Wall Coating Information for the Nitrogen 16 Facility
Sudbury Neutrino Observatory Laboratory

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September 1996

SNO-STR-96-~~xxx~~ 038

Introduction

The nitrogen (^{16}N) generator for calibration of the SNO detector is to be housed in a 4 ft diameter by 6.5 ft deep pit in the corridor junction section of the SNO laboratory. Since the base of this pit is close to the depth of a nearby sump (with an automatic pump operation), waterproofing measures were completed to ensure that the pit would remain dry at all times. This report describes the coating materials used, their installation, and operations experience over the 6 months since the work was completed.

Coating Materials and Installation

The pit is formed from two sections of 4 ft diameter concrete pipe, with a 6 inch thick poured concrete floor. Two years ago, the walls had been coated with a layer of epoxy paint. Some water seepage was observed in the pit, when water levels in the nearby sump were less than 1 ft below the floor of the pit. Subsequently, the nearby sump was deepened to about 2 ft below the pit and a sump pump, with automatic operation when water levels reached 1.5 ft below the pit, was installed. A polyurethane coating system supplied by Normac Adhesive Products Inc. was applied to the walls and floor of the pit, to provide a water seal for the pit, regardless of water levels in the sump. Specifications for the 2 main components of this system - grout and wall coat - are given in Appendix 1.

One day prior to the coating work, the pit was cleaned and dried out using fans, and the water level kept low in the nearby sump. For the floor joint and the top joint between the pipe and a steel cover flange, *Normac 900R primer* was applied to the cleaned and sanded concrete/epoxy paint surface. *Normac BR-5T trowelable polyurethane grout* was mixed (3 parts A to 1 part B) and installed in the 90° joint at the floor, (3/4 inch wide bevelled form), and over the rough joint to the steel flange at the top. All surface holes in the concrete greater than 1/8 inch in size were also filled with this grout material, which sets in about 1 hour, and is highly thixotropic (no flow from vertical layers was observed). After the grout had set, a layer of *Normac NR-5S 400 polyurethane coating* was applied by hand with paint rollers and brushes. For the 80 sq.ft. surface, the 1.5 gallons used (in a mix with 2 parts Part A to 1 part Part B) provided a coating of approximate thickness 1/32 inch (30 mil). Because isocyanate emissions occur during the application, air supply respirators were worn and an exclusion zone near the pit was established (see the report included in Appendix 2).

After the first coat was applied, several bubbles were discovered in the joint at the floor - if water is present, the grout tends to foam and raise from the surface as setting occurs. Three sections of the bevelled grout (totalling about 3 ft) were removed, the area was well dried, and new grout was installed. In total, 4 layers of the polyurethane coat were installed, giving a total thickness close to 1/8 inch. Between coats, any runs were planed smooth and pin holes sealed with the grout. Since the coating work was completed (April 2, 1996) regular inspections have shown the pit to remain dry even when water levels in the sump nearby are comparable to the floor level of the pit. A 1 inch high ring, sealed to the top flange with silicone adhesive, was subsequently added to prevent water spilled on the junction room floor from entering the pit. No change in the sealing was observed when the concrete shielding rings (filling the pit except for a central 1 ft diameter hole) were installed in June 1996. Given the successful sealing of this pit, the Normac coatings have been adopted for hand-applied repair work in the SNO detector cavity, where a sprayed-on polyurethane wall coating (from Urylon Plastics Inc.) is in place. The Normac coating is less tough than the Urylon coat, but it is easy to apply and satisfactory in areas where impact or abrasion are not encountered.

Appendix 1: **Wall Coating Material Specifications** (Normac Adhesive Products Inc.)

BR-5T - Rev. 0

NORMAC® BR-5T PHYSICAL DATA

Product Name:	BR-5T Trowelable Grade Urethane		
Material:	Polyester TD1 Elastomer		
Mix Ratio:		PART A*	PART B
	Weight:	100	33.3
Pack Size:	<u>Kit</u>	<u>PART A</u>	<u>PART B</u>
	1/4 litre	187.5 gms	62.5 gms
	1/2 litre	375 gms	125 gms
	1 litre	750 gms	250 gms

*May solidify upon prolonged standing at low temperatures

TYPICAL PHYSICAL DATA VALUES

Application Life:	1 hour @ 21°C
Tack Free Time:	3 hour @ 21°C
Hardness:	73 Shore A
Bashore Resilence:	41% (ASTM D2632)
Flexibility:	Pass ¼" conical mandrel (ASTM D522)
Modulus @ 300% psi:	745 (ASTM D412)
Tensile Strength, psi:	2025 (ASTM D412)
Elongation %:	540 (ASTM D412)

NORMAC® BR-5T

BR-5T trowellable grade polyurethane is a new maintenance item which can be utilized in the repair of rubberlike components, without the need of cumbersome rubber curing equipment.

