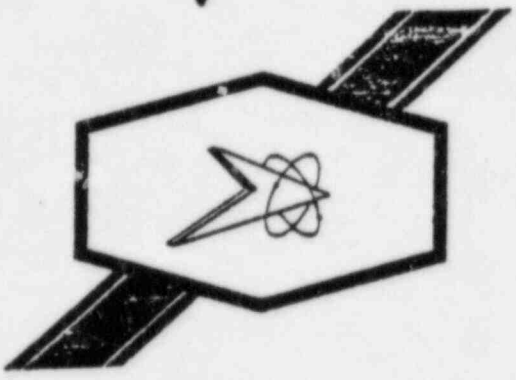
Imperial



TECHNICAL REPORT

NUMBER

#505-81

TITLE

RADIATION TOLERANCE AND DESIGN BASIS ACCIDENT RESULTS ON NUTEC CONCRETE COATING SYSTEMS

FOR

SOUTH TEXAS PROJECT

CUSTOMER

CONDUCTED BY: OAK RIDGE NATIONAL LABORATORIES

Submitted by: Gerald E. Arnold

Accepted By: Gerald E. Arnold

~~Approved:~~

Date: July 7, 1981

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

SCOPE:

The purpose of this test was to evaluate the performance of Imperial's Nutec concrete coating system per the new South Texas Project requirements (attached). This test also demonstrates that Nutec 11S can be applied to unblasted concrete surfaces at film thicknesses up to 105 mils.

SUMMARY:

Five concrete specimens were irradiated and design basis accident tested at Oak Ridge National Laboratories. All five specimens have met the acceptance criteria as established by the South Texas Project ANSI N5.12, and ANSI N101.2.

PROCEDURES:

Five concrete coupons, measuring 2x4x2" in size, were prepared as outlined on the attached panel preparation sheets. The following table summarizes the surface preparation, critical film thicknesses, and the test procedures utilized.

Attached are copies of ORNL's test procedures.

Coupon #	Surface Preparation	System	Max. DFTS (Mils)	Test Designation
A 31	Broomed surface was abrasive "sweep" blasted to remove laitance. Other surfaces were stoned followed by 100 psi compressed air.	11S/1201 11S/11/1201 11S/11S/1201	40 (11S) 40 (11S) 65 (11S)	3.5×10^9 rads 291°F, 70 PSIG
A 36		11S/11S/1201 11S/11S/11S/11/1201 11S/1201	75 (11S) 105 (11S) 25 (11S)	
8703	All surfaces were abrasive "swept" blasted.	11S/11/1201	27 (11S) 17 (11) 13 (1201)	
8706		11/1201	16 (11) 13 (1201)	2×10^8 rads 291°F, 70 PSIG
8715		11S/11/1201/1201	27 (11S) 16 (11) 13 (1201)	

RESULTS:

Refer to individual ORNL results sheets.

Coupon #	Irradiation Level/Results	DBA Results
A 31	3.5×10^9 rads/No defects	No defects
A 36	3.5×10^9 rads/No defects	No defects
8703	2×10^8 rads/No defects	#8F on side 4 No other defects
8706	2×10^8 rads/No defects	No defects
8715	2×10^8 rads/No defects	No defects

CONCLUSION:

Test results indicate that the Nutec concrete coating system successfully met the acceptance criteria per ANSI N101.2 and ANSI N5.12 when subjected to radiation exposure levels of $2x10^8$ rads to $3.5x10^9$ rads and design basis accident conditions of 291°F. and 70 PSIG.

This technical report should be reviewed concurrently with technical report #495-81, which describes an earlier test series for the South Texas Project. Both reports deal with concrete coating systems tested per the STP requirements, applied over various perpared surfaces and higher film thicknesses than previously qualified.

