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FINAL REPORT

ASSESSMENT OF STRIPPABLE COATINGS FOR DEACTIVATION AND DECOMMISSIONING

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ACRONYMS

ASTM	American Society for Testing and Materials
cpm	Counts per Minute
D&D	deactivation and decommissioning
DF	decontamination factor
DOE	U.S. Department of Energy
FETC	Federal Energy Technology Center
FIU	Florida International University
FY97	fiscal year 1997
FY98	fiscal year 1998
FY99	fiscal year 1999
FY00	fiscal year 2000
HCET	Hemispheric Center for Environmental Technology
MISD	multimedia information system for decontamination
SIMCON	simulated contamination
SRS	Savannah River Site

EXECUTIVE SUMMARY

Strippable or temporary coatings are innovative technologies for decontamination that effectively reduce loose contamination at low cost. These coatings have become a viable option during the deactivation and decommissioning (D&D) of both U.S. Department of Energy (DOE) and commercial nuclear facilities to remove or fix loose contamination on both vertical and horizontal surfaces. A variety of strippable coatings are available to D&D professionals. However, these products exhibit a wide range of performance criteria and uses. For instance, some strippable coatings were designed to protect spray paint booths or small tools only, while others can be used for decontaminating or fixing loose contamination on floors and walls. As a result of the lack of comprehensive and comparable performance data regarding these products, D&D professionals tend to make decisions using limited information.

Florida International University's Hemispheric Center for Environmental Technology (FIU-HCET) was commissioned to perform a two-year investigation into strippable coatings. This investigation was divided into four parts: 1) identification of commercially available strippable coating products, 2) survey of D&D professionals to determine current uses of these coatings and performance criteria, 3) design and implementation of a non-radiological testing program to evaluate the physical properties of these coatings, and 4) design and implementation of a radiological testing program to determine decontamination factors and effects of exposure to ionizing radiation.

During fiscal year 1997 (FY97), the following activities were completed:

- Information about strippable coating products was requested from over 30 companies. Nineteen responses were received, with six of these companies selling products that could be used for radiological decontamination.
- D&D professionals were surveyed about current and future uses of strippable coatings as well as about performance criteria to be considered when choosing a product. Over 20 surveys were distributed across the DOE complex, and seven of these facilities provided responses. Performance criteria ranged from a need for the product to be strong and pliable to needs for the product to be inorganic based and not produce a mixed waste.
- A laboratory-scale non-radiological testing program was designed for the evaluation of the physical properties of the selected strippable coating products.

During fiscal year 1998 (FY98), the following activities were completed:

- Non-radiological testing evaluations were performed at FIU-HCET laboratories, determining physical properties of the selected strippable coating products. Testing properties include tensile strength, resistance to abrasion, hardness, and ease of application and removal.
- Laboratory-scale radiological testing was performed to determine decontamination factors for each strippable coating.
- Testing was designed and implemented to evaluate the effectiveness, durability, and decontamination factors of six selected strippable coating materials (ALARA™ 1146, JD

#GP-RDM, Pentek 604, Stripcoat TLC Free, Tech Sol 8001, and Tech Sol 8002) at the DOE-Savannah River Site (SRS) facility.

Testing of strippable coating products will continue into FY99 and FY00 as part of the Federal Energy Technology Center (FETC) project "Deactivation and Decommissioning Technology Assessment."

The main objective for fiscal year 1999 (FY99) is to complete the durability testing at the SRS facility measuring decontamination factors and wear-ability after being applied for 15, 30, 60, 90, and 180 days. The results of the radiological and non-radiological testing, including tests done at FIU-HCET and at the SRS facility, will be incorporated into the FIU-HCET multimedia information system for decontamination.

1.0 INTRODUCTION

Strippable coatings are polymer mixtures, such as water-based organic polymers, that are applied to a surface by paintbrush, roller, or spray applicator. As the polymer reacts, it attracts, absorbs, and chemically binds the contaminants; then, during the curing process, it mechanically locks the contaminants into the polymer matrix. Incorporating fiber reinforcement (such as a cotton scrim) into the coating may enhance the strength of these coatings. Once the coating dries, it can be stripped manually from the surface. In the case of auto-release coatings, the mixture cracks, flakes, and is collected by vacuuming.

The surface properties of these coatings may be modified by applying a thin top coat (e.g., polyvinyl alcohol), which may provide a smoother, less permeable surface that would become less severely contaminated. In such a duplex, the thicker basis layer provides the required mechanical properties (e.g., strength and abrasion resistance), while the top layer provides protection from contamination. Once the strippable coating is removed, the loose surface contamination is removed with the coating, producing a dry, hard, non-airborne waste product.

The use of strippable coatings during D&D operations has proved a viable option. These coatings can be used in the following three functions:

- As a protective coating, when applied to an uncontaminated surface in an area where contamination is present, so that on its removal the surface remains uncontaminated.
- As a decontamination agent, when applied to a contaminated surface, so that on its removal a significant decontamination of loose particulate activity is achieved.
- As a fixative or tie-down coating, when applied to a contaminated surface, so that any loose contamination is tied down, thus preventing the spread of contamination during subsequent handling.

After surveying commercially available strippable coating materials, eight products were found to be suitable for use in a nuclear facility: ALARATM 1146, JD #GP-RDM, Pentek-603 (self-stripping), Pentek 604 (self-stripping), Stripcoat TLC, Stripcoat TLC Free, Tech Sol 8001 (reinforced peelable), Tech Sol 8002, and Tech Sol 8830 (highly concentrated). These coatings can vary widely in their performance characteristics depending on substrate characteristics, type of contamination, and hazardous concentration.

During FY98 the non-radiological testing plan designed in FY97 was implemented. The eight coating materials listed above were tested, and performance parameters are discussed in section 3 of this report. A radiological testing plan was designed and a DOE facility identified to perform the test. Six coating materials will be compared at the SRS facility to determine product effectiveness on different surfaces, decontamination factors, radiation exposures, and the like. Lab and field results will be incorporated into the FIU-HCET multimedia information system.

1.1 PURPOSE OF THIS INVESTIGATION

The purpose of this investigation is to identify and laboratory-scale test strippable coatings that may be used in the D&D of DOE facilities. In addition, the most promising coatings are to be tested in a side-by-side comparison in a radiological area at a DOE facility.

Assessments of the eight selected strippable coating products were conducted by FIU-HCET in Miami, Florida. Comprehensive and comparable data was collected on the physical characteristics (e.g., tensile strength, abrasion resistance, and adhesion) of each coating as well as the ease of applying and removing (i.e., stripping) each product. Data on decontamination factors was collected based on before-and-after radiological surveys using Beta scaler/ratemeter equipment.

The purpose of the assessment performed at the DOE facility was to

- Determine decontamination factors for each strippable coating tested
- Collect first-hand assessments of these coatings from D&D personnel
- Collect typical cost information for application and removal.

The data gathered as part of the testing of commercially available strippable coating products will be used to provide D&D professionals with a single source of comparable information of data relating to physical characteristics, health and safety issues, waste generation, and performance.

2.0 PROJECT DESCRIPTION

The overall project goals for this two-year project are to

- Identify commercially available strippable coating products and vendors.
- Determine performance-based criteria for laboratory-scale testing of strippable coatings.
- Perform the laboratory-scale testing of the selected products.
- Design and implement a radiological testing plan to test strippable coating products in a DOE facility.
- Identify a DOE radiological facility to implement the side-by-side comparison of coating products.
- Generate a final report including laboratory-scale testing data collected.
- Update multimedia information system for strippable coating data.

To facilitate the completion of these project goals, the following tasks were performed:

- Determine commercially available strippable coating products and vendors (FY97 and FY98).
- Perform a survey of DOE D&D professionals to determine current uses of strippable coatings and suggested performance-based criteria for evaluation of strippable coating products (FY97).
- Non-radiologically field-test the strippable coatings that show the greatest promise of meeting the required performance parameters. Test coatings against the survey performance-based criteria, ensuring the data is directly comparable (FY97 and FY98).
- Design and perform the non-radiological testing of strippable coatings (FY97 and FY98):
 - * Application and difficult materials test (refers to section 3.1.1)
 - * Accelerated exposure testing (refers to section 3.1.2)
 - * Durability test: Abrasion resistance, adhesion testing, and film hardness
 - * Tensile strength testing.
- Perform lab-scale radiological testing of strippable coatings to determine decontamination factors for each coating material (FY98).
- Field-test the strippable coatings at a DOE facility. Six strippable coating products were evaluated on a case-by-case basis to determine performance metrics on each case (FY98 and FY99.) (refers to section 3.4).
- Enter performance data on strippable coatings into a multimedia information system (FY98 and FY99).

3.0 RESULTS

Strippable coating for deactivation and decommissioning represents an innovative technology that can be used to decontaminate DOE and commercial nuclear facilities. This technology offers remarkable benefits, which directly or indirectly ensure the effectiveness of each material. These benefits include the following:

- Reduces surface contaminants for low-level radioactive waste
- Decontaminates the site at low cost
- Prevents airborne contamination
- Minimizes the spread of contamination
- Decontaminates the site by using non-toxic, non-volatile compounds and no heavy metal compounds
- Produces solid waste that facilitates disposal or post-treatment after decontamination
- Reduces worker exposure to the contaminated substrate
- Applies easily to the contaminated surface
- Cures relatively quickly
- Reduces labor requirements
- Produces no liquid waste
- Uses equipment for application that is easily cleaned with water.

This project began in November 1996. FY97 was the project keystone. Complete research on available strippable products, selection of coating performance criteria for radiological contamination, and laboratory-scale procedures for non-radiological evaluation were conducted. A survey form was generated and sent to over 30 vendors of strippable coatings requesting technical information about their products (refers to the FY97 year-end report). The information collected includes applicable media and effective temperature ranges for each product, specification of the contaminants that the strippable coating is expected to contain, the product's ability to resist abrasion, and other factors.

