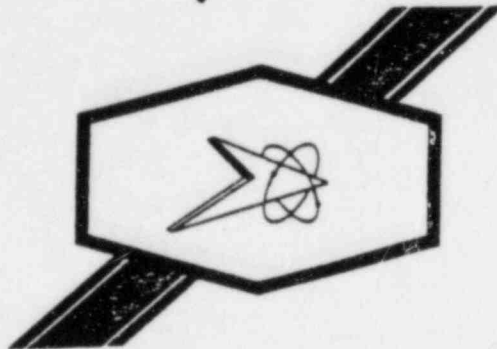


Imperial



TECHNICAL REPORT

NUMBER

#429-80

TITLE

DBA Nutec 1201 Applied Directly to Steel

And Dimetecote 6

FOR

CUSTOMER

Submitted by: Gerald E. Arnold

Accepted by:

Approved: *W. Lee Arnold*

Date: September 16, 1980

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SCOPE - The purpose of this test was to evaluate the DBA performance of Nutec 1201 applied directly to clean steel. The tested specimen described in this report is just one of many panels which were tested to evaluate compatibility of various primers and topcoats, various methods of surface preparation, and repair interfaces.

SUMMARY - Nutec 1201 was applied to a panel containing areas of weathered D6 (Ameron) primer and bare steel cleaned with 3M's Clean n' Strip. Evaluation of the test specimen following a design basis accident test at Oak Ridge National Laboratories revealed no significant defects.

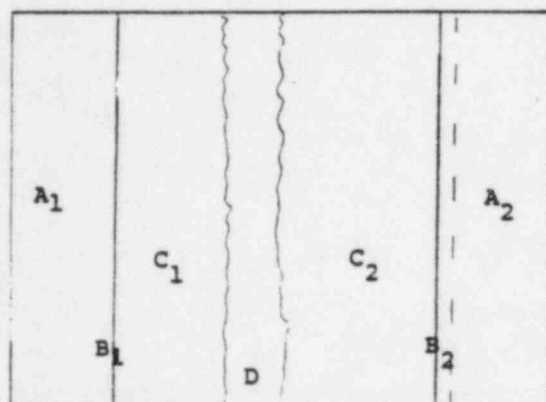
PROCEDURE - A 4 x 5" carbon steel panel (No. 6472), was fabricated as shown in the attached photograph. A 1/4" weld bead was drawn down the center of the panel to simulate a weld seam in a liner plate. The panel was abrasive blasted in a wheelabrator in which a working mix of grit and shot was used. A profile of 2.0 - 2.5 mils was achieved. Along each vertical edge on the front of the panel, a 1" strip was coated with Ameron's D6. The entire back of the panel was also coated. Prior to placement of the panel in an Atlas Weather-o-meter, the D6 on the rear of the plate was topcoated with Nutec 1201. Following adequate cure of the epoxy topcoat, the panel was weathered for 500 hours; with the front side (weld area) exposed directly to the UV and water spray.

After its removal from the weather-o-meter, the D6 on the front was solvent wiped, and the rusted steel was cleaned with a 3M Clean n' Strip wheel. About one-third of the coating system was removed from the rear of the panel with the Clean n' Strip and an additional 1" of the original coating system was feather edged. Nutec 1201 was then applied to both sides of the panel, over the existing coatings and over the remaining clean steel.

The panel was later included in a DBA test series at Oak Ridge National Laboratories - maximum temperature 307°F., maximum pressure 60 psig. Because of the size of the panel (4" minimum diameter), the panel could not be irradiated.

This procedure is diagramed on the following page.

FRONT



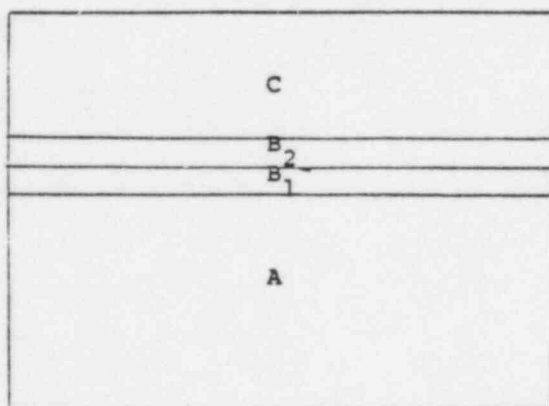
A₁ & A₂ = 1" strips primed with D6, weathered, solvent wiped, and topcoated

B₁ & B₂ = interface areas, B₂ feather edged 1/4" with Clean n' Strip

C₁ & C₂ = Clean n' Strip prepared steel; C₂ equivalent to commercial cleaning. Topcoated with 1201

