>	<u>Cumulative dose</u>	<u>Test results</u>
25	2.1/3.1	1.0×10^9 rads	Coating intact, no defects.
26	2.3/3.2	1.0×10^9 rads	Coating intact, no defects.
27	2.4/3.4	1.0×10^9 rads	Coating intact, no defects.
28	2.4/2.9	1.0×10^9 rads	Coating intact, no defects.
33	3.0/2.3	1.0×10^9 rads	Coating intact, no defects.
34	3.0/2.0	1.0×10^9 rads	Coating intact, no defects.
35	3.0/2.7	1.0×10^9 rads	Coating intact, no defects.
36	3.0/2.7	1.0×10^9 rads	Coating intact, no defects.

*Dry film thickness values provided by Carboline

Evaluated *P. D. Smith*
Approved *W. R. Lamm*

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

Carboline Testing Project #02182

SYSTEM IDENTIFICATION

x Steel panel

Concrete block

1c Carbo Zinc 11

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A10-20-3.

<u>Sample No.</u>	<u>Dry Film Thickness (mils)*</u>	<u>DBA phase</u>	<u>Test results</u>
**1	2.5	Spray	Coating intact, no defects except discoloration
**2	2.6	Spray	Coating intact, no defects except discoloration
**3	2.8	Spray	Coating intact, no defects except discoloration
**4	2.8	Spray	Coating intact, no defects except discoloration
5	2.7	Spray	Coating intact, no defects except discoloration
6	2.3	Spray	Coating intact, no defects except discoloration
7	2.5	Spray	Coating intact, no defects except discoloration
8	2.6	Spray	Coating intact, no defects except discoloration

*Dry film thickness values provided by Carboline
**Irradiated

Evaluated

R. D. B. B. B. B. B.

Approved

W. R. L. L. L. L.

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

Carboline Testing Project #02182

SYSTEM IDENTIFICATION

x Steel panel

Concrete block

1c Carbo Zinc 11

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A10-20-3.

<u>Sample No.</u>	<u>Dry Film Thickness (mils)*</u>	<u>DBA phase</u>	<u>Test results</u>
**9	3.8	Spray	Coating intact, no defects except discoloration
**10	4.3	Spray	Coating intact, no defects except discoloration
**11	4.5	Spray	Coating intact, no defects except discoloration
**12	3.8	Spray	Coating intact, no defects except discoloration
13	4.3	Spray	Coating intact, no defects except discoloration
14	3.8	Spray	Coating intact, no defects except discoloration
15	3.8	Spray	Coating intact, no defects except discoloration
16	3.8	Spray	Coating intact, no defects except discoloration

*Dry film thickness values provided by Carboline
**Irradiated

Evaluated

P. D. Brooks

Approved

W. R. Loring

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

Carboline Testing Project #02182

SYSTEM IDENTIFICATION

x Steel panel

 Concrete block

1c Carbo Zinc 11

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A10-20-3.

<u>Sample No.</u>	<u>Dry Film Thickness (mils)*</u>	<u>DBA phase</u>	<u>Test results</u>
**17	5.8	Spray	Coating intact, no defects except discoloration
**18	5.5	Spray	Coating intact, no defects except discoloration
**19	6.0	Spray	Coating intact, no defects except discoloration
**20	5.8	Spray	Coating intact, no defects except discoloration
21	5.8	Spray	Coating intact, no defects except discoloration
22	6.0	Spray	Coating intact, no defects except discoloration
23	5.5	Spray	Coating intact, no defects except discoloration
24	5.8	Spray	Coating intact, no defects except discoloration

*Dry film thickness values provided by Carboline
**Irradiated

Evaluated

RD Beardslee

Approved

WR Lanning

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

Carboline Testing Project #02182

SYSTEM IDENTIFICATION

x Steel panel

 Concrete block

2c Carbo Zinc 11

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A10-20-3.

<u>Sample No.</u>	<u>Dry Film Thickness (mils)*</u>	<u>DBA phase</u>	<u>Test results</u>
**25	2.1/3.1	Spray	Coating intact, no defects except discoloration
**26	2.3/3.2	Spray	Coating intact, no defects except discoloration
**27	2.4/3.4	Spray	Chalking, discoloration
**28	2.4/2.9	Spray	Coating intact, no defects except discoloration
29	2.3/3.2	Spray	Chalking, discoloration
30	2.4/3.1	Spray	Coating intact, no defects except discoloration
31	2.3/3.5	Spray	Coating intact, no defects except discoloration
32	2.4/3.1	Spray	Coating intact, no defects except discoloration

*Dry film thickness values provided by Carboline
**Irradiated

Evaluated

P. B. B. B. B.

Approved

C. R. L. L. L.

Manufacturer: Carboline
St. Louis, MO

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: 10/27/83

Carboline Testing Project #02182

SYSTEM IDENTIFICATION

x Steel panel

 Concrete block

2c Carbo Zinc 11

DBA TEST

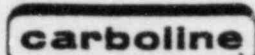
ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A10-20-3.

