AFSPC Metallization Program

Richard E. Bliss
HQ AFSPC/LCMP
richard.bliss@peterson.af.mil

Jim Trammell
SMC/RNP
jim.trammell@rc.patrick.af.mil

Overview

- AFSPC Areas of Corrosion
- Discuss Corrosion Cause and Effect
- Compare Zinc Rich Protective Coatings
- Discuss Coating Application Technology
- Introducing Metallization and Comparisons
- Metallization Application
- Current Applications
- Comparisons

Corrosion Control Areas

- Spacelift
  - Launch Facilities in Support of:

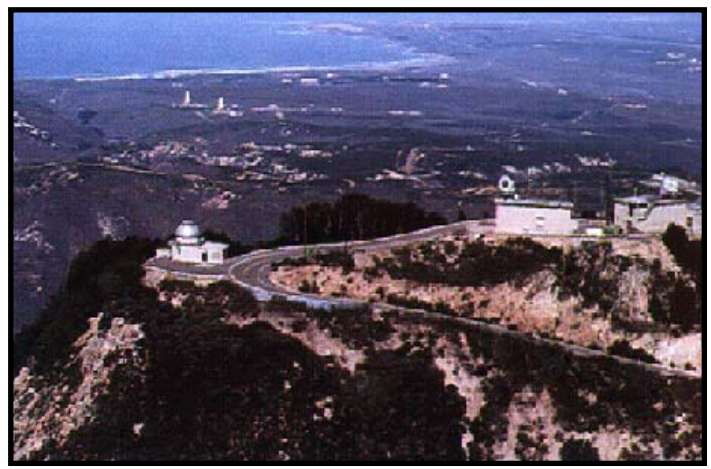
    Atlas

    Delta

    Titan
  - Communications-Electronics

Corrosion Control Areas (cont'd)

- Space Lift
  - Launch Facilities - Cape & Vandenberg
  - Support Equipment (SE)
  - Aerospace Ground Equipment (AGE)
  - Real Property Installed Equipment (RPIE)

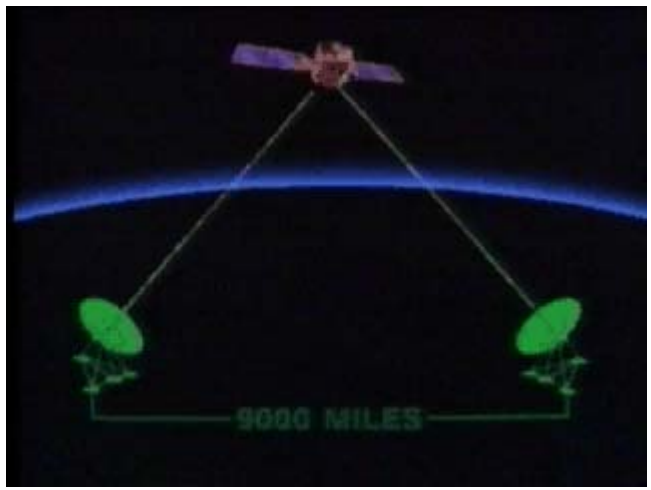


Corrosion Control Areas (cont'd)

- Aircraft
  - UH-1N Helicopters (AFSPC 25)
  - Lead Command for UH-1N (AF 62)
- Intercontinental Ballistic Missiles
  - Minot - 150 MM III
  - Malmstrom - 200 MM III
  - F.E. Warren - 150 MM III & 50 Peacekeepers

