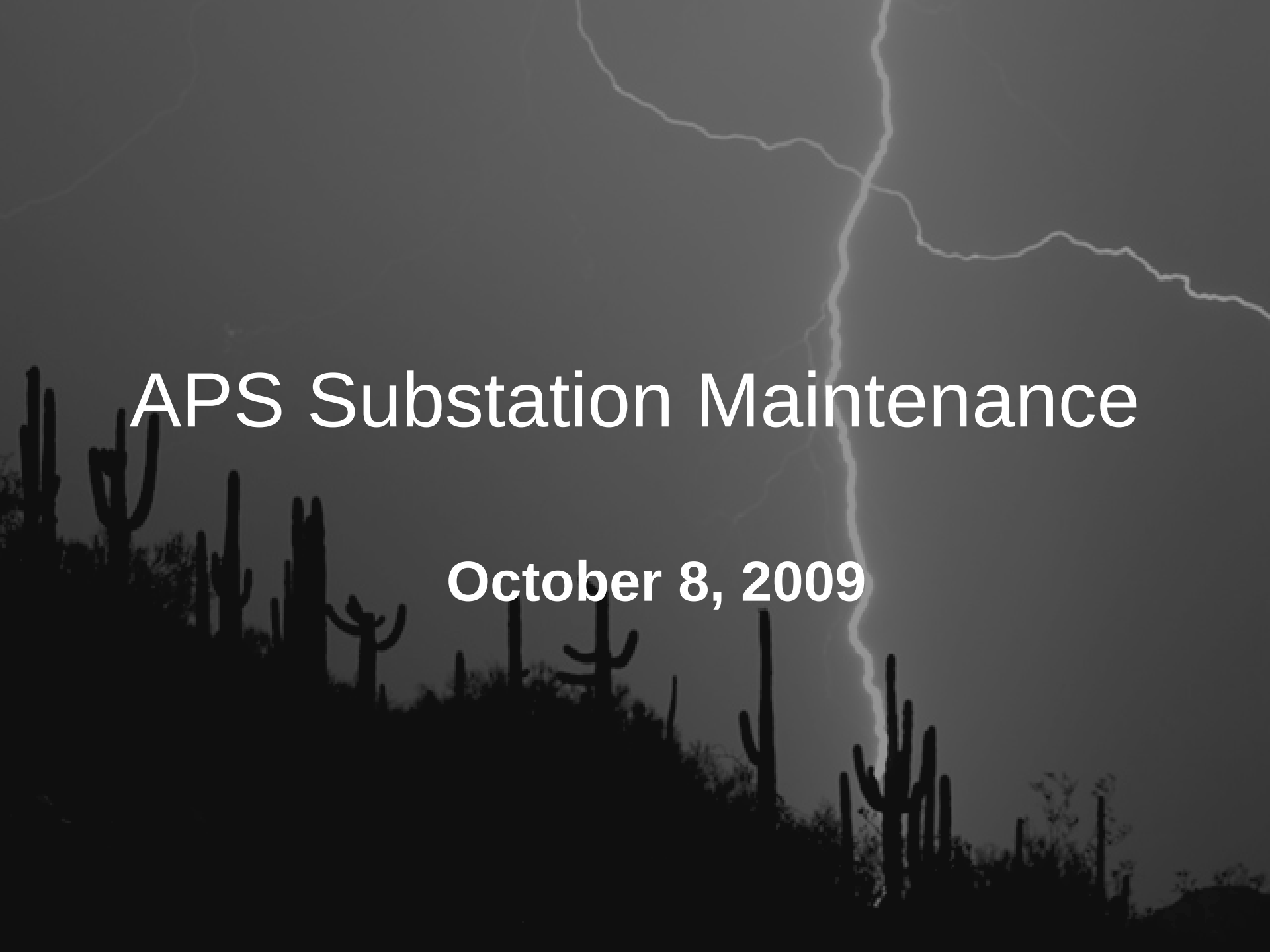


APS Substation Maintenance

October 8, 2009

Substation Criticality Ranking

- Criticality Ranking – Tiers
  - Equipment ranked by – access, consequence, replacement cost, replacement time, redundancy, safety, and environment
  - Substations ranked by – revenue, redundancy, importance, and reliability
- Maintenance frequency can be based on Tier quartile

2009 Planned Maintenance - August

DISTRIBUTION

PROGRAMS

1	Last Month	P	2	Last Month	G	3	Last Month	G	4	Last Month	C	5	Last Month	P
Recloser/Sectionalizer			Automatic Transfer Switch			Capacitor Bank Operational Checks			Public Safety Overhead Line Patrol			Line Maintenance		

6	Last Month	P	7	Last Month	P	8	Last Month	G	9	Last Month	G	10	Last Month	C
Wood Pole Maintenance			Network System Maintenance			Manhole Maintenance			Automation Switch Maintenance			Underground Assurance - XFMR's		

