Corrosion Coupons May Not Be Useful for Predicting Data Center Equipment Failure Rates

Indoor Air 2011 Presentation

H. Coles, P. N. Price, T. Han, A. Gadgil, W. Tschudi

contact: hccoles@lbl.gov, wftschudi@lbl.gov

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BERKELEY LAB

PI's:	A. Gadgil, W. F. Tschudi
Researchers:	H. Coles, P.N. Price, T. Han
Partners:	United States Dept. of Energy (DOE)
	California Energy Commission (CEC)
	Digital Realty Trust, NetApp, Cisco, Gap, U.S. IRS, Sybase
	IT equipment and component manufacturers
Project Term:	Summer 2009/March 2011

Project Goal/Objective

Goal: Remove barriers to using outside-air cooling in data centers; better understand the usefulness of corrosivity measurement coupons.

Objective: Perform a limited exploratory survey of U.S. data centers investigating the relationship between gaseous contamination related corrosion rate levels and IT equipment reliability using the common coupon method (corrosivity monitoring).

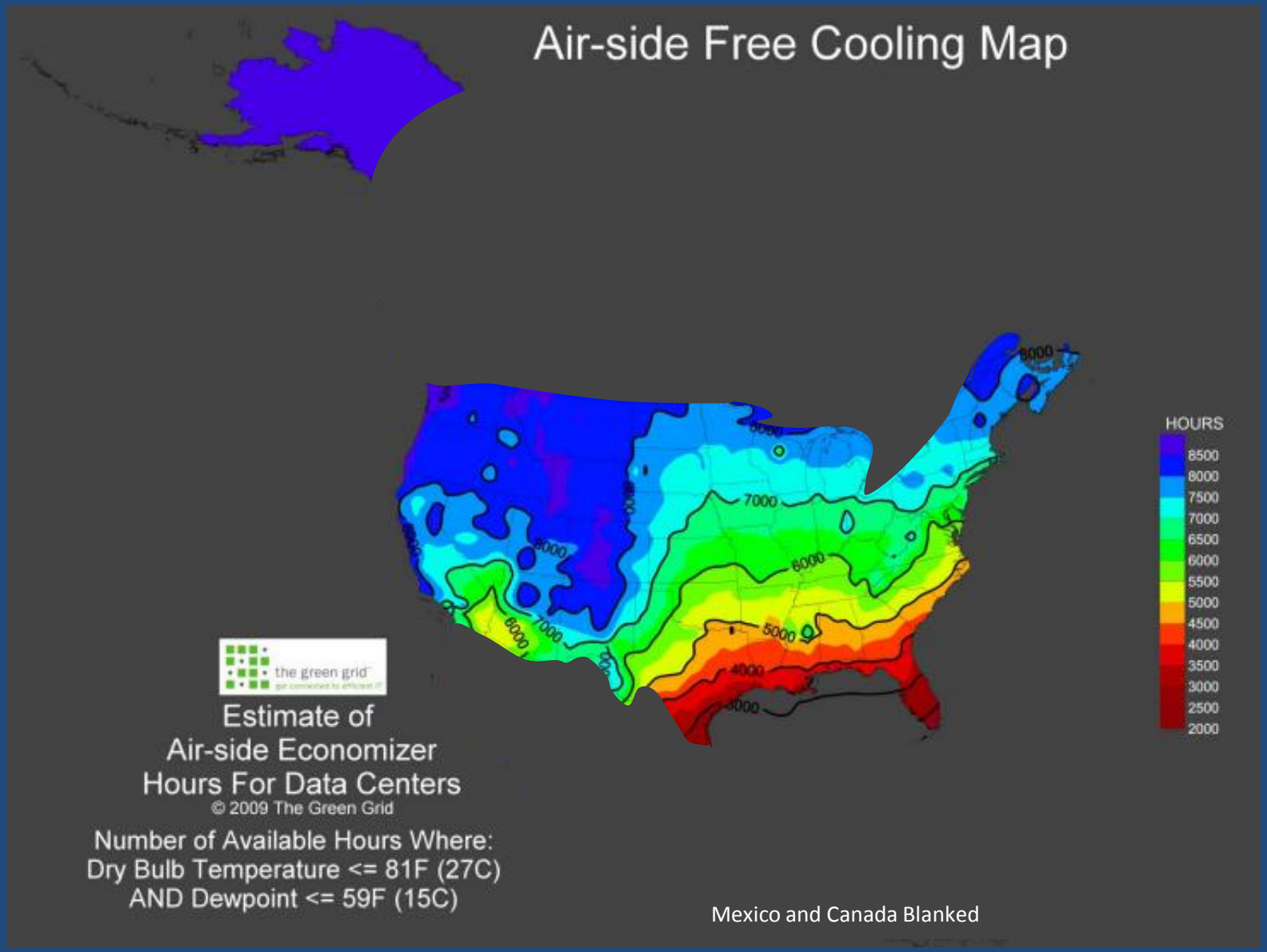
Background / Methods

1. We focused on only gaseous Contamination

2. Reactivity monitoring with Coupons is the common method for gaseous contamination measurement. Applicable Guideline: ANSI/ISA-71.04-1985

3. Measure Corrosivity – Limited Exploratory Measurements of 21 Data Centers
   - Unable to Locate Data Centers with Corrosion Caused Failures
   - Located in High Density Data Center Locations (e.g. Silicon Valley CA)
   - Outside-Air Cooled and Closed Types
   - 19 in the U.S. – 2 in India

Free Cooling – hours/year



Reactivity Monitoring Corrosion Classification Coupon
(most common air corrosivity measurement method)