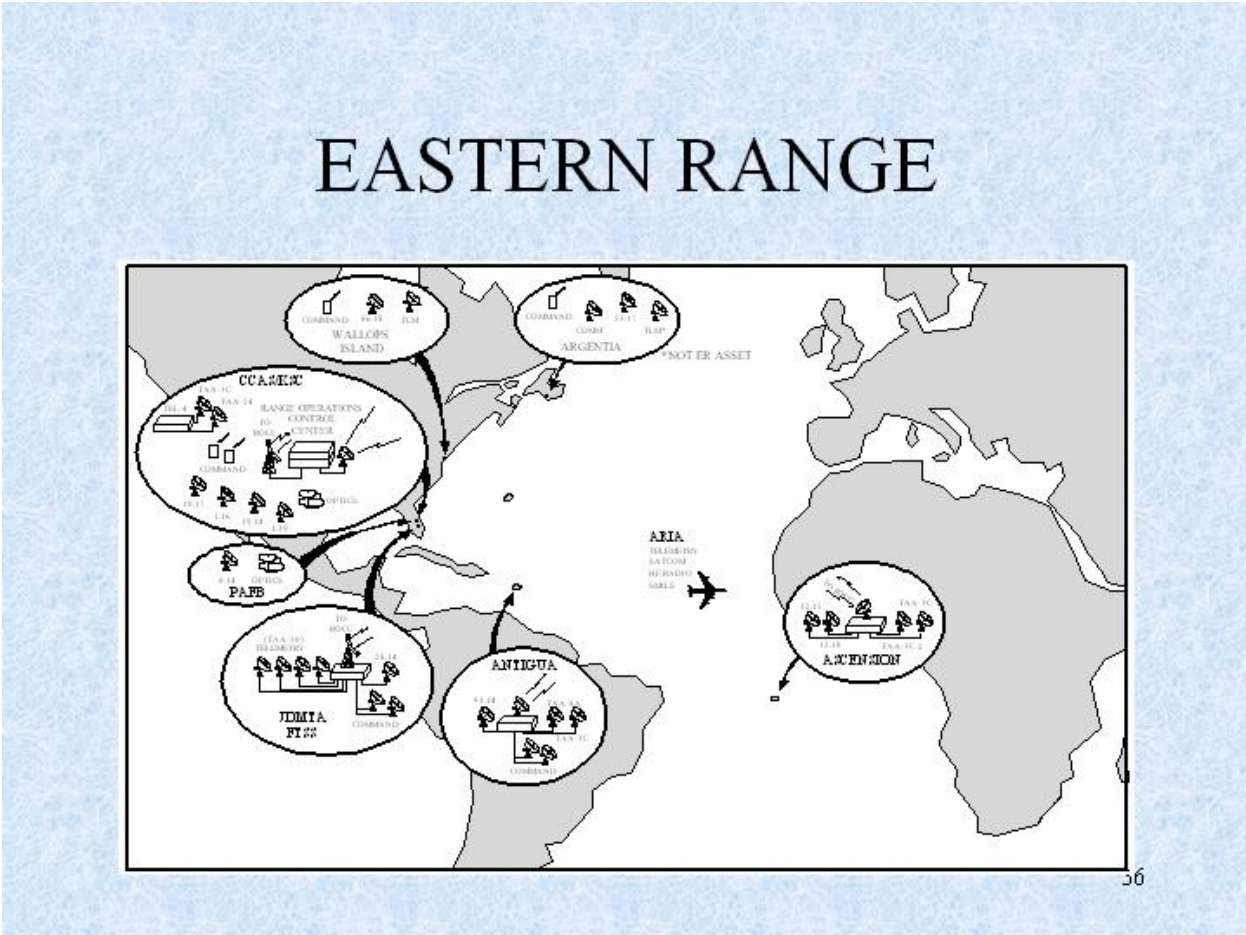
Corrosion Control Areas (cont'd)

- Communications
  - 60 Major Sites Worldwide
  - 16 Major Programs - DSP, AFSCN, Range, DSCS, DMSP, BMEWS, GPS, …..



Corrosion Control Areas (cont'd)

- Spacelift Range
  - Ten Sites on the Eastern Range
  - Seven Sites on the Western Range



Corrosion

- Corrosion is defined as the deterioration of a material due to a reaction with its environment
  - All materials corrode:
    - **Wood** rots and warps
    - **Concrete** absorbs moisture
      - Cracks and spalls
    - **Steel** rusts, pits and scales
- The challenge is how best to protect the material from the environment.
    - Moisture,Oxygen, Chemical Salts,

