

INEEL-97054415

LOCKHEED MARTIN



Lockheed Martin Idaho Technologies Company

## NOTEGRAM

**Date:** February 11, 1997

**To:** Julie A. Hart, MS 3805

**From:** Larry J. Whitmill MS 3765

**Subject:** CRADA NO. 96-CR-07 CLOSEOUT -LJW-01-97 *wlb*

Julie;

Please find attached the LDRD final closure document. Also included is an abstract sent to RWMC personnel as a follow up to the LDRD work. My CRADA partner Dura-Guard Coatings received copies of these documents on 10/18/96 and are aware of the closure of the CRADA partnership.

There were no subject inventions as a result of this work. An invention disclosure document was filed, however both LMITCO and DOE declined to retain rights to the patents and they were not pursued further.

This notegram serves to close out my CRADA activities and forward a copy of the LDRD closure documents to you for your files.

If I can be of any further assistance or you have any questions, feel free to call me at 6-0357.

.cc LDRD project file 2192  
L. J. Whitmill letter file

MASTER

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# **DISCLAIMER**

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**STI BENEFITS CHECKLIST**

CRADA NO.: 96-CR-07 CRADA COMPLETION DATE: 10/18/96

PARTNER: DURA-GUARD COATINGS

PRINCIPAL INVESTIGATOR(S): Larry J. Whitmill

ACCOUNT EXECUTIVE: A. Patrick Pinto

MARK "X" in the appropriate response.

BENEFITS REALIZED?        X   YES           NO

LIST: No test failures. Based on this testing, we now have assurance that waste containers having suffered loss of integrity can be refurbished to meet performance requirements for transportation packaging and WIPP storage, and provide safe long term interim storage at a fraction of the cost of repackaging. Drummed waste all over the U.S. in storage waiting for WIPP to open can benefit from this process. Leaking or severely damaged drums can also be coated providing a containment to allow overpacking rather than removing the contents and repackaging. Radiation exposure and handling cost can be significantly reduced. With support and proper marketing this process can lead us into many problem solving activities within the national infrastructure, DOD, and the waste handling industry.

(Provide a brief summary of the benefits derived as a result of the CRADA; e.g. Subject Inventions, new capabilities, additional work, new business, etc.)

**CONSTRAINTS/EXTERNAL INFLUENCES**

(NOTE: If activity was considered unsuccessful, select one or more of the following reasons.)

- |   |  |
|---|--|
| <u>    </u> Technical or manufacturing problems | <u>    </u> Changes in market conditions   |
| <u>    </u> Funding Availability                | <u>    </u> Competing Technology           |
| <u>    </u> Personnel Changes                   | <u>    </u> Legislative/Regulatory Impacts |
| <u>    </u> Work Scope Changes                  | <u>    </u> Changes in Partner Objectives  |
| <u>    </u> Other: _____                        |  |

**FOLLOW-ON ACTIVITIES**

(NOTE: If applicable, identify one or more follow-on activities that resulted from the CRADA. Place an (x) if applicable and provide a number in the line following the selection to indicate how many, e.g.   x   CRADAs, #   2  . This indicates that your activity resulted in two follow-on CRADAs.

- |                                   |                      |                               |               |
|-----------------------------------|----------------------|-------------------------------|---------------|
| <u>    </u> CRADAS                | # <u>    </u>        | <u>    </u> Licenses          | # <u>    </u> |
| <u>    </u> Cost-shared Contracts | # <u>    </u>        | <u>    </u> Copyrights        | # <u>    </u> |
| <u>    </u> Invention Disclosures | # <u>    </u>        | <u>    </u> Reimbursable WFO  | # <u>    </u> |
| <u>    </u> Technical Assistance  | # <u>    </u>        | <u>    </u> Use of Facilities | # <u>    </u> |
| <u>    </u> Patent Applications   | # <u>    </u> Non US | # <u>    </u>                 |               |
| <u>    </u> Other: _____          |                      |                               |               |

Were Any Awards Given?           YES        X   NO

Project Number: 2192  
Title: Waste Drum Refurbishment  
Principal Investigator: Larry J. Whitmill

## ABSTRACT

Low-carbon steel, radioactive waste containers (55-gallon drums) are experiencing degradation due to moisture and temperature fluctuations. With thousands of these containers currently in use; drum refurbishment becomes a significant issue for the taxpayer and stockholders. This drum refurbishment is a non-intrusive, portable process costing between 1/2 and 1/25 the cost of repackaging, depending on the severity of degradation. At the INEL alone, there are an estimated 9,000 drums earmarked for repackaging. Refurbishing drums rather than repackaging can save up to \$45,000,000 at the INEL.

