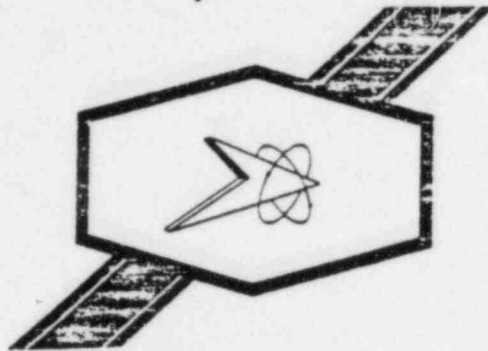


# Imperial



## TECHNICAL REPORT

NUMBER

462-1-81

TITLE  
REVISION

DESIGN BASIS ACCIDENT TEST RESULTS -NUTEC 11S OVER  
CLEAN-N-STRIP AND ABRASIVE BLASTED STEEL

FOR

GENERAL USE

CUSTOMER

Submitted by:

GERALD ARNOLD

Approved:

ROBERT R. TAYLOR

Date:

JANUARY 22, 1982

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

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.

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PDR FOIA  
GARDE85-59 PDR

SCOPE: The purpose of this test was to evaluate the feasibility of applying Nutec #11S surfacer to steel imbedded in concrete (i.e. Richmond inserts, Steel Imbeds) in Service Level I areas of nuclear power plants.

SUMMARY: Design Basis Accident test results from Oak Ridge National Laboratories indicate loss of adhesion on 11S coated specimens and #2 few blisters on 11S/1201 coated specimens which had previously been cleaned to bright metal with a 3M Clean-n-Strip cup wheel.

On the other hand no defects were observed on the 11S surfacer over abrasive blasted steel. Mixed results were obtained on 11S/1201 specimens which had been abrasive blasted. Two of four faces looked excellent; whereas the two remaining faces exhibited some blistering.

Of the eight 11S/abrasive blasted steel interfaces, five exhibited no defects and one contained very few #6 blisters (75% passing). Of the two faces which Oak Ridge National Laboratories reported as #2M, one appears marginal.

PROCEDURES: Eight 2" x 4" x 1/4" carbon steel panels were prepared for coating:

- a. Four were cleaned to bright metal with a 3M Clean-n-Strip cup wheel.
- b. Four were abrasive blasted per SSPC-SP-10, near white blast, with a working mix of G-80, G-50, G-40 steel grit to achieve a surface profile of 2.0 mils.

Nutec #11S was applied to all eight panels over a two day period (one face of each panel a day). Nutec 1201 was then applied to two Clean-n-Strip panels and two blasted panels. Details of the application and curing are outlined on the attached panel preparation sheets.

The coated panels were then submitted to Oak Ridge National Laboratories for Design Basis Accident testing, with maximum 385°F. and 70 psig parameters.

The tested panels were evaluated by ORNL personnel immediately upon removal from the autoclave and reinspected by Imperial following shipment of the panels back to New Orleans.

## CONCLUSIONS:

Based on the test results, application of Nutec 11S is not recommended (for surfaces greater than two square inches) over clean-n'-strip prepared steel in containment areas which would be exposed to the temperature and pressure conditions observed in this test.

Application of Nutec 11S is recommended for overlap on steel imbeds (maximum 2 inches overlap) and over imbedded steel objects (up to six square inches), which have been abrasive blasted or prepared with power tools which impart a surface profile (i.e., roto peen).

Of the eight abrasive blasted faces coated with Nutec 11S, five exhibited no defects and one contained only very few #6 size blisters. Oak Ridge also reported one face of panel 7829 (rear) as having #2 medium blisters. Imperial evaluated the panels thoroughly and believes that ORNL mistakenly evaluated the same face (front side) twice. Imperial has reevaluated the rear of panel 7829 to only few #4 blisters. The front side of panel 7829 was borderline.

Therefore, of the eight abrasive blasted faces tested, Imperial finds that seven comply with the ANSI N101.2 acceptance criteria (no larger than #4 few blisters) and the eight face is borderline. This amounts to an 87.5% success rate.