D = weld area topcoated with 1201

BACK

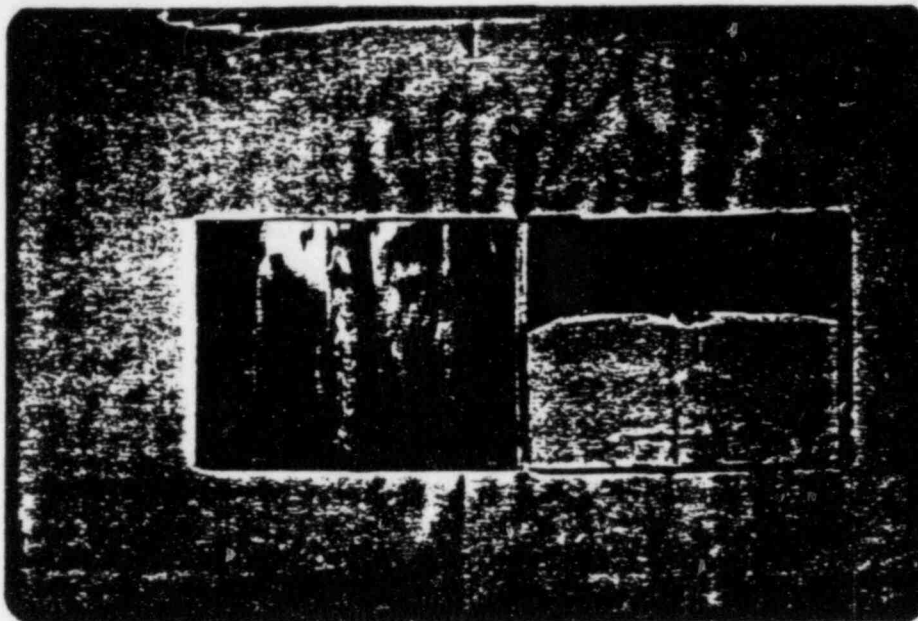


A = original coating system, D6/1201, solvent wiped, and recoated with 1201

B₁ = D6/1201, hand sanded, recoated with 1201

B₂ = D6/1201, feather edged with Clean n' Strip wheel, recoated with 1201

C = original coating system removed with Clean n' Strip and recoated with 1201



LEFT: Front side of panel showing vertical strips of D6 primer, and cleaned repair zone and weld bead.

RIGHT: Rear of panel after removal of coating system from top one third of panel.

RESULTS - Refer to the attached ORNL DBA test results. The attached sketch will illustrate the various areas which were evaluated.

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Dimetcote 6/Nutec 1201 and Nutec 1201 Directly on Steel
2. TYPE SUBSTRATE: ASTM A36 Carbon Steel SIZE: 4 x 5 x 1/4"
3. SURFACE PREPARATION (Describe): Originally abrasive blasted with shot/grit mixture providing a 2.0 - 2.5 mil profile and an SSPC-10 surface.
4. PRODUCT DATA: SAMPLE NO.(s): 6472
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: 06/27/79 7:00 p.m.

COAT	PRODUCT	PRODUCT CODES	BATCH #	APPLICATION METHOD	CONDITIONS R/M(°F)%R.H.	THICKNESS (ins.)	TIME & DATE APPLIED
	D6		6-905041/6-905339	Spray	76°F. 53%	.002 - .004	06/27/79 7 pm
	1201 (black only)		6097/6096	Spray	83°F. 75%	.0045 - .0055	07/13/79 noon

Weathered 504 hours in an Atlas Weather-o-meter

Rusted metal cleaned with a Clean n' Strip wheel

1201		6637/6683	Spray	60°F. 61%	.005 - .006	01/18/80 12:30 pm
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6. CURING CONDITIONS: AMBIENT TEMP. 70 - 80 °F REL. HUMIDITY 45 - 60 %
MINIMUM CURE 60 DAYS
7. TEST PROCEDURE: DBA (307°F., 60 psig)
8. TESTING PERFORMED BY: ORNL DATE SUBMITTED 03/19/80

APPROVED: *DBA*
TEST REPORT NO. 429-80

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: April 30, 1980

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

David L. Apple

Approved

L.T. Lorin

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: April 30, 1980

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

Ralph P. Apple

Approved

L. T. Corbin

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: April 30, 1980

ORNL Log Book No. A 7562; A4-14-80

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			Autoclave preheated.
10 s	307	60 (10 s)	Steam injected.
2 h 47 min	307	60	Pressure maintained by relief valve.
4.5 min	307-270	30	Spray solution added at 75°F.
25 min	270-250	30	
4 days	250	30	
3 min	250-230	0	Fresh spray solution added at 75°F after draining autoclave.
10 min	230-200	10	
3 days	200	10	
End of test			

Evaluated

Roger E. Apple

Approved

L. T. Corbin

Manufacturer: Imperial
New Orleans, Louisiana

Analytical Chemistry Division
Oak Ridge National Laboratory
Date: April 30, 1980

System Identification

x Steel panel Concrete block

D6/Nutec 6/1201

DBA Test Results

ORNL Master Analytical Manual Method No. 2 0922.
ORNL Log Book No. A 7562; A4-14-80

Sample No. DBA phase

Comments

6472

spray

Front: Single large blister, area A-2. No defects, areas A-1, B-1, B-2, C-1, and D. Blisters, #8 few, area C-2.
Rear: Single blister, #2, areas B-1 and C. No defects, areas A, B-2, and D.

Evaluated

Roy L. Apple

Approved

L. T. Corbin

CONCLUSIONS - The following observations were made:

- A. D6/1201 Compatability: Very few blisters were found - all occurring along edges of the panel. Results indicate excellent bond between D6 and 1201.
- B. 1201 Over Steel: No defects in area C₁, and few #8 in area C₂ on the front side. The difference in the occurrence of blisters can be related to the difference in surface preparation between C₁ and C₂. Both were cleaned with a Clean n' Strip but C₁ was cleaned to brush metal whereas some rust was retained in the C₂ area. Results indicate excellent adhesion of the 1201 directly to the steel.

One defect was reported by ORNL in the C area on the rear of the panel. This occurs along the C/B₁ interface.

NOTE: The 1201 performed well directly over steel. However, it should be noted that the panel was not irradiated and that the long term corrosion protective performance of 1201 directly over steel is uncertain.