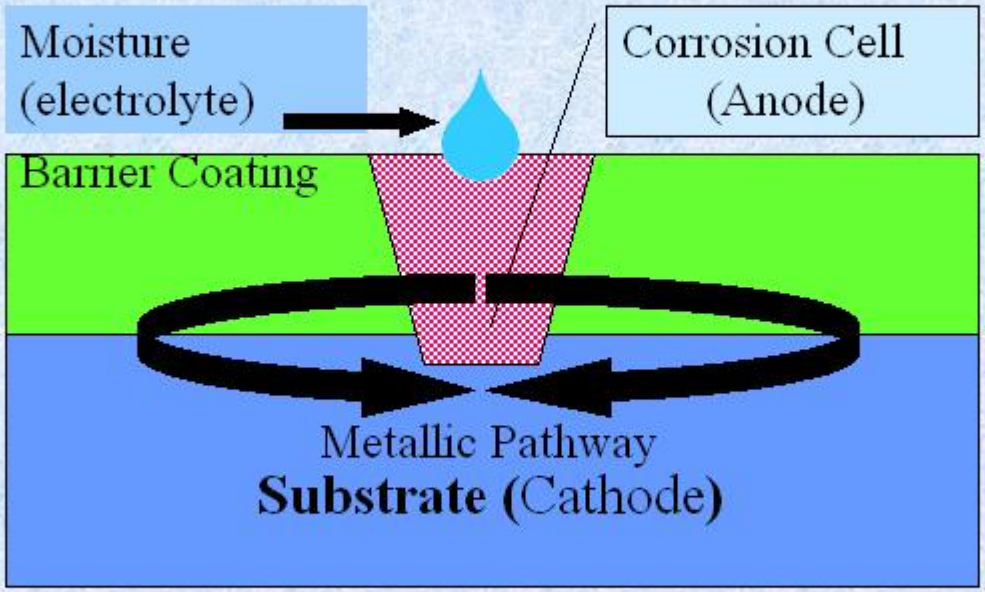
Corrosion Effects

- Safety:
  - Weight and load bearing structures.
  - Food and Beverage contamination.
- Cost:
  - 1994 Estimates: over $300 Billion
    - approximately 4.5% of GNP.
- Appearance:
  - Creates eyesores.
  - Indicates lack of maintenance.

Corrosion Dynamics

- Corrosion (in metal) is an electrochemical reaction that requires 4 elements to occur:
  - » Anode
  - » Cathode
  - » Metallic Pathway
  - » Electrolyte
  - • New steel contains 3 of these elements (A,C,M)
- By eliminating one of these elements, the electrolyte, you can prevent or control corrosion.

Corrosion Dynamics



0.14 Radar Corrosion

0.14 Radar Patrick AFB

Antenna Dish Back-frame

CCAS MiniSODAR Mount Frame, False Cape.
(100 yards from ocean)

Corrosion Control

- Corrosion can be controlled by:
  - Design
  - Inhibitors
  - Materials Selection
  - Cathodic Protection
  - Protective Coatings
  - Alteration of the environment

Protective Coatings

- Protective coatings are the most common means of corrosion protection.
- Coatings provide protection through 3 mechanisms:
  - **Sacrificial**- rich in zinc.
  - **Barrier**- protection from moisture
  - **Inhibitors**- react with moisture to passivate (lead)

Zinc Rich Coatings

- Zinc has proven to be the most effective material to protect steel.
  - It is resistant to most atmospheric conditions yet reactive enough to provide cathodic protection.
  - Relatively inexpensive and readily available
    - Over 1 million tons used annually in the U.S..
    - Approximately 10% of the tonnage used for coatings is applied with zinc rich products.