Additional surveys were sent to DOE D&D professionals requesting information about the current use of strippable coatings at DOE facilities (refers to the FY97 year-end report). Also requested were performance criteria to consider when choosing a strippable coating. Based on these results, the Strippable Coatings Assessment Test Plan and the Health and Safety Plan were generated; testing procedures were written; equipment was ordered; and laboratory-scale testing was completed.

Through FY98 non-radiological and radiological testing programs were conducted at FIU-HCET. Data collected was analyzed, and results were reported and interpreted by FIU-HCET personnel. A radiological testing program was designed and implemented at the SRS facility (side-by side comparison of strippable materials) as part of the field test proposed by FIU-HCET.

Six coating materials were selected to be tested at the SRS facility (refers to section 3.4). The SRS facility test will be extended through FY99 to complete radiological evaluations and a 180-day durability test.

Eight coating materials from six vendors were selected to be evaluated at FIU-HCET. See Table 1 for summaries.

Table 1.
Strippable coating selected for FIU-HCET lab-scale testing

MANUFACTURER/VENDOR	STRIPPABLE COATING PRODUCT
Carboline and Williams Power Corporation	- ALARA™ 1146
Infrastructure Repair Systems, Inc., and FRHAM Safety Products, Inc.	- JDL #GP-RDM
Technical Solutions & Systems, Inc.	- Tech Sol 8001 (Reinforced peelable coating) - Tech Sol 8002 - Tech Sol 8830 (Fixative)
PENTEK, Inc.	- Pentek 603/604 (Self-Stripping)
BARTLETT Services, Inc	- Stripcoat TLC - Stripcoat TLC Free

The following activities were completed in FY98:

- Non-radiological laboratory-scale testing of strippable coatings
- Radiological testing of targeted strippable coatings products
- Identification of a DOE radiological facility to perform a site demonstration
- Design of radiological testing plan and test completion
- Generation and population of multimedia information system for strippable coatings.

All procedures used for the strippable coatings testing program at FIU-HCET were developed based on the American Society for Testing and Materials (ASTM) standards of paints and coating materials. See Appendix A for summaries.

All coatings tested as part of the FIU-HCET laboratory-scale testing program were applied per vendors' instructions and allowed to cure for a minimum of 24 hours prior to testing. Coating material strippability is film thickness-dependent. Therefore, low film thickness (below manufacturer recommendations) may cause difficulty in removing film. On the other hand, thickness above the recommended may cause slower dry time and may reduce decontamination effectiveness. Extra film thickness may cause difficulty in encapsulating the particle to be removed. If the coating is not applied with the proper thickness, the contamination particle may have a greater adherence for the substrate instead of the coating during the stripping operation; therefore, the decontamination factor will be reduced and so will removal efficiency. Table 2

shows recommended film thickness by vendor. These parameters were used during the FIU-HCET testing program.

Table 2.
Recommended film thickness for FIU-HCET lab testing

Strippable Coating	Wet Film Thickness (mils)	Dry Film Thickness (mils)
ALARA™ 1146	40-50	25
JDL #GP-RDM	35-50	21
Pentek 603/604 (self-peeling)	14-20	NA
Strip-coat TLC	40-50	25
Strip-coat TLC Free	40-50	25
Tech Sol 8001 (reinforced peelable)	14-18	11
Tech Sol 8002	14-20	8
Tech Sol 8830 (highly concentrated)	14-16	NA

NA: Not Available

3.1 NON-RADIOLOGICAL LABORATORY-SCALE TESTING OF STRIPPABLE COATINGS

The non-radiological testing plan designed in FY97 was used to evaluate the strippable coating products listed above. Five major activities were performed: application and removal of the strippable coating on difficult materials, accelerated outdoor exposure testing of organic coatings, level of durability testing (abrasion, adhesion, and film hardness), testing of tensile strength properties, and determination of decontamination factors.

3.1.1 Application and Removal of Strippable Coating on Difficult Materials

The following materials were included in the test as difficult materials due to their geometry and substrate characteristics (e.g., non-smooth surfaces, irregular shapes, type of substrate):

- Brick wall – un-coated
- Cable – metal
- Carbon steel plate – coated
- Chain-link fencing
- Concrete floor – coated
- Concrete floor – un-coated
- Galvanized metal post
- I-beam – coated
- Lead brick
- Plastic post
- Stainless steel plate (1 ft x 1 ft)

The strippable coating application and removal test on difficult materials focused on evaluation aspects such as ease of application, drying time, and curing process for each of the strippable

coatings. The application test was performed in two different environments, inside a building and outside in an open area. The method adapted at FIU-HCET was based on a combination of eight ASTM methods:

- D 823-95, "Standard Practice for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels," Practice D
- D 4414-84, "Standard Practice for Measurement of Wet Film Thickness by Notch Gages"
- D 1400-87, "Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Nondestructive Coatings Applied to a Nonferrous Metal Base"
- D 1005-84, "Standard Test Method for Measurement of Dry Film Thickness of Organic Coatings Using Micrometers"
- D 1640-95, "Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature"
- D 660-93, "Standard Test Method for Evaluating Degree of Checking of Exterior Paints"
- D 661-93, "Standard Test Method for Evaluating Degree of Cracking of Exterior Paints"
- D 714-87, "Standard Test Method for Evaluating Degree of Blistering of Exterior Paints."

Table 3 summarizes these test results; a detailed summary is attached in Appendix B.

Table 3.
Coating application on difficult materials summary

Coating Material	Test Observations
ALARA™ 1146	<ul style="list-style-type: none"> • Drying time: 8 hours • When applied to vertical objects, the coating dripped and ran. • Easily removed in single piece from most substrates.
JDL #GP-RDM	<ul style="list-style-type: none"> • Drying time: 8.5 hours • Easily removed in single piece from most substrates. • Forms "checks" (cracks) across the surface as it dries. • When stripped, coating tears at "checked" areas. • Coating is smooth (non-sticky) when dry. • Tedious to remove from cable and chain-link fencing.

Table 3.
Coating application on difficult materials summary (continued)

Coating Material	Test Observations
Pentek 603/604	<ul style="list-style-type: none">• Drying time: 2-3 hours• Self-releasing when dry.• Was applied by paintbrush to all FIU-HCET materials.• Not easy to apply evenly.• Very sticky (honey-like) when wet.• On porous materials, turned pasty and did not release.• Works well on unpainted metal, plastic, or non-porous materials.
Stripcoat TLC	<ul style="list-style-type: none">• Drying time: 9 hours• When applied to vertical objects, the coating dripped and ran (especially on the galvanized steel).• Easy to strip – usually in single piece.• Less sticky than TLC Free; however, still sticks to itself once stripped.• Removes loose layer of brick and concrete when stripped.
Stripcoat TLC Free	<ul style="list-style-type: none">• Drying time: 9 hours• Produces fine mist when sprayed.• Dries sticky/tacky on surface.• Very elastic when dry.• Easy to strip – usually in single piece.• Left residue on some substrates, especially if film was applied too thin.• Couldn't cut with a knife to make removal easier.• Dried coating has a strong odor when stripped.

Table 3.
Coating application on difficult materials summary (continued)

Coating Material	Test Observations
Tech Sol 8001	<ul style="list-style-type: none"> • Drying time: 6 hours • Uses self-adhesive mesh that bonds well to smooth flat surfaces. Coating applied over mesh. • Stripped easily as long as mesh stayed adhered to substrate. • When mesh did not adhere, the coating went through the mesh and was difficult to remove from the substrate. • Left residue on painted substrates.
Tech Sol 8002	<ul style="list-style-type: none"> • Drying time: 7 hours • Liquid coating is thick, slippery when wet, and has a strong odor when wet. • Easily removed from un-coated metal, concrete, and plastic. • Difficult to remove from brick, coated metal or concrete, and non-smooth surfaces. • The dried coating tends to lose adhesion when wet (i.e., left outside in the rain).
Tech Sol 8830	<ul style="list-style-type: none"> • This coating is used as a fixative and is not expected to be removable. This was found to be true during the FIU-HCET testing.

Besides Pentek 603/604 (self-releasing), coating application was easy for most of the materials. When vertical surfaces were sprayed, ALARA™ 1146 and Stripcoat TLC tended to drip and run. The average time drying for coating materials (ALARA™ 1146, JDL #GP-RDM, Stripcoat TLC, and Stripcoat TLC Free) with a wet film thickness ranging between 35 – 50 was 8.6 hrs. In the case of Pentek – 604 (a self-stripping material), the dry time was 3 hours. In the case of Tech Sol 8001 reinforced peelable and Tech Sol 8002, the average time was 6.5 hours. Tech Sol 8830 behaved as a fixative material as was expected. In general, removal test of each coating material on each surface tested was successful. However, JDL #GP-RDM and Tech Sol 8002 gave certain removal difficulty in certain substrates, cable, chain link fencing and brick, coated metal, concrete, plastic, respectively.

3.1.2 Accelerated Outdoor Exposure Testing of Organic Coatings

Accelerated outdoor exposure of organic coatings is related to temperature modifications even though it is not the only variable that can be controlled. Temperature is the easiest control as a variable to accelerate degradation due to thermal changes. The method used at FIU-HCET was "Black Box." The black box is made of aluminum and painted black. Its principle is to increase temperature during the day and lower it overnight to artificially increase the severity of outdoor exposure.

The accelerated exposure test evaluated the exterior durability of coatings applied to metal substrates. The method adapted at FIU-HCET was based on ASTM method D 4141-82, "Standard Test Method for Conducting Accelerated Outdoor Exposure Tests of Coatings." This

procedure exposed each strippable coating, applied to a black box panel rack and facing the equator at 5° from the horizontal, to the outdoor elements for a period of 60 days (November 1997 to January 1998). The black box panel temperatures are comparable to those encountered on the hoods, roofs, and deck lids of automobiles parked in direct sunlight.

