Success Won't Plan for Itself

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Sr. Electrical Engineer
HDR

Planning Ahead

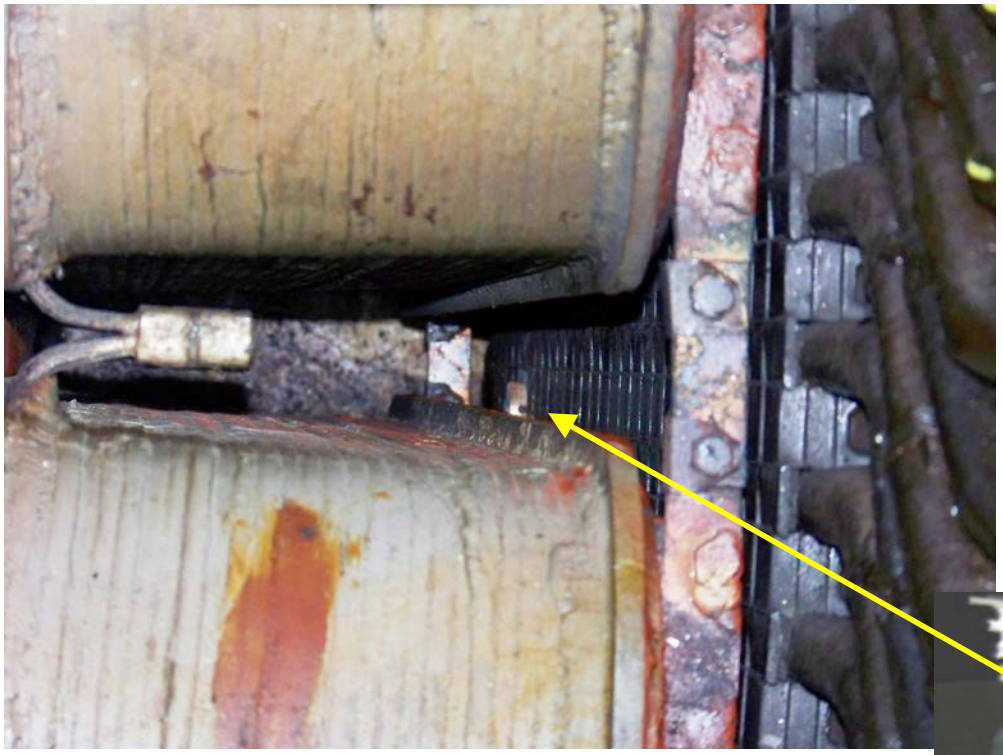
- Murphy's Law & Smith's Law
- Most surprises during outages are not happy ones
- Last-minute reactions to problems are not always the best
- Failure to plan details will derail your budget and schedule
- Plan ahead by considering things that may not be common, but can happen

"It does not do to leave a live dragon out of your calculations, if you live near him." - J.R.R. Tolkien

"Everyone has a plan…..until they get hit." - Mike Tyson

Foreign Material Exclusion (FME)

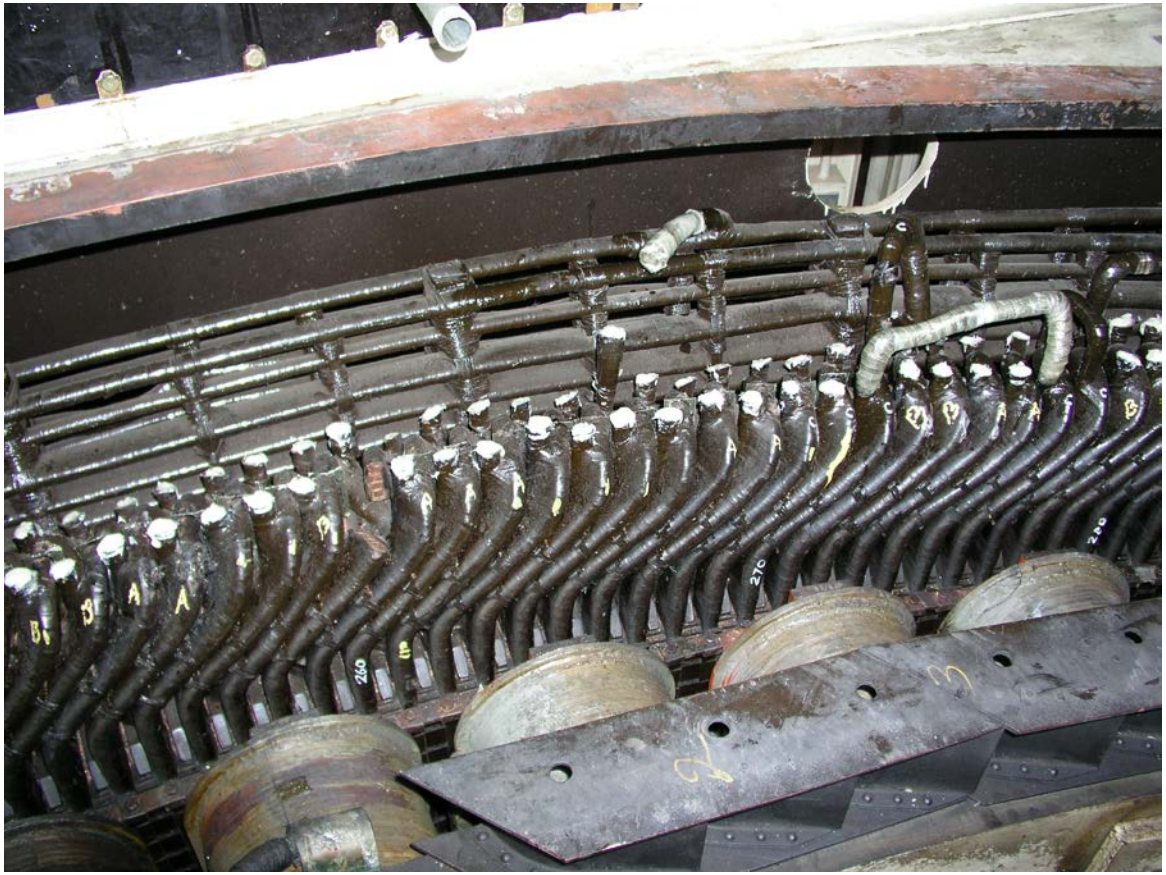
- Have an FME program and use it
- It goes beyond putting up a sign
- Empty pockets and log tools in and out
- Typically on the honor system but can be manned