GALVANIC SERIES

Active

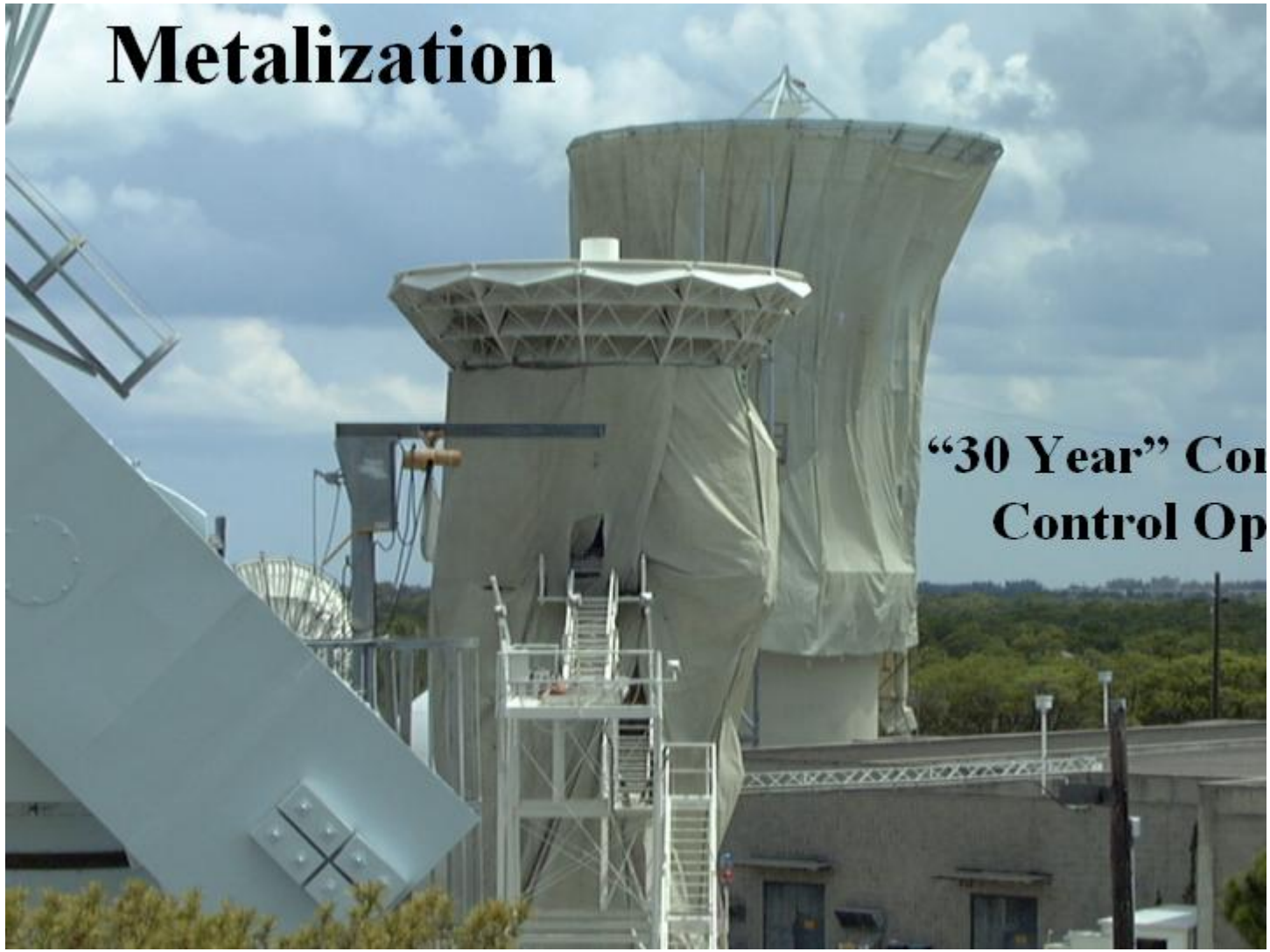
Magnesium
Zinc
Galvenized Steel
Aluminium 1100
Mild Steel
Wrought Iron
Cast Iron