NOTE: Technical reports #353-80 and #413-80 relate Elcometer adhesion test data of Nutec 11S over abrasive blasted and power tool cleaned steel surfaces. These reports are recommended for review, especially for Service Level II and Balance of Plant service, when DBA testing is not required, that is, where the coating system will not be subjected to Loss of Coolant Accident conditions.

PANEL PREPARATION SHEETS

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2" x 4" x 1/4"
3. SURFACE PREPARATION (Describe): Clean-n-Strip cleaned to bright metal
4. PRODUCT DATA: SAMPLE NO.(s): 7822
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: N/A

<u>COAT</u>	<u>PRODUCT</u>	<u>PRODUCT CODES</u>	<u>BATCH #</u>	<u>APPLICATION METHOD</u>	<u>CONDITIONS R/M(°F)&amp;R.H.</u>	<u>THICKNESS (ins.)</u>	<u>TIME &amp; DATE APPLIED</u>
Front	NUTEC	#11S	2417 2102 2103	Squeegee	86/73	.022-.027	9/25/80
Back	NUTEC	#11S	2417 2102 2103	Squeegee	84/76	.021-.027	9/26/80

6. CURING CONDITIONS: AMBIENT TEMP. 80-90 °F REL. HUMIDITY 70-80  
MINIMUM CURE 17 DAYS
7. TEST PROCEDURE: DBA
8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 10/13/80

APPROVED: Harold C. Arnold

TEST REPORT NO. 462-81

## DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: Nutec #11S
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2 x 4 x 1/4"
3. SURFACE PREPARATION (Describe): Clean-n-Strip cleaned to bright metal

1. PRODUCT DATA: SAMPLE NO.(s): 7823
2. 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
Front	NUTEC	#11S	2417 2102 2103	Squeegee	86/73	.022-.027	9/25/80
Back	NUTEC	#11S	2417 2102 2103	Squeegee	84/76	.021-.027	9/26/80

CURING CONDITIONS: AMBIENT TEMP. 80-90 °F REL. HUMIDITY 70-80  
MINIMUM CURE 17 DAYS

TEST PROCEDURE: DBA

TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 10/13/80

APPROVED BY: \_\_\_\_\_

DATE: 1/22/82

PREPARED BY: Maurine Lee

DATE: 1/16/81

TEST REPORT NO.: 462-1-81

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2" x 4" x 1/4"
3. SURFACE PREPARATION (Describe): Clean-n-Strip cleaned to bright metal.
4. PRODUCT DATA: SAMPLE NO.(s): 7824
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: N/A

<u>COAT</u>	<u>PRODUCT</u>	<u>PRODUCT CODES</u>	<u>BATCH #</u>	<u>APPLICATION METHOD</u>	<u>CONDITIONS R/M(°F)&amp;R.H.</u>	<u>THICKNESS (ins.)</u>	<u>TIME &amp; DATE APPLIED</u>
Front	NUTEC	#11S	2417 2102 2103	Sugeegee	86/73	.018-.026	9/25/80
Back	NUTEC	#11S	2417 2102 2103	Squeegee	84/76	.018-.025	9/26/80
	NUTEC	#1201	1958/1959	Spray	74/78	F- .003-.004 B- .006-.007	10/1/80

Total Dry Film Thickness Range - Front .021 -.030  
Back .024 -.032

6. CURING CONDITIONS: AMBIENT TEMP. 80-90 °F REL. HUMIDITY 70-80  
MINIMUM CURE 17 DAYS
7. TEST PROCEDURE: DBA
8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 10/13/80

APPROVED: *Small C. Currie*

TEST REPORT NO. 462-81



DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2" x 4" x 1/4"
3. SURFACE PREPARATION (Describe): Clean-n-Strip cleaned to bright metal
4. PRODUCT DATA: SAMPLE NO.(s): 7825
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
Front	NUTEC	#11S	2417 2102 2103	Squeegee	86/73	.021-.026	9/25/80
Back	NUTEC	#11S	2417 21 2103	Squeegee	84/76	.018-.024	9/26/80
	NUTEC	#1201	1958/1959	Spray	74/78	F- .003-.004 B- .004-.006	10/1/80