11	Last Month	C
Public Safety Underground Inspections		

PROJECTS

1	Last Month	G	2	Last Month	P C	3	Last Month	G
Grey Coverlock Replacement			Wildlife Protection			Smartgrid T&D Remediation		

TRANS

PROGRAMS

1	Last Month	G T	2	Last Month	P T	3	Last Month	C T	4	Last Month	P T	5	Last Month	G T
HPOF Pipe Cable System Maintenance			Line Maintenance			Public Safety Line Patrol			Wood Pole Maintenance			Manhole Maintenance		

SUBSTATION

PROGRAMS

1	Last Month	P T	2	Last Month	G T	3	Last Month	P T	4	Last Month	P T	5	Last Month	P T
Circuit Breaker			XFMR & Reactor Oil Sampling			Protective Relay Maintenance			Relay Functional Testing			Battery Maintenance		

6	Last Month	G T	7	Last Month	C	8	Last Month	P T	9	Last Month	P T	10	Last Month	G T
Series Capacitor Bank Maintenance			Public Safety Substation Inspections			Load Shed Relay Settings			Thermography			Substation Equipment Inspections		

11	Last Month	G T
Doble Testing		

PROJECTS

1	Last Month	E	2	Last Month	E	3	Last Month	E
U-Type Bushings			Substation Fire Protection			On-Line Monitoring		

PROJECTS

4	Last Month	C	5	Last Month	C	6	Last Month	G
Battery Transfer Switch			Feeder Breaker Arresters			Blackstart Generators		

EXCEEDED GOAL

MET GOAL

SOMEWHAT UNDER GOAL

SIGNIFICANTLY UNDER GOAL

12 of 13	**G** = General Maintenance
11 of 13	**P** = Performance Based
7 of 8	**C** = Compliance Based
2 of 3	**E** = EPRI
13 of 15	**T** = TMIP

YTD	86%
THRESHOLD	80%

Substation Maintenance Programs

Circuit Breaker Maintenance

- **Major Maintenance -** Circuit Breakers are subjected to an internal component inspection pursuant to a detailed written procedure. Component rebuild or replacement is generally based on limits of wear or test result guidelines prescribed within the detailed written procedure.
- **Minor Maintenance -** Circuit Breakers are subjected to an external inspection and test process per the same detailed written procedure as above, but with specific step qualifications, which limit the scope. Results of both the inspection and test are then assessed to determine whether a Major Maintenance inspection is warranted.

Circuit Breaker Maintenance

- **Typical Electrical Tests for Major and Minor Maintenance -** Tests are performed for contact resistance, timing, AC high potential, oil dielectric strength, sulfur-hexaflouride (SF_6) gas, moisture content in oil, and local/remote control operation. Doble insulation power factor testing may also be performed on circuit breakers.
- **Typical Inspection Items for Major and Minor Maintenance -** These items include moving and stationary contacts, interrupting components, bushings, operating mechanisms, auxiliary control components, hardware, wiring, lubrication, and calibration/operational checks of pressure or mechanical control and alarm components.

Circuit Breaker Maintenance

- Maintenance based on counter reads
- Breaker Exercise - semi annual
- Metalclad Breaker Maintenance – 5 yrs
- Planned Breaker Replacement
- Blackstart Pneumatic Bkr Changeout

Oil Sampling

- Dissolved Gas Analysis
  - Manual (varies)
  - On-line monitoring (four hours) (138 monitors)
- Oil Quality
  - Dielectric Strength, Acid, Interfacial Tension, Power Factor, Water
  - Every two years

2008 *Edison Award*

The Edison Award 2008
EDISON ELECTRIC INSTITUTE

APS

Winner of 2008 Edison Award

In recognition of innovative leadership and operational excellence in the electric industry

Relays

- Relay maintenance
  - Electro-mechanical relays only
- Relay functional testing
  - All relays
- 4 year frequency for both programs

Battery Maintenance

- Follow IEEE guidelines for:
  - Capacity discharge testing
  - Intercell resistance
  - Specific gravity
  - Temperature
  - Electrolyte level