Table 4 summarizes test results obtained at FIU-HCET for the strippable coating selected. Data observations were collected at 30 days and 60 days. Main observations were color appearance, surface changes, type of removal (pieces or whole strip).

Table 4.
Results of accelerated exposure testing

Coating Material	Initial Appearance	After 30 Days	After 60 Days
Carboline ALARA™ 1146	<ul style="list-style-type: none"> • Light blue • Smooth surface 	<ul style="list-style-type: none"> • No color change • Smooth surface • No peeling or slipping 	<ul style="list-style-type: none"> • No color change • Slightly tacky surface • Stripped in one piece
J.D.L. #GP-RDM	<ul style="list-style-type: none"> • Translucent pale yellow • Smooth surface 	<ul style="list-style-type: none"> • Contracted on sides of sample • After a rain, the coating loses adhesion and can be moved. Re-adheres on hot days. 	<ul style="list-style-type: none"> • Color change to transparent with dark reddish-brown streaks • Stripped in one piece • Left a thick oily yellow residue on test panel
Pentek 603/604	NA	NA	NA
Stripcoat TLC	<ul style="list-style-type: none"> • Deep bright yellow • Tacky surface 	<ul style="list-style-type: none"> • No longer sticky • Developed cracks across surface 	<ul style="list-style-type: none"> • Color change to dark mustard • Cracked surface • Dry surface • Does not strip off surface. Top layer can be scrubbed off but leaves a thick and sticky residue. • Area not exposed to sun was not cracked and did strip easily.
Stripcoat TLC Free	<ul style="list-style-type: none"> • Deep bright yellow 	<ul style="list-style-type: none"> • No longer sticky • Developed cracks across surface 	<ul style="list-style-type: none"> • Color change to dark mustard with light yellow areas • Cracked surface • Dry and rubbery surface • Does not strip off surface. Top layer can be scrubbed off but leaves a thick and sticky residue. • Area not exposed to sun was not cracked and did strip easily.

Table 4.
Results of accelerated exposure testing (continued)

Coating Material	Initial Appearance	After 30 Days	After 60 Days
Tech Sol 8001 Reinforced Peelable Coating	<ul style="list-style-type: none"> Started clear and turned to beige 	<ul style="list-style-type: none"> Lost adhesion in center of sample that fills with water after rain Small crack pattern across surface 	<ul style="list-style-type: none"> Color change to brownish beige Part of coating flaked off exposing the panel. Only mesh stripped off. Coating in between mesh stayed on panel and turned to powder when mesh removed. Coating not exposed to sun stripped easily.
Tech Sol 8002 Peelable Coating	<ul style="list-style-type: none"> Started clear and turned to beige 	<ul style="list-style-type: none"> Small crack pattern across surface 	<ul style="list-style-type: none"> Color changes ranged from beige (thin coating) to dark yellow (thick coating). Small crack pattern across surface Streaks of coating wore away and exposed panel. Does not strip off. Can be scraped with a sharp edge.
Tech Sol 8830 Fixative	<ul style="list-style-type: none"> Started clear and turned to beige 	<ul style="list-style-type: none"> No change 	<ul style="list-style-type: none"> Spotted areas where worn coating exposed the test panel. Extremely thin layer of coating Does not strip and turns to powder when scraped off.

NA: Could not be tested as this coating is "auto-releasing" and had broken off of the panel prior to testing.

The accelerated exposure test was implemented for initial appearance, after 30 days, and after 60 days. After 30 days, most of the coating products presented cracks across the surface. Adhesion was reduced in a couple of cases due to rain. However, Carboline ALARA™ 1146 and Tech Sol 8830 do not show any changes across the surface. After 60 days as shown in the table, the most common changes observed were color, cracked surface, removal difficulty, and surface residual. ALARA™ 1146 and JDL #GP-RDM were the only coatings that could be removed after 60 days.

3.1.3 Durability Test

In order to determine durability of each strippable coating, the following series of tests were performed: abrasion, adhesion, and film hardness. Durability is important for strippable coatings that are applied as a protective coating or as a fixative and are expected to remain in place for any length of time. Based on the results of the tests described below, the coatings were rated

either High, Medium, or Low for durability. A High rating signifies coatings that will not be easily breached (i.e., cut, worn down, or accidentally lifted from the substrate) allowing contamination to penetrate the protective coating. Table 5 shows qualitative results after testing materials.

Table 5.
Qualitative results of durability

Strippable Coating	Durability Rating
ALARA™ 1146	High
JDL #GP-RDM	High
Pentek 603/604 (self-stripping)	NA
Stripcoat TLC	Medium
Stripcoat TLC Free	Medium
Tech Sol 8001 (reinforced peelable)	Medium
Tech Sol 8002	Low
Tech Sol 8830 (highly concentrated)	Medium

NA: Could not be determined; coating is "auto-releasing."

Even though Tech Sol 8830 is classified as a fixative material, the durability rating was Medium. This rating was given according to abrasion results. Tech Sol 8830 may be used as a protective barrier but not for heavy foot traffic purposes due to its low abrasion resistance.

3.1.3.1 Abrasion Resistance

The abrasion test evaluated the resistance of surfaces to rubbing abrasion. The method adapted at FIU-HCET was based on ASTM method D 4060-95, "Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser." The Taber Abraser used for these tests was Model 5130 (see Figure 1) and was manufactured by Taber Industries. Abrasion is produced by the contact of a test sample turning on a vertical axis against the sliding rotation of two weighted abrading wheels. The abrading wheels used for these tests were non-resilient wheels composed of vitrified clay and silicon carbide abrasive particles, H-18 Calibrate. Abrasion resistance is measured as loss in weight at a specified number of cycles, as loss in weight per cycle, or as the number of cycles required to remove a unit amount of coating thickness. Figure 2 shows the abrasion test for Tech Sol 8830.

Figure 1. Taber Abraser—abrasion test.

Figure 2. Result of abrasion testing on Tech Sol 8830.

Table 6 shows the abrasion results obtained at FIU-HCET coating materials evaluation, and Appendix C includes detailed information related to the test.

Table 6.
Abrasion resistance results

Strippable Coating	Abrasion Resistance	Wear Cycles per Mil of Coating
ALARA™ 1146	<ul style="list-style-type: none"> Wear index at 1500 cycles and 500 gram load = 131.2 mg Weight loss = 196.8 mg 	97.4
JDL #GP-RDM	<ul style="list-style-type: none"> Wear index at 1500 cycles and 500 gram load = 222.4 mg Weight loss = 333.6 mg 	66.4
Pentek 603/604	NT	NT
Stripcoat TLC	1	NA
Stripcoat TLC Free	1	NA
Tech Sol 8001	<ul style="list-style-type: none"> Wear index at 300 cycles² and no load = 606mg Weight loss = 181.8 mg 	47.2
Tech Sol 8002	<ul style="list-style-type: none"> Wear index at 300 cycles² and no load = 98.3 mg Weight loss = 29.5 mg 	NA
Tech Sol 8830	<ul style="list-style-type: none"> Wear index at 300 cycles² and no load = 43 mg Weight loss = 12.9 mg 	NA

NT: Could not be tested as this coating is "auto-releasing" and had broken off of the panel prior to testing.

NA: Not Available

1. Weight gain due to abrasive sticking to the strippable coating. Holes developed in the coating prior to completion of the minimum number of cycles.

2. At or right before 300 cycles, the strippable coating was completely worn down to the metal plate.

The above table shows the resistance of organic coatings to abrasion produced by the Taber Abraser. Abrasion resistance is directly proportional to the wear index; thus, "The lower the wear index, the better the abrasion resistance quality of the material." However, in accordance with the ASTM method D 4060-95, Table 1 (*Precision of Taber Abrasion Values*) recommends that at lower values than 500 cycles data may not be suitable. The only two coatings that stood up to the Taber Abraser were ALARA™ 1146 and JDL #GP-RDM. The coating with the highest abrasion resistance quality was ALARA™ 1146.

3.1.3.2 Adhesion Testing

The adhesion test evaluated the adequacy of coating films to adhere to metallic substrates. The method adapted at FIU-HCET was based on ASTM method D 3359-93, "Standard Test Method for Measuring Adhesion by Tape Test." Pressure-sensitive tape was applied over an "X" cut made in the test coating. Figure 3 shows a visual perspective of the adhesion test on Tech Sol 8001. The tape is quickly removed, and the adhesion is assessed qualitatively on the following scale (Table 7). For summaries, see Appendix D.

Table 7.
Qualitative adhesive scale

Scale	Description
• 5A	• No peeling or removal
• 4A	• Trace peeling or removal along incisions or at their intersection
• 3A	• Jagged removal along incisions up to 1/16 in. (1.6 mm) on either side
• 2A	• Jagged removal along most of incisions up to 1/8 in. (3.2 mm) on either side
• 1A	• Removal from most of the area of the X under the tape
• 0A	• Removal beyond the area of the X

Figure 3. Adhesion testing.

If the strippable coating is to fulfill the purpose of protecting or fixing a contaminant to a substrate, especially for any length of time, then it must adhere to the substrate for the expected service life. Strippable coatings, however, must also have the capability of being removed easily after the service life is over. Therefore, this procedure is not entirely applicable to strippable coatings. However, the FIU-HCET test, results of which can be found in Table 8, was designed to predict the chance of accidentally lifting the coating from the substrate during its service life.

**Table 8.
Adhesion testing results**

Strippable Coating	Number of Trials	Mean	Range
ALARA™ 1146	3	4A	All 4A
JDL #GP-RDM	3	4A	4A - 5A
Pentek 603/604	NA	NA	NA
Stripcoat TLC	3	0A	All 0A
Stripcoat TLC Free	3	0A	All 0A
Tech Sol 8001	3	2A	1A - 2A
Tech Sol 8002	3	0A	All 0A
Tech Sol 8830	3	5A	All 5A

NA: Could not be tested as this coating is "auto-releasing" and had broken off of the panel prior to testing.