Total Dry Film Thickness Range - Front .024-.030  
Back .022-.030

6. CURING CONDITIONS: AMBIENT TEMP. 80-90 °F REL. HUMIDITY 70-80  
MINIMUM CURE 17 DAYS

7. TEST PROCEDURE: DBA
8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 10/13/80

APPROVED: David E. Arnold  
TEST REPORT NO. 462-81



DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2" x 4" x 1/4"
3. SURFACE PREPARATION (Describe): Abrasive blasted per SSPC-SP-10, near white blast, with a surface profile of 2.0 mils as read on a Keane-Tator Profile Comparator Disc.
4. PRODUCT DATA: SAMPLE NO.(s): 7826
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: N/A

<u>COAT</u>	<u>PRODUCT</u>	<u>PRODUCT CODES</u>	<u>BATCH #</u>	<u>APPLICATION METHOD</u>	<u>CONDITIONS R/M(°F) &amp; R.H.</u>	<u>THICKNESS (ins.)</u>	<u>TIME &amp; DATE APPLIED</u>
Front	NUTEC	#11S	2417 2102 2103	Squeegee	86/73	.020-.050	9/25/80
Back	NUTEC	#11S	2417 2102 2103	Squeegee	84/76	.024-.030	9/26/80

CURING CONDITIONS: AMBIENT TEMP. 80-90 °F REL. HUMIDITY 70-80  
MINIMUM CURE 17 DAYS

TEST PROCEDURE: DBA

TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 10/13/80

APPROVED: *And E. Carter*  
TEST REPORT NO. 462-81

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2" x 4" x 1/4"
3. SURFACE PREPARATION (Describe): Abrasive blasted per SSPC-SP-10, near white blast, with a surface profile of 2.0 mils as read on a Keane-Tator Profile Comparator Disc.
4. PRODUCT DATA: SAMPLE NO.(s): 7827
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
Front	NUTEC	#11S	2417 2102 2103	Squeegee	86/72	.018-.026	9/25/80
Back	NUTEC	#11S	2417 2102 2103	Squeegee	84/76	.021-.027	9/26/80

6. CURING CONDITIONS: AMBIENT TEMP. 80-90 °F REL. HUMIDITY 70-80  
MINIMUM CURE 17 DAYS

7. TEST PROCEDURE: DBA

8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 10/13/80

APPROVED: Harold E. Carter  
TEST REPORT NO. 462-81

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2" x 4" x 1/4"
3. SURFACE PREPARATION (Describe): Abrasive blasted per SSPC-SP-10, near white blast, with surface profile of 2.0 mils as read on a Keane-Tator Profile Comparator Disc.
4. PRODUCT DATA: SAMPLE NO.(s): 7828
5. DATE AND TIME CURING COMPOUND OR PRIMER APPLIED: N/A

<u>COAT</u>	<u>PRODUCT</u>	<u>PRODUCT CODES</u>	<u>BATCH #</u>	<u>APPLICATION METHOD</u>	<u>CONDITIONS R/M(°F)&amp;R.H.</u>	<u>THICKNESS (ins.)</u>	<u>TIME &amp; DATE APPLIED</u>
Front	NUTEC	#11S	2417 2102 2103	Squeegee	86/73	.022-.027	9/25/80
Back	NUTEC	#11S	2417 2102 2103	Squeegee	84/76	.015-.020	9/26/80
	NUTEC	#1201	1958 1959	Spray	74/78	F- .003-.004 B- .006-.007	10/1/80