PANEL PREPARATION DATA

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Nutec 11S/Nutec 11/Nutec 1201/ Nutec , 11S/1201

2. TYPE SUBSTRATE: Concrete Size: 2 x 4 x 2

3. SURFACE PREPARATION (Describe): Carborundum stone used to remove high lights and loose particles, broomed surface blast swept to remove efflorescence. Cleaned with 100 psi compressed air

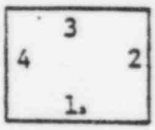
4. PRODUCT DATA: SAMPLE NO.(s): A-31

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

COAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F)%R.H.	THICKNESS (ins.)	TIME & DAT APPLIED
	Nutec	11S	2519/2530/2517	Squeegee	66°F/53%	*	2/4/81 3:00 p.m.
	Nutec	11S	2519/2530/2517	Squeegee	60°F/85%	**	2/5/81 9:00 a.m.
	Nutec	11S	2519/2530/2517	Squeegee	64/55	***	2/9/81 9:30 a.m.
	Nutec	11	2476/2102/2444	Squeegee	62°F/43%	****	2/13/81,2:00
	Nutec	1201	9772/1959	Spray	73°F/52%	*****	2/16/81,3:00

FILM THICKNESS (ins.)		11S *	11S **	11S ***	11 ****	1201 *****
Side 1		.035 - .040				.003 - .005
Side 2		.025 - .040			.001 - .004	.003 - .005
Side 3			.015-.025	.030-.040		.003 - .005
Side 4		.030 - .040				.003 - .005

TOP VIEW OF COUPON



Numbered and broomed surfac

TOTAL DRY FILM THICKNESS RANGE - Side 1 .038-.045 Side 3 .048-.070
Side 2 .029-.049 Side 4 .033-.055

CURING CONDITIONS: AMBIENT TEMP. 70-80 °F REL. HUMIDITY 45-65 %

MINIMUM CURE 7 DAYS

TEST PROCEDURE: DBA/ Radiation Tolerance

TESTS PERFORMED BY: ORNL DATE SUBMITTED 5/1/81

APPROVED Gerald E Arnold

TEST REPORT NO. 505-81

TEST PANEL PREPARATION DATA

. PRODUCT TO BE TESTED: Nutec 11S/Nutec 11/Nutec 1201, Nutec 11S/1201

. TYPE SUBSTRATE: Concrete Size: 2 x 4 x 2

. SURFACE PREPARATION (Describe): Carborundum stone used to remove high lights and loose particles, broomed surface blast swept to remove efflorescence. Cleaned with 100 psi compressed air

. PRODUCT DATA: SAMPLE NO.(s): A-36

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

COAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F)%R.H.	THICKNESS (ins.)	TIME & DA APPLIED
	Nutec	11S	2519/2530/2517	Squeegee	66°F/53%	*	2/4/81 3:00 p.m
	Nutec	11S	2519/2530/2517	Squeegee	60°F/85%	**	2/5/81 9:00 a.m.
	Nutec	11S	2519/2530/2517	Squeegee	62°F/55%	***	2/9/81 9:30 a.m.
	Nutec	11	2476/2102/2444	Squeegee	62°F/43%	****	2/13/81,2:0(
	Nutec	1201	9772/1959	Spray	73°F/52%	*****	2/16/81,3:0(

FILM THICKNESS (ins.)		11S *	11S **	11S ***	11 ****	1201 *****
Side 1			.025-.035	.030-.040		.003-.005
Side 2		.020-.025	.030-.040	.030-.040	.001-.004	.003-.005
Side 3		.020-.025	.030-.040			.003-.005
Side 4		.020-.025				.004-.008

TOP VIEW OF COUPON

Numbered and broomed surfa

TOTAL DRY FILM THICKNESS RANGE - Side 1 .058-.080 Side 3 .053-.070
Side 2 .084-.113 Side 4 .024-.033

CURING CONDITIONS: AMBIENT TEMP. 70-80 °F REL. HUMIDITY 45-65 %

MINIMUM CURE 7 DAYS

TEST PROCEDURE: DBA/Radiation Tolerance

TESTING PERFORMED BY: ORNL DATE SUBMITTED 5/1/81

APPROVED Harold E Arnold

TEST REPORT NO. 505-81

DBA AND RADIATION TOLERANCE

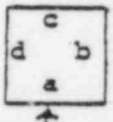
TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S/NUTEC #11/NUTEC #1201
2. TYPE SUBSTRATE: CONCRETE SIZE: 2" x 4" x 2"
3. SURFACE PREPARATION (Describe): Water cured (total immersion) for 11 days. Brush blasted with G40 grit.
4. PRODUCT DATA: SAMPLE NO.(s): 8703
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: N/A

COAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F)%R.H.	THICKNESS (ins.)	TIME & DATE APPLIED
1	NUTEC	#11S	2519/2530/2516	Squeegee	74/87	See below	12/8/80 12:4_
2	NUTEC	#11	2476/2058/2444	Squeegee	72/62	"	12/10/80 10:45
3	NUTEC	#1201	1958/1959	Spray	52/70	"	12/12/80 10:15

FILM THICKNESS (ins.)		#11S	#11	#1201		
Side C	Minimum	.015-.016	.009-.010	.003-.004		
Sides A & B	Average	.021-.022	.012-.013	.007-.008		
Side D	Maximum	.026-.027	.016-.017	.012-.013		

TOP VIEW OF COUPON



Numbered and broomed surfa

TOTAL DRY FILM THICKNESS RANGE - Side C .027-.030 Sides A & B .040-.043 Side D .054-.057

6. CURING CONDITIONS: AMBIENT TEMP. 50-75 °F REL. HUMIDITY 60-90 %
   MINIMUM CURE 33 DAYS
7. TEST PROCEDURE: DBA / Radiation Tolerance
8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 1/14/81

APPROVED: Gerald E. Arnold

TEST REPORT NO. 505 -81

PREPARED BY: J. Mac Gorgas

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11/NUTEC #1201
2. TYPE SUBSTRATE: CONCRETE SIZE: 2" x 4" x 2"
3. SURFACE PREPARATION (Describe): Water cured (total immersion) for 11 days. Brush blasted with G40 grit.
4. PRODUCT DATA: SAMPLE NO.(s): 8706
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: N/A

COAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F)%R.H.	THICKNESS (ins.)	TIME & DATE APPLIED
1	NUTEC	#11	2476/2058/2444	Squeegee	70/68	See below	12/10/80 9:30
2	NUTEC	#1201	1958/1959	Spray	52/70	"	12/12/80 10:15

FILM THICKNESS (ins.)		#11	#1201			
Side C	Minimum	.009-.010	.003-.004			
Sides A & B	Average	.012-.013	.007-.008			
Side D	Maximum	.015-.016	.012-.013			

TOP VIEW OF COUPON

Numbered and broomed surfa

TOTAL DRY FILM THICKNESS RANGE - Side C .012-.014 Sides A & B .019-.021 Side D .027-.029

6. CURING CONDITIONS: AMBIENT TEMP. 50-70 °F REL. HUMIDITY 60-70 %
   MINIMUM CURE 33 DAYS
7. TEST PROCEDURE: DBA/Radiation Tolerance
8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 1/14/81

APPROVED: Gerald E. Arnold

TEST REPORT NO. 505-81

PREPARED BY: Jeron Sawyer

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S/NUTEC #11/NUTEC #1201

2. TYPE SUBSTRATE: CONCRETE SIZE: 2" x 4" x 2"

3. SURFACE PREPARATION (Describe): Water cured (total immersion) for 11 days. Brush blasted with G40 grit.

4. PRODUCT DATA: SAMPLE NO.(s): 8715

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

COAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F)%R.H.	THICKNESS (ins.)	TIME & DATE APPLIED
1	NUTEC	#11S	2519/2530/2516	Squeegee	74/87	See below	12/8/80 12:45 p.m.
2	NUTEC	#11	2476/2058/2444	Squeegee	70/68	"	12/10/80 9:30 a.m.
3	NUTEC	#1201	1958/1959	Spray. (Mist coat)	52/70	"	12/12/80 10:50 a.m.
4	NUTEC	#1201	"	Spray	53/70	"	12/12/80 11:15 a.m.

