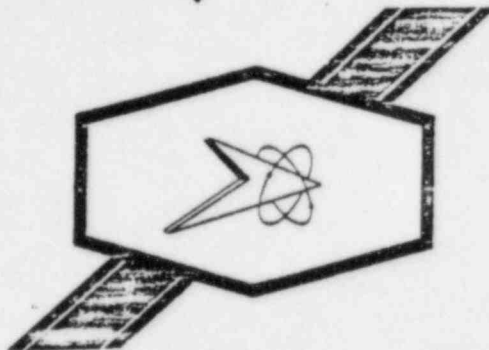


Imperial



TECHNICAL REPORT

NUMBER

#495-81

TITLE

Nutec 11S/Nutec 1201
Nutec 11S/Nutec 11/Nutec 1201
Radiation Tolerance,
Design Basis Accident Testing (ORNL)
FOR

Company Knowledge

CUSTOMER

Submitted by: Gerald E. Arnold

Approved By: *Gerald E. Arnold*

Date: June 10, 1981

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

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PDR FDIA
GARDE85-59 PDR

SCOPE:

The purpose of this test is to evaluate the performance of Nutec 11S applied at film thicknesses of .020-.115" under design basis accident conditions specified for the South Texas Project. The effects of various mixing techniques and compressed air cleaning are also studied.

BACKGROUND:

The six test specimens were included in the South Texas Project test to generate data on Nutec 11S at film thicknesses higher than the currently qualified 35 mil. maximum DFT imposed in Service Level 1 areas, to comply with the newly revised STP test requirements and to provide data on surface preparation other than abrasive blasting.

SUMMARY:

All six specimens exhibited no defects when subjected to the STP design basis accident conditions (291°F., 70 PSIG). Two of the specimens were irradiated to 2×10^8 rads; radiation tolerance was excellent.

PROCEDURES:

Concrete coupons, measuring 2x4x2", were coated as described in the attached panel preparation sheets. On coupons A32, A34, and A38, Nutec 11S was applied at various film thicknesses and in 1-3 coats. Some faces also received a tight coat of Nutec 11.

Coupons A78, A83, and A85 were coated with Nutec 11S and Nutec 11 which had either been hand mixed with a spatula or with a Cowles mixer. One face of each coupon received no Nutec 11. Therefore, the coupons in both sets represent both the Nutec 11S/11/1201 and the Nutec 11S/1201 system.

The test specimens were submitted to Oak Ridge National Laboratories. Coupons A32 and A83 were irradiated to 2×10^8 rads; all coupons were DBA tested per the South Texas requirements, with maximum temperature and pressure, of 291°F. and 70 PSIG, respectively. (See attachment summary)

Refer to the attached ORNL statement for a description of the tests performed.

RESULTS:

Refer to individual ORNL results sheets.

<u>Coupon No.</u>	<u>Irradiation</u>	<u>DBA Results</u>
A32	Yes	No defects
A34	No	"
A38	No	"
A78	No	"
A83	Yes	"
A85	No	"

CONCLUSION:

At the LOCA conditions simulated in this test, the Nutec concrete system performed satisfactorily:

- A) Without Nutec 11 (Nutec 11S/1201)
- B) At Nutec 11S thicknesses of .020-.070" (one coat)
- C) At Nutec 11S thicknesses of .040-.115" (two-three coats)
- D) At Nutec 11 thicknesses of .001-.010"
- E) At Nutec 1201 thicknesses of .003-.012"
- F) Regardless of dispersion speed (mixing)
- G) Over various prepared surfaces

The data demonstrates that both the 11S/11/1201 and 11S/1201 systems met the acceptance criteria of ANSI NS.12 and ANSI N101.2, when subjected to a radiation exposure level of 2×10^8 rads and DBA conditions of 291°F and 70 PSIG.

This report should be reviewed in conjunction with Imperial's technical report #505-81, which describes the results of a second DBA test series on the Nutec concrete coating system.