15/16 inch socket

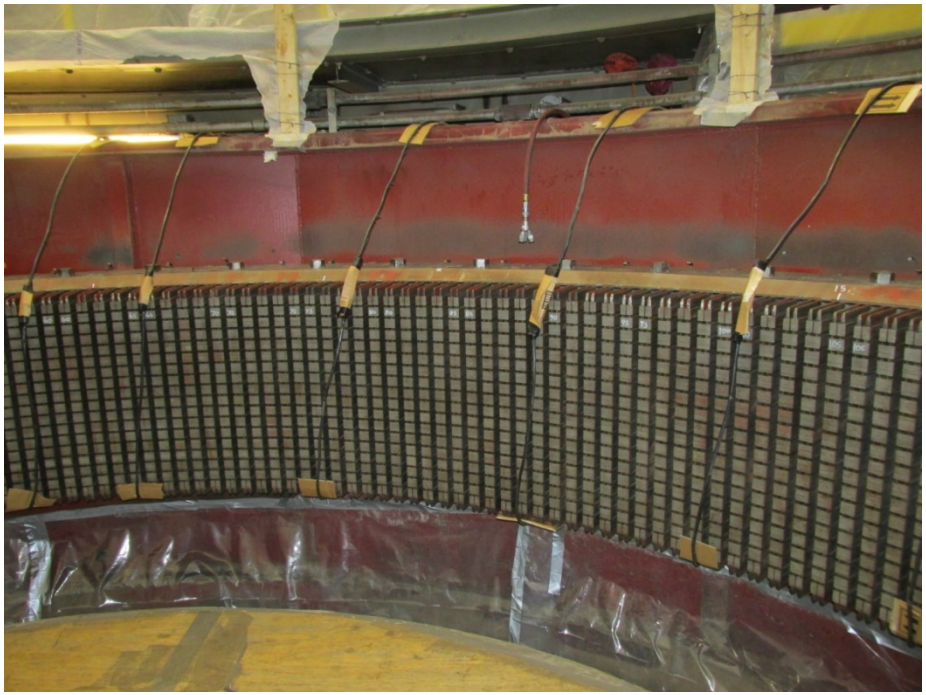
Used for air cooler bolts

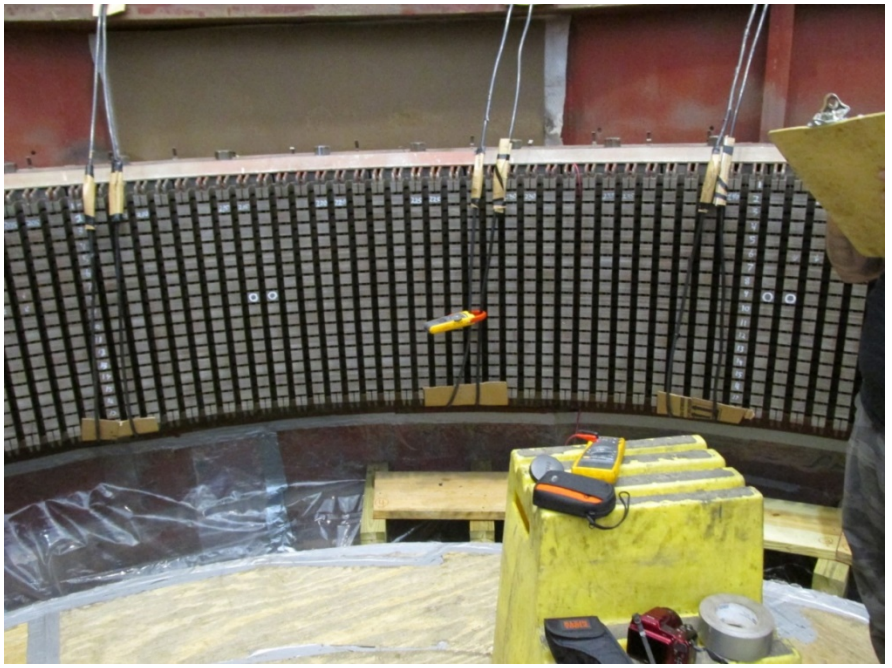
- 36 coils were damaged
- 2 parallel paths per phase removed (1/3 of the winding)
- Operated for about 1-1/2 years like this
- Then, restack core and rewind