Series Capacitor Bank Maintenance

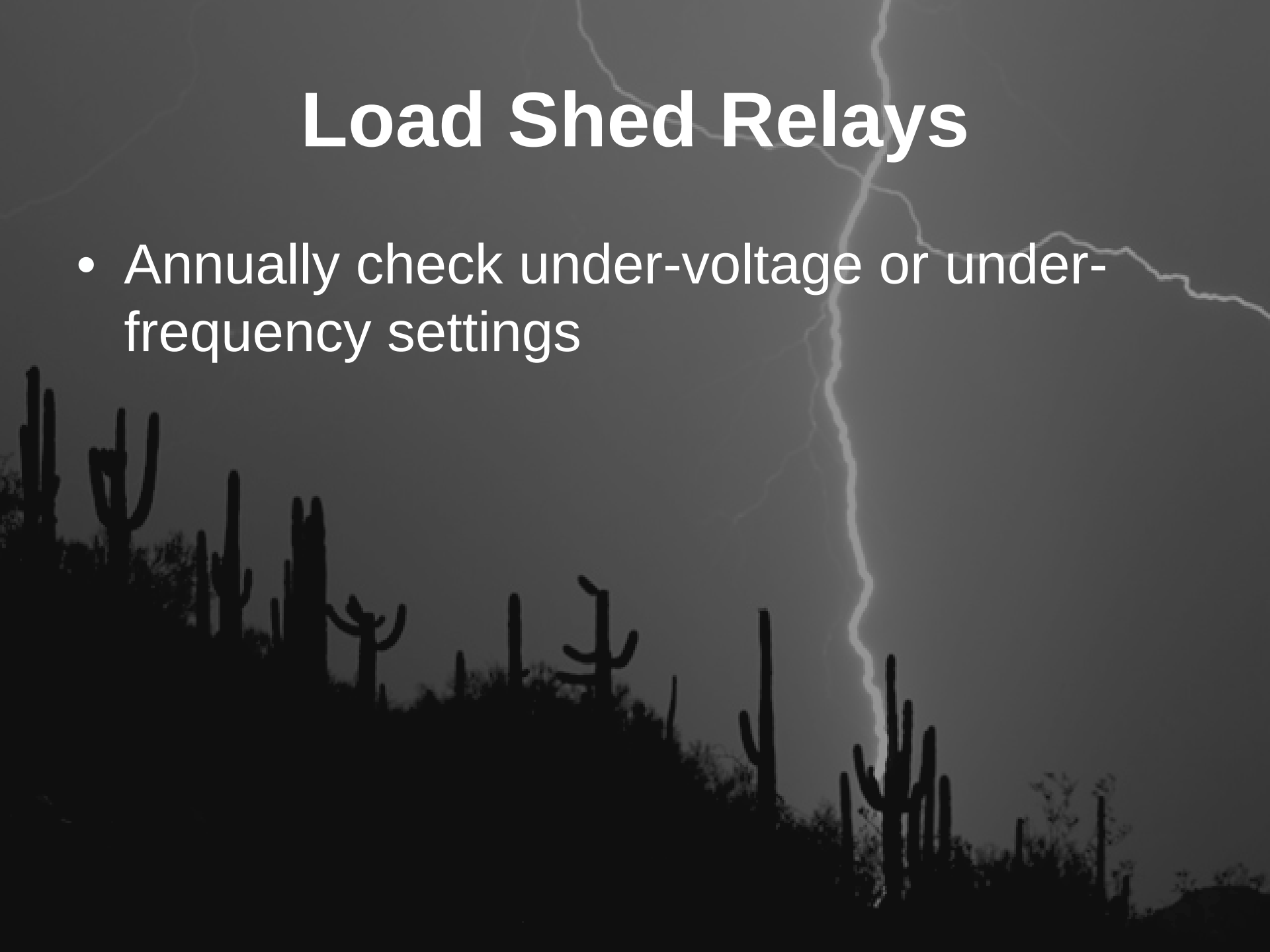
- Five years for new, electronic banks
  - Visual for contamination, corrosion, bulging or leaking cans, hardware
  - MOVs
  - CTs
  - Columns
  - Bypass breakers
  - Triggered air gaps

Public Safety Inspections

- Annually check for:
  - Warning signs
  - Fence and gate integrity
  - Ground erosion
  - Vandalism
  - Vegetation, outside grading or other providing potential access

Load Shed Relays

- Annually check under-voltage or under-frequency settings



Thermography

- Scans performed on transformers, breakers, switches and other current carrying devices
- “Hotspots” analyzed and prioritized

Equipment Inspections

- **Equipment -** Oil leaks, oil level, counter reads, SF_6 levels, temperatures, and pressures. Transformer fans are operated, and moisture is bled from breaker air tanks. Regulators are inspected. Trouble or suspected trouble is reported for corrective maintenance.
- **Control Vault -** A general visual inspection is performed and breaker red lights, evidence of rodent intrusion, battery chargers, and station batteries are checked and recorded.