<u>Sample No.</u>	<u>Dry Film Thickness (mils)*</u>	<u>DBA phase</u>	<u>Test results</u>
**33	3.0/2.3	Spray	Chalking, discoloration
**34	3.0/2.0	Spray	Chalking, discoloration
**35	3.0/2.7	Spray	Coating intact, no defects except discoloration
**36	3.0/2.7	Spray	Coating intact, no defects except discoloration
37	3.0/2.3	Spray	Coating intact, no defects except discoloration
38	3.0/2.3	Spray	Coating intact, no defects except discoloration
39	3.0/3.0	Spray	Coating intact, no defects except discoloration
40	2.8/2.5	Spray	Coating intact, no defects except discoloration

*Dry film thickness values provided by Carboline
**Irradiated

Evaluated *[Signature]*

Approved *[Signature]*



280 HANLEY INDUSTRIAL CT. ST. LOUIS, MO 63144

TEST PANEL PREPARATION DATA

Testing Project #02182

Coating System: 1c Carbo Zinc 11

Substrate Type: Steel, Certified ST1 Surface Prep.: SSPC-SP10-63

For: DBA ☒ Radiation ☒ Decon ☐ Physical ☐ Chemical ☐ Other: ☐

I. Coating System

<u>1c Carbo Zinc 11</u>	at <u>2.0-3.0</u>	Mils DFT
_____	at _____	Mils DFT
_____	at _____	Mils DFT
_____	at _____	Mils DFT
_____	at _____	Mils DFT
_____	at _____	Mils DFT
Total	_____	Mils DFT

II. Batch Numbers

Product <u>CZ 11</u>	Part A <u>3C0841M</u>	Part B <u>3F5182Z</u>
Product _____	Part A _____	Part B _____
Product _____	Part A _____	Part B _____
Product _____	Part A _____	Part B _____
Product _____	Part A _____	Part B _____

III. Application Criteria

Specimen Number	Product	Side	Date Applied	Method Applied	°F Temp.	% Rel. Hum.	Actual Dry Film Thickness	
							DFT/Coat	Total DFT
1	CZ11	A	8/18/83	Spray	78°	75	2.5	2.5
2		B					2.6	2.6
3		A					2.8	2.8
4		B					2.8	2.8
5		A					2.7	2.7
6		B					2.3	2.3
7		A					2.5	2.5
8		B					2.6	2.6

Issued: November 1, 1983

Submitted by: *Gudy Vacker*

Title: Supervisor, Testing Dept.

Sheet 1 of 7

jas/110183
test panel prep data 02182



TEST PANEL PREPARATION DATA

Testing Project #02182

Coating System: 1c Carbo Zinc 11

Substrate Type: Steel, Certified ST1

Surface Prep.: SSPC-SP10-63

For: DBA ☒ Radiation ☒ Decon ☐ Physical ☐ Chemical ☐ Other: ☐

I. Coating System

1c Carbo Zinc 11	at	3.0-5.0	Mils DFT
	at		Mils DFT
	at		Mils DFT
	at		Mils DFT
	at		Mils DFT
	at		Mils DFT
	Total		Mils DFT

II. Batch Numbers

Product CZ 11	Part A 3C0841M	Part B 3F5182Z
Product	Part A	Part B
Product	Part A	Part B
Product	Part A	Part B
Product	Part A	Part B

III. Application Criteria

Specimen Number	Product	Side	Date Applied	Method Applied	°F Temp.	% Rel. Hum.	Actual	
							Dry Film Thickness DFT/Coat	Total DFT
9	CZ11	A	8/17/83	Spray	86°	50	3.8	3.8
10		B					4.3	4.3
11		A					4.5	4.5
12		B					3.8	3.8
13		A					4.3	4.3
14		B					3.8	3.8
15		A					3.8	3.8
16		B					3.8	3.8

Issued: November 1, 1983

Submitted by: *Vicky Kocor*

Title: Supervisor, Testing Dept.

Sheet 2 of 7

jas/110183

test panel prep data 02182



TEST PANEL PREPARATION DATA

Testing Project #02182

Coating System: 1c Carbo Zinc 11

Substrate Type: Steel, Certified ST1 Surface Prep.: SSPC-SP1G-63

For: DBA x Radiation x Decon Physical Chemical Other:

I. Coating System

<u>1c Carbo Zinc 11</u>	at <u>5.0-7.0</u>	Mils DFT
<u> </u>	at <u> </u>	Mils DFT
<u> </u>	at <u> </u>	Mils DFT
<u> </u>	at <u> </u>	Mils DFT
<u> </u>	at <u> </u>	Mils DFT
<u> </u>	at <u> </u>	Mils DFT
<u> </u>	Total	<u> </u> Mils DFT

II. Batch Numbers

Product <u>CZ 11</u>	Part A <u>3C0841M</u>	Part B <u>3F5182Z</u>
Product <u> </u>	Part A <u> </u>	Part B <u> </u>
Product <u> </u>	Part A <u> </u>	Part B <u> </u>
Product <u> </u>	Part A <u> </u>	Part B <u> </u>
Product <u> </u>	Part A <u> </u>	Part B <u> </u>

III. Application Criteria

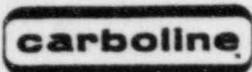
Specimen Number	Product	Side	Date Applied	Method Applied	°F Temp.	% Rel. Hum.	Actual Dry Film Thickness	
							DFT/Coat	Total DFT
17	CZ11	A	8/18/83	Spray	78°	75	5.8	5.8
18		B					5.5	5.5
19		A					6.0	6.0
20		B					5.8	5.8
21		A					5.8	5.8
22		B					6.0	6.0
23		A					5.5	5.5
24		B					5.8	5.8

Issued: November 1, 1983

Submitted by: *Julia Kocor*
Title: Supervisor, Testing Dept.