Core Loop Testing

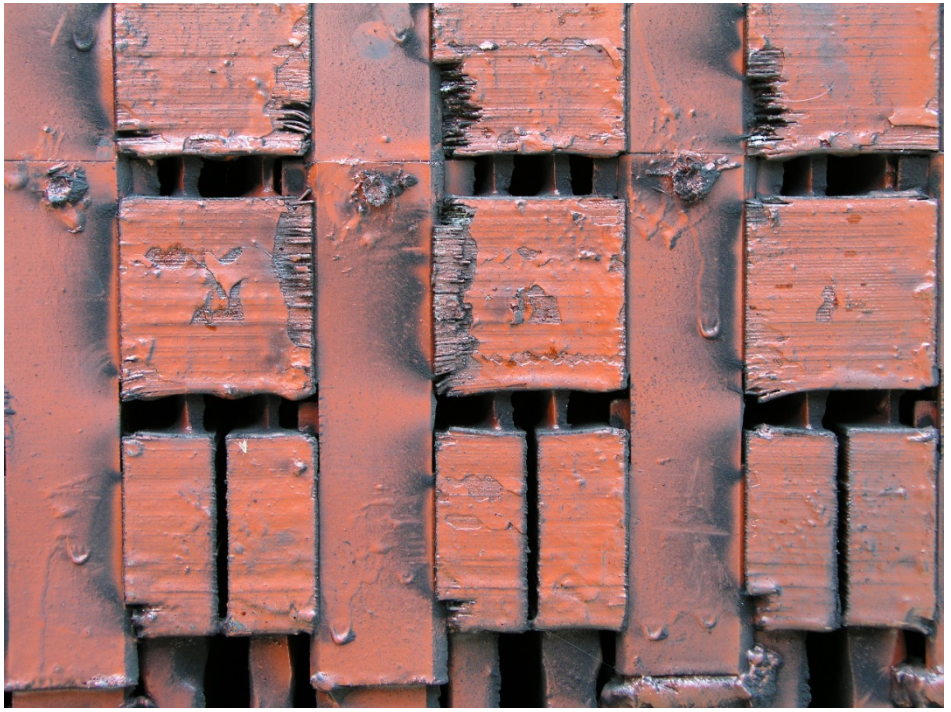
- Is there room to install core loop cable?
- Some machines have very little space under the core
- Inspect early in outage planning process for places to run core test cable
- El-CID is often a good alternative

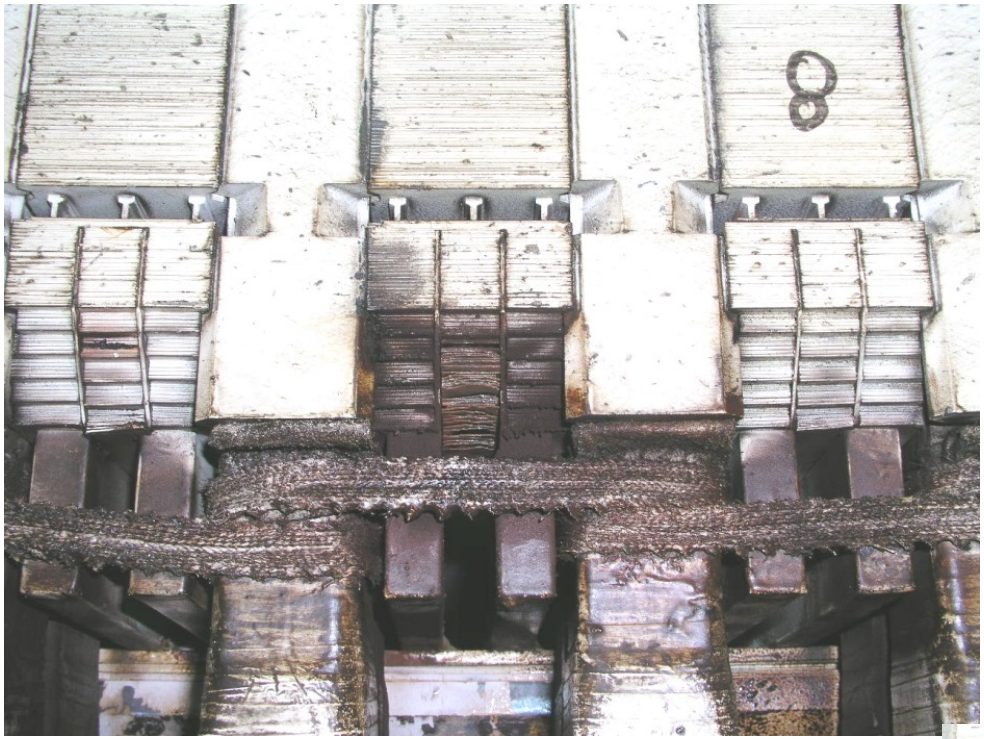




Is It Time for A Core Replacement?

- Evaluate core condition ahead of time
- Brittle laminations
- Replace based on age alone?