FILM THICKNESS (ins.)		#11S	#11	#1201(Mist)	#1201	
Side C	Minimum	.015-.016	.010-.011	.001-.0015	.005-.0055	
Sides A & B	Average	.021-.022	.012-.013	.001-.0015	.008-.0085	
Side D	Maximum	.026-.027	.015-.016	.001-.0015	.011-.0115	

TOP VIEW OF COUPON

Numbered and broomed surfa

TOTAL DRY FILM THICKNESS RANGE - Side C .031-.033 Sides A & B .042-.045 Side D .053-.056

6. CURING CONDITIONS: AMBIENT TEMP. 50-75 °F REL. HUMIDITY 65-90 %

MINIMUM CURE 33 DAYS

7. TEST PROCEDURE: DBA /Radiation Tolerance

8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 1/14/81

APPROVED: Gerald E. Arnold

TEST REPORT NO. 505-81

PREPARED BY: J. Milloy Jaeger III

ORNL
PROCEDURES

Manufacturer: Imperial

New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

REPORT OF IRRADIATION AND DBA TESTING

The irradiation and design basis accident (DBA) tests are conducted, respectively, in accordance with Bechtel Corporation specifications CP-951 and CP-956 in Standard Specification Coatings for Nuclear Power Plants (or with modifications as noted in Table 2, DBA test conditions). The tests are designed to meet specifications set in both ANSI 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 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 Ralph L. Boyle

Approved L. T. Corbin

Manufacturer: Imperial

New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

ORNL Log Book No. A9675, A6-2-1

Table 1. DBA solution composition, distilled water

Reagent	Concentration
Boric acid, H_3BO_3	0.28 M
Sodium hydroxide, NaOH	Required to adjust pH to 9.5

Table 2. DBA test conditions

Time	Temperature (°F)	Pressure (psig)	Comments
Start	150		Autoclave preheated.
10 min	150-291		Solution injected at 260°F.
20 min	291	70	Pressure maintained by relief valve.
45 min	291-260		
80 min	260	39	Pressure adjusted with N_2.
120 min	260-220		
180 min	220	20	
210 min	220-160		
21 h	160	5	
10 d	125	2	Placed in fresh solution in constant temperature bath.
End of test			

Evaluated Roger L. Hyatt

Approved L. T. Corbin

RADIATION TOLERANCE
RESULTS

Manufacturer: Imperial

New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

SYSTEM IDENTIFICATION

____Steel panel __x__Concrete block

11S/11/1201

RADIATION TOLERANCE TEST

ORNL Master Analytical Manual Method No. 2 0921; Bechtel Corporation Specification No. CP-951; ORNL Log Book No. A9675, A5-28-1 .

Initial dose rate: 1.2×10^7 rad/h

Test conducted in: __x__ air _____ water

Sample No.	Cumulative dose	Test results
A-31	3.5×10^9 rad	Coatings intact, no defects all areas.
A-36	3.5×10^9 rad	Coatings intact, no defects all areas.

Evaluated Ralph L. Boyd

Approved L. T. Lin Lin

Manufacturer: Imperial

New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

SYSTEM IDENTIFICATION

____ Steel panel __x__ Concrete block

11S/11/1201

RADIATION TOLERANCE TEST

ORNL Master Analytical Manual Method No. 2 0921; Bechtel Corporation Specification No. CP-951; ORNL Log Book No. A9675, A5-26-1 .

Initial dose rate: 1×10^7 rad/h

Test conducted in: __x__ air _____ water

Sample No.	Cumulative dose	Test results
8703	2×10^8 rad	Coatings intact, no defects.

Evaluated Ralph L. Apple

Approved K. T. Compton

Manufacturer: Imperial

New Orleans, Louisiana

Analytical Chemistry Divisic
Oak Ridge National Laborator
Date: June 17, 1981

SYSTEM IDENTIFICATION ____Steel panel __x__Concrete block

11/1201

RADIATION TOLERANCE TEST

ORNL Master Analytical Manual Method No. 2 0921; Bechtel Corporation Specification No. CP-951; ORNL Log Book No. A9675, A5-26-1 .

Initial dose rate: 1×10^7 rad/h

Test conducted in: __x__ air _____ water

Sample No.	Cumulative dose	Test results
8706	2×10^8 rad	Coatings intact, no defects.