Sheet 3 of 7

jas/110183
test panel prep data 02182



380 HAWLEY INDUSTRIAL CT. ST. LOUIS MO 63144

TEST PANEL PREPARATION DATA

Testing Project #02182

Coating System: 2c Carbo Zinc 11

Substrate Type: Steel, Certified ST1 Surface Prep.: SSPC-SP10-63

For: DBA ☒ Radiation ☒ Decon ☐ Physical ☐ Chemical ☐ Other: ☐

I. Coating System

1st coat Carbo Zinc 11	at	2.1-2.4	Mils DFT
2nd coat Carbo Zinc 11	at	2.9-3.5	Mils DFT
	at		Mils DFT
	at		Mils DFT
	at		Mils DFT
Total			Mils DFT

II. Batch Numbers

Product <u>CZ 11</u>	Part A <u>3C0841M</u>	Part B <u>3F5182Z</u>
Product <u>CZ 11</u>	Part A <u>3C0841M</u>	Part B <u>3F5182Z</u>
Product <u></u>	Part A <u></u>	Part B <u></u>
Product <u></u>	Part A <u></u>	Part B <u></u>
Product <u></u>	Part A <u></u>	Part B <u></u>

III. Application Criteria

Specimen Number	Product	Side	Date Applied	Method Applied	°F Temp.	% Rel. Hum.	Actual Dry Film Thickness	
							DFT/Coat	Total DFT
25	CZ11	A	8/18/83	Spray	78°	75	2.1	2.1
26		B					2.3	2.3
27		A					2.4	2.4
28		B					2.4	2.4
25	CZ11	A	8/19/83	Spray	86	54	3.1	5.2
26		B					3.2	5.5
27		A					3.4	5.8
28		B					2.9	5.3

Issued: November 1, 1983

Submitted by: Yoly Koorlor

Title: Supervisor, Testing Dept.

Sheet 4 of 7

jas/110183
test panel prep data 02182



TEST PANEL PREPARATION DATA

Testing Project #02182

Coating System: 2c Carbo Zinc 11

Substrate Type: Steel, Certified ST1 Surface Prep.: SSPC-SP10-63

For: DBA x Radiation x Decon Physical Chemical Other:

I. Coating System

1st coat Carbo Zinc 11	at 2.1-2.4 Mils DFT
2nd coat Carbo Zinc 11	at 2.9-3.5 Mils DFT
	at Mils DFT
	at Mils DFT
	at Mils DFT
Total	Mils DFT

II. Batch Numbers

Product CZ 11	Part A 3C0841M	Part B 3F5182Z
Product CZ 11	Part A 3C0841M	Part B 3F5182Z
Product	Part A	Part B
Product	Part A	Part B
Product	Part A	Part B

III. Application Criteria

Specimen Number	Product	Side	Date Applied	Method Applied	°F Temp.	% Rel. Hum.	Actual Dry Film Thickness	
							DFT/Coat	Total DFT
29	CZ11	A	8/18/83	Spray	78	75	2.3	2.3
30		B					2.4	2.4
31		A					2.3	2.3
32		B					2.4	2.4
29	CZ11	A	8/19/83	Spray	86	54	3.2	5.5
30		B					3.1	5.5
31		A					3.5	5.8
32		B					3.1	5.5

Issued: November 1, 1983

Submitted by: *Yuly Kozlov*
Title: Supervisor, Testing Dept.

Sheet 5 of 7

jas/110183
test panel prep data 02182

carboline

385 HAWLEY INDUSTRIAL CT. ST. LOUIS, MO 63144

TEST PANEL PREPARATION DATA

Testing Project #02182

Coating System: 2c Carbo Zinc 11Substrate Type: Steel, Certified ST1 Surface Prep.: SSPC-SP10-63For: DBA ☒ Radiation ☒ Decon ☐ Physical ☐ Chemical ☐ Other: ☐I. Coating System

1st coat Carbo Zinc 11	at 2.8-3.0 Mils DFT
2nd coat Carbo Zinc 11	at 2.0-3.0 Mils DFT
	at Mils DFT
	at Mils DFT
	at Mils DFT
Total	Mils DFT

II. Batch Numbers

Product CZ 11	Part A 3C0841M	Part B 3F5182Z
Product CZ 11	Part A 3C0841M	Part B 3F5182Z
Product	Part A	Part B
Product	Part A	Part B
Product	Part A	Part B

III. Application Criteria

Specimen Number	Product	Side	Date Applied	Method Applied	°F Temp.	% Rel. Hum.	Actual	
							Dry Film Thickness DFT/Coat	Total DFT
33	CZ11	A	8/17/83	Spray	86	50	3.0	3.0
34		B					3.0	3.0
35		A					3.0	3.0
36		B					3.0	3.0
33	CZ11	A	8/19/83	Spray	86	54	2.3	5.3
34		B					2.0	5.0
35		A					2.7	5.7
36		B					2.7	5.7

Issued: November 1, 1983Submitted by: *Guly Kartan*
Title: Supervisor, Testing Dept.