BR-5T is an elastomeric polymer, that when mixed in proper portions, will yield a tough rubbery compound with exceptional abrasion and tear resistance. Typical uses for BR-5T are conveyor belt repairs, rubber repairs and off-road tire repairs.

BR-5T comes in convenient pre-weighed containers, that when mixed thoroughly, can be applied in any thickness without the risk of shrinkage, due to the absence of volatile solvents. The cured repair can be machined or buffed to a smooth finish.

APPLICATION

The areas to be repaired should be thoroughly cleaned in preparation for patching. The following procedures is recommended.

1. Wash the patch area and scrub with a wire brush to loosen and remove surface contaminants, such as dirt or particles, wood chips, etc.

2. Remove loose particles with a clean rag or blow air from a compressed air gun across the surface.

3. Wipe the surface of the patch area with a rag soaked in toluene (toluol), or suitable solvent, This is to remove any oily contaminants which may be in the repair area. Now remove any excess solvent with a clean dry rag.

4. The repair area must now be buffed with a disc grinder, or wire wheel to freshen up the rubber surface. Feather any sharp, exposed edges.

5. If steel is exposed it should be sandblasted or ground with a disc grinder before a suitable primer is applied.

6. Other than available urethane chloroprene cements, such as Normac 900R will give a good bond to rubber or urethane.

7. After the second coat of adhesive is applied, the mixing of the BR-3T may commence.

8. Calculate the volume in the repair area, and weigh out the required portions of Part "A" and "B" of the BR-5T. 375 gms. of Part "A" and 125 gms. of Part "B" will displace 25 cubic inches or approximately 400 cubic centimeters.

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NR-5S 400 PHYSICAL DATA

Product Name: NR-5S 400 Part "A" and Part "B"

Product Description: A 100% solids urethane coating designed for application by brush or roller.

Material: 100% Solids - Aliphatic polyether urethane based coating

Mix Ratio:

	Part "A"	Part "B"	Part "C"* (Optional)
Weight:	100	50	1.33
Volume:	100	50	0.76

*Optional: Part "C" refers to colour only. The amounts indicated are to be added to the mixed "A" and "B" clear, only when you are using approved colourants.

Pack Size:

Kit	Part "A"	Part "B"
4 litre (gal.)	4.55 kg. (10.0 lbs.)	2.27 kg. (5.0 lbs.)
20 litre (5 gal.)	9.09 kg. (20.0 lbs.)	4.55 kg. (10.0 lbs.)

TYPICAL PHYSICAL DATA VALUES

Application Life: 30 to 45 minutes @ 21°C (70°F)

Tack Free: 1½ to 2 hrs. @ 21°C (70°F)

Print Free: 3 to 4 hours @ 21°C (70°F)

Hardness: 92-94 Shore A

Bashore Resilience: 40% (ASTM D2632)

Impact Resistance: Greater than 160 in./lbs. (ASTM D2794)

Tear Strength: 363 lb f/in. Die C (ASTM D-624)

NORMAC®

NR-5S 400 PHYSICAL DATA

Tensile Strength:	3825 psi (ASTM D412) - Method A
Elongation:	302% (ASTM D412) - Method A
Abrasion Resistance:	0.0017 grams weight loss per 1000 cycles, H22 wheel, at 1000 gms. (ASTM D1-044)
Operating Temperature:	-56°C (-70°F) to 93°C (200°F)
Fungus Resistance:	Non-nutrient
Weight of Cured Coating:	44 gm./m² @ 25 microns 0.90 lbs. per 100 ft.² at .001" thick
Modulus 100%:	1380 psi (ASTM D412)
Ultimate Cure:	5 days at 30 dry mils at 70°F
Recoat Times:	Minimum: 60 - 90 minutes Maximum: 72 hours
Volatile Organic Compound (V.O.C.):	0% V.O.C. - as material is 100% solids, 100% reactive.
Mixed Solids Content:	100%
Flash Point:	Greater than 100°C. See MSDS.
Application:	Normac NR-5S 400 can be dipped, brushed, sprayed or rolled. For brushing - use a natural bristled paint brush. Allow the NR-5S 400 to become tack-free before applying second and successive coats. Build rate per coat will vary depending on the substrate. For vertical surfaces 0,2mm to 0,3mm (.008" to 012") will be the maximum build. For roller or power roller coating - use a short napped roller as this will reduce the amount of roller hairs left in the coating. Build per coat can be as high as 0,4 to 0,5mm (.016" to .020").

Appendix 2: **MEMORANDUM**

To: J. Fitzgerald
L. Moriarty
D. Hepburn
N. Bodson
B. Robertson
K. Langille
G. Morbin
P. Oliver
R. Price
G. St. Louis

From: D. Hallman
Date: September 26, 1995
Re; N-16 Pit Coating Procedure

NORMAC POLYURETHANE COATING PROCEDURE
N-16 PIT, SNO LABORATORY

E.D. Hallman, Laurentian University

(minutes of the Fail Safe Meeting - August 30, 1995)
(Attending: Norm Bodson, Doug Hallman, Ken Langille, George Morbin, Larry Moriarty, Doug O'Connor, Phil Oliver, Barry Robertson.)