before exposure

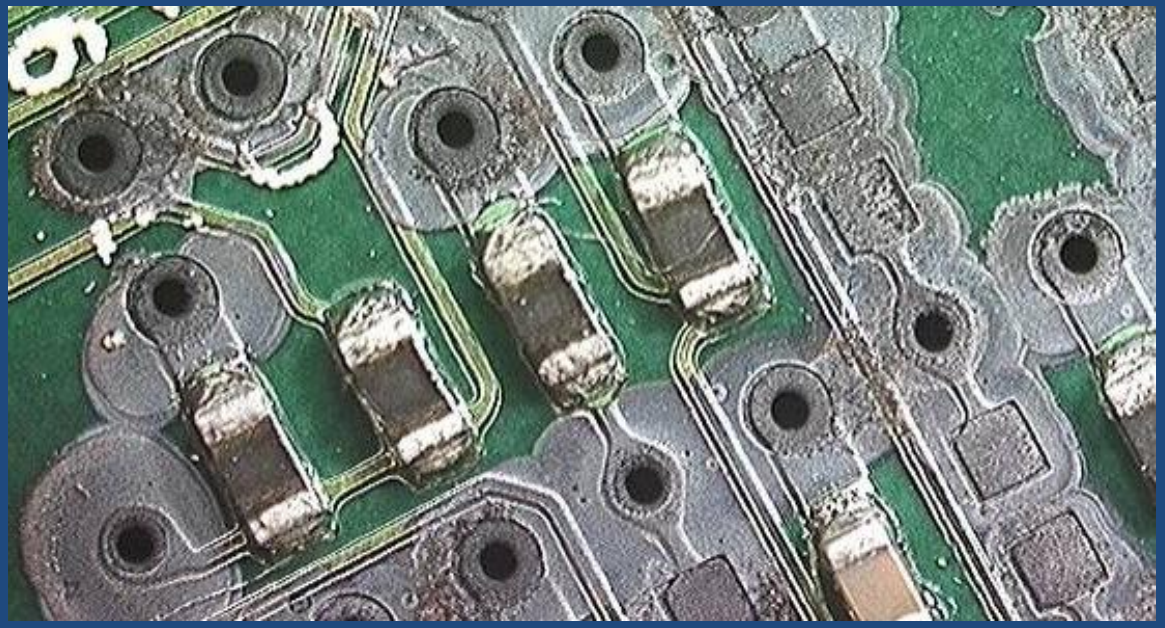
copper strip

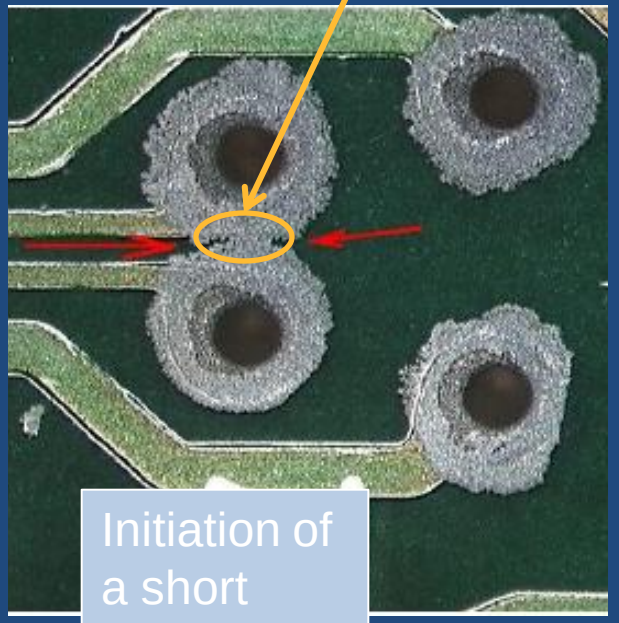
silver strip

after exposure

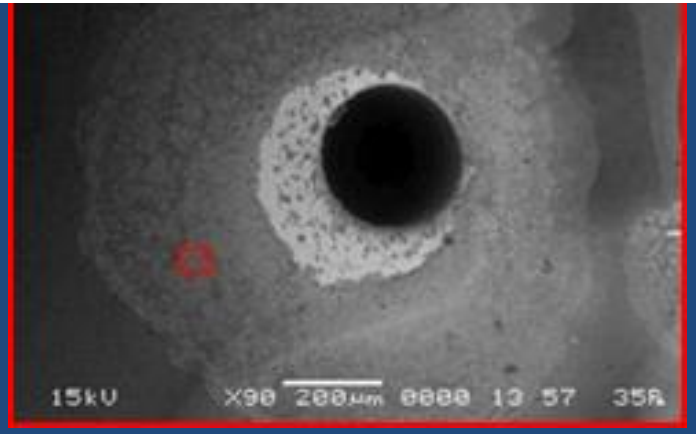