Noble

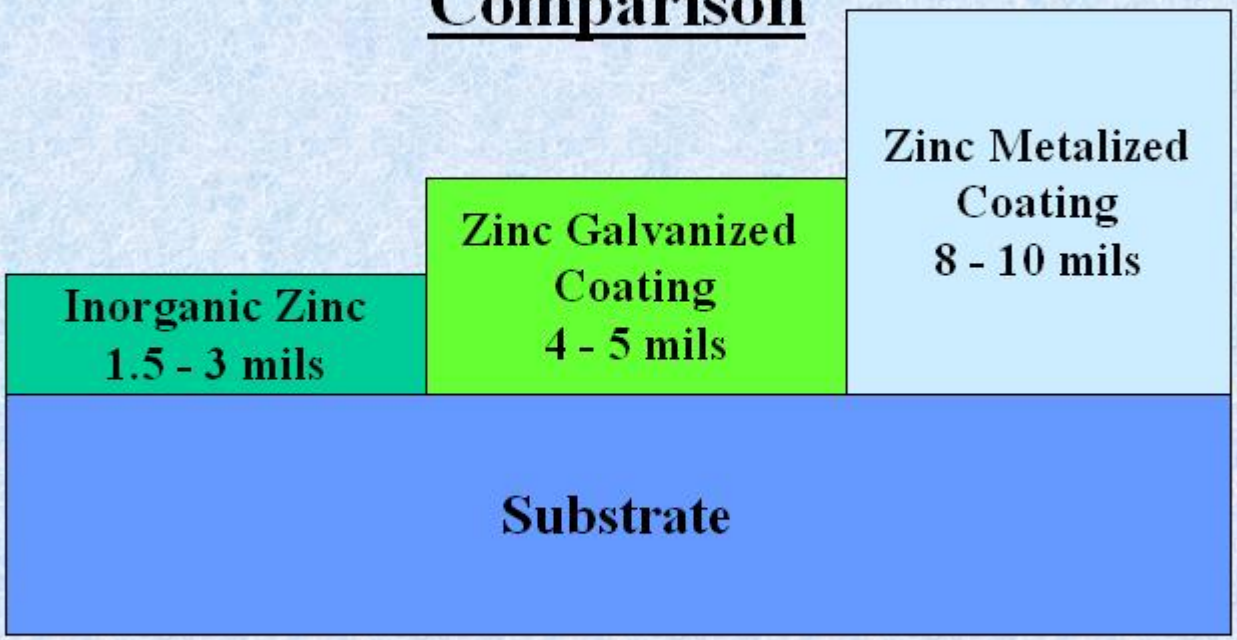
Stainless Steel Type 304
Graphite
Gold

Zinc Application Methods

- Zinc Coatings (Air or Airless Spray)
  - Inorganic
  - Organic
- Galvanizing
  - Hot dipped
  - Electro-plated
- Metalizing (Thermal Spray)
  - Electric Arc
  - Flame
  - Plasma


Metalization
"30 Year" Co
Control Op

Nominal Application Coating Comparison



Who Uses Metalization?

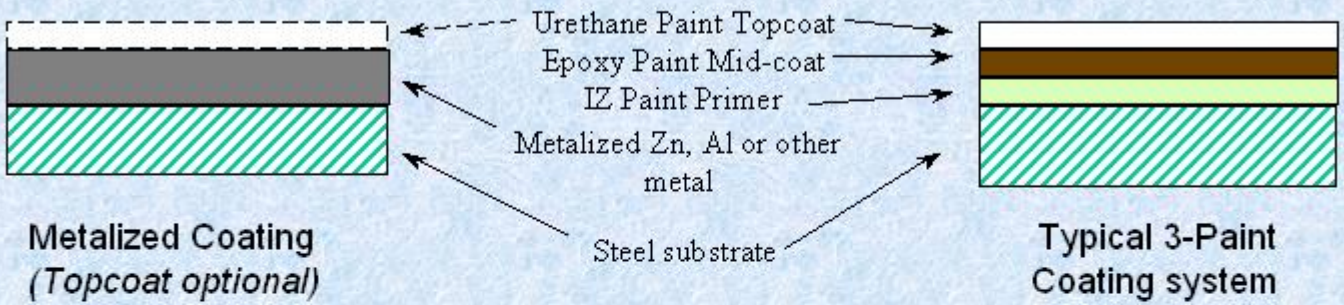
- U.S. Air Force and Navy
  - » Bombs, Buoys, Decks and Hulls
  - » Radar, Telemetry Mounts
- Conoco, BP, Shell Oil
  - » Gulf and North Sea Oil Platforms
- Norfolk Southern, CSX
  - » RR Tanker and Hopper Cars
- Panama Canal
- FPL Nuclear Power Plants
- D.O.T.
  - » Florida, New York, Etc
- Disney World
- Indianapolis Speedway

Metalization Applications

- **Any Structural Steel**
- **PME Items**
  - Radar, Telemetry, Optical and Command Mounts
- **Tanks**
  - Storage (Fresh Water meets AWWA Std D102-78)
- **Ship Hulls / Barges**
- **Pipelines**
- **Towers**
- **Hot Surfaces** ie: **Exhaust Stacks, steam pipe, mufflers**
- **CP to concrete / concrete re-bar**

Product Comparison

How does a Metalized Coating out-perform Paint?