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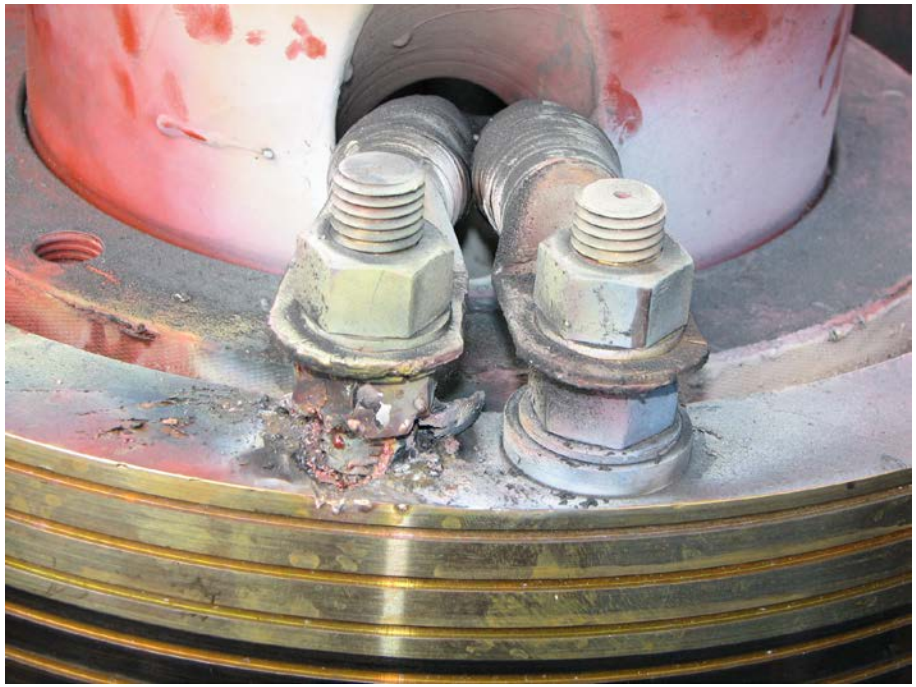
Insulator Replacement

- Replace slip ring and field lead insulators
- Insulation resistance testing can give a good indication of insulator problems