Based on current but ever changing WIPP Waste Acceptance Criteria (WAC), this drum refurbishment process will restore drums to a WIPP acceptable condition plus; drums with up to 40% thinning of the wall can be refurbished to meet performance test requirements for DOT 7A Type A packaging. A refurbished drum provides a tough, corrosion resistant, waterproof container with longer storage life and an additional containment barrier.

Drums are coated with a high-pressure spray copolymer material approximately .045 inches thick. Increase in internal drum temperature can be held to less than 15°F. Application can be performed hands-on or the equipment is readily adaptable and controllable for remote operations. The material dries to touch in seconds, is fully cured in 48 hours and has a service temperature of -60° to 500°F. Drums can be coated with little or no surface preparation.

This research was performed on drums however research results indicate the coating is very versatile and compatible with most any material and geometry. It could be used to provide abrasion resistance, corrosion protection and waterproofing to almost anything.

## FY 96 TECHNICAL OBJECTIVES

1. Seek out requirements and demonstrate the concept to interested parties.
2. Procure test materials and specimens.
3. Refurbish drums and perform DOT and corrosion tests.
4. Evaluate test results and prepare final documentation.

## FY 96 TECHNICAL ACCOMPLISHMENTS

Container integrity is a key issue in storage, transport, and management of radioactive waste. It is a concern to the temporary storage custodian, the shipper, the transporter and the receiver at the final repository. Since responsibility is transferred several times throughout the life of a waste package, container integrity becomes a widespread concern. Unfortunately container integrity only poses a problem for the current custodian. It is their responsibility to store and/or handle the waste package safely and to ensure that the package will meet the acceptance criteria of its next custodian.

Container integrity -or loss of it- is recognized as a problem common to DOE sites. The components that make up the packaging are the only barriers between the waste and the environment. Generally this packaging is made up of some combination of plastic bags, inner poly-liners and the steel drum itself with or without filter vents. Currently, container integrity is gauged by external appearance and in some cases nondestructive metal-thickness testing.

Representative samples from container inventories at the INEL have been evaluated for container integrity. Approximately 7% were rejected or marked for overpack. Of that 7%, approximately 84% were marked for overpack due generally to rust and dents. In all but the most severe cases this drum refurbishment process can bring those 84% back into an acceptable condition. This testing demonstrates that a drum wall thickness of .059 inches (16 gauge) corroded down to .036 inches (20 gauge) can be refurbished and pass the DOT 7A Type A performance tests. That is approximately a 40% loss of wall thickness.

The drum refurbishment is accomplished by spray-coating the exterior with a rust inhibiting, highly abrasion resistant polymeric material. The coating material, applied at high pressure and relatively low temperature, is fast curing, simple to apply, emits no volatile organic compounds (VOC's), and adheres to almost any surface. This waterproof, one piece membrane can be applied at temperatures down to freezing, either indoors or outside.

Container preparation for spray coating can range from nothing, to media blasting the exterior surface. Although the coating can be applied over the top of rust and adheres very well; there may be cases when it is desirous to clean an area or to roughen a surface for better adhesion.

## **TESTING AND EVALUATION**

Testing was performed at Dura-Guard Coatings facility located at 803 Lindsay Blvd. in Idaho Falls, Id. Drums were tested and evaluated in accordance with the DOT 7A Type A requirements. The testing involved subjecting refurbished drums containing simulated radioactive contents to prescribed tests.

To establish the feasibility of refurbishing drums using this method, the worst case was used for testing. Since it is obvious a drum completely coated with this waterproof membrane is waterproof, water spray tests were not performed. Compression tests and penetration tests were performed only on the weakest specimen, since if the weakest one passes the others will obviously pass. The free drop test from 4 feet was performed on all test specimen. Container contents were simulated with fine powder in this case flour.

The acceptance criteria for the drop test, compression test, and penetration test is no loss or dispersal of radioactive contents. The accepted method of verification is no visible loss when using finely divided material, such as flour or cement dust. This is the same method of verification used in all DOE evaluations of this packaging type.

The compression test consists of a compressive load of 5,000 pounds for a period of 24 hours. The penetration test is a 1 1/4 " diameter bar with hemispherical head weighing 13.2 pounds dropped longitudinally on the weakest point of the container from a distance of 3.3 feet. The free drop test is a 4 foot drop of a drum weighing 1,000 pounds onto its side impacting the bolt closure ring (BCR) and the drum seam, and an angle drop (approximately 45°) impacting the corner of the drum at the intersection of the BCR and the drum seam.

