

# USAF Dehumidification Efforts for Corrosion Control

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**AFRL/RXSSR**



# Overview



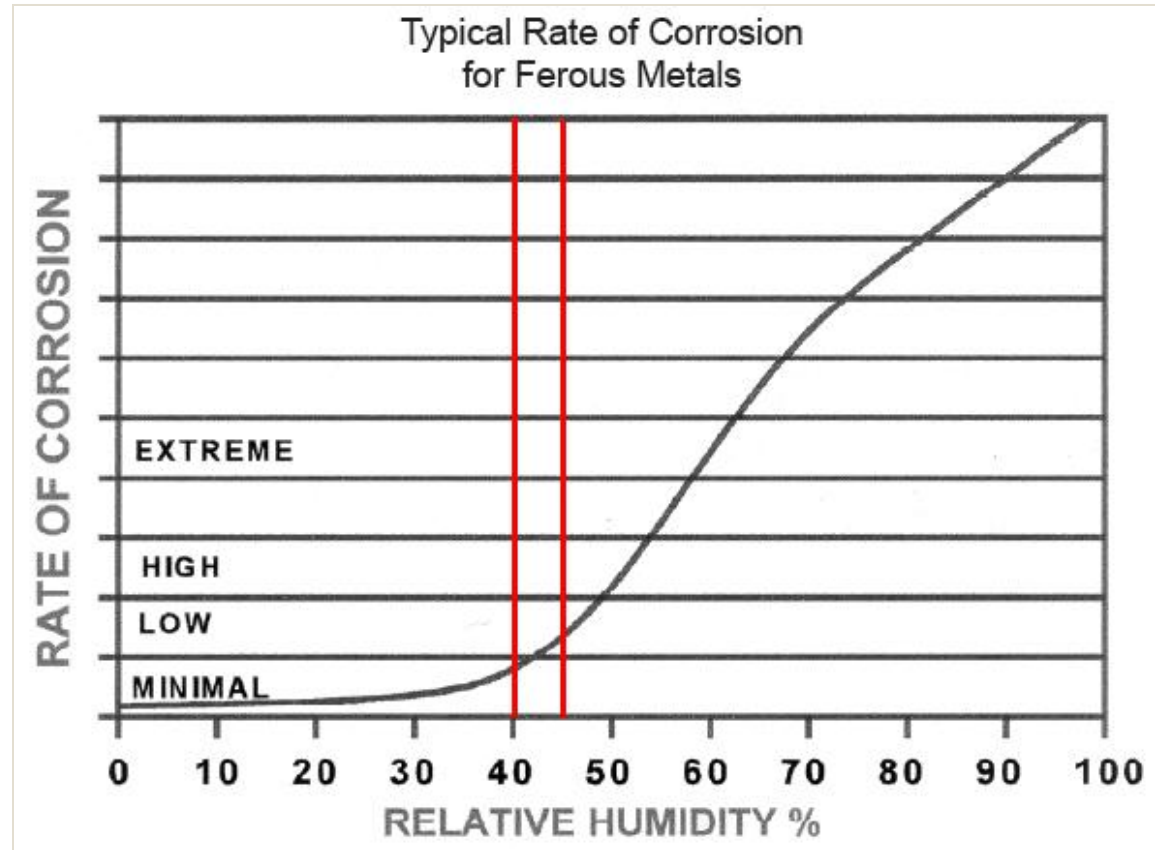
- **Fundamental Corrosion Control**
- **Why DH**
- **DH Concept**
- **Current DH Efforts**
- **Green Shelter**
- **Control Humidity Protection Shelters**
- **DH Evaluations**
- **AFCPCO goals**



# Fundamental Corrosion Control



- **Corrosion Conditions**
  - Anode
  - Cathode
  - Electrolyte
  - Electrical Contact
- **Humidity vs. Corrosion**
  - Corrosion rate increases exponentially above 50% RH
  - Typical control range: 30-50% RH
  - Anything below 30% could lead to static charge buildup