Evaluated Roy L. Ayers

Approved L. T. Corbin

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

SYSTEM IDENTIFICATION ____ Steel panel x Concrete block

11S/11/1201

RADIATION TOLERANCE TEST

ORNL Master Analytical Manual Method No. 2 0921; Bechtel Corporation Specification No. CP-951; ORNL Log Book No. A9675, A5-26-1 .

Initial dose rate: 1×10^7 rad/h

Test conducted in: x air ____ water

Sample No.	Cumulative dose	Test results
8715	2×10^8 rad	Coatings intact, no defects.

Evaluated Ralph F. Apple

Approved L. T. Lamont

DBA
RESULTS

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

SYSTEM IDENTIFICATION

____ Steel panel x Concrete block

11S/11/1201

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A6-2-1 .

Sample No.	DBA phase	Test results
A-31	spray*	Coatings intact, no defects all areas.
A-36	spray*	Coatings intact, no defects all areas.

*Irradiated.

Evaluated Ralph T. Apple

Approved J. T. Bigham

Manufacturer: Imperial

New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

SYSTEM IDENTIFICATION ____Steel panel x Concrete block

11S/11/1201

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A6-2-1 .

Sample No.	DBA phase	Test results
8703	spray*	Coatings intact, no defects after 28 h. Blisters #8 few, side 4 at end of test. No other defects.

*Irradiated.

Evaluated Paul F. Apple

Approved L. T. Corbin

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

SYSTEM IDENTIFICATION ____ Steel panel x Concrete block

11/1201

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A6-2-1 .

Sample No.	DBA phase	Test results
8706	spray*	Coatings intact, no defects all areas.

*Irradiated.

Evaluated Ralph L. Ryple

Approved L. T. Corbin

Manufacturer: Imperial

New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: June 17, 1981

SYSTEM IDENTIFICATION ____Steel panel __x__Concrete block

11S/11/1201

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A6-2-1 .

Sample No.	DBA phase	Test results
8715	spray*	Coatings intact, no defects all areas.

*Irradiated.

Evaluated Ray E. Apple

Approved L. T. Lin

SOUTH TEXAS PROJECT
REQUIREMENTS

PROTECTIVE COATINGS SYSTEM DESIGN AND SELECTION CRITERIA

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

1.2 All surfaces to be finished with a coating, surfacer, or paint type product will be included in this technical reference document: System Design and Selection Criteria, under one of the following Service Level Classifications:

SERVICE LEVEL I - Pertains to those coating systems, applied to structures, systems, and components, which are essential to the prevention of, or the mitigation of the consequences of, postulated accidents that could cause undue risk to the health and safety of the public.

SERVICE LEVEL II - Pertains to those coating systems which are essential to maintain the intended normal operating performance or, coating systems that are applied to surfaces which can be directly contaminated by spraying or flowing contaminated liquids.

SERVICE LEVEL III - Pertains to those coatings systems, applied to systems and components, that have not been designated to be coated with Service Level I or Service Level II coatings , including all of the balance of plant subject to environmental, service condition, workmanship and the "best practice" of the trade, state of the art, considerations.

1.3 The design criteria is defined and the test standards for coating materials are considered.

1.4 The qualification of protective coating suppliers and applicators is considered.

1.5 The interface activities with purchasing, quality assurance, and quality control are considered.

2.0 GENERAL DESIGN REQUIREMENTS

2.1 The coating system design goal for Service Level I, Service Level II

and Service Level III areas is for a service life of 40 years. The coating systems to be selected are maximum life materials. The coatings materials will serve 40 years with proper maintenance.

2.2 The coating systems to be used in Service Level I areas are to be tested by the supplier in an independent testing laboratory in accordance with the DBA conditions established by this technical reference document in section 3.0. Service Level I coatings must also satisfactorily pass the requirements of sections 5, 6, 7 & 8.

2.3 The manufacturers and suppliers are to establish QA and QC procedures and documentation to certify that materials tested are the same formula and of the same quality as those to be supplied to the project. The materials are to be tested for reliability and quality using tests and test procedures in accordance with appropriate Federal Standards, ASTM, and other special product tests as applicable.

2.4 All coatings material to be used for Service Level II will be subject to testing according to sections 5, 6, 7 & 8, as well as all of the QA requirements as required for reliability and quality.