exposed for 30 or 60 days typical

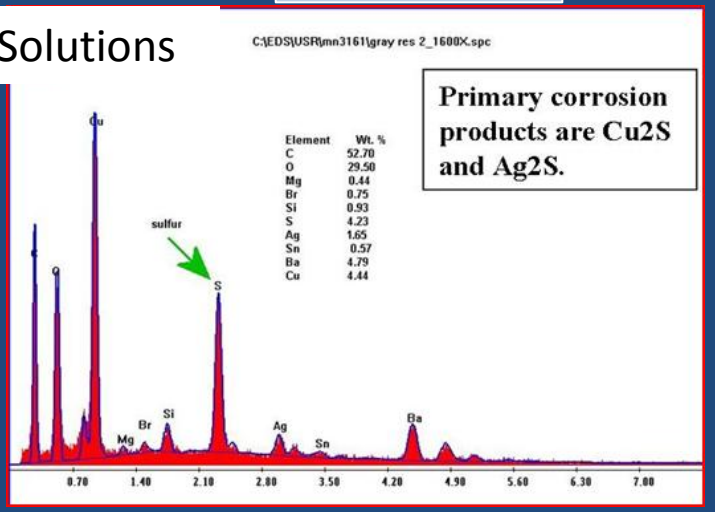
No Failures in Survey Example – Short Caused by Creep Corrosion on Immersion Silver Type Printed Circuit Boards