Doble Testing

- Overall tests
- Bushing tests
- Hi-collar tests
- Oil tests
- Surge arrester tests
- SFRA and LR testing done and receipt and upon cause

Substation Maintenance Projects

- Type U Bushings
- Fire Protection
- On-Line Monitoring
- Battery Transfer Switches
- Feeder Breaker Arresters
- Back Up Generators

2009 Maintenance Basis

Diagnostic	TMIP	Tier 1 (>100kV)	Tier 1 (92)	Tier 2 (170)	Tier 3 (80)	Tier 4 (39)
Visual Inspection	PDIO	Monthly for WP, RC, SG, WW, OC, CH, PP, MK	4 / year	3 / year	2 / year	Annually
Thermography	PDIO	Monthly for WP, RC, SG, WW, OC, CH, PP, MK	4 /year (1 - Spring, 1-Night, 1- Sum, 1 - Fall)	2 /year (1 - Spring or Fall, 1- Summer)	1 /year	1 /year
Corona Scans		1 /year	For Cause	For Cause	For Cause	NA
Sound Levels		Baseline - then For Cause		Baseline - then For Cause	For Cause	NA
Vibration / Acoustical / Ultrasound		Baseline - then For Cause		Baseline - then For Cause	For Cause	NA
SF6 Scans / ANSA (Partial Discharge)		For Cause		For Cause	For Cause	NA
Breaker Maintenance						
Micro: Lubricatbn, Timing, Electrical Test, Calibration			Every 6 years	Every 6 years	Every 6 years	
Major Cubicle Switch Gear	PDIO	>100kV Counter Based	As Required	As Required Every 5 years	As Required	
Transformer Maintenance						
Dissolved Gas Analysis Oil Screening Tests			Annually, For Cause, by 2010 all EHV transformers will have an on-line gas-in-	Every other year		
Power Factor Test		Every 5 years	Every 7 years	Every 7 years	Every 10 years	NA
Capacitance Test	(PDIO)	Every 5 years	Every 7 years	Every 7 years	Every 10 years	NA
Winding Resistance Test	At Install	Every 5 years	Every 7 years	Every 7 years	Every 10 years	NA
Total Turns Ration Test	Then for cause	Every 5 years	Every 7 years	Every 7 years	Every 10 years	NA
Megger Test		Every 5 years	Every 7 years	Every 7 years	Every 10 years	NA
Leakage Reactance		Every 5 years	Every 7 years	Every 7 years	Every 10 years	NA
Relay Maintenance	Maximo		Every 4 years	Every 4 years	Every 4 years	NA
Relay Functionals	Maximo		Every 4 years	Every 4 years	Every 4 years	NA
Batteries						
Capacity Testing	PDIO	Acceptance test at installation, within 2 years of acceptance test, within 7 years of acceptance test, within 12 years of acceptance test, and within 17 years of acceptance test. Once battery reaches 85% of manufacturer's guaranteed service life (After 17 years) or shows signs of degradatbn (i.e., 10% drop in capacity from previous test or 10% below the manufacturer's rating or any other condition that makes the battery suspect) it is tested every year.				
Resistance Testing	PDIO	Annually				
Maintenance	PDIO	3 times a year				

Annual Maintenance Plans

Project Description	PM Goal 2005	2006	2007	2008	PM's to Fulfill Maintenance Basis
Circuit Breaker Maint	21	104	109	140	330
Xfmr & Reactor Oil Sampling	279	1141	810	1122	1122
Relay Maint	1920	1824	1860	1898	1898
Functionals	2194	2452	2451	2783	2783
Battery Capacity Tests	106	125	117	113	113
Battery Maintenance	1544	1647	1637	1652	1652
Series Capacitor Bank Maint	7	3	6	5	12
Thermography Scans	342	553	995	997	997
Substation Inspections	927	1642	1840	1875	1875
Doble Testing	36	90	100	180	286
Metal Clad Switchgear Maint		0	0	20	22
PVDB1 Switch Retro Fits		84	196		Ongoing
Wild Life Protection	80	81	135	70	Ongoing
U-Type Bushings	NA	NA	36	39	Ongoing
On-Line Monitoring Retro-Fits			17	25	Ongoing
Battery Charger Replacement				75	Ongoing
Battery Transfer Switch				126	Ongoing

Insert Key Solutions

POWER DELIVERY **IQ**™ **ER** DASHBOARD™ **IQ** REVIEW™

An Integrated Maintenance Tracking Program

- Equipment Condition Assessment
- Equipment Health
- Project Status
- Program Status
- Performance Indicators
- Equipment Reliability
- PM Templates
- Maintenance Basis
- Maintenance Strategy
- Reporting

POWER DELIVERY IQ™

Insert Key Solutions, Inc.