Sheet 6 of 7

jas/110183
test panel prep data 02182



TEST PANEL PREPARATION DATA

Testing Project #02182

Coating System: 2c Carbo Zinc 11

Substrate Type: Steel, Certified ST1

Surface Prep.: SSPC-SP10-63

For: DBA x Radiation x Decon Physical Chemical Other:

I. Coating System

1st coat Carbo Zinc 11	at 2.3-3.0 Mils DFT
2nd coat Carbo Zinc 11	at 2.0-3.0 Mils DFT
	at Mils DFT
	at Mils DFT
	at Mils DFT
Total	Mils DFT

II. Batch Numbers

Product CZ 11	Part A 3C0841M	Part B 3F5182Z
Product CZ 11	Part A 3C0841M	Part B 3F5182Z
Product	Part A	Part B
Product	Part A	Part B
Product	Part A	Part B

III. Application Criteria

Specimen Number	Product	Side	Date Applied	Method Applied	°F Temp.	% Rel. Hum.	Actual Dry Film Thickness	
							DFT/Coat	Total DFT
37	CZ11	A	8/17/83	Spray	86	50	3.0	3.0
38		B					3.0	3.0
39		A					3.0	3.0
40		B					2.8	2.8
37	CZ11	A	8/19/83	Spray	86	54	2.3	5.3
38		B					2.3	5.3
39		A					3.0	6.0
40		B					2.5	5.3

Issued: November 1, 1983

Submitted by: *Willy Corbett*
Title: Supervisor, Testing Dept.

Sheet 7 of 7

jas/110183
test panel prep data 02182



SURFACE PREP AND CURE DATA FOR TESTING PROJECT 02182

2"x4"x $\frac{1}{4}$ " certified ASTM A36 Steel

Surface Preparation: gritblasted to SSPC-SP10-82 with a
2.0-3.0 mil profile

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

CURE DATA

Coatings	Cure Time	Temperature Range	Humidity Range
1c CZ 11 @ 2.0-3.0 mils	30 days	80°F (27°C)	80%
1c CZ 11 @ 3.0-5.0 mils	30 days	80°F (27°C)	80%
1c CZ 11 @ 5.0-7.0 mils	30 days	80°F (27°C)	80%
2c CZ 11 @ 2.0/3.0 mils	First Coat: 24 hours	74-86°F (23-30°C)	53-78%
	2nd Coat: 30 days	80°F (27°C)	80%
2c CZ 11 @ 3.0/2.0 mils	First Coat: 48 hours	74-86°F (23-30°C)	50-78%
	2nd Coat: 30 days	80°F (27°C)	80%

All CZ11 panels were cured in Thermotron Environmental Chamber at 80°F, 80% R.H. In addition, panels remained in ambient room conditions a few days at Carboline plus additional time at ORNL prior to testing.

jas/042784

Surface Prep/Cure Data TP02182

carbolinePRODUCT IDENTIFICATIONProduct Name Carbo Zinc Product Number 11Generic Description Inorganic Zinc PrimerWeight Per Gallon Part A Base Range From 8.6 To 9.1 Green
8.7 To 9.0 GreyPart B Zinc Range From N/A To N/APart C N/A Range From N/A To N/AViscosity Brookfield
(list method) 75 ± 2°FPart A - Range From 100 To 300 cpsPart B - Range From N/A To N/APart C - Range From N/A To N/A

Total Solids

Part A - 35 ± 3 % Weight N/A % VolumePart B - 100 % Weight 100 % VolumePart C - N/A % Weight N/A % Volume

Flash Point D-93-73 ASTM

Part A - 56 °FPart B - Powder °FPart C - N/A °FMixed Components - N/A °F

Mixing Ratio

Part A 100 By Weight N/A By VolumePart B 220 By Weight N/A By VolumePart C N/A By Weight N/A By VolumeRecoat Time at 40°F 36 hrs. Full Cure Time 36 hrs. At 40 °F
at 50°F 24 hrs. 24 hrs. At 50 °Fat 70°F 12 hrs. 12 hrs. At 70 °Fat 90°F 8 hrs. 8 hrs. At 90 °F

Service Temperature Limits

Maximum 110** °F Wet 750 °F DryMinimum -60 °F Wet -60 °F DryStorage Life 12 MonthsPot Life - @ 50°F 16 hrs @ 70°F 8 hrs @ 90°F 4 hrs

Compressive strength ASTM C-579-68

7 days @ 70°F N/A

Tensile strength ASTM C-307-61

7 days @ 73°F N/A

Modulus of Elasticity ASTM C-580-74

7 days @ 73°F N/A

Flexural strength ASTM C-580-74

7 days @ 73°F N/A

Initial set time ASTM C-308-71

@ 73°F N/A

**Continuous Immersion Service

Date 5/4/84 Approved M. H. H. H. H. H. Test Report No. N/A

TS- 06376-2

carboline

PRODUCT IDENTITY AND QUALITY ASSURANCE CERTIFICATION RECORD

PURCHASER

Carboline Company

CUSTOMER P.O. #

CARBOLINE INVOICE # 17544SHIP TO
ADDRESS350 Hanley Ind Ct
St Louis, Mo 63144ATTENTION Robt Reals