2.5 All fabricated metal such as structural steel, piping, vessels and liner plate will be mechanically blasted and coated with an Inorganic Zinc-Rich Coating or will be hot dip galvanized. The Inorganic Zinc coating and/or galvanizing may be top coated as required. The documentation and traceability shall be in accordance with the intent of ANSI N101.4 as interpreted in the coating specifications.

2.6 Electrical equipment and instrument items will be supplied completely finished with the manufacturers standard finish. Suitability of coating shall be reviewed by Materials Engineering. Colors shall be as specified in purchase documents, as well as necessary instructions relative to the documentation and traceability of the coating product used on this equipment.

2.7 Other equipment items will be supplied either prime coated only, using Inorganic Zinc, for finish coats in the field or they may be completely shop coated. Certain types of equipment may require specialty or additional painting and will be painted as required according to the service conditions and class of environment to which the equipment will be exposed.

2.8 Above ground uninsulated piping for service up to 200°F will receive the same coating as the structural steel in the same area, where practical. Damaged, rusted, and field welded areas will be cleaned and primed to correspond with the original coating system applied.

2.9 Uninsulated pipe and equipment operating between 200°F and 750°F will be mechanically blasted and coated with an Inorganic Zinc Rich Coating.

2.10 All uninsulated piping or equipment operating above 750°F shall receive, if required, a special coating based on the exposed environmental conditions for the specific area.

2.11 All concrete surface subject to radioactive contamination will be coated with an epoxy, phenolic, or any other appropriate generic type of coating to improve ability to decontaminate. The concrete surfaces will be prepared to receive the final coat using an approved curing compound/sealer, and compatible surfacer. These concrete surfaces will be smooth and free of porosity as required, for the application of topcoats.

2.12 The curing compound, if used, for concrete is to be applied as soon as practical after the forms are removed prior to the occurance of surface contamination. All top coating as required by the applicable coating specifications is to be accomplished in accordance with ANSI N5.12-1973.

2.13 Architectural concrete surfaces, walls, floors, and roofs will be protected with a penetrating surface sealer where specified. In most applications, the sealer will not change the natural appearances of the concrete, but will be a sealer for waterproofing.

2.14 Other architectural surfaces will receive at least two coats of latex or alkyd paint finishing colors, to be specified on the architectural drawings.

2.15 Coatings for balance of plant, or Service Level III, will require good quality control practice to see that they are applied in accordance with the general painting specification for the area. Quality Assurance and Quality Control, 100% Inspection, that is used in the containment and other safety related areas, will not be used for the balance of plant. Balance of plant or Level III area is subject to the best practice of the industry, state of the art considerations. A listing of surfaces coated and coatings used will be maintained for the use of plant operating personnel.

2.16 All coating systems are to be applied in the correct sequence of events to assure accessability and the availability of an area in order to attain a high quality application.

3.0 DBA TEST CONDITIONS

3.1 The coatings for Service Level I are to withstand DBA conditions as described by the project DBA temperature and pressure vs. time curves for PWR reactors. The chemical spray environment consists of a boric acid solution with a PH of 4.0 to 10.5 maximum adjusted with sodium hydroxide. The solution is to contain 2000 to 4000 ppm boric acid, 0.15 ppm maximum chloride, and 0.15 ppm maximum flouride. Make

up water quality is to be the same as the reactor coolant systems make up water.

3.2 The general exposure conditions are set by the design basis accident (DBA) pressure and thermal conditions for the South Texas Project as identified in Brown & Root criteria document 1E019RQ005-C and are outlined below:

Temperature - 291°F
Pressure - 56.5 psig
Relative Humidity - 100% for 30 days

contradicts pg 1 — attach. 2&3

3.3 Testing for the carbon steel and concrete test panels shall be in accordance with ANSI N101.2-1972.

3.4 Each coated panel to be DBA tested is to be exposed to all test media consecutively with the radiation testing to be last in the series. Conversely, panels tested individually on only one environment will not be accepted.