The results indicate that the ALARA TM 1146 and JDL #GP-RDM strippable coatings would be less likely than the other coatings to be accidentally lifted from the substrate once applied. This does not indicate that these coatings cannot be removed at all, just that it takes a deliberate effort to remove the coatings. Tech Sol 8830, a fixative, performed as expected being permanently affixed to the substrate.

3.1.3.3 Film Hardness

The film hardness test evaluated the resistance of coating materials to surface scratching. The method adapted at FIU-HCET was based on ASTM method D 3363-92a, "Standard Test Method for Film Hardness by Pencil Test." Pencils of various degrees of hardnesses are drawn along the coating panel using a fixed pressure and at a fixed angle to the surface starting with the hardest pencil and continuing down the hardness scale. Calibrated drawing leads, using the Pencil Scratch Hardness Tester from Gardco, were utilized meeting the following scale of hardness:

6B – 5B – 4B – 3B – 2B – B – HB – F – H – 2H – 3H – 4H – 5H – 6H – 7H – 8H – 9H

Softer

Harder

As demonstrated in Figure 4, this procedure is continued until 1) the pencil does not cut into or gouge the film (Gouge Hardness) or 2) the pencil does not scratch the film (Scratch Hardness). Results of the film hardness test are found in Table 9 below.

Figure 4. Film hardness testing.

Table 9 shows the hardness test results for coating materials generated at FIU-HCET.

Table 9.
Film hardness test results

Strippable Coating	Gouge Hardness ¹	Scratch Hardness ²
ALARA™ 1146	9H	9H
JDL GP-RDM	9H	2H (pulled coating from panel leaving "bubbles" in coating)
Pentek 603/604	NA	NA
Stripcoat TLC	9H	6B
Stripcoat TLC Free	9H	6B
Tech Sol 8001	9H	6B
Tech Sol 8002	9H	6B
Tech Sol 8830	F	HB

NA: Could not be tested as this coating is "auto-releasing" and had broken off of the panel prior to testing.

¹ Gouge hardness is the hardest pencil that will leave the film uncut for a stroke length of at least ¼ inch.

² Scratch hardness is the hardest pencil that will not rupture or scratch the film.

The results listed above indicate that many of the strippable coatings tested will not cut or be gouged when accidentally scraped with a sharp object. Most of the coating did leave scratch marks when the pencil was applied; however, the coating integrity was not breached. This information is important for any strippable coating that is expected to be applied to an object and left in place for a period of time (e.g., 6 months). If the coating can be easily cut or gouged, then the contaminants that the coating is supposed to be protecting against may penetrate through the cut spreading contamination.

3.1.4 Tensile Strength Testing

This test evaluates the tensile strength and elongation or any tensile deformation of the strippable coatings. The method adapted at FIU-HCET was based on a combination of two ASTM methods: D 2370-92, "Standard Test Methods for Tensile Properties of Organic Coatings" and D 412-87, "Standard Test Methods for Rubber Properties in Tension." Testing was performed using a COMPTEN Industries Compression and Tensile Testing Machine, Model 942 KVC 1000. The equipment maximum force capability is 20 lbs. Each material is placed in position, and the force is applied until the material breaks. The rupture force and the distance between the benchmarks at the time of rupture are recorded to compute tensile force of rupture (Ts) for each tested material. Coating materials should break between gage length and a rupture force less than 20 lbs.

The specimen shape selected to evaluate tensile properties in coating materials may affect results on tension properties. The ASTM methods recommend performing the test by using dumbbell shape or ring specimens, if possible, instead of rectangular (straight) specimens, which tend to break in the grips. However, if the coating material is extremely elastic and it is not feasible to prepare dumbbell shape samples, the rectangular shape is accepted, and the results are valid.

Table 10 is a summary of calculations for tensile strength. This table shows the mean values that represent the tensile properties of each material. Ten valid specimens were considered for each

material. A valid specimen is considered when its rupture is inside the benchmarks. Applying an external force (P_r) on each specimen induces this rupture. The mean values were calculated, as per ASTM, by selecting from five of 10 valid specimens that show the highest tensile strength for each material tested. Appendix E, Tables 1 to 5, contains detailed data for each material tested.

Table 10.
Tensile strength results

Strippable Coating	Tensile Strength Arithmetic Average (lb/in ²)	Tensile Strength Standard Deviation (lb/in ²)	Tensile Strength Standard Deviation Based on Entire Population (lb/in ²)	Tensile Temporary Elongation Arithmetic Average (%)	Permanent Elongation Arithmetic Average (%)
ALARA™ 1146 (Dumbbell)	1,102.2	49.2	517.2	224.5	452.0
JDL #GP-RDM (Rectangular)	272.3	42.2	105.5	822.14	6.67
Pentek 603/604	NP	NP	NP	NP	NP
Stripcoat TLC (Rectangular)	20,984.3	1,040.8	9,417.6	382.4	336.8
Stripcoat TLC Free	NA	NA	NA	NA	NA
Tech Sol 8001	NA	NA	NA	NA	NA
Tech Sol 8002 (Dumbbell)	1,142.9	21.7	527.8	1,562.4	89.6
Tech Sol 8830	NA	NA	NA	NA	NA

NOTE: Statistical calculations were made based on five (5) highest values of Ts according to the ASTM standards.

NP: Could not be tested as this coating is "auto-releasing" and had broken off of the panel prior to testing.

NA: These specimens broke outside gage length; therefore, values did not meet the ASTM specified requirements.

Tech Sol 8002 and ALARA™ 1146 coating materials were tested using dumbbell-shaped specimens as is recommended by ASTM methods. JDL #GP-RDM and Stripcoat TLC were tested using rectangular-shaped specimens because dumbbell-shaped samples did not break due to material elasticity. JDL #GP-RDM rectangular-shape results show that the Tensile Strength, TS, for this material varies from 347.2 and 247.9 lb/in². An average of 4.01 lbs. is needed to experience rupture in this product. TS Tech Sol 8002 dumbbell shape did not break at maximum force applied (20 lbs.), but deformation was observed. In accordance with the experimental data collected, the TS for this material is greater than 22222.2 lb/in². TLC coating rectangular shape follows same path as Tech Sol 8002. The TS for TLC is greater than 1179.9 lb/in². ALARA™ 1146 coating dumbbell shape broke at an average rupture force of 4.44 lbs. In accordance with Table 10, ALARA™ 1146 TS varies from 1085.8 to 1107 lb/in².

Tensile strength properties are important for coating materials. They are indicators of coating behaviors related to environmental stress (e.g., weather conditions). The best coating material as

per tensile properties was Stripcoat TLC, which presented the highest tensile strength value. The higher the Ts value, the easier to remove the coating material in a single piece. This result agrees with results obtained during the evaluation of difficult materials (section 3.1.1)

3.2 DETERMINATION OF DECONTAMINATION FACTORS FOR STRIPPABLE COATING PRODUCTS

This procedure intends to determine decontamination factors for each coating material tested. The procedure is an adaptation from the paper "*Development of Simulated Contamination (SIMCON) and Miscellaneous Decontamination Scooping Tests*," WINCO - 1188, written by R. L. Demmer, January 1994, Westinghouse Idaho Nuclear Company, Inc.

Decontamination factors for strippable coating materials were performed as follow: Several stainless steel disks (1" diameter by 1/4" thick) were prepared by adding contaminant solutions (Uranium (U): Chemical Identification—U in 2% HNO_3 , Thorium (Th): Chemical Identification—Th in 2% HNO_3 , and Cesium (Cs): Chemical Identification—Cs SO_4). These solutions were prepared in accordance with FIU-HCET procedure (FY97) as follows: U & Th 1 mg/ml and Cs-10 mg/ml. Each disk was spiked with 0.1ml of U, Th, and Cs solutions. The application order was U, Th, and Cs within intervals of 2.25 hours to allow complete drying between application. Refer to Figures 5 and 6 to visualize disk preparation.

Figure 5. Application of Uranium, Thorium, and Cesium to stainless steel disk tests.

Figure 6. Drying process of test coupons after contaminant application.

Decontamination factor testing was performed by conducting a radiological pre-survey on each disk using a beta counter/ratemeter for a reading time of 60 minutes. Each coating was applied in accordance with recommendations given in Table 2. After the curing time, the coating material was removed from disks, and a final reading was conducted (post-survey). Table 11 shows final decontamination factors calculated; detailed results are reported in Appendix F.

Table 11.
Decontamination factors

Strippable Coating	Decontamination Factors	Average Removal (%)
ALARA™ 1146	2.27	55.89
JDL #GP-RDM	1.53	34.83
Pentek 603	4.35	77.03
Stripcoat TLC	1.87	45.29
Stripcoat TLC Free	2.26	55.75
Tech Sol 8001	NA	NA
Tech Sol 8002	NA	NA
Tech Sol 8830	NA	NA

NA: Not Available

Decontamination Factor = Initial Contamination / Final Contamination ($DF = A_o/A_f$)

Decontamination factors were determined based on Beta pre- and post-survey readings. The highest decontamination factor found was Pentek 603 (4.35), which showed a greater removal efficiency compared to the other specimens tested. The removal efficiency for the rest of the coatings tested are reported in the preceding table. Tech Sol 8001 and 8002 coatings were not tested at FIU-HCET. However, they will be determined at the SRS facility assessment.

3.3 IDENTIFICATION OF A DOE RADIOLOGICAL FACILITY TO PERFORM A SITE DEMONSTRATION

FIU-HCET and the DOE agreed to perform a field evaluation of strippable coating materials at the Savannah River Site (SRS) radiological facility. The 321-M Fuel Fabrication Facility at Savannah was built in the 1950s to manufacture fuel tubes for the SRS production reactors. The facility covers approximately 62,000 square feet. The structure's characteristic is steel frame with asbestos-cement panel siding and a flat roof. Casting, forging, extruding, and machining equipment were used to produce uranium-aluminum fuel tubes. About 9,000 square feet of the facility have become contaminated with residual Uranium (U-235). The contamination can be found in equipment, enclosures, ventilation ducts, floors, walls, and overheads.