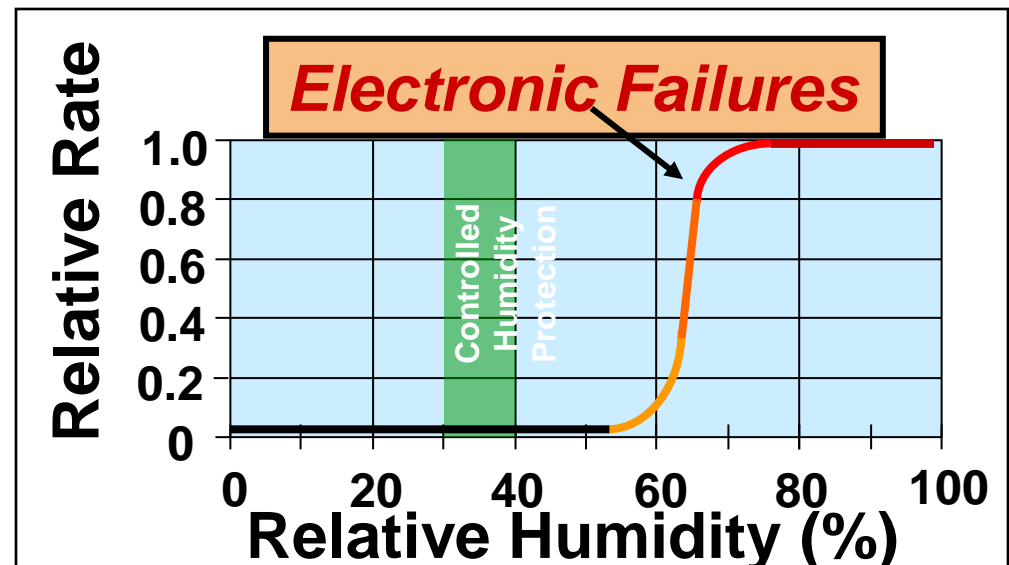
**CONCEPT: BREAK THE CORROSION CIRCUIT BY REMOVING THE CONDUCTIVE ELECTROLYTE**



# Why DH



- **15%- 20% electronic failures due to moisture induced corrosion**
- **DH most effective method to protect equipment from corrosion**
- **Seen 9 to 1 ROI**
  - Reduced maintenance costs
  - Improved reliability

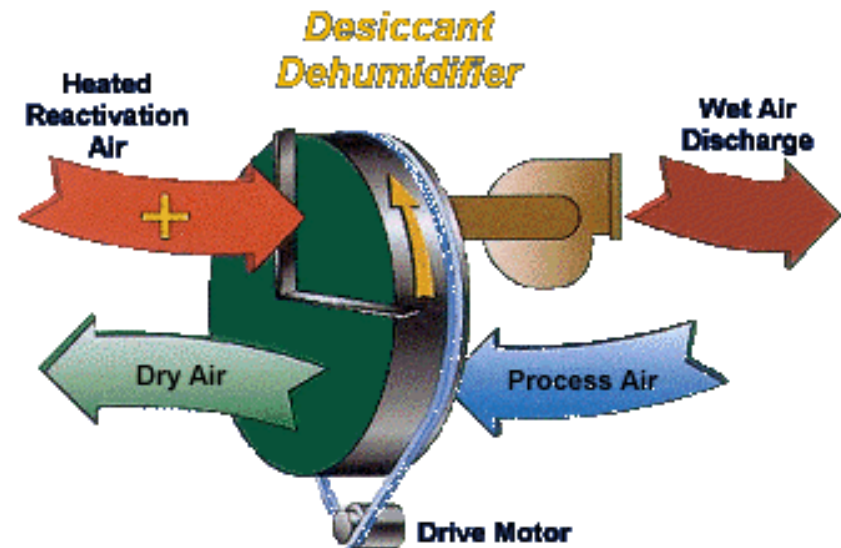




# DH Concept



- Dehumidification (DH) can be achieved by:
  - Cooling - vapor condensation
  - Heating - air expansion
  - Desiccants - materials with high affinity for water
  - Combination thereof
- DH can be Sheltered or Unsheltered
- Air Dehydration Units
  - Uses a self rejuvenating desiccant wheel dehumidifier
  - Closed or open loop





# Current DH Efforts



- **Unsheltered Controlled Humidity Protection**
  - Uses mobile DH units
  - Reduces moisture derogation of avionics and electronic systems
- **Current CHP efforts**
  - KC-135, Hickam AFB, HI
  - F-16, McEntire ANG, SC
  - C-130, McEntire ANG, SC
  - F-22, Tyndall AFB, FL