Standard DOT certified drums were coated and drop tested to establish a baseline. Specialty drums with 20 gauge walls were obtained to represent drums with 40% loss of wall thickness. These drums were coated and tested. A single drum was tested repeatedly until all tests were complete. In every case there were no drum failures. The strength of this product is best demonstrated by testing a DOT certified drum using the most severe 4 foot drop test we could imagine. That is, a drum filled to capacity with water, closed, coated and tested. Again no failures, even after repeated tests on the same specimen.

## **NEW OR INCREASED TECHNICAL CAPABILITY AT THE INEL**

Based on this testing we now have assurance that waste containers having suffered loss of integrity can be refurbished to meet performance requirements for transportation packaging and WIPP storage, and provide safe long term interim storage at a fraction of the cost of repackaging. Drummed waste all over the U.S. in storage waiting for WIPP to open can benefit from this process. Leaking or severely damaged drums can also be coated providing a containment to allow overpacking rather than removing the contents and repackaging. Radiation exposure and handling cost can be significantly reduced.

## **BUSINESS DEVELOPMENT OPPORTUNITIES**

This research was conducted under a CRADA with Dura-Guard Coatings, a locally owned and operated small business in Idaho Falls. They currently provide their services and products regionally and are prepared to support drum refurbishment activities at the INEL. They plan to market this process with the other labs and private utilities. LITCO has declined patent ownership however DOE is still interested and is awaiting the result of the LDRD research. Familiarization with the product tends to broaden the areas that can potentially benefit from this coating for example roads and bridges, tanks and containments, and leaking chemical warfare containers. With support and proper marketing this process can lead us into many problem solving activities within the national infrastructure, DOD, and the waste handling industry.

## **ABSTRACT**

Low-carbon steel, radioactive waste containers (55-gallon drums) are experiencing degradation due to moisture and temperature fluctuations. With thousands of these containers currently in use; drum refurbishment becomes a significant issue for the taxpayer and stockholders. This drum refurbishment is a non-intrusive, portable process costing between 1/2 and 1/25 the cost of repackaging, depending on the severity of degradation. At the INEL alone, there are an estimated 9,000 drums earmarked for repackaging. Refurbishing drums rather than repackaging can save up to \$45,000,000 at the INEL.

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Drums are coated with a high-pressure spray copolymer material approximately .045 inches thick. Increase in internal drum temperature can be held to less than 15°F. Application can be performed hands-on or the equipment is readily adaptable and controllable for remote operations. The material dries to touch in seconds, is fully cured in 48 hours and has a service temperature of -60° to 500°F. Drums can be coated with little or no surface preparation.

This research was performed on drums however research results indicate the coating is very versatile and compatible with most any material and geometry. It could be used to provide abrasion resistance, corrosion protection and waterproofing to almost anything.

## **REQUIREMENTS**

The following is a list of requirements and wants for refurbished drums.

*Must meet the tests and conditions of 49 CFR 173.465 including:*

Each package must pass the following tests without leakage or dispersal of contents for each of the content forms: form 1, fine powder; form 2, sand; and form 3, solids.

### **DROP TEST**

Free drop onto an unyielding surface from 4 feet, under maximum load conditions in a manner that causes maximum damage.

### **WATER SPRAY TEST**

Simulate exposure to rain of approximately 2 inches per hour for at least one hour.

### **COMPRESSION TEST**

Add a compressive load of 5,000 lbs. to the top of a drum for a minimum of 24 hours.

### **PENETRATION TEST**

A bar 1.25 inches in diameter with a hemispherical head and weighing 13.2 pounds, dropped from 3.3 feet with its longitudinal axis vertical onto the center of the weakest part.

Must have the ability to mark and label the drum.

Must be able to be decontaminated.

Must have a mechanism for tamper indication.

*The method of refurbishment will ideally provide the following additional properties:*

Abrasion resistance

Rust inhibiting

In-Situ application

No container preparation required

Hands-on or remote operation

Allow handling with standard equipment

Does not increase the fire load during storage at RWMC

Fire retardant/ fireproof for WIPP

WIPP acceptable

No VOC's

Create no new hazardous waste streams

Can be applied without generating enough heat to increase internal pressure substantially

No special permitting required

Spot repairs and coatings

Good adherence

Quick curing/drying

Applied indoors/outdoors

Applied during extreme temperature conditions

Mobility

Variable, controllable application thickness

### **TEST DESCRIPTION**

Drum testing was fashioned after DOT evaluation testing. Drums were loaded and tested to replicate the DOT evaluations as closely as possible.