NAME OF PROJECT

Batch Number	STANDARD	BATCH
	N/A	<u>3C 0841 m</u>
Date of Manufacture	N/A	<u>March 1983</u>
Shelf Life	12 Months	<u>3-84</u> Exp. Date
Weight Per Gallon (FMS 141a, 4.84)	8.5-9.3 lbs.	<u>2.95</u> lbs
Viscosity - Method	Brookfield	<u>Brookfield</u>
Viscosity	150-250 cps	<u>162 cps</u>
Temperature	75 ± 2°F	<u>75</u> °F
Color - Visual	Depends on Order	<u>GREEN</u>
Number	N/A	<u>0300</u>
This Batch Tested By--Initial/Date <u>D.J.</u> <u>4/27/83</u>		
Mixing Ratio by Weight	100 Parts Base	to 220 Parts Zinc Filler
THEORETICAL COVERAGE 1000 mil sq.ft./gal.		
Pot Life 8 (minimum)	Hours at 75 °F	50 % R.H.
Flash Point--Pensky-Martens Closed Cup (ASTM D-93) (This Component Only)		
	56 °F	
Tack Free Time 1/2 (minimum)	Hours at 75 °F	50 % R.H.
Recoat Time 12 (minimum)	Hours at 75 °F	50 % R.H.
Final Dry Time 12 (minimum)	Hours at 75 °F	50 % R.H.
Specified Carboline Thinner #33 or #21		
Recommended Dry Film Thickness Per Coat 2 - 3 Mils		

This product is hereby certified as manufactured in accordance with the Carboline Quality Assurance Program. When mixed in accordance with Carboline printed instructions, it is within manufacturing tolerances of the batches originally tested in accordance with ANSI N101.2, ANSI N101.4 and ANSI 512.

Q.A./Q.C. Supervisor
Signature: John PitalDate: 5-2-83Production Services Department--Signature: Werner B. BrannerTitle: Inspector5-4-83Form Date: 6/15/80Approval: John F. Mulla

QB 61330 4

carboline

PRODUCT IDENTITY AND QUALITY ASSURANCE CERTIFICATION RECORD

PURCHASER Carboline Co

CUSTOMER P.O. # _____

"SHIP TO" ADDRESS 350 Hawley Ind. Ct.CARBOLINE INVOICE # 31749St Louis Mo. 63144ATTENTION Susan Hamilton

NAME OF PROJECT _____

FORGEIATION AND TEST DATA

	STANDARD	BATCH
Batch Number	N/A	<u>3F5182Z</u>
Date of Manufacture	N/A	<u>June 1983</u>
Shelf Life	<u>24 Months</u>	<u>6/83</u> Exp. D.
Color - Visual	<u>Metallic Gray</u>	<u>Metallic Gray</u>
Sieve Analysis 325 mesh	<u>5% Maximum Retained</u>	<u>1.5% Retained</u>
(QCT# 127) 100 mesh	<u>99.9% Minimum Through</u>	<u>100% Through</u>
This Batch Tested By—Initial/Date	<u>ML 1</u>	<u>7-15-83</u>

Mixing Ratio: See Liquid Component Product Identity Certifications or Application Instructions.

This product is hereby certified as manufactured in accordance with the Carboline Quality Assurance Program. When used in accordance with Carboline printed instructions, it is within manufacturing tolerances of the batches originally tested in accordance with ANSI N101.2, ANSI N101.4 and ANSI 512.

Q.A./Q.C. InspectorSignature: James Z BrannerDate: 7-14-83Production Services Department—Signature: [Signature]Title: Inspector 8/11/83Form Date 4/28/81Approval [Signature]

QB 42881-1

OAK RIDGE NATIONAL LABORATORY
OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37831

May 2, 1984

Mr. Tom Aldinger
M&QS
Bechtel Group, Inc.
50 Beale Street
P. O. Box 3965
San Francisco, CA 94119

Dear Tom:

This is in response to my phone conversations with Mr. Yuly Korobov and yourself concerning Carboline Testing Project #02182 and your request for clarification of our comments on samples 27, 29, 33 and 34. The comments read "chalking, discoloration". The discoloration occurred on all samples in this test; the color changed from green to dark gray. The chalking as reported for the above samples was not excessive and indicates that some material could be removed from the samples by wiping with a cloth.

If there are any questions or we can be of further service, please call on us.

Sincerely,

R D Brooksbank
R. D. Brooksbank
Chemist

RDB:lp

cc: Yuly Korobov ✓

TESTING PROJECT: 02182

<u>Sample No.</u>	<u>DFT Before</u>	<u>DFT After</u>
1	2.5	2.5
2	2.6	2.6
3	2.8	2.8
4	2.8	2.8
5	2.7	2.3
6	2.3	3.0
7	2.5	2.9
8	2.6	2.3
9	3.8	3.4
10	4.3	3.3
11	4.5	3.3
12	3.8	3.3
13	4.3	2.9
14	3.8	3.3
15	3.8	3.1
16	3.8	3.5
17	5.8	7.0
18	5.5	8.0
19	6.0	7.2
20	5.8	8.0
21	5.8	6.7
22	6.0	7.1
23	5.5	8.0
24	5.8	7.8
25	5.2	5.6
26	5.5	7.4
27	5.8	6.0
28	5.3	6.0
29	5.5	5.8
30	5.5	6.3
31	5.8	6.6
32	5.5	6.2
33	5.3	6.3
34	5.0	6.3
35	5.7	6.3
36	5.7	7.2
37	5.3	6.3
38	5.3	6.6
39	6.0	6.2
40	5.3	6.5



LABORATORY TEST REPORT

Testing Project Number: 01978.1

Date: May 14, 1982

Report # Final Time 7 days

Date of Grading: December 22, 1981

Total Design Test Duration 7 days

Requested by: Mr. D. W. McBride

Performance of Carbo Zinc 11 Systems Exposed to 340°F Bechtel
TITLE: CP956-2/76 LOCA Curve.