ref. Free Air Cooling Poster-Randy Schueller-DFR Solutions

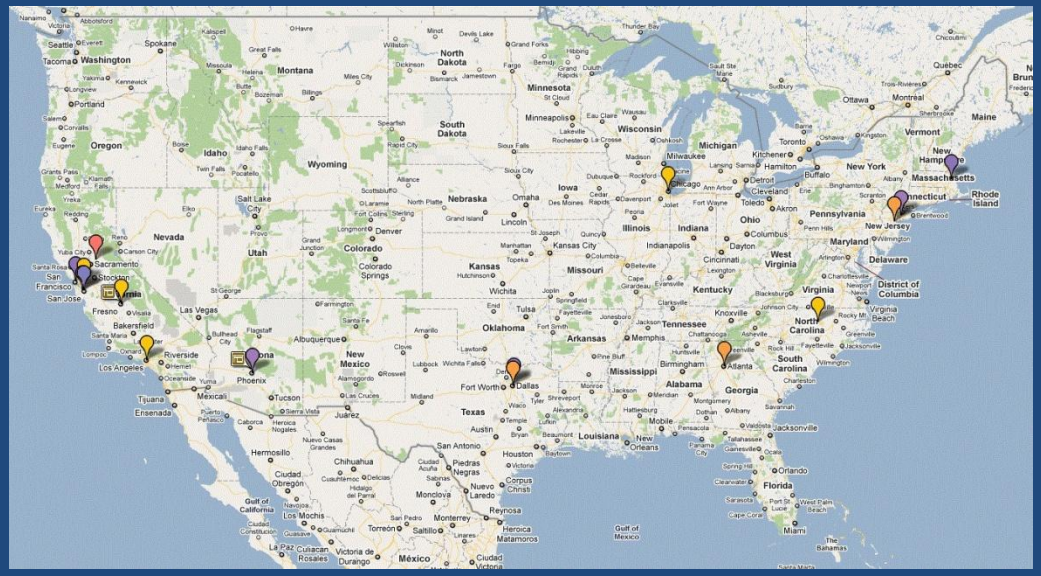




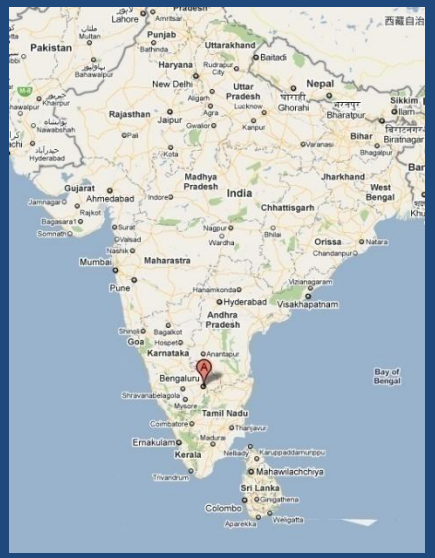
Data Center Corrosivity Limited Survey performed by Lawrence Berkeley National Laboratory

Locations in US (19 data centers) and Bangalore India (2 data centers)

Coupons exposed for one thirty day period during Aug. – Nov. 2010



15. Bangalore India



1. Silicon Valley CA
2. Dublin CA
3. Rocklin CA
4. Research Triangle Park NC
5. Fresno CA
6. Richardson TX
7. Atlanta GA
8. Los Angeles CA
9. Chicago IL
10. Phoenix AZ
11. San Francisco CA
12. Boston MA
13. Dallas TX
14. Piscataway NJ