Total Dry Film Thickness Range - Front .025-.031  
Back .021-.027

6. CURING CONDITIONS: AMBIENT TEMP. 80-90 °F REL. HUMIDITY 70-80  
MINIMUM CURE 17 DAYS

7. TEST PROCEDURE: DBA

8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 10/13/80

APPROVED: Donald E. Arnold  
TEST REPORT NO. 462-81

DBA AND RADIATION TOLERANCE

TEST PANEL PREPARATION DATA

1. PRODUCT TO BE TESTED: NUTEC #11S
2. TYPE SUBSTRATE: ASTM A-36 Carbon Steel SIZE: 2" x 4" x 1/4"
3. SURFACE PREPARATION (Describe): Abrasive blasted per SSPC-SP-10, near white blast, with a surface profile of 2.0 mils as read on a Keesee-Rator Surface Profile Comparator Disc.
4. PRODUCT DATA: SAMPLE NO.(s): 7829
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
Front	NUTEC	#11S	2417 2102 2103	Squeegee	86/73	.022-.027	9/25/80
Back	NUTEC	11S	2417 2102 2103	Squeegee	84/76	.020-.050	9/26/80
	NUTEC	#1201	1958 1959	Spray	74/78	F- .002-.003 B- .006-.007	10/1/80

Total Dry Film Thickness Range - Front .024-.030  
Back .026-.057

6. CURING CONDITIONS: AMBIENT TEMP. 80-90 °F REL. HUMIDITY 70-80 %  
MINIMUM CURE 17 DAYS
7. TEST PROCEDURE: DBA
8. TESTING PERFORMED BY: Oak Ridge National Laboratories DATE SUBMITTED 10/13/80

APPROVED: Harold E. Arnold  
TEST REPORT NO. 462-81

ORNL PROCEDURES

Manufacturer: Imperial  
New Orleans, LA

Analytical Chemistry Division  
Oak Ridge National Laboratory  
Date: 11/13/80

### 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  $1 \times 10^6$  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

Carl F. Hyle

Approved

L. T. Carlson

Manufacturer: Imperial  
New Orleans, LA

Analytical Chemistry Division  
Oak Ridge National Laboratory  
Date: 11/13/80

ORNL Log Book No. A 7562; A10-29-80

Table 1. DBA solution composition, distilled water

Reagent	Concentration
Boric acid, $H_3BO_3$	6200 ppm
Hydrazine, $NH_2NH_2$	50 ppm
Trisodium phosphate, $Na_3PO_4 \cdot 12H_2O$	Required to adjust pH to 9.7

Table 2. DBA test conditions

Time	Temperature (°F)	Pressure (psig)	Comments
Start	214		Autoclave preheated.
58 s	385	68	Steam injected.
10 min	385	70	Pressure maintained by relief valve.
4 min	385-340	70	
6 h	340	70	
20 s	220	30	Spray solution added at 75°F.
20 min	220-250	30	Adjusted pressure with $N_2$ .
4 days	250	30	
20 s	170	-15	Fresh spray solution added after draining autoclave.
25 min	170-200	10	
3 days	200	10	

Evaluated

*Robert L. Apple*

Approved

*W. T. Cochran*



TEST RESULTS

OAK RIDGE NATIONAL LABORATORY

OPERATED BY  
UNION CARBIDE CORPORATION  
NUCLEAR DIVISION



POST OFFICE BOX X  
OAK RIDGE, TENNESSEE 37830

November 13, 1980

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

Dear Jerry:

The enclosed report contains test results recently obtained on the Imperial protective coatings. This test was designed to encompass the 385 and the 340°F envelope curves.

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

Sincerely,

*L. T. Corbin*  
L. T. Corbin, Section Head  
Analytical Chemistry Division

LTC:dmw

Enclosures

Manufacturer: Imperial  
New Orleans, LA

Analytical Chemistry Division  
Oak Ridge National Laboratory  
Date: 11/13/80

System Identification

x Steel panel        Concrete block

11S (clean n'strip)

DBA Test Results

ORNL Master Analytical Manual Method No. 2 0922.  
ORNL Log Book No. A 7562; A10-29-80

<u>Sample No.</u>	<u>DBA phase</u>	<u>Comments</u>
7822	spray	Front: loss of adhesion. Rear: loss of adhesion.
7823	spray	Front: blisters, #2 few. * Rear: blisters, #2 few.