The N-16 pit is a 6 ft 6 inches deep by 4 ft diameter concrete pipe with a 6 inch concrete floor, installed below laboratory floor level just outside the entrance to the SNO Utility Room. It is to be coated with a waterproof layer prior to the installation of shielding rings and the N-16 generator (for detector calibration). It was agreed that the material chosen for patching the Urylon cavity liner - NORMAC NR-5S 400 polyurethane - be used in the pit, to further test application procedures and the coating prior to its use in the cavity. Since one of the two-components of this polyurethane product contains isocyanates, special precautions are required during its application.

Materials and Delivery to the Site

For a 0.125 (1/8) inch thick coating of the 80 sq ft surface of the pit, 6 gallons of NR-5S 400 is required. The coating will be applied with rollers and brushes. The two components will be delivered underground in their original shipping containers inside a specially marked SNO 'blue box'. A spill kit consisting of an empty 5 gallon container, rags and scoops, will also be included. Any waste materials after the coating process will be packaged and returned to surface in the blue box, and disposed of by SNO.

Application Procedures

1. Rubber gloves, Tyvek suits and full face air supply respirators are to be worn by the coating personnel and any assistants near the application site.

2. The components will be mixed on a table near the site (by weight).

3. Air monitoring carried out during a previous test of this material in the laboratory (March 1995 - report attached), indicates levels of HDA (an isocyanate component) well below the TLV at 5 m from the application point (in the deck area). Thus, an exclusion zone, marked with ropes and signs will be set up to include most of the junction room area, except for a narrow corridor to permit personnel to move along the air handler # 2 side, from the personnel area to the control room. This application will be done on a shift when no work is planned for the utility room. Exhaust air from the site moves through the junction to the car wash and out of the laboratory. A small, diluted fraction of exhaust air may be recirculated into the SNO lab, once the exhaust reaches the laboratory entry gate (in the mine drift).

4. Since the pit is a 'confined space', all Ministry of Labour requirements for work in the pit will be followed. In particular, any applicators will wear full air supply respirators, and full body harnesses, and there will be a manual hoist (using an hitch installed on the mezzanine above) available for emergency escape use). A guard will be posted near the pit when application is in process.

5. The crew will include two applicators, a guard and a monitor for the air supply equipment, all having air supply respirators.

6. Two monitoring sites will be set up, one at the edge of the pit, and a second at the car wash entry door (clean room side), to check air quality during the application.

7. Any lighting within two meters of the site will be of explosion-proof type. Two fire extinguishers are to be located nearby.

8. The coating will be applied in a minimum of three layers, white, gray and white. each layer up to 25 mils in thickness. At the bottom joint between pipe and floor. a thicker (more thixotropic) grout mixture of this product will be trowelled on to bevel the joint and minimize the possibility of cracking. It may be necessary to allow part of the coating to set (about one hour), prior to finishing the rest, given the confined surface being coated. It is planned that two coats be applied per 8 hour shift, so that two shifts will be required.

9. An inspection of the pit will be carried out to see if any concrete repair is required, at least one week ahead of the coating work. The pit will be dried out with a ventilator fan, with the pit cover removed (guard installed), one week prior to the application.

10. Scheduled time for application - during the week of October 2 - 6, 1995. The level foreman will be notified of this work and its schedule.

Action Items

a)	safety signs, supplies, air supply equipment, ladder lighting	- George Morbin
b)	scheduling of work, arranging for hitch	- Larry Moriarty
c)	ordering of materials, application equipment MSDS information	- Doug Hallman
d)	scheduling of monitoring (Derek Erickson)	- Doug Hallman
e)	review of procedures	- Ken Langille - Doug O'Connor

Appendix: Procedure for repair of cavity wall (at platform cable 6 spreader bar)

A 5 cm long gouge in the Urylon cavity liner will be repaired by the end of September with the following procedure:

1. Patch area will be reached by a worker on the SNO bosun's chair (mounted through cable deck opening) from an access point on the acrylic vessel scaffolding tower.
2. Since only about 100 mL of material is needed, the NR-5S-400 components will be taken to the site by hand (D. Hallman) in containers enclosed in a gallon pail. From air levels of HDA, measured in the previous test, it is clear that air levels for this small amount will be far below the Time Weighted Average Exposure criterion (TWAEC). A chemical full face respirator could be worn by the applicator. Rubber gloves are required and a second container (containing the aluminum mixing tray for the patch) will be fastened to the bosun's chair.
3. The two components will be measured (with an electronic balance) and mixed in the deck area. The patch will be applied with a brush, after any protruding material near the gouge is cut flat, and the surrounding surface roughened with a rasp. Overlap with surrounding Urylon should be 5 cm or more. Two or three coats may be required to build up the gouge area to the height of the surrounding Urylon. A set time of about 45 minutes between coats is required.