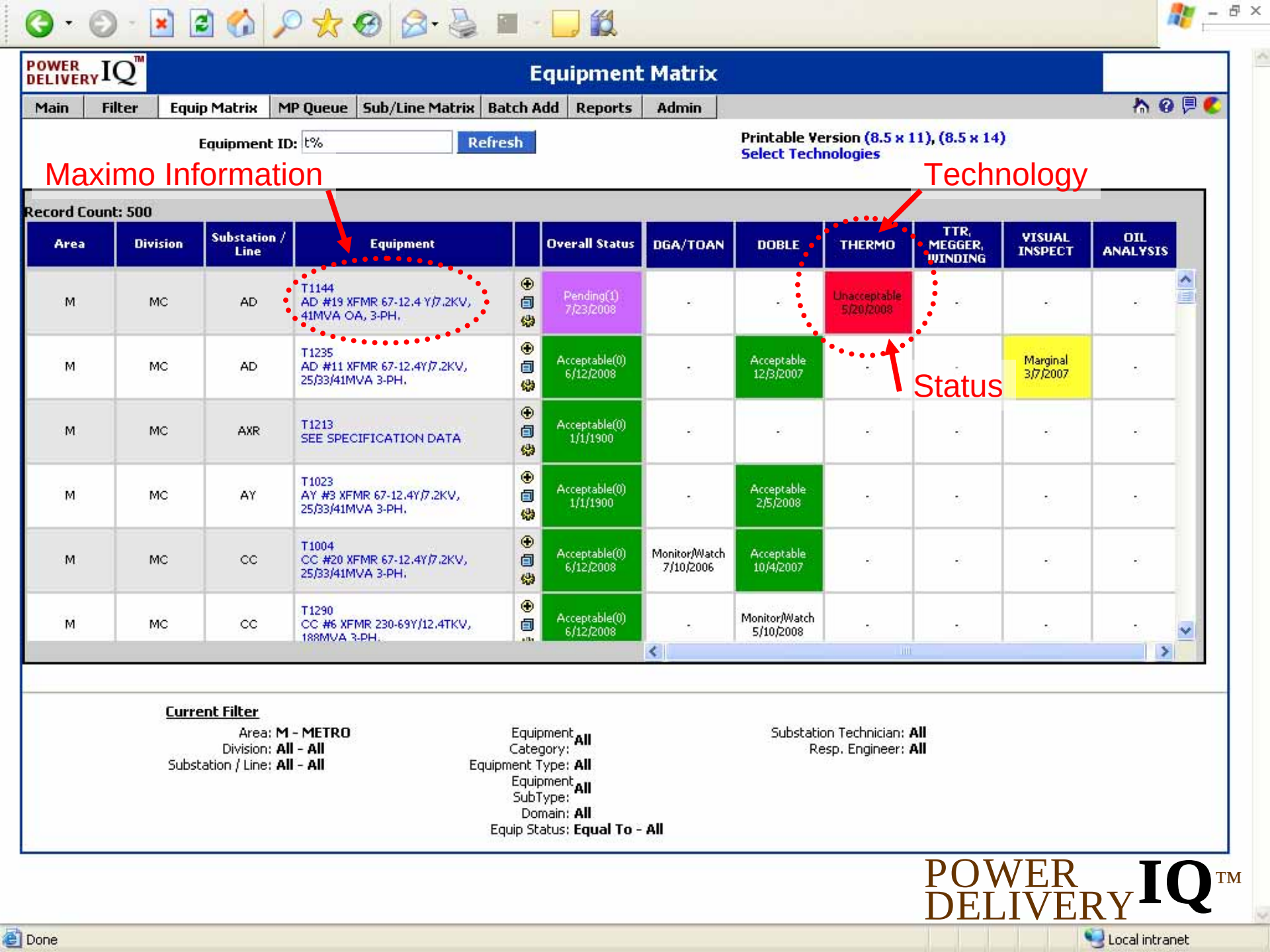
PDIQ is a database engine that stores critical information in the form of technology exams to display equipment health in matrix displays. Since equipment health is dictated from many types of data sources, all exam types have been identified and implemented. These individual technologies roll up to an overall equipment heath status. Email notifications of referral or unacceptable results is available.

ER DASHBOARD™

ER Dashboard is an integral performance indicator platform for equipment reliability. The integration is by region (Metro, North and South), and then by area (East, West, Central). The performance indicators roll up to each regions' area. The Maintenance strategy also rolls up to a display.

IQ REVIEW™

IQ Review is a centralized database that stores Preventative Maintenance templates and compares them with the performed technology exams. This also documents the Maintenance Basis (utilizing the EPRI Tier classification for the substation). The incorporation of the Maintenance strategy to varying equipment types and situations captured in one area is the real strength of this system.