\* Following shipment back to Imperial,  
inspection revealed areas of delamination  
on both sides. *SEA*

Evaluated

*Robert L. Rasmussen*

Approved

*L. T. Borker*

Manufacturer: Imperial  
New Orleans, LA

Analytical Chemistry Division  
Oak Ridge National Laboratory  
Date: 11/13/80

System Identification

x Steel panel        Concrete block

11S/1201 (clean n'strip)

DSA Test Results

ORNL Master Analytical Manual Method No. 2 0922.  
ORNL Log Book No. A 7562; A10-29-80

<u>Sample No.</u>	<u>DBA phase</u>	<u>Comments</u>
7824	spray	Front: blisters, #2 few. Rear: blisters, #2 few.
7825	spray	Front: blisters, #2 few. Rear: blisters, #2 few.
--	--	

Evaluated

Ralph F. Rye

Approved

W. T. Perkins

Manufacturer: Imperial  
New Orleans, LA

Analytical Chemistry Division  
Oak Ridge National Laboratory  
Date: 11/13/80

System Identification

x Steel panel        Concrete block

11S

DBA Test Results

ORNL Master Analytical Manual Method No. 2 0922.  
ORNL Log Book No. A 7562; A10-29-80

<u>Sample No.</u>	<u>DBA phase</u>	<u>Comments</u>
7826	spray	Front: coatings intact, no defects. Rear: coatings intact, no defects.
7827	spray	Front: coatings intact, no defects. Rear: coatings intact, no defects.

Evaluated

Robert A. Reple

Approved

L. T. Collins

Manufacturer: Imperial  
New Orleans, LA

Analytical Chemistry Division  
Oak Ridge National Laboratory  
Date: 11/13/80

System Identification

x Steel panel        Concrete block

11S/1201

DBA Test Results

ORNL Master Analytical Manual Method No. 2 0922.  
ORNL Log Book No. A 7562; A10-29-80

<u>Sample No.</u>	<u>DBA phase</u>	<u>Comments</u>
7828	spray	Front: coatings intact, no defects. Rear: blisters, #6 few.
7829	spray	Front: blisters, #2 medium. * Rear: blisters, #2 medium.