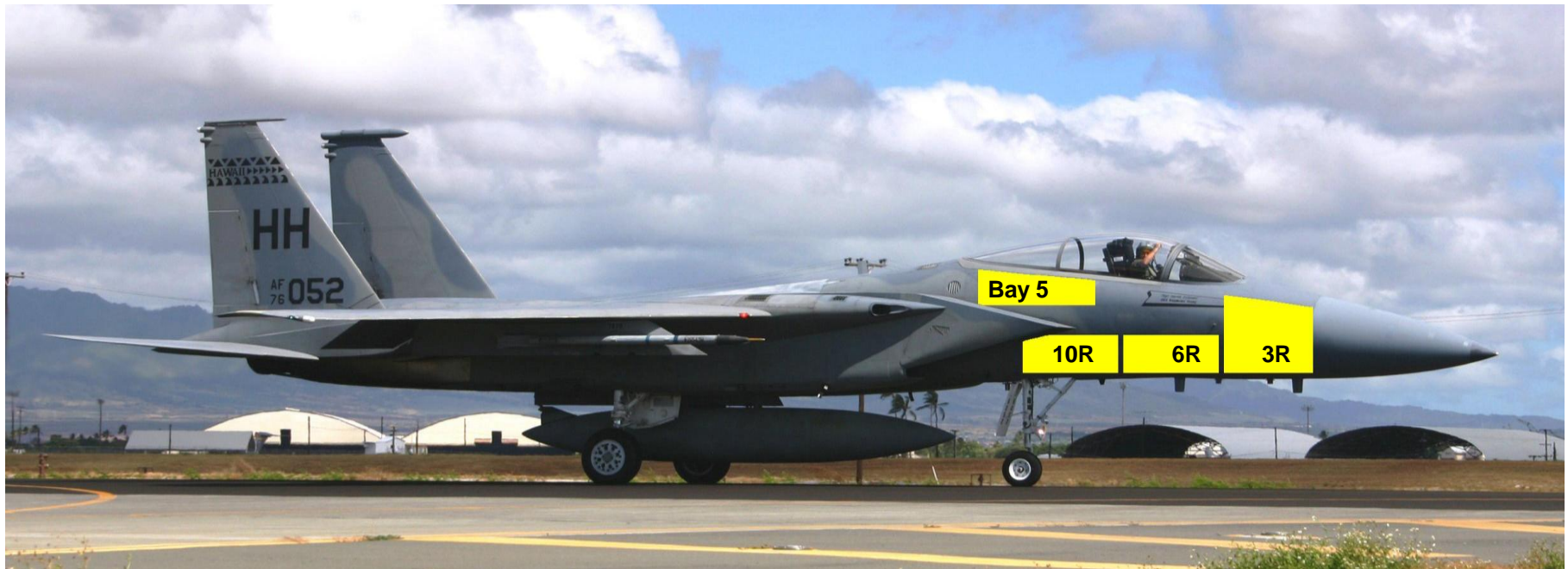




# Current DH Efforts



- **General Location of Most LRU's Dehumidified**





# Current DH Efforts





# Current DH Efforts



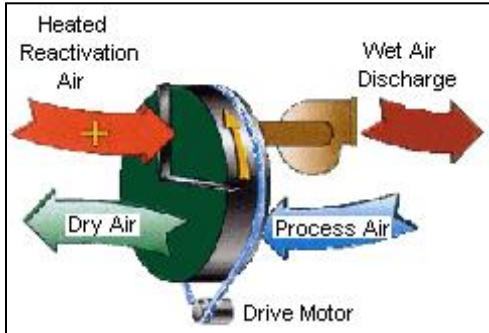
- **Sheltered Controlled Humidity Protection**
  - Climate controlled
  - For aircraft and AGE
- **Current efforts**
  - AGE, Savannah ANG, GA
    - AFCPCO Green Shelter test
  - AGE, Hickam AFB, HI
- **Future Shelter efforts**
  - F-22, Hickam AFB, HI
  - Kadena AB, Japan





# The Green Shelter

## Dehumidification Unit



Renewable energy powers dehumidification equipment (DH)



LED lighting also powered by renewable energy

Booth contained in maintenance shelter for added corrosion protection and a comfortable working environment

## Retractable Sealed Booth



Stored AGE

DH maintains dry air in storage booths, protecting AGE equipment from corrosion and moisture infiltration

## Soft Wall Maintenance Shelter





# CHP Shelters



- **Used to prevent corrosion on outer skin**
- **Being developed for the F-22 at Hickam AFB**
- **Pre-Engineered Steel Structure designed specifically for DH**