SUMMARY OF TEST PROCEDURES

Coupon #	Surface Prep.	System	Max. DFT (Mils)	Rad. Levels	Comments
A 32	Broomed surface was abrasive blasted; all other surfaces were stoned follow- ed by compressed air cleaning.	11S/1201 11S/11S/1201	70 (11S) 60 (11S)	2×10^8 rads	
A 34		11S/1201 11S/11/1201 11S/11S/1201 11S/11S/11S/11/1201	25 (11S) 40 (11S) 115 (11S) 75 (11S)	No radiation	
A 38		11S/11/1201 11S/11S/11/1201 11S/11S/1201	45 (11S) 70 (11S) 70 (11S)	No radiation	
A 78		11S/11/1201	30 (11S) 10 (11) 12 (1201)	No radiation	#11S & #11 were hand mixed.
A 83	Broomed surface was abrasive blasted; all other surfaces were wire brushed follow- ed by compress- ed air cleaning.	11S/11/1201	30 (11S) 10 (11) 12 (1201)	2×10^8 rads	#11S & #11 were hand mixed.
A 85		11S/11/1201	30 (11S) 10 (11) 12 (1201)	No radiation	#11S and #11 were mixed on a Cowles dissolver.

TEST PROCEDURES

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: May 26, 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. Hyslop*

Approved *L. T. G. Lewis*

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: May 26, 1981

ORNL Log Book No. A9675, A5-5-1

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		Steam 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 spray solution in constant temperature bath.
End of test			

Evaluated

Ralph L. Apple

Approved

L. T. Gustin

PANEL PREPARATION DATA

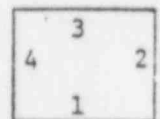
TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Nutec 11S/Nutec 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-32
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
	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°F/55%	***	2/9/81 9:30 a.m.
	Nutec	1201	9772/1959	Spray	73°F/52%	*****	2/16/81, 3:00

FILM THICKNESS (ins.)		11S *	11S **	11S ***	11 *****	1201 *****
Side 1	max.	.060-.070				.003-.005
Side 2	min.	.040-.050				.003-.005
Side 3			.010-.020	.030-.040		.003-.005
Side 4			.010-.020	.030-.040		.003-.005

TOP VIEW OF COUPON



Numbered and broomed surface

TOTAL DRY FILM THICKNESS RANGE - Side 1 .063-.075 Side 3 .043-.065
Side 2 .043-.055 Side 4 .044-.074

CURING CONDITIONS: AMBIENT TEMP. 70-80 °F REL. HUMIDITY 45-65 %
MINIMUM CURE 7 DAYS

TEST PROCEDURE: DBA and Rad

TESTING PERFORMED BY: CRN DATE SUBMITTED 4-28-81

APPROVED Paul C. Arnold

TEST REPORT NO. 495-81

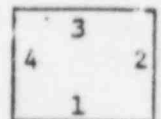
TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Nutec 11S/Nutec 11/Nutec 1201 Nutec 11S/Nutec 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-34
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
	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, 2:00
	Nutec	1201	9772/1959	Spray	73°F/52%	*****	2/16/81, 3:00

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

TOP VIEW OF COUPON



Numbered and broomed surface

TOTAL DRY FILM THICKNESS RANGE - Side 1 .023-.030 Side 3 .086-.124
Side 2 .029-.049 Side 4 .053-.080

CURING CONDITIONS: AMBIENT TEMP. 70-80 °F. REL. HUMIDITY 45-65 %
MINIMUM CURE 7 DAYS

TEST PROCEDURE: DBA

TESTING PERFORMED BY: ORNL DATE SUBMITTED 4-28-81

APPROVED [Signature]

TEST REPORT NO. 495-81

TEST PANEL PREPARATION DATA

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

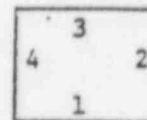
PRODUCT DATA: SAMPLE NO.(s): A- 38

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
	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, 2:00
	Nutec	1201	9772/1959	Spray	73°F/52%	*****	2/16/81, 3:00

FILM THICKNESS (ins.)		11S *	11S **	11S ***	11 ****	1201 *****
Side 1	min.		.030-.045		.001-.004	.003-.005
Side 2	max.	.025-.030	.030-.040		.001-.004	.003-.005
Side 3		.025-.030		.030-.040		.003-.005
Side 4		.025-.030	.030-.040			.003-.005