PURPOSE: The purpose of this testing project is to determine how various Carbo Zinc 11 systems will perform in the upcoming 340°F Bechtel CP956-2/76 LOCA Curve tests at Oak Ridge National Laboratory scheduled for early 1982. The systems to be tested are:

1. 1c Carbo Zinc 11 @ 3 mils
2. 1c Carbo Zinc 11 @ 6 mils
3. 2c Carbo Zinc 11 @ 3/2 mils
4. 3c Carbo Zinc 11 @ 5/2/2 mils
5. 3c Carbo Zinc 11 @ 3/2/2 mils
6. 1c Carbo Weld 11/1c Carbo Zinc 11 @ 1.5/3.0 mils

CONCLUSIONS: Please refer to "Results".

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.

carboline

A. Test Coupons

Description: 2x4x1/4 steel panels conforming to Carboline Specification ST1 (See Appendix 1)
Surface Preparation: Gritblasted to SSPC-SP 10-63 with a 1.0-3.0 mil profile.
Abrasive Medium 50/50 mix of GFH #40 grit and S230 shot.
Note: Before priming, the coupons were vapor degreased.

B. Systems Tested

System Number	Coating System	Color	Batch No.	Dry Film Thinning Thickness		
				Thinner	Ratio	Range
1.	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	10%	3.0-3.3 mils
			B: 1E2388Z	1A2473M		
2.	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	10%	6.2-7.3 mils
			B: 1E2388Z	1A2473M		
3.	1c Carbo Zinc 11	green 0300	A: 0J5543M	#33	12%	3.1-3.4 mils
			B: 9E1683Z	0D3885M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	1.6-2.8 mils
			B: 1E2388Z	1F0964M		
4.	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	10%	6.4-7.0 mils
			B: 1E2388Z	1A2473M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	1.9-2.5 mils
			B: 1E2388Z	1A2473M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	3.5 mils
			B: 1E2388Z	1A2473M		
5.	1c Carbo Zinc 11	green 0300	A: 0J5543M	#33	12%	2.8-3.3 mils
			B: 9E1683Z	0D3885M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	1.6-2.0 mils
			B: 1E2388Z	1F0964M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	1.7-2.0 mils
			B: 1E2388Z	1F0964M		
6.	1c Carbo Weld 11	gray 0700	A: 0M2879M	#33	5%	1.7 mils
			B: 1E2388Z	1A2473M		
	1c Carbo Zinc 11	green 0300	A: 1E5640M	#33	50%	3.0-3.5 mils
			B: 1E2388Z	1A2473M		

System Number	C. Cure Schedule		Temperature Range	Humidity Range
	Coating System	Time		
1.	1c Carbo Zinc 11	2 months, 2 weeks	22-83°F	21-97%
2.	1c Carbo Zinc 11	2 months, 2 weeks	22-83°F	21-97%
3.	1c Carbo Zinc 11	7 months, 12 days	21-91°F	10-97%
	1c Carbo Zinc 11	2 months, 16 days	22-83°F	21-97%
4.	1c Carbo Zinc 11	1 month	26-86°F	21-97%
	1c Carbo Zinc 11	24 hours	70-76°F	39-41%
	1c Carbo Zinc 11	34 days	22-69°F	28-97%
5.	1c Carbo Zinc 11	7 months, 12 days	21-91°F	10-97%
	1c Carbo Zinc 11	24 hours	75-79°F	55-60%
	1c Carbo Zinc 11	2 months, 15 days	22-83°F	21-97%
6.	1c Carbo Weld 11	2 weeks	28-69°F	29-97%
	1c Carbo Zinc 11	20 days	22-68°F	28-97%

D. Exposure

Bechtel CP956 (2/76) LOCA Curve
1. Time-Temperature-Pressure Curve

<u>Time</u>	<u>Temperature*</u>	<u>Pressure*</u>
Initial	Ambient	Ambient
Initial to 6 hours	3-1°F (171°C)	70 psig
6 hours to 96 hours	2-1°F (121°C)	30 psig
96 hours to 7 days	2-1°F (93°C)	10 psig

*These are theoretical values. The next page are graphs of the theoretical and actual LOCA temperature and pressure curves. The data for the actual LOCA curves are from the chart recording for this test, found on page 97, Lab Book #230.

2. Water Chemistry

Deionized water pH = 7.2

Note: All test panels were suspended in the vapor phase of test.