4.0 ACCEPTANCE CRITERIA

4.1 As a minimum the following physical characteristics shall be used to determine a nuclear coatings acceptability.

4.2 Flaking - shall be evaluated in accordance with ASTM D772-47 "Standard Method of Evaluating Degree of Flaking (Scaling) of Exterior Paints". Flaking or peeling shall not be permitted.

4.3 Blistering - shall be evaluated in accordance with ASTM D714-56 "Standard Method of Evaluating Degree of Blistering of Paint". Blistering shall be limited to size 4 intact blisters not exceeding a "frequency of a few" as shown in ASTM D714-56 photographic reference standards.

4.4 Checking - shall be evaluated in accordance with ASTM D660-44 "Evaluating Degree of Checking of Exterior Paints". Checking is permitted: however, checking shall not exceed the No. 8 standard as contained in ASTM D660-44 photographic reference standards.

4.5 Cracking - shall be evaluated in accordance with ASTM D661-44 "Evaluating Degree of Cracking of Exterior Paint". Any evidence of cracking seen with the unaided eye shall constitute unacceptability.

4.6 Chalking - shall be evaluated in accordance with ASTM D659-74 "Evaluating Degree of Chalking with Exterior Paints". Chalking shall not exceed the No. 8 standard as contained in ASTM D659-74 photographic reference standards.

4.7 Delamination - or peeling generally indicates a loss of adhesion of the

system to the substrate and therefore shall not be permitted.

4.8 Discoloration - would be expected for some formulations but, does not mean the system has failed, therefore discoloration shall be permitted.

4.9 Evidence of tackiness or softening of the coating system, sufficient to impair the function or serviceability of the containment liner shall not be permitted. The test specimen shall be evaluated within 2 hours after removal from the test chamber for the defects listed above. Any other defects or changes in coating properties which will render the coating system nonfunctional will be cause for rejection.

5.0 RADIATION EXPOSURE

Normal Operation [1]	$.50 \times 10^8$ Rads
STP Calculated LOCA Irradiation @ 30 days [2]	$.33 \times 10^8$ Rads
Total	$.83 \times 10^8$ Rads

References:

1. IEEE STD 383-1974 recommends a value of $.50 \times 10^8$ Rads as the normal 40 year design value.
2. Brown & Root Calculation A479NC130

However, IEEE STD 323-1974 suggests the use of 1.50×10^8 Rads from LOCA irradiation. For conservatism the nuclear coatings specified for the containment liner will be qualified at:

Normal Operation	$.50 \times 10^8$ Rads
LOCA Irradiation	1.50×10^8 Rads
Total	2.0×10^8 Rads

Testing of the carbon steel and concrete test panels shall be in accordance with ANSI N101.2-1972.

ACCEPTANCE CRITERIA - As a minimum the acceptance criteria specified in section 4.0 shall determine a nuclear coatings acceptability.

6.0 DECONTAMINATION FACTORS

Decontamination factors for the Containment Liner as a minimum are as follows:

a.	Water @ 25°C	DF = 5
b.	Acid @ 25°C	DF = 1.3
c.	Acid @ 80°C	DF = 1.3
d.	Overall	DF = 10

TABLE I

COORDINATES FOR STP DBA CURVES

TIME (Seconds)	TEMPERATURE °F	PRESSURE (psig)	EVENT
0	65-120	0	Break
16.5	255	34	Core Flood Tank Injection Begins
23	261	38.5	Peak Containment Pressure During Blowdown
25	260	38	ECCS Injection Begins End Of Blowdown
52.5	270	41	Beginning of Fan Cooler Operation
111.5	272	47	Beginning of Containment Spray Injection
142.1	274	48	End Of Core Reflood
3.7min 221	275	48.4	Peak Containment Pressure
1,550	255	37	Beginning of Recirculation
3,820	260	39	End Of Steam Generator Energy Release
2½hr 9,000	220	20	Containment Pressure is 50% Of Design Value
21hr 75,600	160	5	Hot Leg Injection Initiated CSS Stopped
11.6 days 1,000,000	125	2	End Of Transient