TOP VIEW OF COUPON



Numbered and broomed surface

TOTAL DRY FILM THICKNESS RANGE - Side 1 .034-.054 Side 3 .058-.075
Side 2 .059-.079 Side 4 .058-.075

CURING CONDITIONS: AMBIENT TEMP. 70-80 °F REL. HUMIDITY 45-65 %
MINIMUM CURE 7 DAYS

TEST PROCEDURE: DBA

TESTING PERFORMED BY: ORNL DATE SUBMITTED 4-28-81

APPROVED [Signature]

TEST REPORT NO. 495-81

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Nutec 11S/Nutec 11/Nutec 1201, Nutec 11S/Nutec 1201
2. TYPE SUBSTRATE: Concrete SIZE: 2" x 4" x 2"
3. SURFACE PREPARATION (Describe): Blast swept on broomed surface to remove efflorescence; remaining faces wire brushed and blown down with 100 psi compressed air to remove dust and loose concrete.
4. PRODUCT DATA: SAMPLE NO.(s): A-78
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED _____

COAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F)&R.H.	THICKNESS (ins.)	TIME & DATE APPLIED
	Nutec	11S*	2519/2086/2516	squeegee	71/73	See below	3-27-81
	Nutec	11*	2476/2683/2444	squeegee	73/64	"	4-2-81
	Nutec	1201	2606/2607	spray	69/51	"	4-6-81

FILM THICKNESS (ins.)	Nutec 11S	Nutec 11	Nutec 1201	TOTAL DFT RANGE
Side 1	.020-.030	.006-.010	.008-.012	.034-.052
Side 2 Min.	.020-.030		.008-.012	.028-.042
Side 3	.020-.030	.006-.010	.008-.012	.034-.052
Side 4	.020-.030	.006-.010	.008-.012	.034-.052

TOP VIEW OF COUPON



Numbered and broomed surface

6. CURING CONDITIONS: AMBIENT TEMP. 65-80 °F REL. HUMIDITY 45-90
MINIMUM CURE 7 DAYS

7. TEST PROCEDURE: DBA

8. TESTING PERFORMED BY: ORNL DATE SUBMITTED 4-28-81

*Hand mixed

APPROVED: Quall C. Arnold

TEST REPORT NO: 495-81

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Nutec 11S/Nutec 11/Nutec 1201, Nutec 11S/Nutec 1201
2. TYPE SUBSTRATE: Concrete SIZE: 2" x 4" x 2"
3. SURFACE PREPARATION (Describe): Blast swept on broomed surface to remove efflorescence; remaining faces wire brushed and blown down with 100 psi compressed air to remove dust and loose concrete.
4. PRODUCT DATA: SAMPLE NO. (s): A-83
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
	Nutec	11S*	2519/2086/2516	squeegee	71/73	See below	3-27-81
	Nutec	11*	2476/2683/2444	squeegee	73/64	"	4-2-81
	Nutec	1201	2606/2607	spray	69/51	"	4-6-81

FILM THICKNESS (ins.)	Nutec 11S	Nutec 11	Nutec 1201	TOTAL DFT RANGE
Side 1	.020-.030	.006-.010	.008-.012	.034-.052
Side 2 min.	.020-.030		.008-.012	.028-.042
Side 3	.020-.030	.006-.010	.008-.012	.034-.052
Side 4	.020-.030	.006-.010	.008-.012	.034-.052

TOP VIEW OF COUPON



Numbered and broomed surface

CURING CONDITIONS: AMBIENT TEMP. 65-80 °F REL. HUMIDITY 45-90
 MINIMUM CURE 7 DAYS

TEST PROCEDURE: DBA / Radiation Tolerance

TESTING PERFORMED BY: ORNL DATE SUBMITTED 4-28-81

*Hand mixed

APPROVED: *Charles E. Arnold*

TEST REPORT NO: 495-81

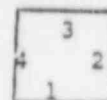
TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Nutec 11S/Nutec 11/Nutec 1201, Nutec 11S/Nutec 1201
2. TYPE SUBSTRATE: Concrete SIZE: 2"x4"x2"
3. SURFACE PREPARATION (Describe): Blast swept on broomed surface to remove efflorescence;
remaining faces wire brushed and blown down with 100 psi compressed air to remove dust and
loose concrete.
4. PRODUCT DATA: SAMPLE NO.(s): A-85
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED _____

COAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F) & R.H.	THICKNESS (ins.)	TIME & DATE APPLIED
	Nutec	11S*	2519/LN138-17-2	squeegee	71/73	See below	3-27-81
	Nutec	11*	2476/LN138-17-1	squeegee	73/64	"	4-2-81
	Nutec	1201	*2606/2607	spray	69/51	"	4-6-81

FILM THICKNESS (ins.)	Nutec 11S	Nutec 11	Nutec 1201	TOTAL DFT RANGE
Side 1	.020-.030	.006-.010	.008-.012	.034-.052
Side 2 min.	.020-.030		.008-.012	.028-.042
Side 3	.020-.030	.006-.010	.008-.012	.034-.052
Side 4	.020-.030	.006-.010	.008-.012	.034-.052

TOP VIEW OF
COUPON



Numbered and
broomed surface

6. CURING CONDITIONS: AMBIENT TEMP. 65-80 °F REL. HUMIDITY 45-90
 MINIMUM CURE 7 DAYS
7. TEST PROCEDURE: DBA
8. TESTING PERFORMED BY: ORNL DATE SUBMITTED 4-26-81

*Cowles Mixed

APPROVED: Grall E. Arnold

TEST REPORT NO: 495-81

RESULTS

OAK RIDGE NATIONAL LABORATORY

OPERATED BY
UNION CARBIDE CORPORATION
NUCLEAR DIVISION



POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

May 26, 1981

Mr. Gerald E. Arnold
Technical Representative
Imperial Professional Coatings
P.O. Box 29077
New Orleans, Louisiana 70189

Dear Jerry:

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 yours,

A handwritten signature in cursive script, appearing to read "L. T. Corbin".

L. T. Corbin, Section Head
Analytical Chemistry Division

LTC:dmw

Enclosures

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: May 26, 1981

SYSTEM IDENTIFICATION

Steel panel x Concrete block

11S/1201

RADIATION TOLERANCE TEST

ORNL Master Analytical Manual Method No. 2 0921; Bechtel Corporation
Specification No. CP-951; ORNL Log Book No. A9675, A5-5-1.

Initial dose rate: 1.0 x 10⁷ rad
Test conducted in: x air water

Sample No.

Cumulative dose

Test results

A-32

2 x 10⁸ rad

Coatings intact, no defects.

Evaluated

Approved

Paul F. Apple
L. T. Gish

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: May 26, 1981

SYSTEM IDENTIFICATION

Steel panel x Concrete block

11S/1201

DBA TEST

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A9675, A5-5-1

<u>Sample No.</u>	<u>DBA phase</u>	<u>Test results</u>
A-32	spray*	Coatings intact, no defects, all areas.
A-34	spray	Coatings intact, no defects, all areas.
A-38	spray	Coatings intact, no defects, all areas.

*Irradiated.

Evaluated

Ralph F. Apple

Approved

L. T. Corbin

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: May 26, 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, A5-5-1.

Initial dose rate: 1.0 x 10⁷ rad
Test conducted in: x air water

Sample No.

Cumulative dose

Test results

A-83

2 x 10⁸ rad

Coatings intact, no defects.

Evaluated

Ralph L. Apple

Approved

L. T. Collins

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: May 26, 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, A5-5-1

<u>Sample No.</u>	<u>DBA phase</u>	<u>Test results</u>
A-78	spray	Coatings intact, no defects, all areas.
A-83	spray*	Coatings intact, no defects, all areas.
A-85	spray	Coatings intact, no defects, all areas.

*Irradiated.

Evaluated

Approved

King, R. L. Appl
L. T. Costin