•**Adhesion Strength**: While a metalized coating and paint both form a mechanical bond with a blast steel surface, typical adhesion strength for metalized coatings is much stronger than primer paints. Unlike paint, the adhesion strength does not degrade when exposed to thermal cycling.
•**Dry film properties**: A metalized coating is harder and stronger than paint. Combined with the bond properties, this makes a metalized coating more resistant to Impact, Abrasion and Wear than paint. A metalized coating is not affected by UV exposure.
•**Anodic Protection**: A zinc or aluminum metalized coating anodically protects the underlying steel by sacrificial mechanisms. Protection is more effective and more efficient than zinc paint because the metalized coating is in direct contact with the steel without "interference" from the paint binder.
•**Chemical Resistance**: Metalized coatings (particularly Aluminum) achieve some measure of resistance due to formation of a tightly adherent oxide layer. A Topcoat may be applied to improve protection or provide desired appearance.

Process Comparison

How does a Metalized Coating out-perform Paint?

Consideration	Metalizing	Painting	Remark
Use on ANY Surface		X	Metalizing is accomplished strictly for corrosion control, is most suitable for Steel and will often require a topcoat.
Degree of Surface Prep required		X	Metalizing requires Blast surface prep.
Environmental concerns	X		NO VOC's, NO Containment, NO Overspray
HAZ Storage or waste	X		None
Safety	X		No VOC, flammable liquids, Isocynates, etc. No need for air monitoring.
Application Restricitions	X		No mixing, set-up, or pot-life limits. No recoat windows. Reduced application restrictions
Production (coverage rates)	X	X	Better than Brush. Comparable to Spray painting but with fewer problems.
Skill/Ease of Operation	X		Easier to use and fewer problems than Conventional or Airless Spraying application.
Dry film characteristics	X		Harder, better adhesion, can be used for high temperature applications
Appearance and Choice of Color		X	Choice of Color, appearance, gloss, texture, etc. requires Painting
Temperature / Humidity	X		Most paints have 40-50F degree limitations. Problems with application/cure in high humidity.

Metalizing vs. Painting

Shop Item comparison: Blast and Coat a 10 sq-ft "Widget"

STEP	Painting	Metalizing
1. Equipment requirements /set-up time	Compressor, Blast gear, Paint gear . Set-up time 30 minutes.	Compressor, Generator, Blast Gear, wire feeder Set-up time 30 minutes
2. Blasting	Blast to Commercial or near White or White Metal, as needed. 10-15 minutes	Blast to Commercial or near White or White Metal, as needed. 10-15 minutes
3. Post Blast / Pre-Paint preparations.	Blowdown to "Dust Free" test for salts, Mix paint, induction time . Stripe coat all edges. 30 minutes	**No mixing required required.** No induction time.
4. Apply coating	Spray 3-6 mils DFT inorganic zinc or similar paint. 3-6 minutes.	Electric arc metalize 3-8 mils with: Zinc -- 1 minute, or Aluminum -- 2 minutes **Can Metailize and Blast simultaneously.**
5. Clean-up	Flush lines, clean gun, cap all paints and thinners. Drum all waste paint, rags, etc.	**Not required.** PROCEED IMMEDIATELY to STEP 6.
6. Applying next coat	Recoat window/cure time, etc. before application of midcoat. 8 HOURS. (Next day repeat 1, 3, 4 --epoxy midcoat-- and step 5). REPEAT again next Day all above to apply a Urethane topcoat	Topcoat or sealer, if required, can be applied immediately. SAME DAY -- 3 Hours Apply 3-6 mils DFT urethane topcoat. Painting steps 3, 4 and 5
NET RESULTS	**THREE COAT PAINT SYSTEM. To Last approx. 7 -10 years. Allow three days to apply, mainly due to recoat window and cure time between coats.**	**METALIZE w/Urethane Topcoat. System can typically last 30 years. Can be applied all in a matter of a few hours.**