POWER DELIVERY IQ™
Equipment Matrix
Main
Filter
Equip Matrix
MP Queue
Sub/Line Matrix
Batch Add
Reports
Admin
Equipment ID: t%
Refresh
Printable Version (8.5 x 11), (8.5 x 14)
Select Technologies
Maximo Information
Technology
Status
Record Count: 500
Area
Division
Substation / Line
Equipment
Overall Status
DGA/TOAN
DOBLE
THERMO
TTR, MEGGER, WINDING
VISUAL INSPECT
OIL ANALYSIS
M MC AD T1144 AD #19 XFMR 67-12.4 Y/7.2KV, 41MVA OA, 3-PH. Pending(1) 7/23/2008 - - Unacceptable 5/20/2008 - - -
M MC AD T1235 AD #11 XFMR 67-12.4Y/7.2KV, 25/33/41MVA 3-PH. Acceptable(0) 6/12/2008 - Acceptable 12/3/2007 - - Marginal 3/7/2007 -
M MC AXR T1213 SEE SPECIFICATION DATA Acceptable(0) 1/1/1900 - - - - - -
M MC AY T1023 AY #3 XFMR 67-12.4Y/7.2KV, 25/33/41MVA 3-PH. Acceptable(0) 1/1/1900 - Acceptable 2/5/2008 - - - -
M MC CC T1004 CC #20 XFMR 67-12.4Y/7.2KV, 25/33/41MVA 3-PH. Acceptable(0) 6/12/2008 Monitor/Watch 7/10/2006 Acceptable 10/4/2007 - - - -
M MC CC T1290 CC #6 XFMR 230-69Y/12.4TKV, 188MVA 3-PH. Acceptable(0) 6/12/2008 - Monitor/Watch 5/10/2008 - - - -
Current Filter
Area: M - METRO
Division: All - All
Substation / Line: All - All
Equipment Category: All
Equipment Type: All
Equipment SubType: All
Domain: All
Equip Status: Equal To - All
Substation Technician: All
Resp. Engineer: All
POWER DELIVERY IQ™
Done
Local intranet

Technology History | Overall Status History | Current Exam History | Edit Technology Exam

Add Technology Exam

Email

Technology Exam

Equipment: File Attachments (0) Printable Version

Area:	M - METRO	**Equipment Category:**	SUBS
Division:	MC - METRO CENTRAL	**Equipment Type:**	Xfmr - Other than Inst Xfmr's
Substation / Line:	AD - Adobe Substation	**Equipment SubType:**	TRANSFMR
Equipment:	T1144 AD #19 XFMR 67-12.4 Y/7.2KV, 41MVA OA, 3-PH.	**Overall Status:**	Pending
Classification:	Not Set	**Maint. Strategy:**	No Approved Maintenance Strategy
		Trend Report:	View Trend Report
Tier:	1	**Maint. Procedure:**	

Electronic File Attachments

Technology Exam: File Attachments (0)

Status

Status:	Unacceptable	**Date/Time:**	5/20/2008 12:00:00 AM
Active:	Open	**Technology:**	INFRARED THERMOGRAPHY
Field Tech:	Yirsa, Nicholas A	**Inspection Type:**	Routine
Resp. Engineer:	Barbera, Steven J		
Last Upd. By:	Barbera, Steven J		
Last Upd. Date:	10/6/2008 1:41:39 PM		

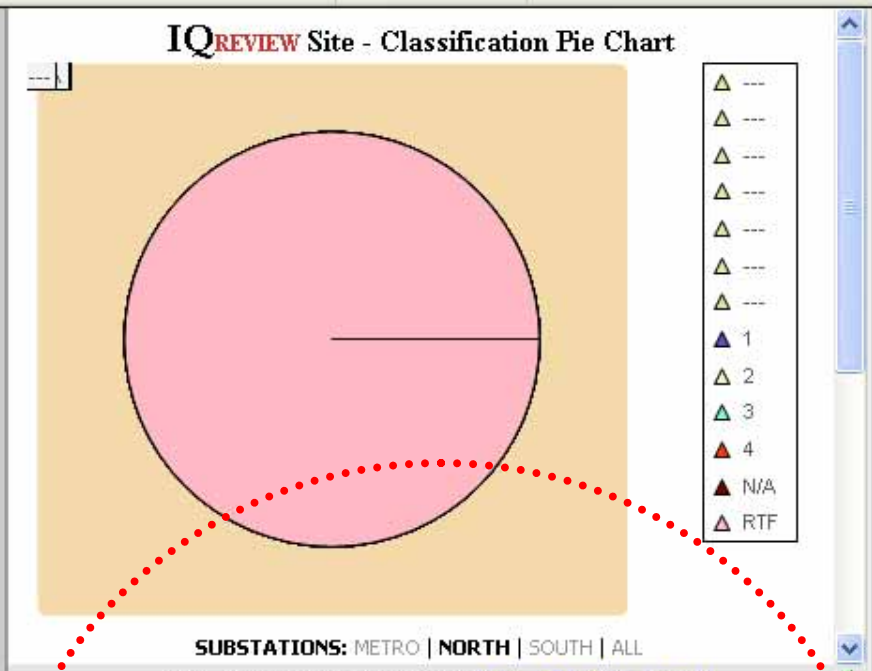
Problem/Initial Analysis: HOT SPOT ON BUSHING ROD IN THE NORTH PHASE HIGH SIDE BUSHING. IT IS VERY LIKELY THAT IT IS MUCH HOTTER INSIDE THAT BUSHING ON THE THREADED SECTION OF THE ROD.