The SRS assessment intends to obtain comparable data on strippable coatings, catalog operational data on the strippable coatings, assign a generalized performance evaluated and reported to each strippable coating, determine decontamination factors for each strippable coating, and evaluate durability of each coating over time.

3.4 DESIGN OF RADIOLOGICAL TESTING PLAN

The scope of this assessment includes side-by-side assessments of six commercially available strippable coatings. The assessments will be made under comparable field radiological conditions. Pre-assessment surface surveys of the test areas will be performed before the coatings are applied. After each coating dries and is removed, the areas will be resurveyed and decontamination factors determined. Additional data on application, appearance, removal, waste, and costs will be collected to evaluate overall performance of each coating. Durability tests will be performed, with sections of each coating being removed at 15-, 30-, 60-, 90-, and 180-day intervals. Refer to Appendices G, H, I, J, and K for data collection forms. The following five manufacturers/vendors and six strippable coating products were selected to perform the assessment:

MANUFACTURER/VENDOR

- Carboline and Williams Power Corporation Infrastructure Repair Systems, Inc.
- FRHAM Safety Products, Inc.
- Technical Solutions & Systems, Inc.
- PENTEK, Inc.
- BARTLETT Services, Inc.

STRIPPABLE COATING PRODUCT

- ALARA™ 1146
- JDL#GP-RDM
- Tech Sol 8001
- Tech Sol 8002
- PENTEK-604 (Self- Stripping)
- Stripcoat TLC Free

NOTE: Tech Sol 8830 and Stripcoat TLC will not be evaluated at the SRS site. Tech Sol 8830 is a fixative coating and does not apply for decontamination purposes. Stripcoat TLC is no longer manufactured.

Each strippable coating will be field-applied in a small previously surveyed test area to determine decontamination factors, confirm product effectiveness and cost considerations. The results of this demonstration will be addressed in an independent report after the evaluation is completed.

4.0 CONCLUSIONS

The activities planned for FY98 of strippable coatings are complete. These activities included the following:

- Non-radiological testing evaluations: Performed at FIU-HCET laboratory, determining physical properties of the selected strippable coating products. Testing properties include tensile strength, resistance to abrasion, hardness testing, and ease of application and removal.
- Radiological survey: Performed using Beta Scaler/ratometer equipment to determine decontamination factors on each strippable coating tested. Contaminant elements used were Cesium (Cs), Thorium (Th), and Uranium (U).
- Large-scale test plan: Designed to evaluate the effectiveness of six selected strippable coating materials (ALARA™ 1146, JDL[#]GP-RDM, Pentek 604, Self-stripping, Stripcoat TLC Free, Tech Sol 8001 Reinforced peelable), at the DOE-SRS facility.
- The test plan for the DOE - SRS facility was implemented as a side-by-side comparison of different strippable coating materials. Concrete floor (log storage room) and carbon steel surfaces (casting furnace enclosures, angle-iron racks, and scrap rack carts) were selected as test panels.
- Non-radiological and radiological data collected at FIU-HCET laboratory was tabulated, processed, and interpreted by FIU-HCET professionals.

In accordance with the data collected during different test evaluations conducted at FIU-HCET, some observations can be concluded as follow:

- ALARA™ 1146 coating showed high durability, lasting long in outdoor conditions, working well on most materials, high adhesion but easily removed in a single piece, classified as a hard material (9H) and with a medium-high tensile strength that facilitates coating removal. The abrasion resistance can be considered high, which minimizes the surface resist wearing due to contact with another surface moving. ALARA™ 1146 decontamination factor was 2.27 (medium-high), and its removal percentage efficiency was above 50 percent.
- JDL[#]GP-RDM coating showed high durability. However, outdoor conditions affect material adhesion. When wet, the coating loses adhesion; during hot days, it re-adheres. It works well on most materials, but on cable metal and chain link fencing it presented some difficulty leaving residual on substrate after removal. It can be removed as a single piece from most materials leaving a thick oily yellow residue. The abrasion resistance is high, and it is classified as a hard material (9H) with a low tensile strength. JDL[#]GP-RDM decontamination factor was 1.53 (medium-low), and its removal percentage efficiency was 35 percent.
- Pentek 604/603 is a self-releasing coating, difficult to apply on non-porous materials, yet works well on metals, plastic, and non-porous materials. Since this coating is auto-releasing only, two evaluations were done: application on difficult materials and decontamination factor test. It worked well on unpainted metal, plastic, and non-porous materials, but did not release from porous materials in this test. Pentek 603 decontamination factor was 4.35 (high),

and its removal percentage efficiency was above 75 percent. Pentek 603 produced the best results during decontamination factor testing.

- Stripcoat TLC showed a medium durability, short-lasting outdoor conditions. When applied to vertical objects, the coating ran easily. Outdoor conditions affect material adhesion, producing cracks across substrate. It works well on most materials, but could not be removed from chain link fencing. It can be removed in a single piece from most materials tested. It is classified as a medium-hard material (6H) with a very high tensile strength, which facilitates removal. This data agrees with the adhesion test, which was 0A (very easy removal). Stripcoat TLC decontamination factor was 1.87 (medium-low), and its removal percentage efficiency was 45 percent.
- Stripcoat TLC Free showed a medium durability, short-lasting outdoor conditions. Outdoor conditions affect material adhesion, producing cracks across substrate. It works well on most materials, but was difficult to remove from chain link fencing. It can be removed in a single piece from most materials tested but leaves residual on substrates. Classified as a medium-hard material (6H), Stripcoat TLC Free decontamination factor was 2.26 (medium-high), and its removal percentage efficiency was above 55 percent.
- Tech Sol 8001 coating showed a medium durability, short-lasting outdoor conditions. It works well on concrete floor coated and un-coated, galvanized metal, I-beam coated, and lead brick. The self-adhesive mesh reinforces its peelable characteristics. The abrasion resistance test results did not satisfy ASTM standards. The coating wore before a minimum number of cycles acceptable per the method. This material presented a scratch hardness scale medium-hard (6H). Tech Sol 8001 decontamination factor will be determined during the SRS side-by-side demonstration.
- Tech Sol 8002 coating showed a low durability, short-lasting outdoor conditions, and difficult to remove from most materials. The abrasion resistance test results did not satisfy ASTM standards. The coating wore before a minimum number of cycles acceptable per the method. This material presented a scratch hardness scale medium-hard (6H). Tech Sol 8002 decontamination factor will be determined during the SRS side-by-side demonstration.
- Tech Sol 8830 coating is a fixative material, which in accordance with FIU-HCET evaluations was true. It is long-lasting in outdoor conditions and has a wear index of 43 mg, which ensures high abrasion quality or high-wearing resistance. The abrasion resistance test results did not satisfy ASTM standards. The coating wore before a minimum number of cycles acceptable per the method. Tech Sol 8830 adhesion test results were not peeling removal. This material presented a scratch hardness scale medium-hard (HB) in the middle of the film hardness scale.

5.0 REFERENCES

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APPENDIX A

COMPARISON OF PERFORMANCE-BASED CRITERIA WITH TESTING METHODS

Performance-based Criteria	ASTM #	ASTM Method Name
Must be easy to apply and remove.	D 823-95	Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels (Practice D)
(a)	D 4414-84	Measurement of Wet Film Thickness by Notch Gages (Procedure A)
(a)	D 1400-87	Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base
(a)	D 1005-84	Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers
Fast cure time before second coat can be applied or the coating can be removed.	D 1640-95	Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
Product must be strong and pliable.	D 3363-92a	Film Hardness by Pencil Test
Product must be strong and pliable.	D 2370-92	Tensile Properties of Organic Coatings
Product must be strong and pliable.	D 4060-95	Abrasion Resistance of Organic Coatings by the Taber Abraser
Should be able to leave in place for at least 30 days.	D 3359-93	Measuring Adhesion by Tape Test (Method A)
Should be able to leave in place for at least 30 days.	D 4141-82	Conducting Accelerated Outdoor Exposure Tests of Coatings (Procedure A)
(b)	D 660-93	Evaluating Degree of Checking of Exterior Paints
(b)	D 661-93	Evaluating Degree of Cracking of Exterior Paints
(b)	D 714-87	Evaluating Degree of Blistering of Paints
Decontamination factors.	(INEL method)	Simulated Determination of Decontamination Factors

(a) These methods combined with D 823-95 constitute the application procedure.

(b) These methods combined with D 4141-82 constitute the exposure testing procedure.

NOTE: Refer to the FY97 year-end report for a complete list of performance criteria

APPENDIX B

DIFFICULT MATERIALS RESULTS

DIFFICULT MATERIALS RESULTS

Difficult Material	ALARA™ 1146	JDL #GP-RDM	Pentek 603/604	Stripcoat TLC	Stripcoat TLC Free	Tech Sol 8001	Tech Sol 8002
Brick Wall – Uncoated	Removed in a single piece. Also removed to layer of brick.	Removed in relatively a single piece. Tore in areas where adhered to mortar between bricks.	Turned pasty. Did not remove.	Easily removed in a single piece.	Stuck very well. Difficult to remove; however, did come off in a single piece.	Mesh did not stick to the entire wall. Where mesh stuck, the coating was easy to remove. Where mesh did not stick, the coating went through the mesh and had to be rubbed off.	Very difficult to remove. Came off in pieces.
Cable Metal	Removed in a single piece after a cut was made down the center. Tedious to remove and coating was left in between strands.	Very tedious to remove. Came off mostly in several medium-size pieces.	Did not remove from the cable.	Easily removed in a single piece once cut. Very little left on the cable after removal.	Removed in long strips. Left a residue on substrate where the coating was applied too thin.	Mesh would not attach to the cable. Could not apply coating.	Adhered very tightly to the substrate. Had to be removed in pieces.
Carbon Steel Plate – Coated	Extremely easy to remove in a single piece.	Easy to remove. Tore in place where coating was checked.	Cracked but did not lift from the substrate.	Very easy to remove in a single piece.	Easy to remove in a single piece.	Mesh lifted from the plate in several areas. Where mesh stuck, the coating was easy to remove. Where mesh did not stick, the coating went through the mesh and had to be rubbed off.	Very difficult to remove. Came off in small pieces.
Chain Link Fencing	Fairly easy to remove in small pieces.	Very tedious to remove.	Did not remove from the substrate.	Fairly easy to remove in long strands.	Tedious to remove. Came off in small pieces. Very elastic and sticky.	Mesh would not attach to the fencing. Could not apply coating.	Tedious to remove. Came off in small pieces.