Inside Data Center Copper Coupon Measurement Levels: Not Problematic

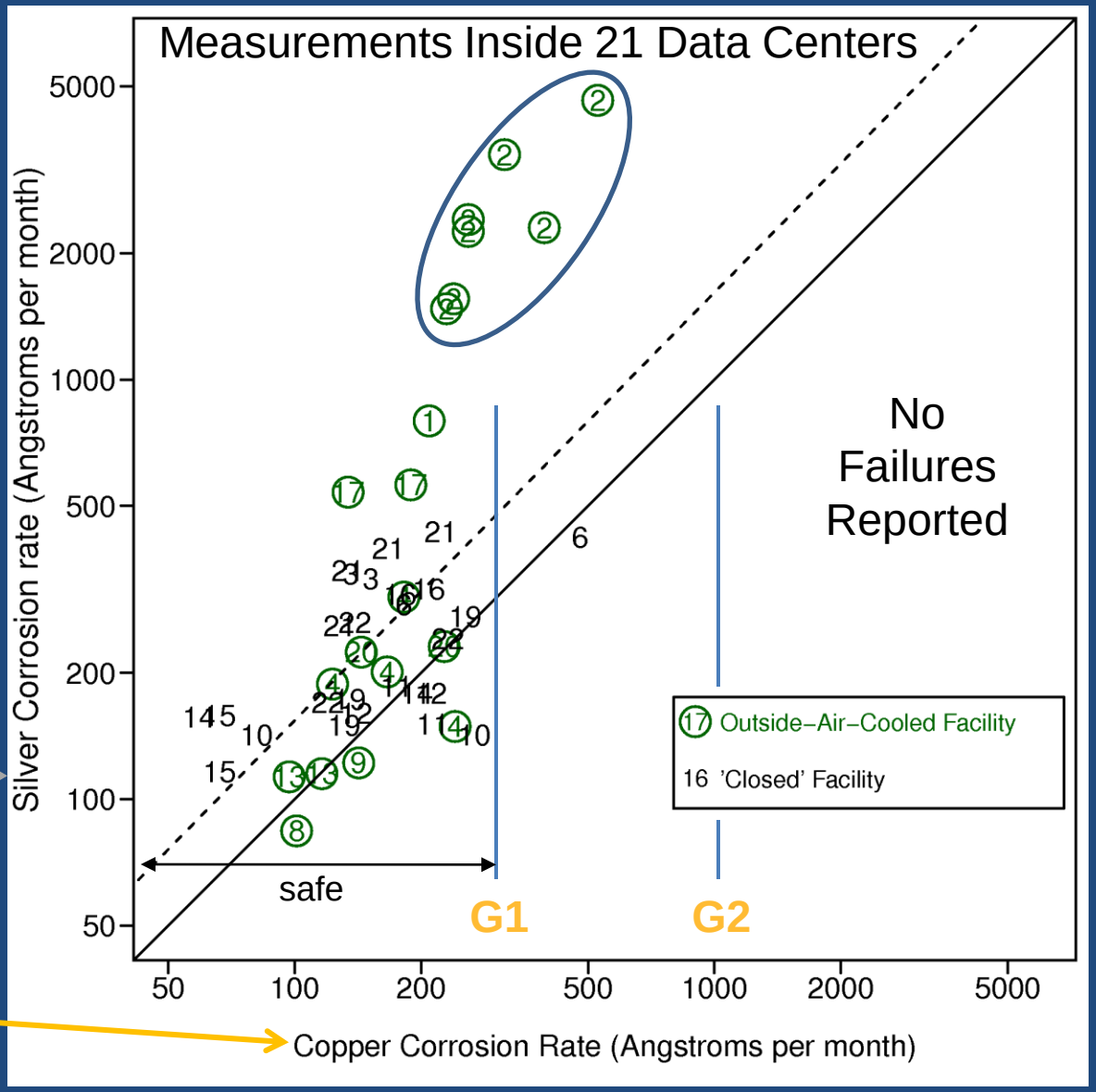
ANSI/ISA-71.04-1985
(lists copper only)

G1= <300 angstrom(Å)/mo.
(mild, corrosion not a factor

G2= 300-1000 Å/mo.
(moderate, corrosion may be a factor

silver not currently listed in an ANSI/ISA guideline

ANSI/ISA 71.04 1985 applies to copper only.