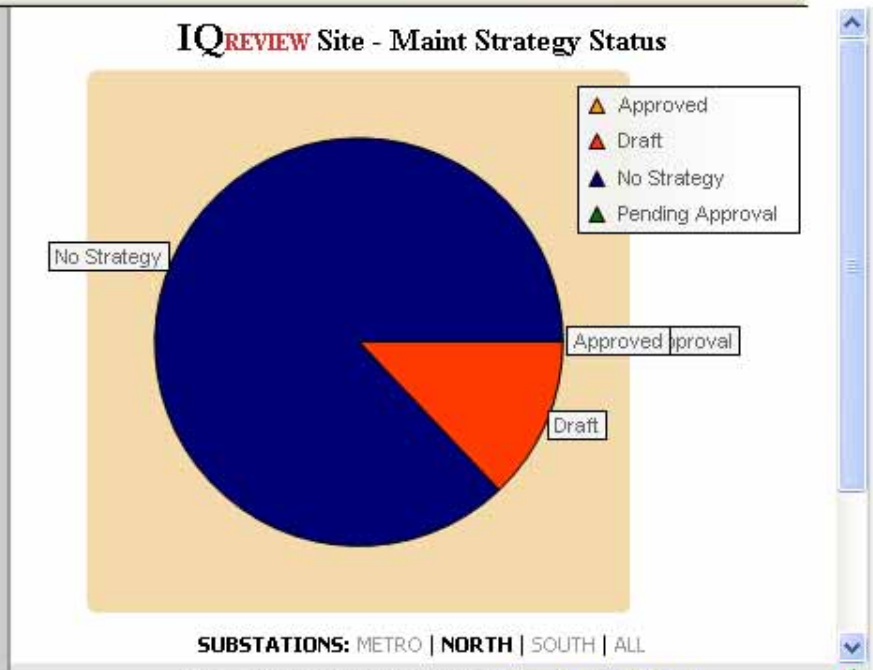
Engineering Analysis

Engineering Analysis and Recommendations:

Engineer Analysis:

POWER DELIVERY IQ™





POWER DELIVERYIQ Component Health Status

METRO					
METRO CENTRAL	99% (3606)	1% (51)	0% (1)	0% (0)	0% (1)
METRO EAST	98% (2821)	2% (49)	0% (1)	0% (0)	0% (0)
METRO WEST	99% (3892)	1% (27)	0% (0)	0% (0)	0% (0)
NORTH					
NORTHEAST	99% (2755)	0% (8)	0% (6)	0% (1)	0% (0)
NORTHWEST	99% (1407)	1% (13)	0% (0)	0% (0)	0% (0)
SOUTH					
SOUTHEAST	99% (1511)	1% (22)	0% (0)	0% (0)	0% (0)
SOUTHWEST	98% (1197)	2% (24)	0% (1)	0% (0)	0% (1)

Advanced Search

Performance Indicator by area

ER DASHBOARD™

Local intranet

Add Template

Equipment Category: SUBSTATIONS

Template Type: Utility

- Breakers
  - **SF6 Interrupting Media**
    - Breaker SF6, 1 pressure (puffer) Ext. Capacitors (B) - Approved
    - Breaker SF6, 1 pressure (puffer) No Ext. Capacitors (B) - Approved
    - Breaker SF6, 2 pressure - Approved
  - **Oil Interrupting Media**
    - Breaker, Oil (Outdoors) (B) - Approved
  - **Vacuum Interrupting Media**
    - Breaker, Vacuum Bottle (Outdoors R-Mag) (B) - Approved
    - Breaker, Vacuum Bottle (Outdoors) (B) - Approved
  - **Switchgear Vac Interrupting Media**
    - Breaker, Vacuum Bottle (Switchgear Cubicle) (B) - Approved
  - **Switchgear Air Magnetic Int. Media**
    - Breaker, Air Magnetic (Switchgear Cubicle) (B) - Approved
- Capacitors
  - **Series Capacitor Bank**
    - Series Capacitor Bank (CBSE) (GE Only) - Approved
    - Series Capacitor Banks (CBSE) (Westinghouse Only) - Approved
  - **Shunt Capacitor Bank**
    - Shunt Capacitor Banks (CBSH) - Approved
- Switches
  - **Oil Switches**
    - Oil Switches (OCRs) - Approved
- Transformer
  - **Network Transformers**
    - Network Transformers (NT) (integral part of NT/NP) - Approved
  - **Power Transformer**
    - Transformers EHV (>69kV) - Approved
    - Transformers HV (<=69kV) - Approved
- Electrical
  - **Mobile Substations**
    - Mobile Substations (T - Mbl#) - Approved
  - **OTHER**
    - High Pressure Fluid Filled (HPFF) Cable System - Approved
    - Network Protector (NP) (integral part of NT/NP) - Approved
    - Serveron TM8, TM3 Gas In Oil Monitors (OLM) - Approved
    - Substation (General) - Approved
    - Voltage Regulators (LR, R) - Approved
  - **Batteries**
    - Battery and Battery Charger (BA) - Approved - Pending Approval
  - **Protective Relays**
    - Relays (General) - Approved