Metalization Advantages

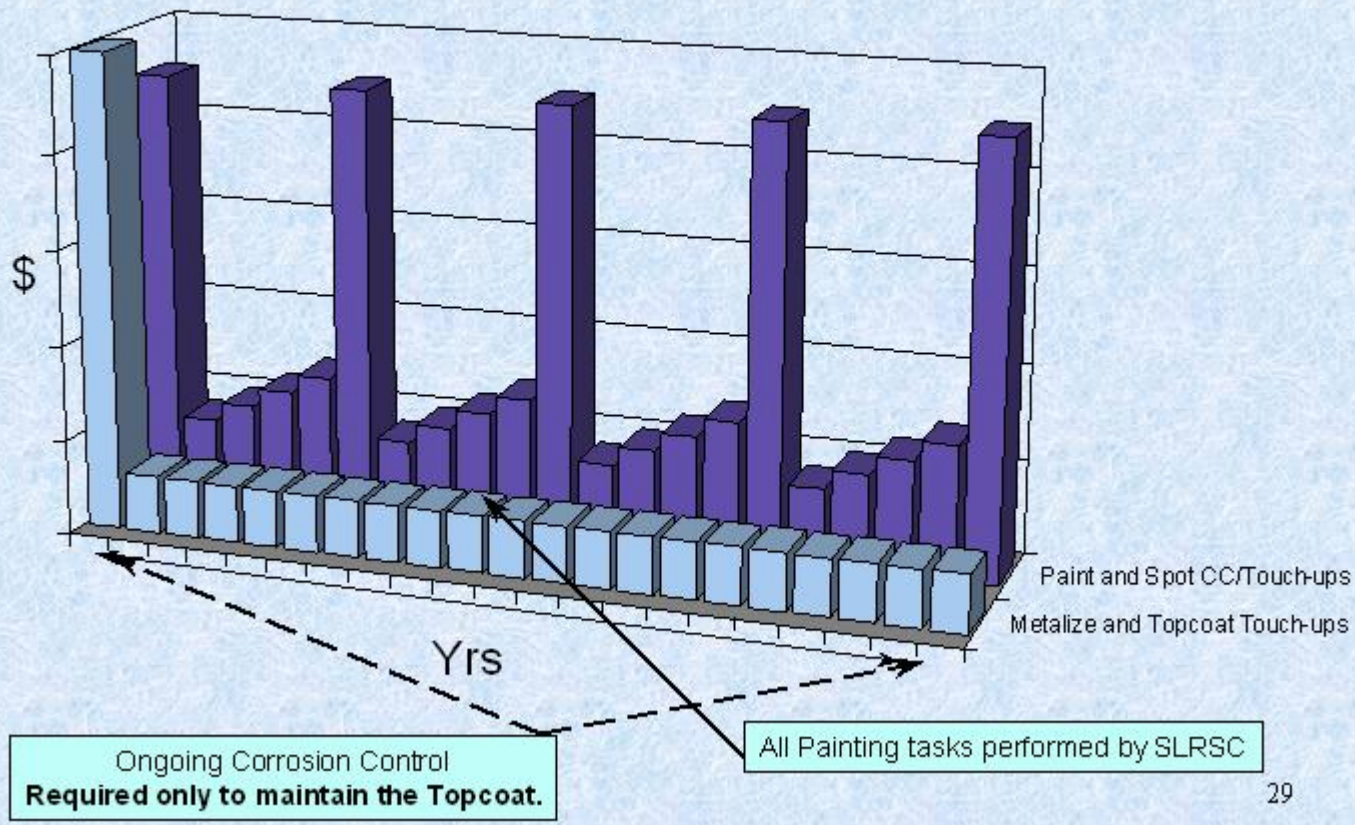
1. Eliminates the use of out-dated special purpose painting materials.
2. Cost savings by eliminating unused materials with limited pot life or shelf life.
3. Reduction in Hazardous Waste storage and disposal costs.
4. Saves procurement time for special purpose materials.
5. Provides protection against surface damage; no chips or cracks.
6. Provides corrosion protection that can tolerate high temperatures.
7. Outsourcing provides the capability for dynamic workloads.
8. Reduces Transportation Limitations inherent with flammable materials.
9. Does not require induction or cure time.
10. Environmentally compliant, no VOC's.
11. Less sensitive to ambient conditions.
12. Reduces system downtime and impact to equipment and operations.

