Installation of Corrosion Control Solutions During System RESET

John Repp – Elzly Technology Corporation
I. Carl Handsy – US Army TACOM
Matthew Koch – USMC CPAC Program Office
<table>
<thead>
<tr>
<th>1. REPORT DATE</th>
<th>2. REPORT TYPE</th>
<th>3. DATES COVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEB 2009</td>
<td></td>
<td>00-00-2009 to 00-00-2009</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. TITLE AND SUBTITLE</th>
<th>5a. CONTRACT NUMBER</th>
<th>5b. GRANT NUMBER</th>
<th>5c. PROGRAM ELEMENT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation of Corrosion Control Solutions During System RESET</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. AUTHOR(S)</th>
<th>5d. PROJECT NUMBER</th>
<th>5e. TASK NUMBER</th>
<th>5f. WORK UNIT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</th>
<th>8. PERFORMING ORGANIZATION REPORT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Army TACOM, 6501 E. 11 Mile Rd., Warren, MI 48397-5000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</th>
<th>10. SPONSOR/MONITOR’S ACRONYM(S)</th>
<th>11. SPONSOR/MONITOR’S REPORT NUMBER(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12. DISTRIBUTION/AVAILABILITY STATEMENT</th>
<th>13. SUPPLEMENTARY NOTES</th>
<th>14. ABSTRACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved for public release; distribution unlimited</td>
<td>2009 U.S. Army Corrosion Summit, 3-5 Feb, Clearwater Beach, FL</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15. SUBJECT TERMS</th>
<th>16. SECURITY CLASSIFICATION OF:</th>
<th>17. LIMITATION OF ABSTRACT</th>
<th>18. NUMBER OF PAGES</th>
<th>19a. NAME OF RESPONSIBLE PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. REPORT</td>
<td>Same as Report (SAR)</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>unclassified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. ABSTRACT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>unclassified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. THIS PAGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>unclassified</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard Form 298 (Rev. 8-98)  
Prescribed by ANSI Std Z39-18
Background

- Corrosion of ground weapon systems results in significant monetary costs
  - LMI Army Cost of Corrosion Report - $2B annually
  - LMI USMC Cost of Corrosion Report - $0.7B annually
- Some vehicles, such as legacy systems may be predisposed to corrosion
- For modern weapon systems exposure to corrosive environments and / or repair may reduce the corrosion control systems
- Upgrade or restoration of the corrosion control systems is needed
OSD Project Overview

- Incorporating proven and commercially available corrosion control technologies
- Leveraging the opportunities system RESET affords us
- Working with the PMs, OEMs and organizations performing RESET activities
- Demonstrating appropriate technologies for the weapon system
- Determining the ROI of the installation
Why Upgrading During RESET Makes Sense

- RESET provides an ideal opportunity to insert corrosion control technologies
- Weapon systems are typically largely disassembled to facilitate repair
- Worn out / broken components are repaired
- Complete coating removal and reapplication is already planned
- Facilities already have equipment and skilled workers to perform these activities
Technology Examples

- Paints and coatings
  - Zinc-rich
  - High-build polyurethane
- Plating and metalizing
  - Zinc and aluminum alloys
  - High purity non-aqueous aluminum plating
- Part replacement
  - Corrosion resistant parts
  - Non-metallic components
  - Part upgrade (e.g., galvanized body panels)
Technology Example – High Build Polyurethane Coating
Demonstrated Benefits – Zinc-rich Coatings

- Widespread use on infrastructure elements (e.g., bridges and highways)
- Used on modern weapon systems (e.g., USMC MTVR)
- Past Army project demonstrated benefit
  - 7-years in marine environment
  - Compared to traditional CARC system over steel
  - Negligible deterioration of zinc-rich material
Demonstrated Benefits – Non-aqueous Electroplated Aluminum

- Potential drop-in replacement for Cadmium
- Does not demonstrate hydrogen embrittlement / environmentally assisted cracking issues
- Able to match torque / tension requirements for Cadmium (with dry-film lubricant)
- Performs well with trivalent chrome rinse
- Technology used by
  - Joint Strike Fighter (JSF)
  - BMW, VW and Volvo in automotive applications
Demonstrated Benefits – Galvanized Body Panels