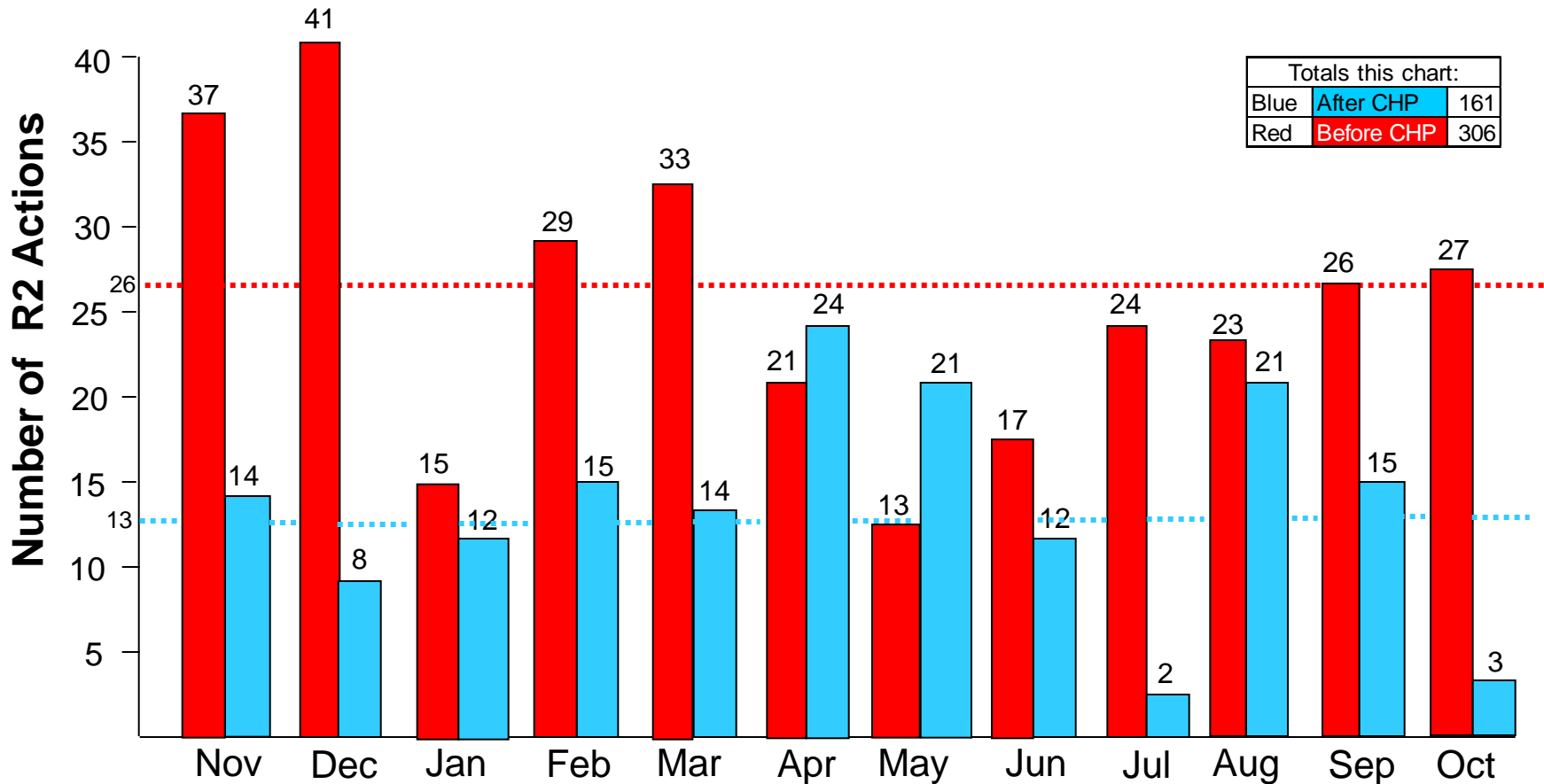




# DH Evaluation



**F-15A/B LRU Remove & Replace (R2) Comparison:  
R2 Actions Reduced by 47% After CHP**





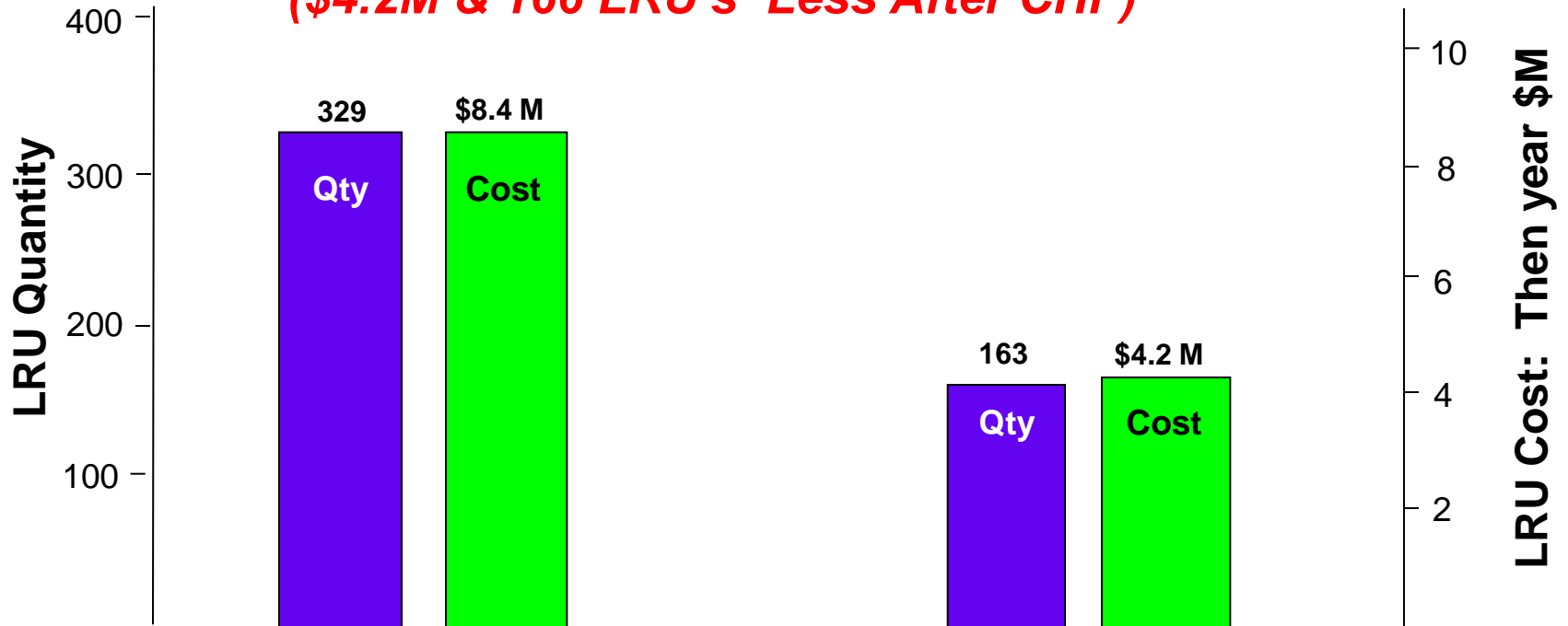
# DH Evaluation



## F-15 A/B LRU Cost & Quantity Comparison After 12 Months

16 CHP Slots  
Used avg  
47% of time  
for all A/B/C/D  
model F-15s

**Issue Costs and Quantities 50 % Less After CHP**  
**(\$4.2M & 166 LRU's Less After CHP)**



**Before CHP**  
Nov 05 thru Oct 06  
Average possessed acft: 19

**After CHP**  
Nov 06 thru Oct 07  
Average possessed acft: 14



# DH Evaluations



Service	Timeframe	Equipment	Results
RAF	2000s	Tornados	24% decrease in “no fault” discrepancies 15% decrease in avionics maintenance
US Navy	1993	EP-3 Aries	Avionics reliability improved 25% Increased MTBF 7-30%
US Navy	1995	A-6E Intruder	Increased MTBF 21%
US Army	1997-1998	UH-60 Blackhawk	Savings of \$2.2 million



# DH Evaluations



Service	Timeframe	Equipment	Results
USAF	2006	KC-135, Hickam	TBD
USAF	2006	F-15, Hickam	R2 actions reduced by 47% Labor hours reduced by 31% monthly
USAF	2008	F-16, McEntire	TBD
USAF (AFCPCO)	2009	AGE, Savannah	50% Decrease in corrosion from sealed booth to shelter 50% Decrease in corrosion from shelter to outside
USAF	2011	F-22, Tyndall	TBD



# AFCPCO goals



- **Condition-based maintenance (CBM+)**
  - High Velocity Maintenance (C-130)
  - Maintenance Steering Group (MSG-3)
- **New DH chapter on TOs**
  - 1-1-691
  - 35-1-3
  - -23
- **Expeditionary Combat Support System (ECSS)**



# Summary



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# Questions



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