DIFFICULT MATERIALS RESULTS (CONTINUED)

Difficult Material	ALARA™ 1146	JDL #GP-RDM	Pentek 603/604	Stripcoat TLC	Stripcoat TLC Free	Tech Sol 8001	Tech Sol 8002
Concrete Floor -Coated	Removed in a single piece.	Removed in a single piece.	The coating cracked but did not loosen from substrate.	Very easy to remove in a single piece.	Easier to remove than uncoated concrete. Was removed in a single piece.	Much harder to remove than uncoated concrete. Removed in a single piece. Not all of the coating was removed with the mesh. Had to be rubbed off of substrate.	Extremely difficult to remove. Could not pull off; had to rub off of substrate.
Concrete Floor - Uncoated	Easier to remove than coated concrete. Removed in a single piece.	Easier to remove than coated concrete. Removed in a single piece.	The coating cracked but did not loosen from substrate.	Removed in a single piece.	Removed in a single piece.	Easy to remove in a single piece.	Removed in a single piece.
Galvanized Metal Post & Plate	Easy to remove in a single piece.	Easy to remove in a single piece.	Released within 24 hours.	Ran on vertical substrate when applied; however, was easily removed in one piece.	Easy to remove in a single piece. Left a light residue on substrate.	Removed in a single piece. Left a light residue on substrate.	Adhered tightly to substrate. Removed in medium-size pieces.
I-Beam – Coated	Adhered tightly to substrate. Removed in multiple pieces. Removed some paint.	Removed in two pieces.	The coating cracked but did not loosen from substrate.	Easy to remove in two pieces. Removed some paint.	Removed in multiple pieces but with no difficulty. Removed some paint.	Removed in mesh-size pieces. Removed large amounts of paint.	Extremely difficult to remove. Could not pull off; had to rub off of substrate.
Lead Brick	Easily removed in a single piece.	Easily removed in a single piece.	Not performed.	Easily removed in a single piece.	Adheres tightly to substrate. Removed in a single piece.	Easily removed in a single piece.	Difficult to remove. Could not be pulled off; had to rub off of substrate.

DIFFICULT MATERIALS RESULTS (CONTINUED)

Difficult Material	ALARA™ 1146	JDL #GP-RDM	Pentek 603/604	Stripcoat TLC	Stripcoat TLC Free	Tech Sol 8001	Tech Sol 8002
Plastic Post	Easily removed in a single piece once cut down the center. Ran when applied.	Easily removed in a single piece. Tore in areas where checking was found in coating.	Released within 24 hours.	Easily removed in a single piece.	Removed in multiple pieces. Easier to rub off than pull. Could not be cut; very elastic.	Easily removed in a single piece.	Removed in multiple pieces with few problems.
Stainless Steel Plate (1 ft x 1 ft)	Easily removed in a single piece.	Easily removed in a single piece.	Released within 3 hours.	Very easy to remove in a single piece.	Very easy to remove in a single piece.	Easily removed. Residue left on substrate.	Easily removed in a single piece.
Wood Post	Adhered tightly to substrate. Brought up large splinters of wood when removing.	Easily removed in strips. The coating checked more on this substrate than any other.	The coating cracked but did not loosen from substrate.	Easily removed in a single piece once cut was made down the center.	Removed in multiple pieces. Hard to remove where coating was applied too thin.	Adhered tightly to substrate. Removed in a single piece.	Difficult to remove. Removed in small to medium pieces.

APPENDIX C

ABRASION RESISTANCE OF STRIPPABLE COATINGS

Strippable Coating		Initial Weight (mg)	Final Weight (mg)	Wear Index	Weight Loss (mg)	No. of Cycles	Weight Added (g)	Wear Cycles Per Mil	Coating Thickness (mils)
ALARA™ 1146	H-18	80726.2	80529.4	131.2	196.8	1500	500	97.4	15.4
JDL #GP-RDM	H-18	82517.9	82184.3	222.4	333.6	1500	500	66.4	22.6
Pentek 603/604	NP	NP	NP	NP	NP	NP	NP	NP	NP
Stripcoat TLC	H-18	80597.9	80602.3	1	1	800	1000	NA	27.4
Stripcoat TLC Free	H-18	78724.6	78737.6	1	1	300	500	NA	NA
Tech Sol 8001	H-18	77035.6	76853.8	606.0	181.8	300	0	47.2	6.36
Tech Sol 8002	CS-10	75514.5	75485.0	98.3	29.5	300	0	NA	NA
Tech Sol 8830	CS-10	72813.3	72800.4	43.0	12.9	300	0	NA	NA

H-18: Calibrate

CS-10: Calibrate

NP: Could not be tested, as this coating is "auto-releasing" and had broken off the panel prior to testing.

NA: Not available

APPENDIX D

ADHESION TEST ON A 12 X 12 PANEL

Strippable Coating	Trial 1	Trial 2	Trial 3
ALARA™ 1146	5A	5A	5A
JDL #GP-RDM	0A	0A	0A
Pentek 603/604	0A	0A	0A
Stripcoat TLC	1A	2A	2A
Stripcoat TLC Free	4A	4A	4A
Tech Sol 8001	4A	5A	4A
Tech Sol 8002	0A	0A	0A
Tech Sol 8830	5A	5A	5A

NOTE: The test was performed using Permacel Polyester film tape.

0A: Test could not be performed, as this coating is "auto-releasing".

APPENDIX E

TENSILE STRENGTH TESTING DATA SHEET

Table 1.
ALARA™ 1146 – Dumbbell Shape

SPRAYING

Application Date: 06/29/98
 Application Time: 1:35 P.M.
 Temperature During Drying: 74.4 °F
 Relative Humidity During Drying: 46.7 %
 Wet Film Thickness: 40-45 mils

CUTTING

Cutting Date: 07/1/98
 Cutting Time: 1:00 P.M.
 Temperature During Cutting: 74.4 °F
 Relative Humidity During Cutting: 46.7%

AVG. DRY FILM															
THICKNESS [in]	TEST #	TIME	T [°F]	R.H [%]	A [in ²]	Li [in]	Lf [in]	Wo [in]	Lp [in]	Er [in/min]	Et [%]	Ep [%]	Pr [lb]	TS [lb/in ²]	
0.0171	5	2:45	74.9	45.2	0.0043	2.6880	9.125	0.2500	1.1000	10.05	239.5	340	4.58	1071.35	
0.0179	6	2:47	74.9	46.1	0.0045	2.6880	8.938	0.2500	1.2000	10.08	232.5	380	4.65	1039.11	
0.0172	12	3:05	75.1	43.8	0.0043	2.5630	8.563	0.2500	1.1000	10.14	234.1	340	4.76	1106.98	
0.0187	18	3:15	75.3	43.9	0.0047	2.5000	8.500	0.2500	1.2000	9.970	240.0	380	4.58	979.68	
0.0175	19	3:20	75.3	44.2	0.0044	2.5000	7.875	0.2500	1.1000	9.970	215.0	340	4.18	955.43	
0.0170	21	3:28	75.2	44.1	0.0043	2.5630	7.875	0.2500	1.2000	9.970	207.3	380	3.86	908.24	
0.0157	22	3:31	75.2	44.2	0.0039	2.5000	7.813	0.2500	1.1000	9.970	212.5	340	4.07	1036.94	
0.0169	24	3:44	74.8	43.5	0.0042	2.4380	8.063	0.2500	1.2000	9.990	230.7	380	5.01	1185.80	
0.0169	26	2:15	75.8	46.5	0.0042	2.7500	8.313	0.2500	1.7500	9.920	202.3	600	4.51	1067.46	
0.0156	31	2:30	75.1	44.6	0.0039	2.7500	8.688	0.2500	1.7500	9.950	215.9	600	4.21	1079.49	

TEST #: Specimen Test Number

Li: Initial Specimen Length [in]

Er: Rate of Elongation [in/min]

TS: Tensile Strength [lb/in²]

T: Temperature [°F]

Lf: Final Specimen Length [in]

Et: Temporary Elongation [%]

R.H.: Relative Humidity [%]

Wo: Initial Sample width [in]

Ep: Permanent Elongation [%]

A: Original Sectional Area [in²]

Lp: Final Gage Length [in]

Pr: Tensile Force to Rupture [lb]

Table 2.
JDL #GP-RDM – Rectangular Shape

SPRAYING

Application Date: 06/15/98
 Application Time: 1:50 P.M.
 Temperature During Drying: 74.4°F
 Relative Humidity During Drying: 46.7%
 Wet Film Thickness: 45-50 mils

CUTTING

Cutting Date: 06/18/98
 Cutting Time: 9:30 A.M.
 Temperature During Cutting: 73.9 °F
 Relative Humidity During Cutting: 46.3%