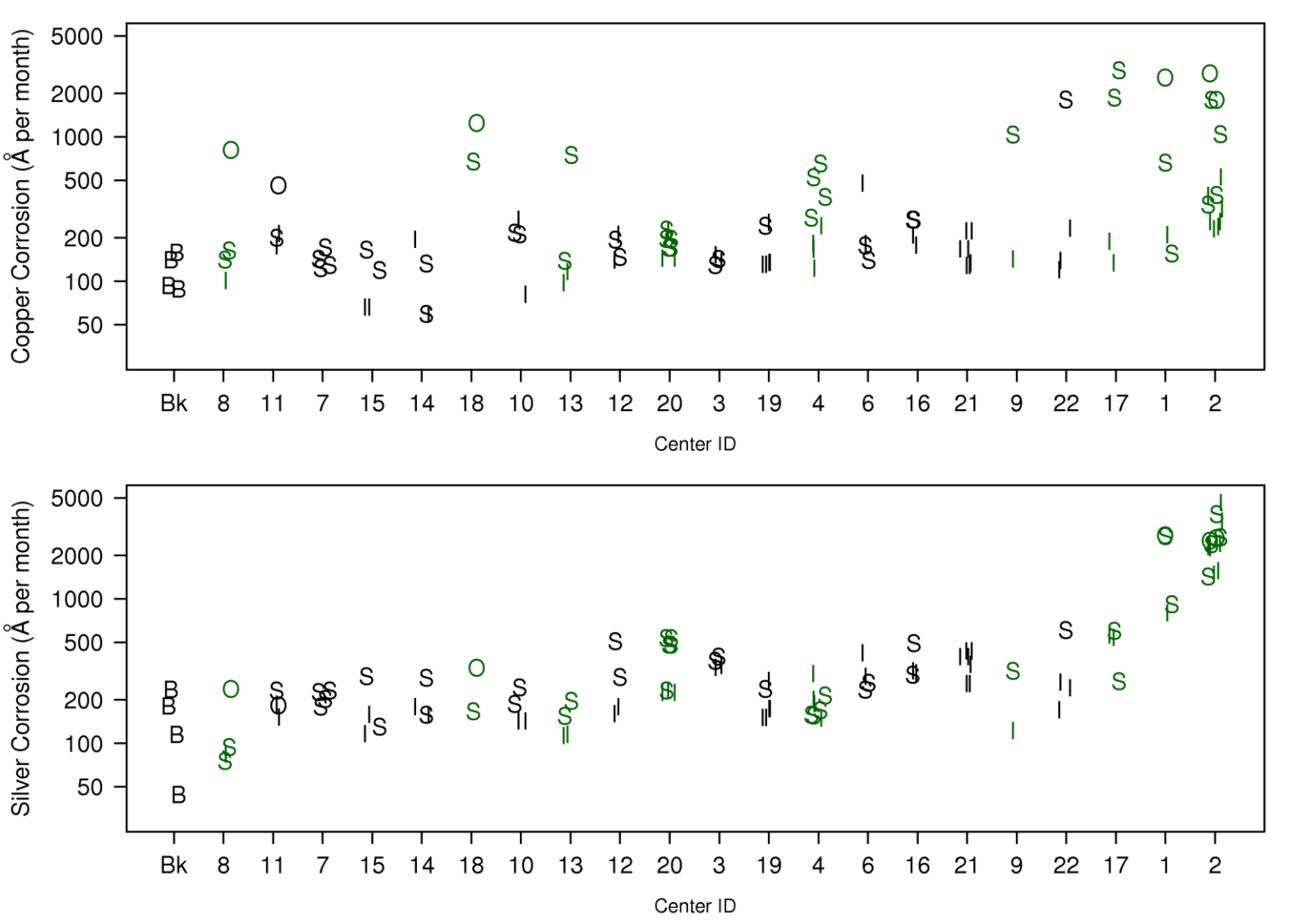


Results / Conclusions

- Corrosion rate measurements at outside-air cooled and "closed" data centers are comparable.
- All copper measurements were below levels thought to be problematic – per ANSI/ISA 71.04 1985 severity table, level G1.
- No IT equipment failures reported at any data centers tested (21)
- Poor correlation between copper and silver corrosion rate measurements.
- Corrosion measurements had high variability at the monitored data centers.
- One U.S. site had comparatively high silver corrosion rate measurements but reported no failures. The copper measurement rates were not unusually high.
- Corrosion rate measurements measured outside were higher than those measured inside.
- <u>High silver corrosion rates are NOT a good predictor of reported higher IT equipment failure – per our observed data</u>

Additional Slides

All Measurements – Sorted by Data Center ID#



All Coupon Measurements

O = outside

S= in supply ducts

I = inside near IT equip.

B = background
(not deployed)