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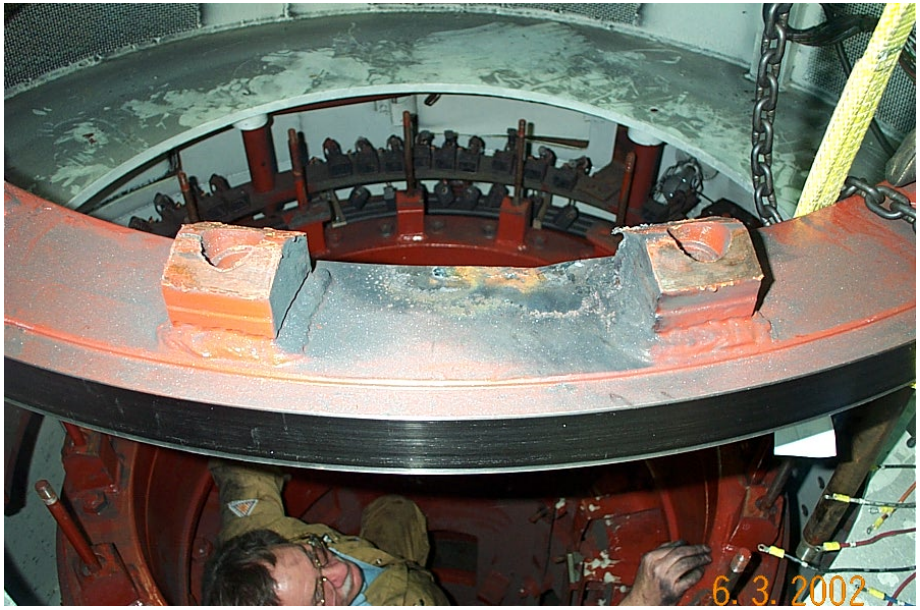
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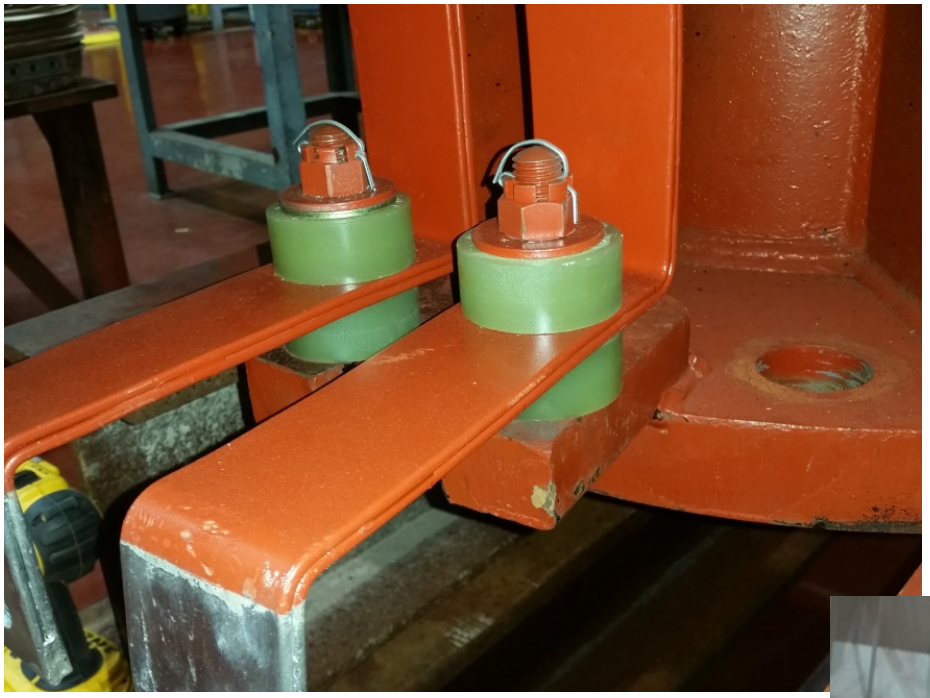
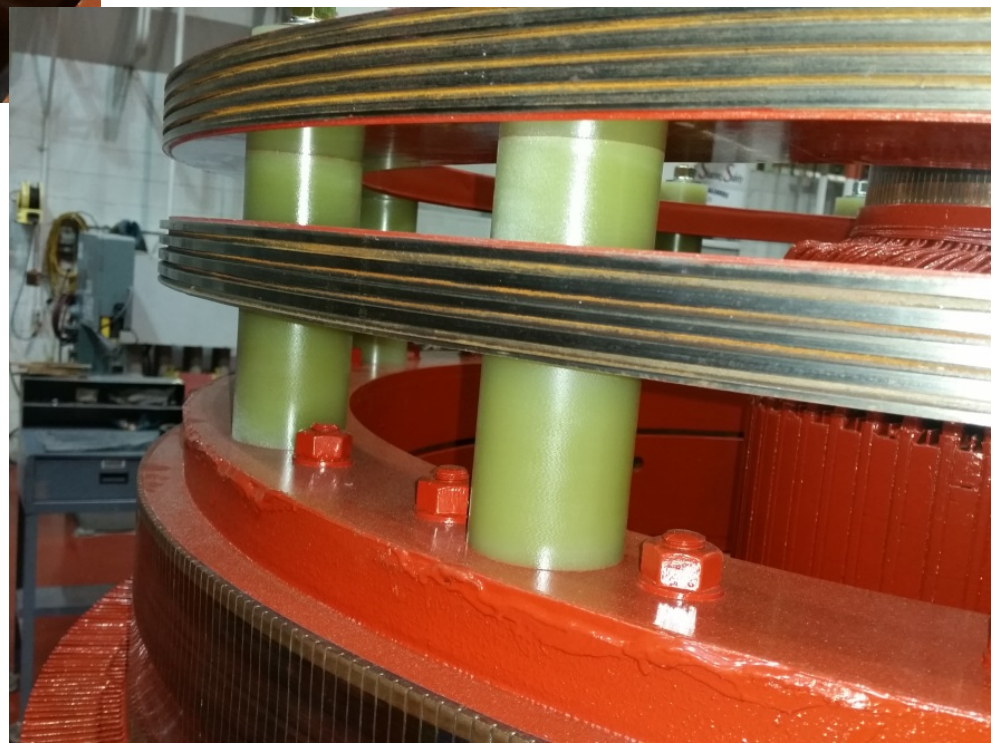
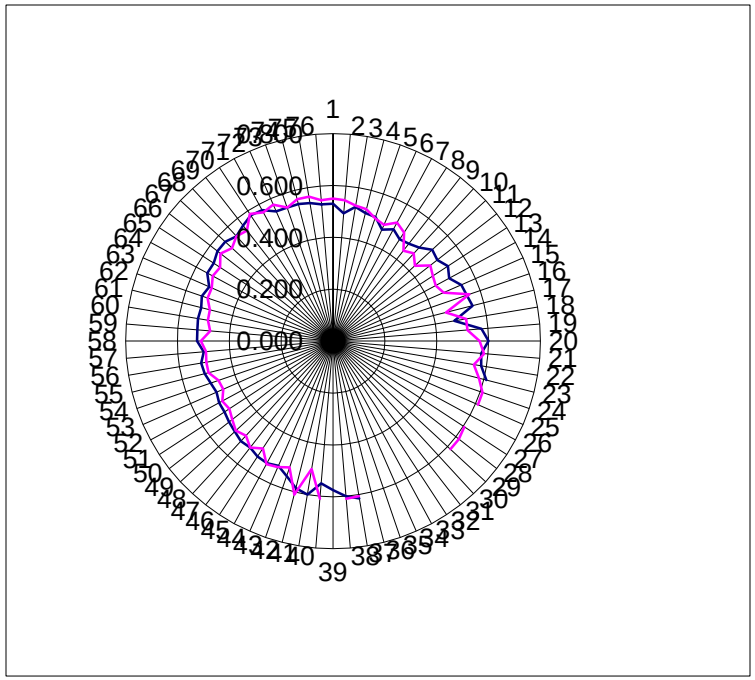
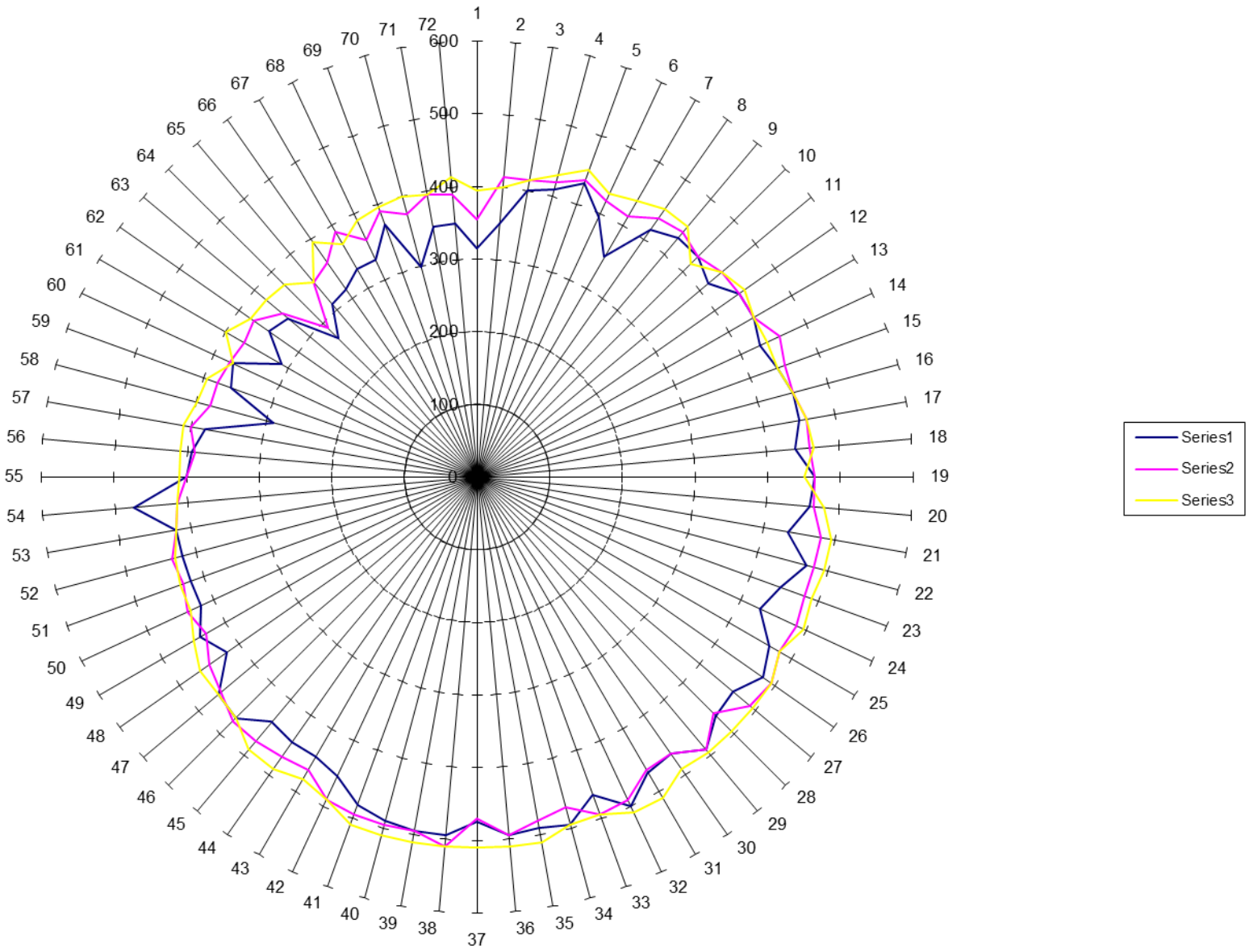