\* *Imperial inspection of panels*

*Front: #2-#4, few-medium (borderline)*

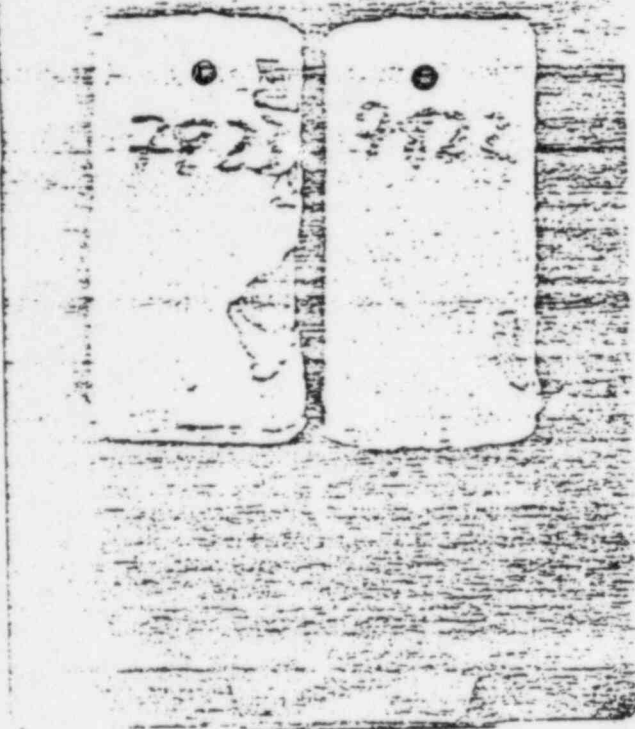
*Rear: #4 few*

Evaluated

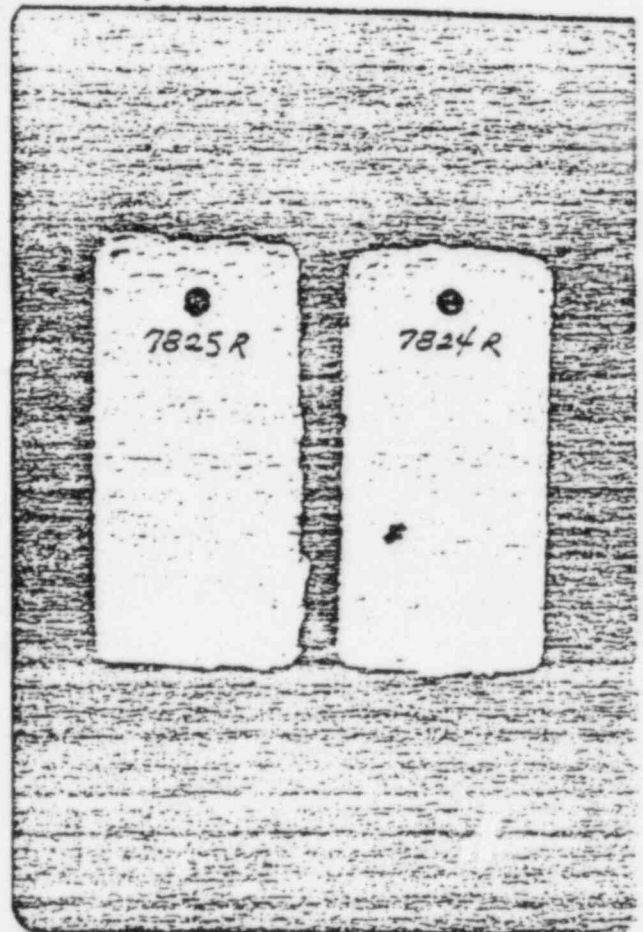
*Ralph L. Smith*

Approved

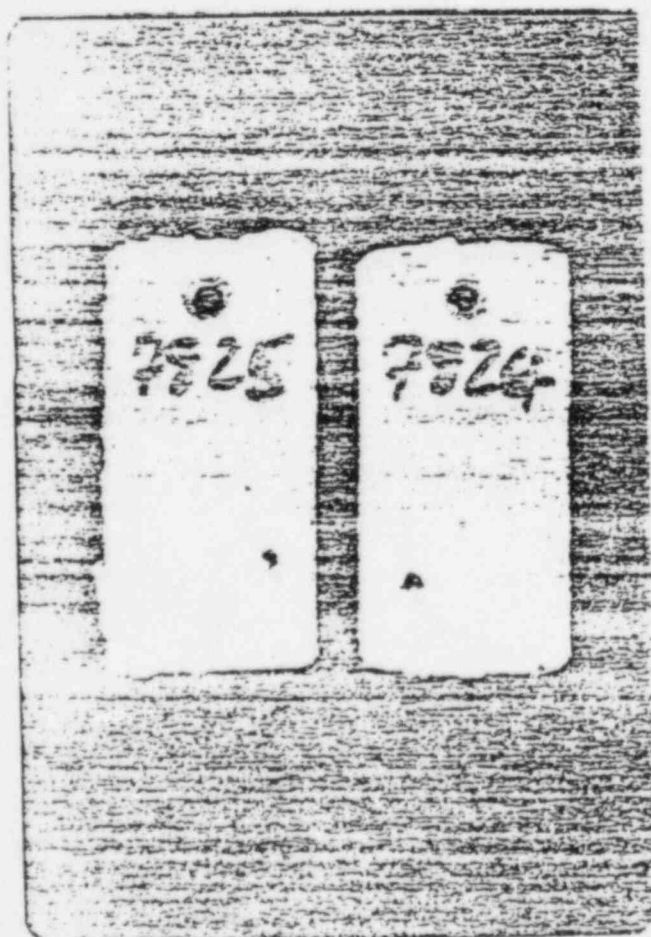