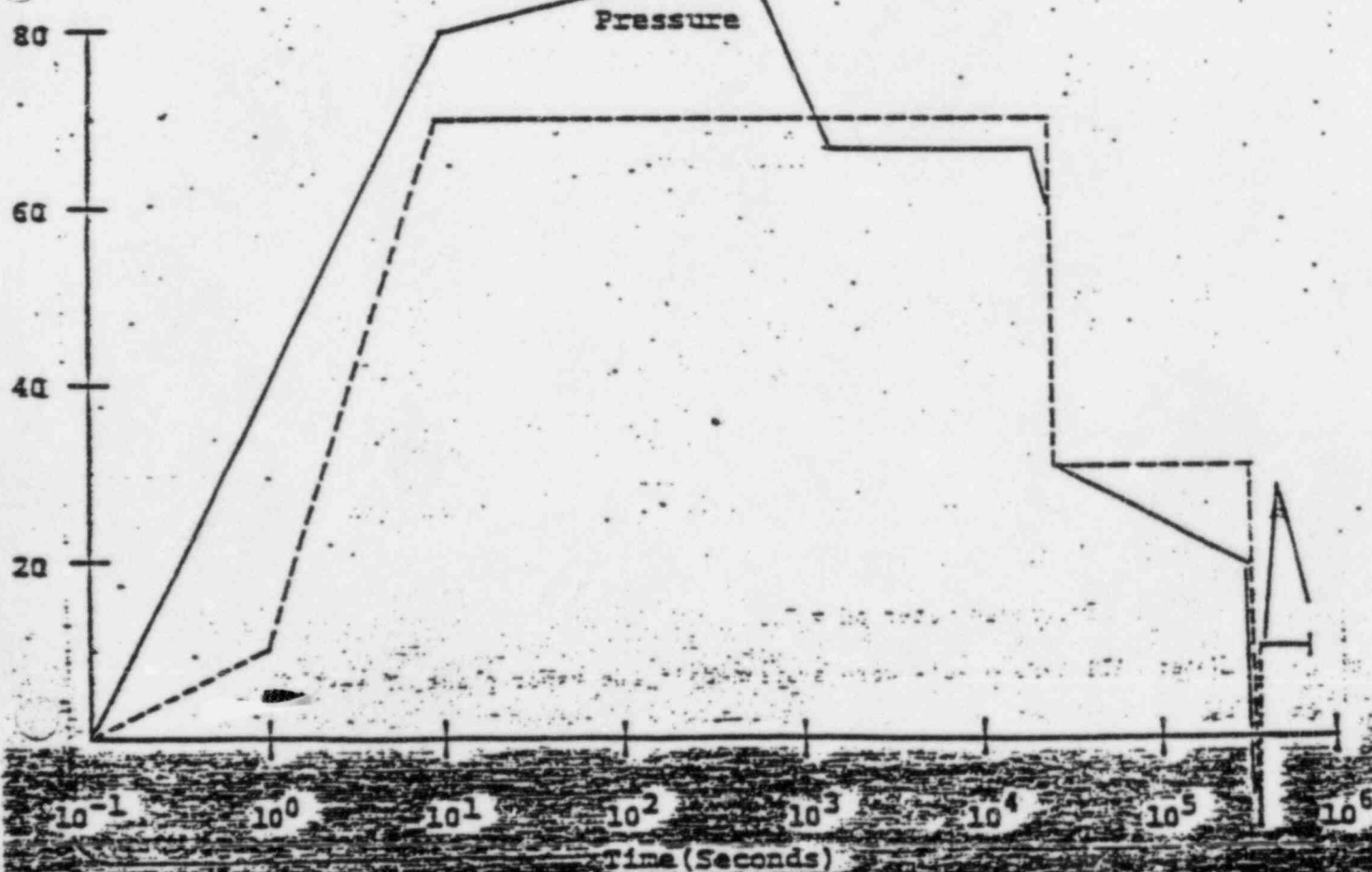
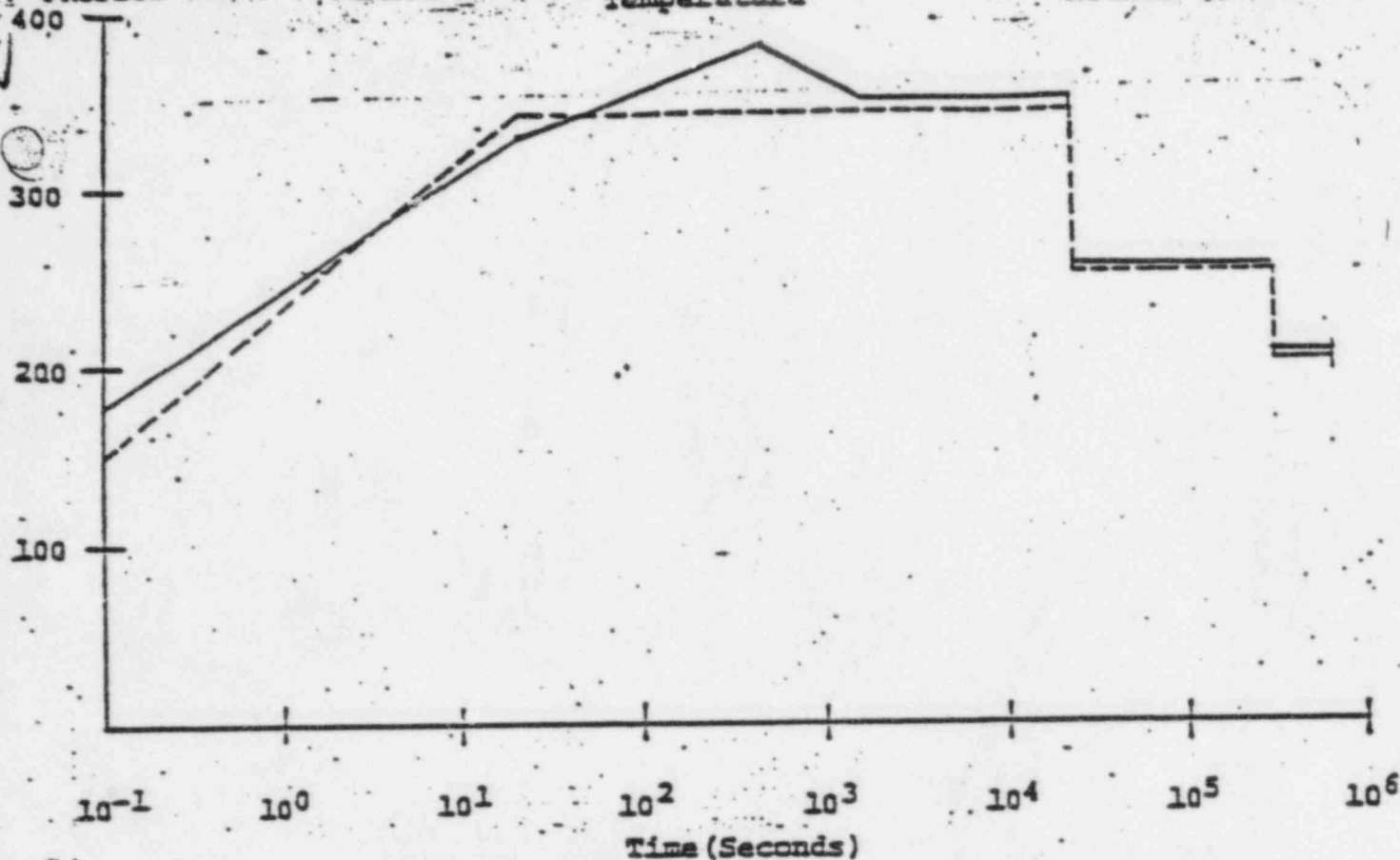
PROJECT #01978-1