Airgap Readings

- Take airgap readings prior to outage
- Plan how to safely move stator and have equipment available
- Do airgap readings always correlate well with center wire readings?
- Take post outage airgap readings

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Series1
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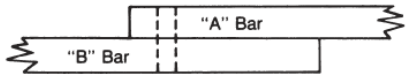
ENERPAC

Bus Bolting Procedure

- Have a procedure and require it's use
- Contractors, too!
- Infrared inspections

HARDWARE FOR JOINING LIKE OR UNLIKE METALS



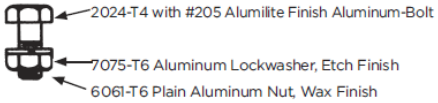
If "A" BAR is	Cu	AL	AL	Galvanized Steel	Galvanized Steel
and "B" BAR is	Cu	Cu	AL	Cu	AL
Recommended Series of Hardware	(1) Si-Br (2) SS (3) GS	(1) SS *or* GS	(1) AL (2) SS *or* GS	(1) Si-Br (2) SS *or* GS	(1) AL (2) SS *or* GS

KEY:
Si-Br—Silicon Bronze GS—Galvanized Steel
SS—Stainless Steel AL—Aluminum
(1) denotes preferred hardware usage.

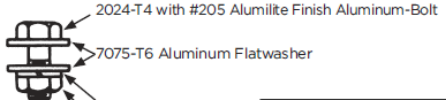
NOTE:
Contact sealant should be used between Aluminum to Aluminum and Aluminum to Copper connections.

ALUMINUM CONNECTORS

Aluminum Connector (Clamping Hardware)



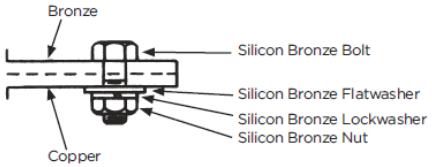
Aluminum To Aluminum Assemblies (Tongue Mounting Hardware As Assembled At Factory)



BRONZE CONNECTORS

Bronze Connector (Clamping Hardware)

Bronze To Copper Assemblies (Tongue Mounting Hardware)