*L. T. Corbin*



7822-7823



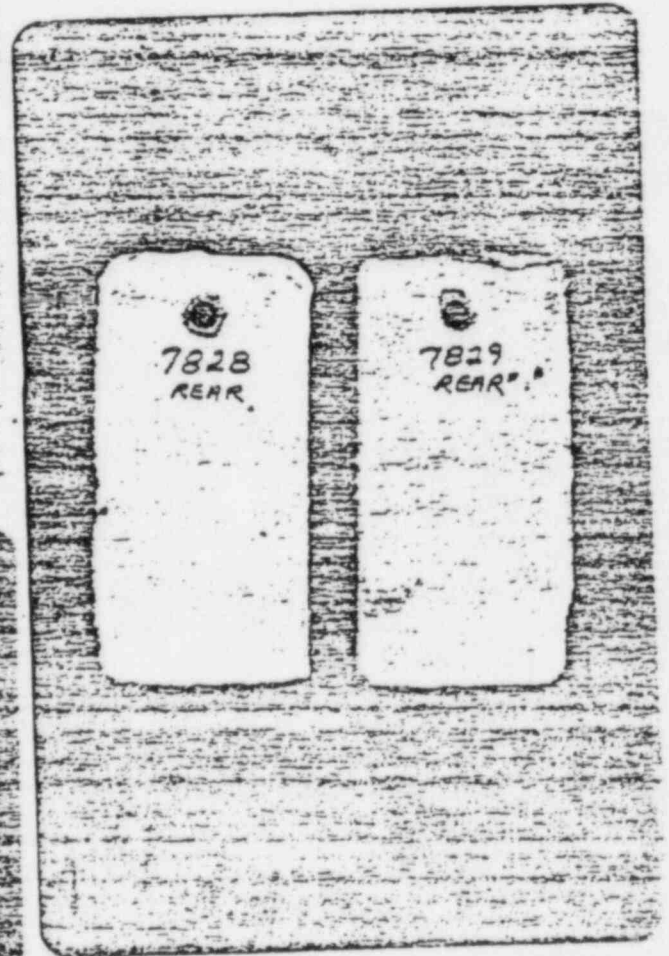
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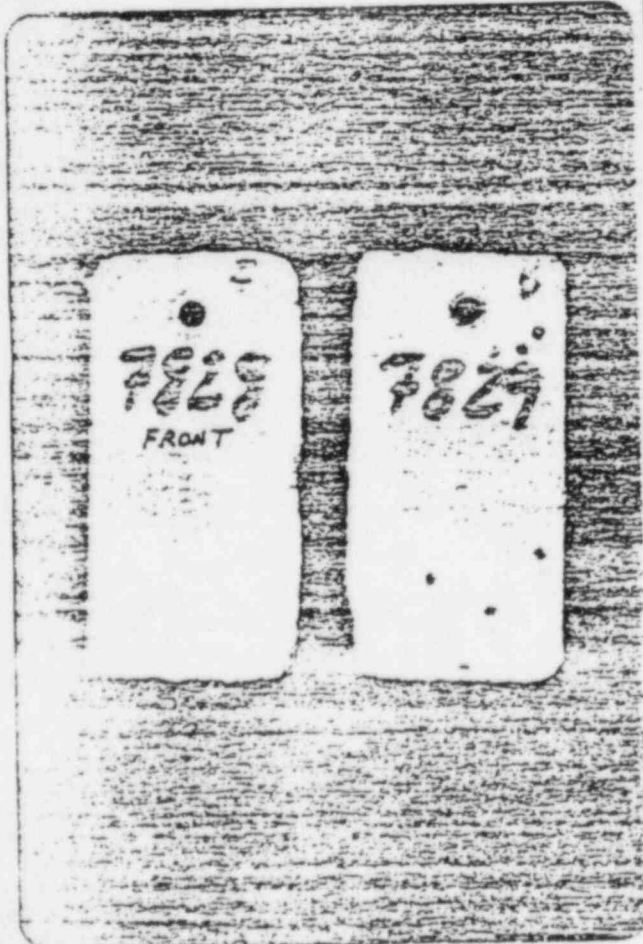
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7826-7827