AVG. DRY FILM THICKNESS [in]	TEST #	TIME	T [°F]	R.H [%]	A [in ²]	Li [in]	Lf [in]	Wo [in]	Lp [in]	Er [in/min]	Et [%]	Ep [%]	Pr [lb]	TS [lb/in ²]
0.0219	3	1:44	74.1	45.9	0.016	1.000	8.250	0.750	0.800	9.940	725	6.67	4.00	243.53
0.0192	4	1:54	74.6	46.0	0.014	1.000	9.313	0.750	0.800	9.970	831	6.67	5.00	347.22
0.0222	7	2:55	74.6	45.3	0.017	0.813	7.438	0.750	0.800	10.010	815	6.67	4.30	258.26
0.0211	8	2:58	74.6	45.6	0.016	0.875	8.188	0.750	0.800	10.000	836	6.67	4.10	259.08
0.0214	9	3:00	74.7	46.0	0.016	0.875	8.625	0.750	0.800	9.980	886	6.67	4.00	249.22
0.0254	12	3:12	74.7	45.6	0.019	0.813	7.500	0.750	0.800	10.000	823	6.67	3.90	204.72
0.0239	17	3:27	74.9	44.8	0.018	0.875	7.875	0.750	0.800	10.060	800	6.67	3.80	211.99
0.0242	19	3:33	75.1	44.5	0.018	0.875	7.188	0.750	0.800	10.060	721	6.67	3.60	198.35
0.0233	21	3:35	75.4	44.6	0.017	0.875	7.250	0.750	0.800	10.070	729	6.67	3.70	211.73
0.0199	22	3:46	75.3	44.1	0.015	0.875	7.375	0.750	0.800	10.070	743	6.67	3.70	247.91

TEST #: Specimen Test Number

T: Temperature [°F]

R.H.: Relative Humidity [%]

A: Original Sectional Area [in²]

Li: Initial Specimen Length [in]

Lf: Final Specimen Length [in]

Wo: Initial Sample Width [in]

Lp: Final Gage Length [in]

Er: Rate of Elongation [in/min]

Et: Temporary Elongation [%]

Ep: Permanent Elongation [%]

Pr: Tensile Force to Rupture [lb]

TS: Tensile Strength [lb/in²]

Table 3.
Stripcoat TLC – Rectangular Shape

SPRAYING	
Application Date:	06/23/98
Application Time:	10:00 A.M.
Temperature During Drying:	74.4°F
Relative Humidity During Drying:	46.7%
Wet Film Thickness:	40 mils

CUTTING	
Cutting Date:	06/25/98
Cutting Time:	8:15 A.M.
Temperature During Cutting:	73.2 °F
Relative Humidity During Cutting:	41.7%

AVG. DRY FILM														
THICKNESS [in]	TEST #	TIME	T [°F]	R.H [%]	A [in ²]	Li [in]	Lf [in]	Wo [in]	Lp [in]	Er [in/min]	Et [%]	Ep [%]	Pr [lb]	TS [lb/in ²]
0.0242	1	3:08	74.9	46.0	0.018	0.750	12.000	0.750	1.600	10.14	1500	113	20.00	1101.93
0.0226	2	3:12	74.8	45.1	0.017	0.813	12.000	0.750	1.400	10.11	1377	87	20.00	1179.94
0.0241	3	3:21	74.6	45.0	0.018	0.688	12.000	0.750	1.500	10.17	1645	100	20.00	1106.50
0.0249	4	3:24	74.4	44.6	0.019	0.813	12.000	0.750	1.500	10.18	1377	100	20.00	1070.95
0.0246	5	3:29	74.5	44.0	0.018	0.813	12.000	0.750	1.400	10.14	1377	87	20.00	1084.01
0.0237	6	3:26	74.8	43.9	0.018	0.688	12.000	0.750	1.400	10.16	1645	87	20.00	1125.18
0.0234	7	3:33	74.7	44.1	0.018	0.688	12.000	0.750	1.400	10.20	1645	87	20.00	1139.60
0.0236	8	3:36	74.9	44.3	0.018	0.750	12.000	0.750	1.500	10.15	1500	100	20.00	1129.94
0.0248	11	3:45	74.6	43.8	0.019	0.688	12.000	0.750	1.400	10.19	1645	87	20.00	1075.27
0.0234	12	3:48	74.5	42.8	0.018	0.688	12.000	0.750	1.400	10.18	1645	87	20.00	1139.60

TEST #: Specimen Test Number

T: Temperature [°F]

R.H.: Relative Humidity [%]

A: Original Sectional Area [in²]

Li: Initial Specimen Length [in]

Lf: Final Specimen Length [in]

Wo: Initial Sample Width [in]

Lp: Final Gage Length [in]

Er: Rate of Elongation [in/min]

Et: Temporary Elongation [%]

Ep: Permanent Elongation [%]

Pr: Tensile Force to Rupture [lb]

TS: Tensile Strength [lb/in²]

Table 4.
Stripcoat TLC Free – Rectangular Shape

SPRAYING

Application Date: 06/23/98
 Application Time: 10:00 A.M.
 Temperature During Drying: 74.4°F
 Relative Humidity During Drying: 46.7%
 Wet Film Thickness: 50 mils

CUTTING

Cutting Date: 06/25/98
 Cutting Time: 8:15A.M.
 Temperature During Cutting: 73.2 °F
 Relative Humidity During Cutting: 41.7%

AVG. DRY FILM														
THICKNESS [in]	TEST #	TIME	T [°F]	R.H [%]	A [in ²]	Li [in]	Lf [in]	Wo [in]	Lp [in]	Er [in/min]	Et [%]	Ep [%]	Pr [lb]	TS [lb/in ²]
0.0257	1	2:20	73.6	47.8	0.01928	0.6880	12.000	0.7500	1.5000	10.07	1644	100	0.60	31.13
0.0258	2	2:25	74.1	48.7	0.01935	0.7500	12.000	0.7500	1.5000	10.04	1500	100	20.00	1033.59
0.0244	3	2:27	74.0	49.1	0.0183	0.7500	12.000	0.7500	1.5000	10.08	1500	100	20.00	1092.90
0.0263	4	2:31	74.4	48.5	0.01973	0.7500	12.000	0.7500	1.1250	10.07	1500	50	20.00	1013.94
0.0248	5	2:36	74.1	47.9	0.0186	0.7500	12.000	0.7500	1.0630	10.13	1500	42	0.60	32.26
0.0234	6	2:40	74.6	47.8	0.01755	0.8130	12.000	0.7500	1.1250	10.07	1376	50	20.00	1139.60
0.0243	7	2:43	74.4	47.6	0.01823	0.7500	10.375	0.7500	1.1250	10.13	1283	50	0.60	32.92
0.0244	8	2:47	74.6	47.2	0.0183	0.6880	10.938	0.7500	1.1250	10.14	1490	50	0.60	32.79
0.0244	9	2:51	74.6	47.3	0.0183	0.7500	12.000	0.7500	1.1250	10.14	1500	50	20.00	1092.90
0.0251	10	2:54	74.9	46.6	0.01883	0.7500	11.000	0.7500	1.0630	10.15	1367	42	0.62	32.93

TEST #: Specimen Test Number

T: Temperature [°F]

R.H.: Relative Humidity [%]

A: Original Sectional Area [in²]

Li: Initial Specimen Length [in]

Lf: Final Specimen Length [in]

Wo: Initial Sample Width [in]

Lp: Final Gage Length [in]

Er: Rate of Elongation [in/min]

Et: Temporary Elongation [%]

Ep: Permanent Elongation [%]

Pr: Tensile Force to Rupture [lb]

TS: Tensile Strength [lb/in²]

Table 5.
Tech Sol 8002 – Dumbbell Shape

SPRAYING
Application Date: 06/16/98
Application Time: 9:30 A.M.
Temperature During Drying: 73.8 °F
Relative Humidity During Drying: 50.6%
Wet Film Thickness: 14-16 mils

CUTTING
Cutting Date: 06/23/98
Cutting Time: 8:45 A.M.
Temperature During Cutting: 74.1 °F
Relative Humidity During Cutting: 44.0%

AVG. DRY FILM THICKNESS [in]	TEST #	TIME	T [°F]	R.H [%]	A [in²]	Li [in]	Lf [in]	Wo [in]	Lp [in]	Er [in/min]	Et [%]	Ep [%]	Pr [lb]	TS [lb/in²]
0.0036	18	3:25	74.5	47.3	0.001	2.500	12.000	0.250	1.063	10.020	380	325	20.00	22222.22
0.0043	17	3:40	74.5	47.3	0.001	2.438	12.000	0.250	1.063	9.990	392	325	20.00	18604.65
0.0037	1	3:45	74.2	47.8	0.001	2.500	12.000	0.250	1.063	10.010	380	325	20.00	21621.62
0.0038	2	3:50	74.5	47.8	0.001	2.438	12.000	0.250	1.125	9.990	392	350	20.00	21052.63
0.0039	3	4:02	74.7	47.2	0.001	2.500	12.000	0.250	1.063	10.010	380	325	20.00	20512.82
0.0044	4	11:08	73.7	47.0	0.001	2.625	12.000	0.250	1.125	10.020	357	350	20.00	18181.82
0.0054	5	11:15	73.6	46.8	0.001	2.500	12.000	0.250	1.125	10.030	380	350	20.00	14814.81
0.0054	6	11:18	73.8	46.7	0.001	2.438	12.000	0.250	1.125	10.020	392	350	20.00	14814.81
0.0045	7	11:24	73.7	46.7	0.001	2.438	12.000	0.250	1.125	9.970	392	350	20.00	17777.78
0.0046	8	11:30	73.9	47.2	0.001	2.438	12.000	0.250	1.063	10.040	392	325	20.00	17391.30
0.0042	9	11:35	74.2	47.0	0.001	0.563	12.000	0.250	1.063	10.040	2031	325	20.00	19047.62
0.0041	10	11:40	74.1	47.0	0.001	2.500	12.000	0.250	1.125	10.030	380	350	20.00	19512.20