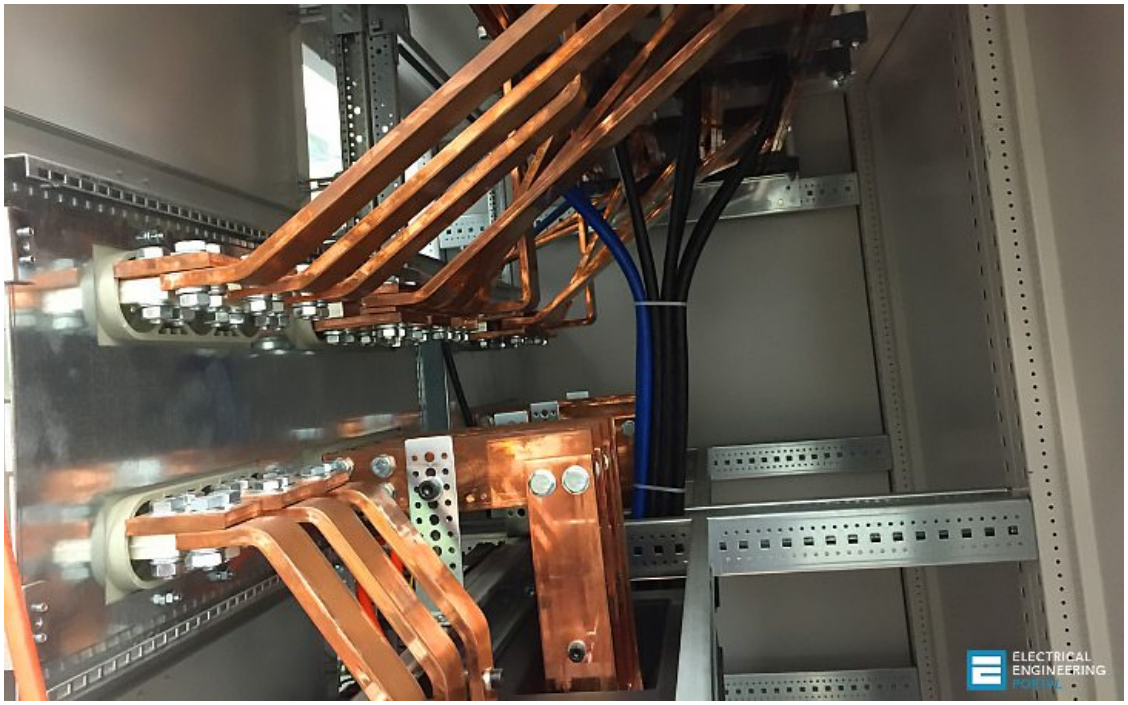


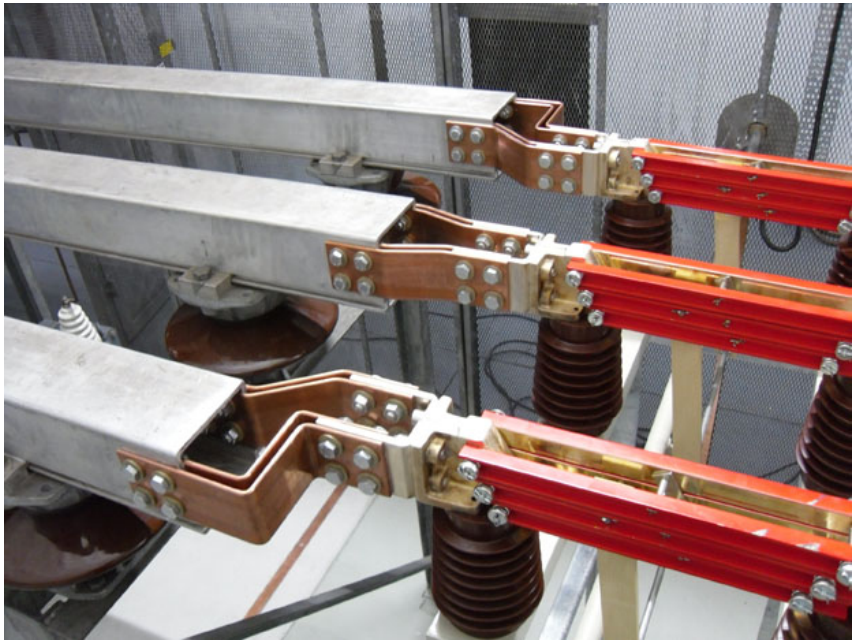
RECOMMENDED TORQUE VALUES FOR BOLTED CONNECTORS

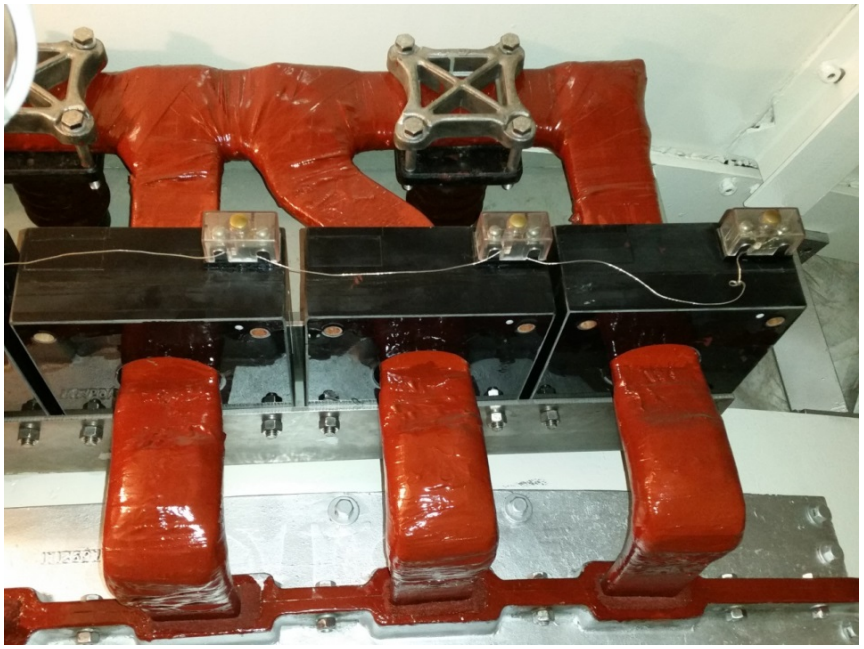
Tightening Force Applied to Hardware: Following are ANDERSON'S recommended torque values applying to all clamping hardware used in connectors and fittings.