TAA-3 Telemetry After

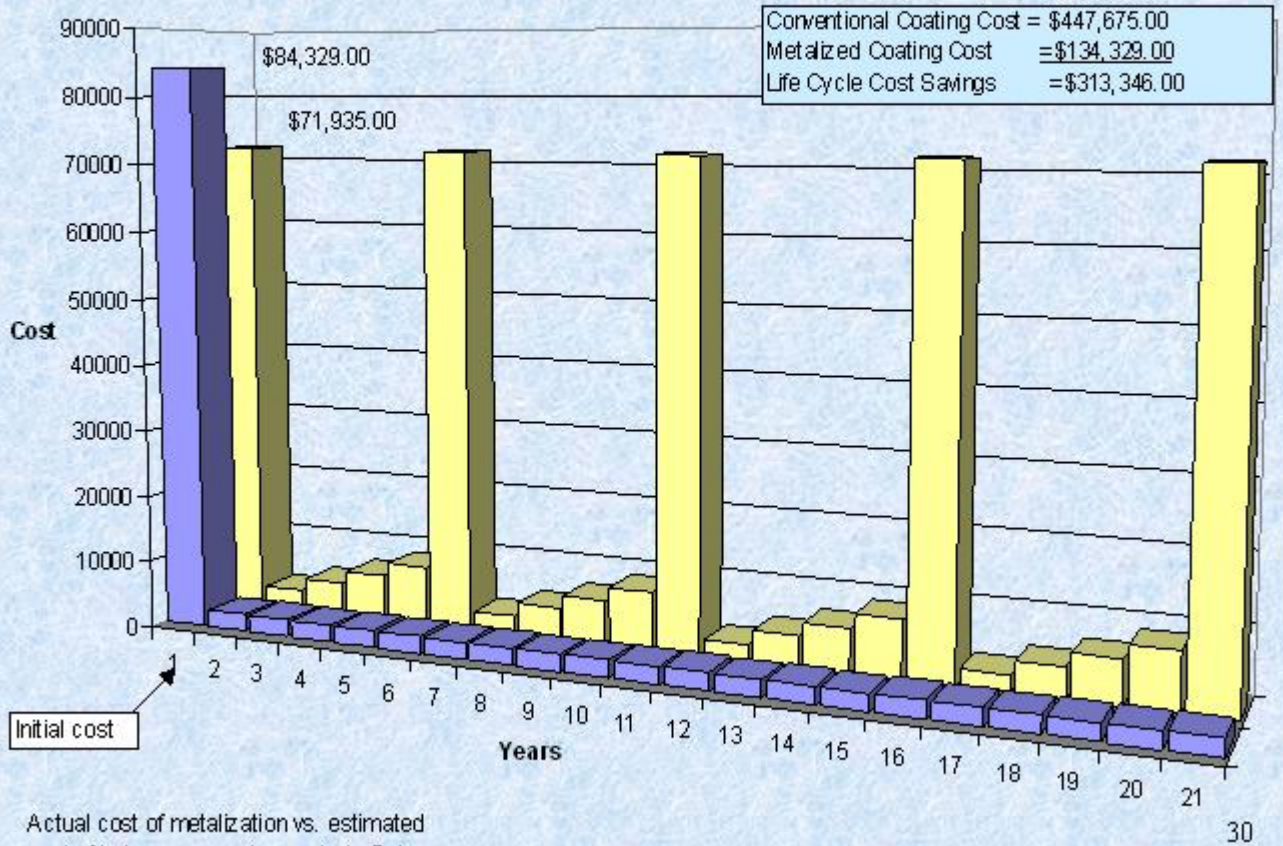
TAA - 8 Antigua

- Test Continuation
  - Location – Patrick AFB
  - Duration – Four Years

Painting vs. Metalizing, "Relative effort" Methodology Comparison over a 20 year lifecycle



Radar System
20 Year Relative Cost Comparison



Actual cost of metalization vs. estimated cost of in house corrosion control efforts.

Conclusion

- Metalizing is a superior process for controlling corrosion on steel items and out performs even the best 3-coat Paint systems for most applications.
- Metalizing produces no VOC's; requires no thinners; does not require special shipping or storage measures and generates no Hazardous Waste.
- Metalizing has fewer process "steps" and "limitations", and is more forgiving to apply than High Performance paints.
- Use and Clean-up is safer.
- Significant life cycle cost savings.
- Metalization reduces downtime and impact to operations.

Summary

- AFSPC Areas of Corrosion
- Discuss Corrosion Cause and Effect
- Compare Zinc Rich Protective Coatings
- Discuss Coating Application Technology
- Introducing Metallization and Comparisons
- Metallization Application
- Current Applications
- Comparisons

QUESTIONS!

Thank You