TEST #: Specimen Test Number

Li: Initial Specimen Length [in]

Er: Rate of Elongation [in/min]

TS: Tensile Strength [lb/in²]

T: Temperature [°F]

Lf: Final Specimen Length [in]

Et: Temporary Elongation [%]

R.H.: Relative Humidity [%]

Wo: Initial Sample Width [in]

Ep: Permanent Elongation [%]

A: Original Sectional Area [in²]

Lp: Final Gage Length [in]

Pr: Tensile Force to Rupture [lb]

APPENDIX F

DECONTAMINATION FACTOR RESULTS

Strippable Coating	Disk Test Preparation (U, Th, Cs)	Beta Before Coating	Net cpm ¹	Beta after Removal	Net cpm ¹
		Counts/Time		Counts/Time	
Survey Reading Time =		60 min		60 min	
ALARA™1146	1	5472	48.98	3592	23.45
	2	6137	60.00	3586	23.35
	3	5350	46.89	3502	21.95
AVERAGE			51.94		22.91
STANDARD DEVIATION			7.06		0.84
DECONTAMINATION FACTOR: 2.27					
JDL #GP-RDM	1	6727	76.32	5050	51.12
	2	5294	52.43	4047	34.40
	3	5327	52.98	3959	32.93
AVERAGE			60.58		39.48
STANDARD DEVIATION			13.63		10.10
DECONTAMINATION FACTOR: 1.53					
Pentek -603	1	5510	56.75	2823	14.00
	2	5624	58.65	2724	12.35
	3	5296	53.19	2725	1.10
AVERAGE			56.20		12.91
STANDARD DEVIATION			2.78		0.95
DECONTAMINATION FACTOR: 4.35					
Stripcoat TLC	1	4679	40.88	3426	23.27
	2	5309	51.38	3718	28.14
	3	5100	47.90	3562	25.54
AVERAGE			46.72		25.56
STANDARD DEVIATION			5.35		2.44
DECONTAMINATION FACTOR: 1.87					
Stripcoat TLC FREE	1	5127	48.35	3253	20.39
	2	5481	54.25	3523	24.89
	3	5917	61.52	3672	27.37
AVERAGE			54.71		24.21
STANDARD DEVIATION			6.60		3.54
DECONTAMINATION FACTOR: 2.26					

NOTE: ¹cpm= counts per minuteDecontamination Factor = Initial Contamination / Final Contamination (DF = A₀/A_f)

APPENDIX G

PRODUCT QUESTIONNAIRE – SRS FACILITY

Strippable Coating Name: _____

Evaluator's Name: _____

Date: _____

1. Physical Description of Strippable Coating Prior to Use:

a) Viscosity:

- ☐ Liquid
- ☐ Syrupy
- ☐ Gummy
- ☐ Pasty

b) Phase Separation:

(Liquid/Solid) or (Liquid/Liquid)

- ☐ No
- ☐ Yes, Explain: _____

c) Mixing Difficulty:

- ☐ How Long? _____ min.
- ☐ Very Easy _____ Easy _____ Hard _____

d) Odor:

- ☐ None ☐ Pleasant
- ☐ Strong ☐ Unpleasant

2. Was the strippable coating treated prior to application?

- ☐ No
- ☐ Diluted, Explain: _____
- ☐ Filtered, Explain: _____

Application Process:

1. Qualitative Description on the use of the Spray Applicator:

(eg. problems with spray applicator, ease of setup, etc.)

2. Description of Coating Application:

- ☐ Running or Dripping
- ☐ Discoloration upon application
- ☐ Other: _____

3. Describe ease of application of strippable coating:

- ☐ Easy to apply
- ☐ Okay to apply, but not really easy
- ☐ Difficult to apply

Why?

Post Application:***Dry Appearance:***

- ☐ Rough
- ☐ Smooth
- ☐ Blistering:
(See appended page for scale)
 - Few
 - Medium
 - Medium Dense
 - Dense
- ☐ Cracking:
 - No
 - Yes, High Medium Low
- ☐ Separated from surface
- ☐ Warped (ie. wrinkled, lumpy, distorted)
- ☐ Curled at corners or along edges
- ☐ Sticky Surface

Coating Removal:

1. *Was the coating easy to remove?*

- ☐ Yes, minimal work to remove. Majority of pieces were:
 - ☐ Large strips or pieces (>12")
 - ☐ Medium pieces (4" to 12")
 - ☐ Small pieces (<4")
- ☐ No, it took real effort to get off
- ☐ Didn't come off
- ☐ Self-stripped (Came off by itself)
 - ☐ All
 - ☐ Partial, What percentage _____%

2. *Describe any problems encountered during the removal process.*

OVERALL EVALUATION

Would you recommend using this strippable coating for other decon jobs?

- ☐ Yes, Why? _____

- ☐ No, Why? _____

APPENDIX H

SURFACE CONDITIONS*

* NOTE: Pre and post survey readings must be taken at the same points; Also, the strippable coatings' layouts need to be displayed on each grid survey.

Evaluator's Name: _____

Date: _____

SURFACE	SURFACE TYPE	LOCATION	SURFACE DESCRIPTION (before application)	DIMENSIONS (L x W) in ²	PRE-CONTAMINATION LEVEL	POST-CONTAMINATION LEVEL
					HP Survey ID #	HP Survey ID #
Casting Furnace Enclosures	Carbon Steel & Plexiglass	Casting Room	☐ Dusty ☐ Oily ☐ Scratched ☐ Rough ☐ Smooth		Pre-FA Pre-FB Pre-FC	Post-FA Post-FB Post-FC
Log Storage Room Walls	Carbon Steel	Machining Room	☐ Dusty ☐ Oily ☐ Scratched ☐ Rough ☐ Smooth		Pre-LSRW	Post-LSRW
Angle Iron Racks	Carbon & Stainless Steel	Log Storage Room	☐ Dusty ☐ Oily ☐ Scratched ☐ Rough ☐ Smooth		Pre-LST	Post-LST
Scrap Rack Carts	Carbon Steel	Casting Room	☐ Dusty ☐ Oily ☐ Scratched ☐ Rough ☐ Smooth		Pre-SRC	Post-SRC

APPENDIX I

DATA COLLECTION SHEETS

LOCATION: _____

Evaluator's Name: _____

APPLICATION					REMOVAL			
Product	Date/Time	Volume Applied (gal)	Wet Color	Wet Film Thickness (mils)	Date/Time	Dry Color	Surface Description	Coating Weight (lbs)
ALARA 1146	Date: Start: Finish:			1.	Date: Start: Finish:		☐ Sticky	
				2.			☐ Oily	
				3.			☐ Residue ☐ Rough ☐ Smooth	
JDL #GP-RDM	Date: Start: Finish:			1.	Date: Start: Finish:		☐ Sticky	
				2.			☐ Oily	
				3.			☐ Residue ☐ Rough ☐ Smooth	
TECH SOL 8001	Date: Start: Finish:			1.	Date: Start: Finish:		☐ Sticky	
				2.			☐ Oily	
				3.			☐ Residue ☐ Rough ☐ Smooth	
TECH SOL 8002	Date: Start: Finish:			1.	Date: Start: Finish:		☐ Sticky	
				2.			☐ Oily	
				3.			☐ Residue ☐ Rough ☐ Smooth	
PENTEK-604	Date: Start: Finish:			1.	Date: Start: Finish:		☐ Sticky	
				2.			☐ Oily	
				3.			☐ Residue ☐ Rough ☐ Smooth	
TLC FREE	Date: Start: Finish:			1.	Date: Start: Finish:		☐ Sticky	
							☐ Oily	
							☐ Residue ☐ Rough ☐ Smooth	

APPENDIX J

DURABILITY TEST: DAYS (15, 30, 60, 90, 180)

Evaluator's Name: _____

Date: _____

HP Survey ID #: _____

COATING MATERIAL	COLOR	APPEARANCE	COATING REMOVAL	PROBLEMS/COMMENTS
1146 ALARA		☐ Smooth ☐ Brittle ☐ Cracked ☐ Dried Out ☐ Other: _____	☐ Large strips (>12") ☐ Medium pieces (4" – 12") ☐ Small pieces (<4") ☐ Difficult, How much was left: _____ % ☐ Didn't come off ☐ Self-stripped, what percentage _____ %	
TECH SOL 8001		☐ Smooth ☐ Brittle ☐ Cracked ☐ Dried Out ☐ Other: _____	☐ Large strips (>12") ☐ Medium pieces (4" – 12") ☐ Small pieces (<4") ☐ Difficult, How much was left: _____ % ☐ Didn't come off ☐ Self-stripped, what percentage _____ %	
TECH SOL 8002		☐ Smooth ☐ Brittle ☐ Cracked ☐ Dried Out ☐ Other: _____	☐ Large strips (>12") ☐ Medium pieces (4" – 12") ☐ Small pieces (<4") ☐ Difficult, How much was left: _____ % ☐ Didn't come off ☐ Self-stripped, what percentage _____ %	
TLC FREE		☐ Smooth ☐ Brittle ☐ Cracked ☐ Dried Out ☐ Other: _____	☐ Large strips (>12") ☐ Medium pieces (4" – 12") ☐ Small pieces (<4") ☐ Difficult, How much was left: _____ % ☐ Didn't come off ☐ Self-stripped, what percentage _____ %	

APPENDIX K

DURABILITY TEST

CONTAMINATION LEVELS							
SURFACE	INITIAL	24 HOURS	15 DAYS	30 DAYS	60 DAYS	90 DAYS	180 DAYS
	HP Survey ID #	HP Survey ID #	HP Survey ID #	HP Survey ID #	HP Survey ID #	HP Survey ID #	HP Survey ID #
Log Storage Room Wall	Pre-LSRW	Post-LSRW	Post-LSRW.15	Post-LSRW.30	Post-LSRW.60	Post-LSRW.90	Post-LSRW.180