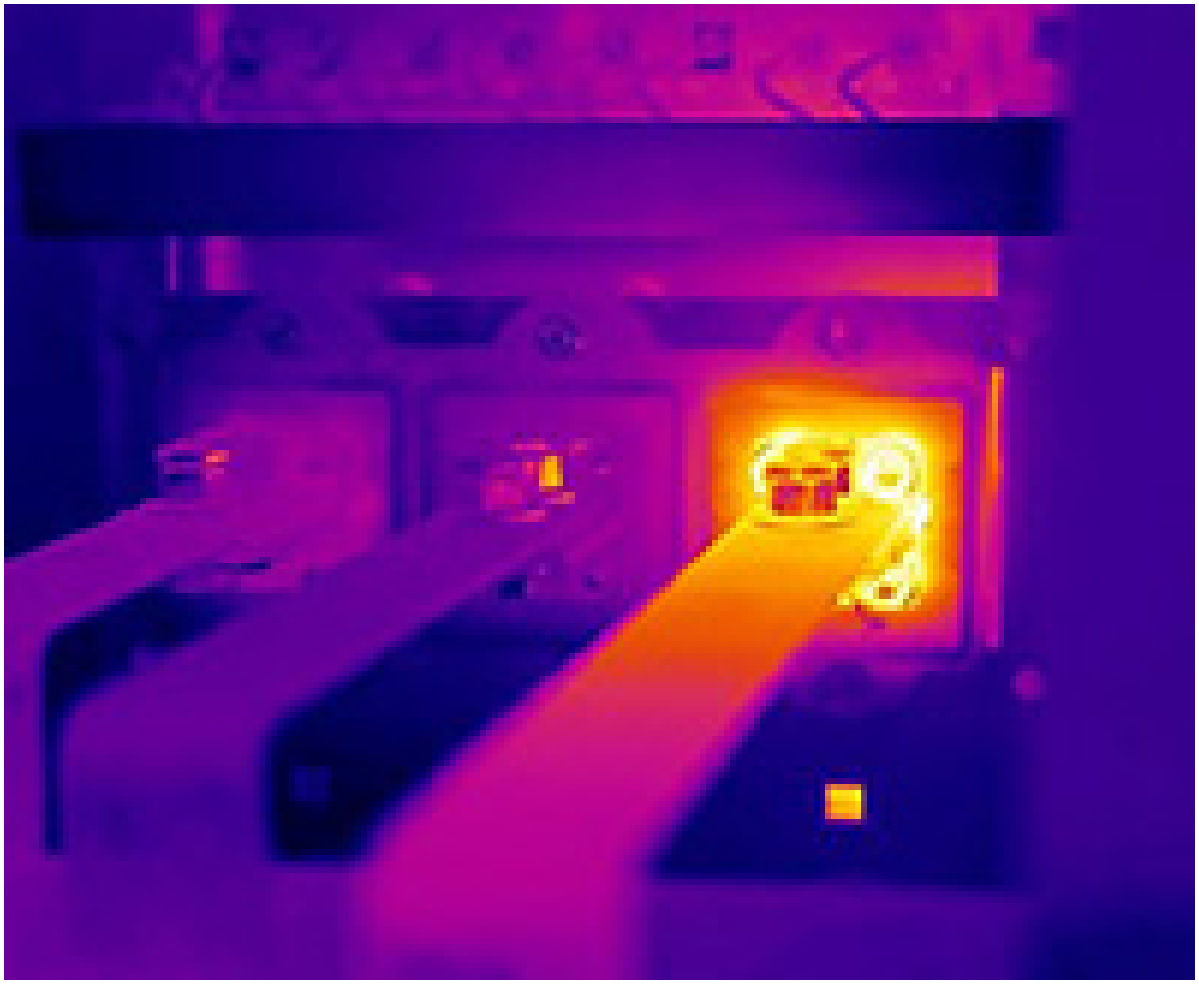
NOTE:
Care should be taken to prevent sealant from being applied to hardware since torque values will be affected if the hardware becomes lubricated with sealant.

BOLT DIA.	RECOMMENDED TORQUE NON-LUBRICATED STEEL & SILICON BRONZE HDWE. LB. INCHES	RECOMMENDED TORQUE LUBRICATED HDWE. & ALUMINUM HDWE. LB. INCHES*
5/16"	180	120


ELECTRICAL
ENGINEERING








Spot *132
°C
FLIR
150
-13


Spot *141
°C
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Additional Items

- Lead paint on frame
- Asbestos in winding or winding components
- NERC testing to be done following unit uprate, exciter modifications, governor modifications, protective relay settings
- Wire checking after outages
- Test crane well before outage
- Lessons learned program
- Risk analysis