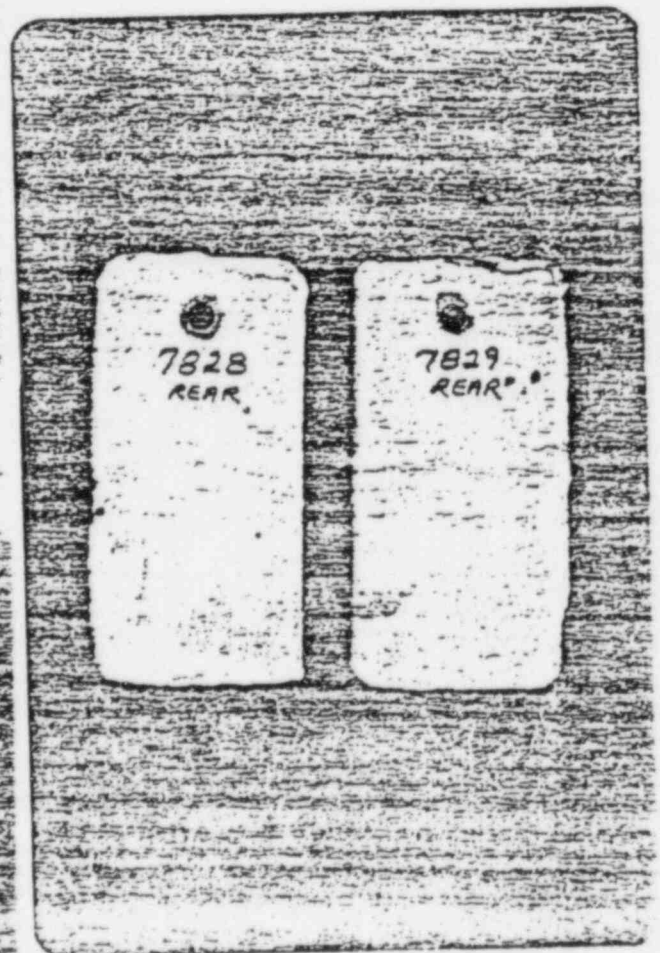
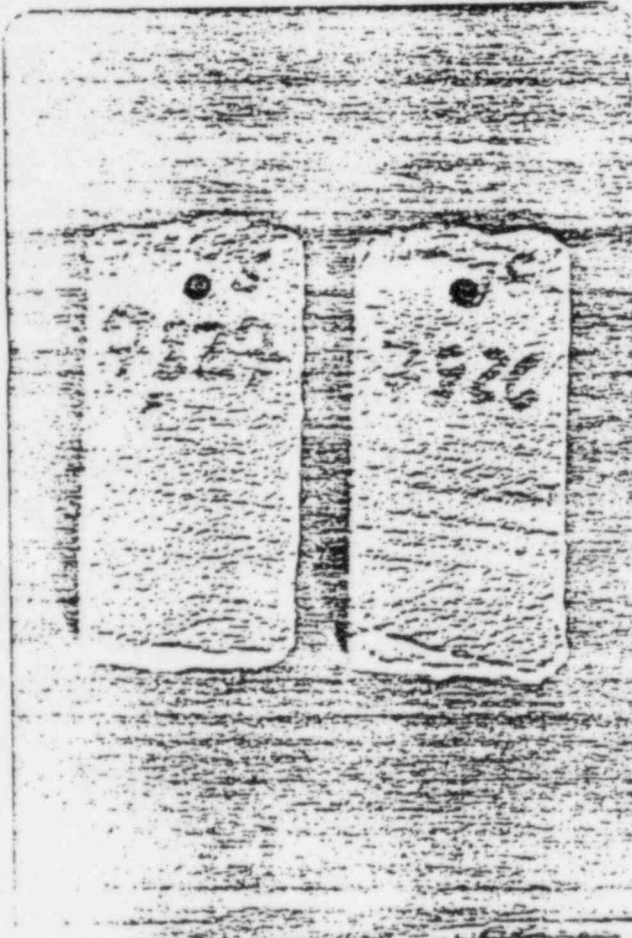
7826-7829 R



7826-7829

Technical Report 462-81

7826-7827



7826-7829 R



7826-7829