Drums were loaded with a 4" layer of flour, a 4" layer of sand, 600 lbs of metal with oats filler, 4" sand, and 4" of flour. Drums were loaded to 922 lbs. Test drums for DOT evaluations are loaded to 900 lbs.



Drums were loaded, the lid and seal placed on the drum, and the bolt ring tightened to 40 ft-lbs while tapping the ring. A coating approximately .045 in. thick was applied and allowed to cure for 36 hours.

A single drum was then put through the battery of tests including dropping the same drum twice, once on its side, and once on 45° angle on the corner of the bolt closure. Deformation is acceptable however any loss of contents qualifies as failure.

All drums passed with no failures. Drums suffered significant deformation but no loss of contents.

In addition to the DOT testing an additional test was performed just as a scoping test. For this test a drum was filled with water, closed, and coated. The 4 foot drop test was then performed; again no failures. This was significant in that; from a conversation with a member of the DOT evaluation team it was learned that in the earliest stages of developing the test acceptance criteria, the team tried this same test with no successes.

Based on DOE evaluations of DOT 7A Type A packaging for 55-gallon drums (MLM-3245, 1987), drums loaded with form 1 contents must be packaged with specific restrictions. These restrictions are beyond what is required for forms 2 and 3 since it is more difficult to contain fine powders than the courser materials. In addition to what is required for forms 2 & 3, drums containing form 1 material must have:

**DOT 17C Steel Drum (55-gal)** For form 1 an inner bag (4-mil or greater) is required in order to pass the drop test. RTV may be used in lieu of the 4-mil bag.

**DOT 17C Steel Drum (55-gal) with pressure relief device** For form 1 an inner bag (4-mil or greater) and a 90-mil HDPE or equivalent are required in order to pass the drop test.

*(NOTE) For purposes of this refurbishment testing, drums with pressure reliefs were not tested. Any precautions taken due to the presence of the pressure relief would be expected to apply as well to refurbished drum.*

**DOT 17C/90-mil HDPE liner 55-gal drum** For form 1 contents, a closed (not necessarily sealed with an adhesive) 90-mil HDPE liner is required to pass the 4-ft. drop test.

**DOT 17H Steel Drum (55-gal)** For form 1 contents, RTV sealant or equivalent must be applied to the surface of the gasket in contact with the drum body.

For this drum refurbishing testing there were no inner bags, no HDPE liners nor any RTV sealant used. This implies that with coated drums the integrity of the bags, liners and sealants is not a concern.

## COST BENEFIT ANALYSIS

The cost benefits from drum refurbishment are realized in three distinct areas: operations, transportation and storage. Degraded drums can be prepared for shipment to WIPP in three different ways: refurbishment, overpacking into a larger container, or repackaging (removing the contents and repackaging into a new 55-gallon drum).

Operations cost for drum refurbishment are \$75 for material. Operations costs for overpacking include the cost of new containers; a poly-lined 83-gallon overpack \$200 each and ten-drum overpacks (TDOP) approximately \$50 each, or a Standard Waste Box (SWB) at \$1,200 each. Handling costs associated with overpacking are equivalent to those associated with refurbishment and therefore no savings is realized. However in the case of a drum earmarked for repackaging, operations and handling costs are approximately \$2,500 per drum. Although not included in this cost benefit analysis, repackaging is adding to the total inventory of waste for disposal or storage.

Standard 55-gallon drums, SWBs, and TDOPs are authorized shipping containers for shipment in the TRUPACT-II for shipments to WIPP. Up to three TRUPACT-IIs can be shipped per truckload. A TRUPACT-II can hold (14) 55-gallon drums (2 stacked 7-packs) or; (2) SWBs; or 1 TDOP. A SWB can hold (4) 55-gallon drums and a TDOP can handle (10) 55-gallon drums. A truckload can contain any combination of the three TRUPACT-II configurations. Therefore a single truckload can carry 42 good or refurbished drums down to 24 damaged drums.

Since there are no additional transportation or storage costs associated with drum refurbishment it can be used as the baseline for the cost benefit over overpacking or repackaging. Since both these options take up more space there will be fewer containers per shipment requiring more shipments and more storage space at WIPP. Additional cost for shipping and storage could easily exceed \$5,000 per drum.