Series C-700 - 4/10 Data Curve

Theoretical

Temperature

Actual



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LOCA Grading Procedure
(ASTM D3911-80)

The test coupons are examined and evaluated within 4 hours after removal from the test chamber for the following coating defects:

Delamination - report extent
Cracking - report extent ..
Peeling - report extent
Blistering - report in accordance with ASTM Method D714

Key to Symbols in Results

B-blistering
CD-coating discoloration
F-few

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RESULTS:

Panel Identification and Coating System	Dry Film Thickness (mils)	Delamination	Cracking	Peeling	Blistering	Other Performance Characteristics
1A; Side A 1c Carbo Zinc 11	3.0	none	none	none	none	CD
1A; Side B 1c Carbo Zinc 11	3.3	none	none	none	none	CD
2A; Side A 1c Carbo Zinc 11	7.3	none	none	none	none	CD
2A; Side B 1c Carbo Zinc 11	6.2	none	none	none	none	CD
3A; Side A 1c Carbo Zinc 11 1c Carbo Zinc 11	3.4 1.6 5.0	none	none	none	none	CD
3A; Side B 1c Carbo Zinc 11 1c Carbo Zinc 11	3.3 2.6 5.9	none	none	none	none	CD
3B; Side A 1c Carbo Zinc 11 1c Carbo Zinc 11	3.2 2.8 6.0	none	none	none	none	CD
3B; Side B 1c Carbo Zinc 11 1c Carbo Zinc 11	3.1 2.0 5.1	none	none	none	none	CD

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SULTS

Identification d Coating System	Dry Film Thickness (mils)	Delamination	Cracking	Peeling	Blistering	Other Performance Characteristics
Side A 1c Carbo Zinc 11 1c Carbo Zinc 11 1c Carbo Zinc 11	6.4 1.9 3.5 11.8	none	none	none	none	CD
Side B 1c Carbo Zinc 11 1c Carbo Zinc 11 1c Carbo Zinc 11	7.0 2.5 3.5 13.0	From edge spreading 1/2" onto plane area,	none	none	none	CD
Side A 1c Carbo Zinc 11 1c Carbo Zinc 11 1c Carbo Zinc 11	3.0 1.6 2.0 6.6	none	none	none	none	CD
Side B 1c Carbo Zinc 11 1c Carbo Zinc 11 1c Carbo Zinc 11	3.3 1.7 2.0 7.0	none	none	none	none	CD
Side A 1c Carbo Zinc 11 1c Carbo Zinc 11 1c Carbo Zinc 11	3.1 2.0 1.7 6.8	none	none	none	none	CD

RESULTS

Identification Coating System	Dry Film Thickness (mils)	Delamination	Cracking	Peeling	Blistering	Other Performance Characteristics
Side B 1c Carbo Zinc 11	2.6	none	none	none	#2F-B	CD
1c Carbo Zinc 11	2.0					
1c Carbo Zinc 11	2.0					
	<u>6.8</u>					
Side A 1c Carbo Weld 11	1.7	none	none	none	none	CD
1c Carbo Zinc 11	3.0					
	<u>4.7</u>					
Side B 1c Carb Weld 11	1.7	From edge spreading 1/2" onto plane	none	none	none	CD
1c Carbo Zinc 11	3.5					
	<u>5.2</u>					

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052682

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M. Dugan/Group Leaders

APPENDIX 1

Carboline Specification CB1

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 $\frac{1}{4}$ 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".