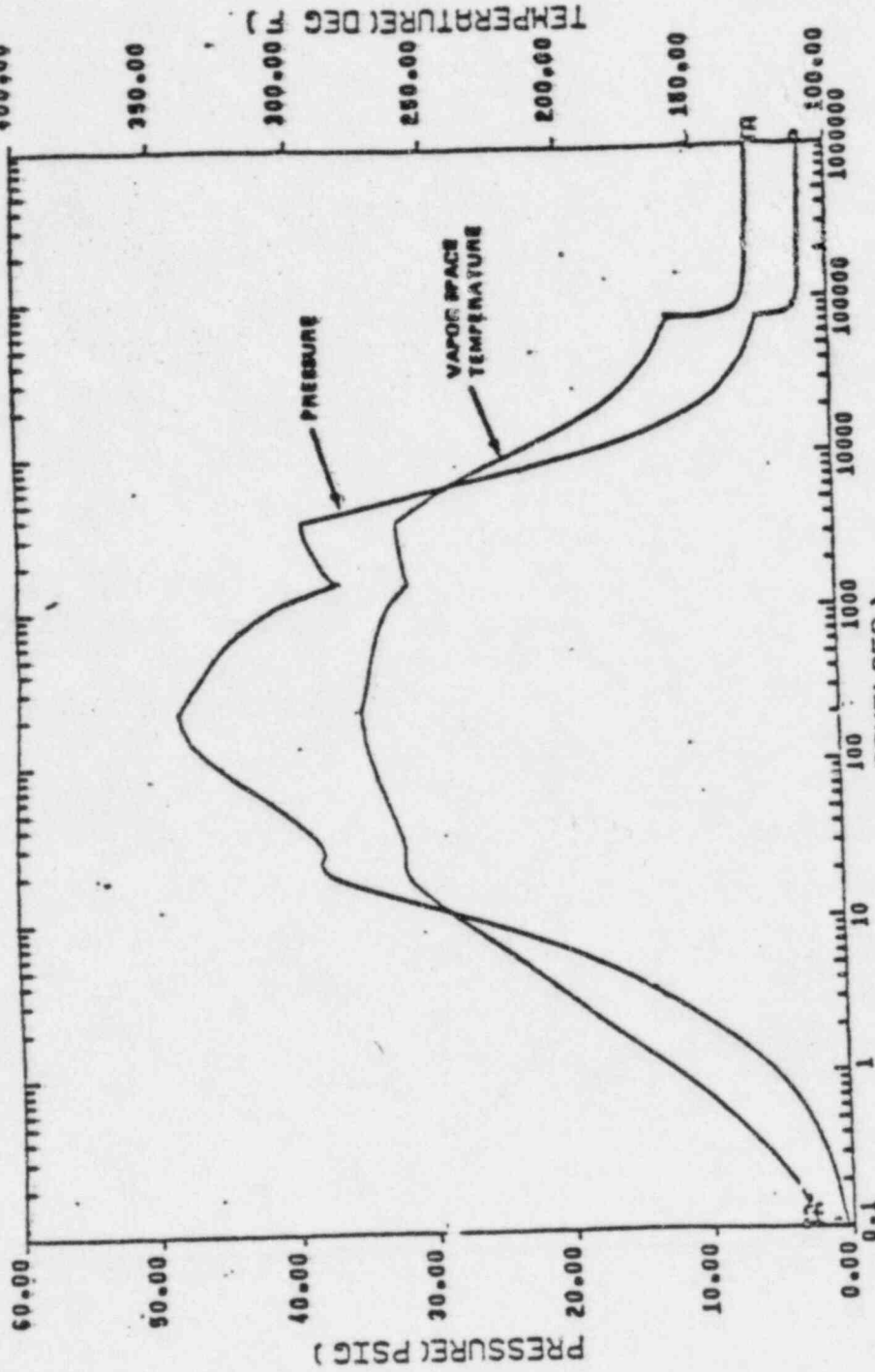


Figure 1: STP DBA Curves

CPSES NRC TRT

SSER- COATINGS 2

DBA QUALIFICATION TESTING

WORK PACKAGE DATA -

DBA TEST REPORTS VOL II OF II

(CONTINUATION OF "DBA REPORTS - SITE CIVIL ENGR FILE")