- Galvanized sheet steel is commonly used in commercial automotive applications
- Manufacturing components out of galvanized steel is readily accomplished
- Modern Example
  - FMTV vehicles originally used carbon steel on cabs and experienced corrosion issues
  - Subsequent cabs were upgraded to galvanized steel with no reported issues

- On body panels (like doors) corrosion often occurs along the bottom seam
  - Collection point for contaminants
  - No drainage / ability to clean out contaminants
**First Platform – Stryker**

<table>
<thead>
<tr>
<th>Non-aqueous Electroplated Aluminum</th>
<th>High Build Polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Majority of Cadmium replaced</td>
<td>Concerns exist in wheel areas</td>
</tr>
<tr>
<td>Hex-chrome rinse still being used</td>
<td>High impact area where coating loss can progress</td>
</tr>
<tr>
<td>Some components still use Cadmium</td>
<td>Once voids occur corrosion can progress rapidly</td>
</tr>
<tr>
<td>Looking toward material as a single, drop-in replacement</td>
<td>Considering chip-resistant materials for this application</td>
</tr>
</tbody>
</table>
Other Platforms

- **HMMWV**
  - Review of past corrosion inspection data has identified several potential issues
  - Battery areas and hold-down brackets
  - Reflectors
  - Latches, guides and brackets
  - Material changes or coatings can improve these areas

- **Engineering Equipment**
  - Working with PMs to identify opportunities
  - Typically these are bought to commercial standards
  - Opportunities for the use of zinc-rich coatings on steel components
Other Platforms (cont'd)

- **Trailers**
  - Cargo beds known to be corrosion prone
  - Typically thin-gage sheet steel with CARC coating
  - Coating easily removed with normal installation / removal of cargo
  - Use of chip-resistant materials can reduce this damage and protect both the substrate and CARC coating

- **MRAP vehicles**
  - Rapid procurement resulted in less stringent corrosion control requirements / enforcement
  - Add-on components (e.g., water can brackets, antenna mounts, etc.) are typically carbon steel
  - Opportunity to improve performance with zinc-rich coating and / or replacements
  - Reviewing use of Cadmium on systems for elimination
Single-source Cadmium replacement

Pending outcome of most recent test results, favoring non-aqueous electroplated aluminum

Provides similar or better performance than Cadmium

Working with DLA to determine how to most readily get this into the system

Eliminate the need to specify system-unique requirements

Eliminate recontamination of the system during maintenance
Status of Initiatives

- Non-aqueous electroplated aluminum
  - Review of technical literature near completion
  - Results of current testing expected in next 1-2 months
  - Samples being prepared for Stryker demonstration
- High-build polyurethane coatings
  - Recent work by USMC being considered for implementation
  - During Stryker demonstration review systems for coating demonstration
  - Review of USMC trailer test cases planned
Status of Initiatives (cont'd)

- **HMMWV**
  - Data analysis complete
  - Meeting planned with PM to discuss opportunities and solutions
  - Identify best solutions for implementation and move forward with demonstration

- **Engineering Equipment**
  - Briefed PM on solutions sets
  - Working with them on identification of specific opportunities and test systems

- **Cross-platform initiative**
  - Participating in DoD efforts on Cadmium and Hex-chrome elimination
  - Drafting position letter to be issued by TACOM / TARDEC
Current Schedule

- **Winter / Spring 2009**
  - Stryker demonstrations
  - Polyurethane evaluations
  - Meeting with PM HMMWV and identify demonstration opportunities
  - Follow-up with PM Engineering Equipment
- **Spring / Summer 2009**
  - Complete all demonstrations
  - Revisit Stryker for evaluation of technologies
  - Compile application data for development of work instructions and ROI analysis
- **Fall 2009**
  - Final report on technologies investigated
  - Final maintenance instructions
  - Develop plan for future investigations and ROI validation