Available Templates
EHV Transformer

IQ REVIEW™

Done

Local intranet

Template View

Close Window

Template for EHV Transformer

Transformers EHV (>69kV)

Equipment Category: **SUBSTATIONS**
Category/SubCategory: **Transformer / Power Transformer**
SME: **Arndt, Gregory M**
Resp. Engineer: **Gamez, Lonnie**
Rev Number: **1**
Status: **Approved**
Approved By - Date: **Arndt-6/12/2008**

Boundary Definition | New Template
SME Summary | Delete Template
Comments | Create Draft
Implementation History
Revision History
Operating Experience
Commitments
Condition Definitions
File Attachments(0)

Task View | FMECA View

Maintenance Strategy by Type

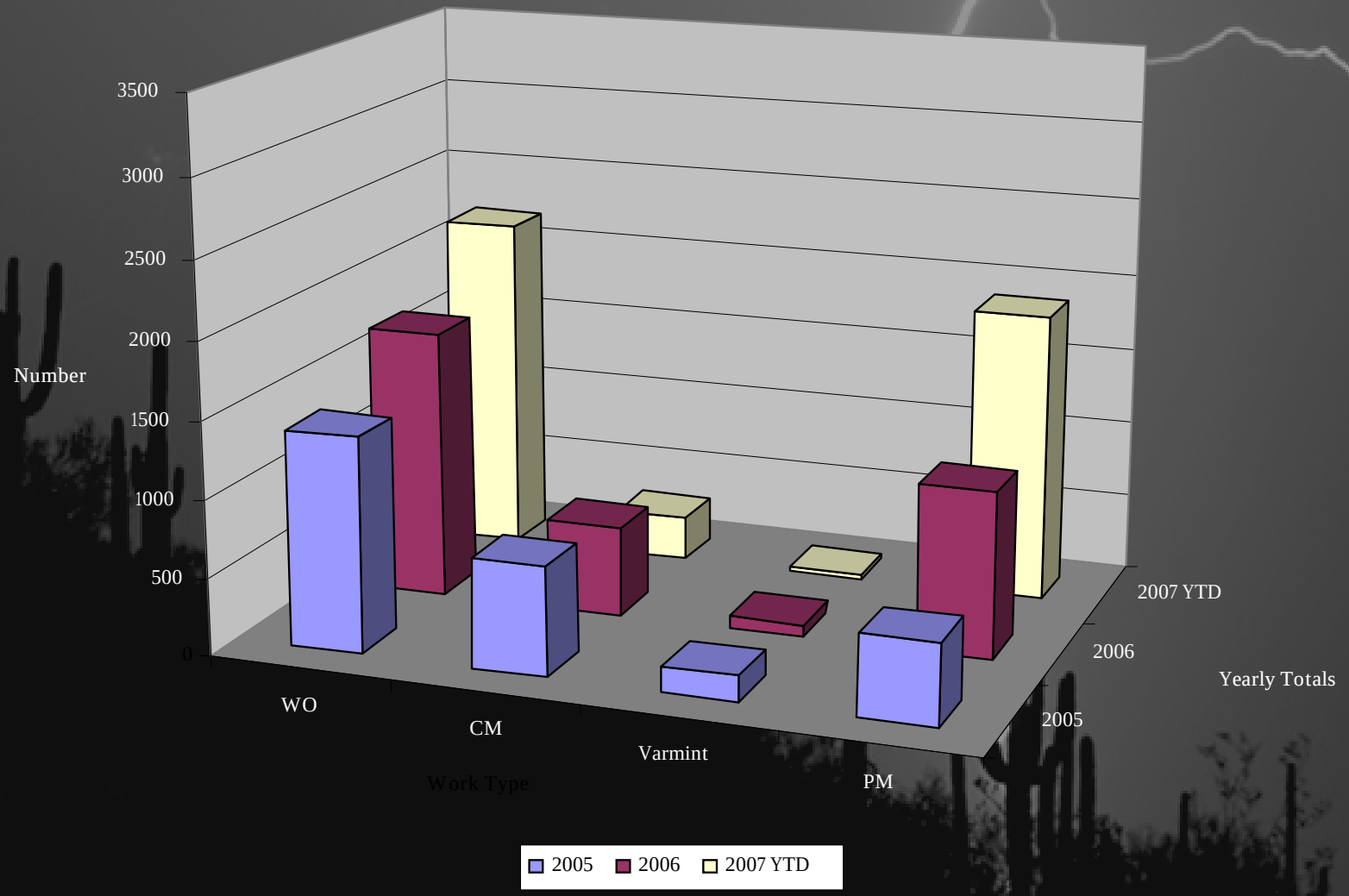
Substation Tier Level

View Basis Text

Tier	1	2	3	4	N/A	---	---	---	---	---	---	---
Failure Finding												
Thermography	2.00 M	6.00 M	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Failure Mode												
	Man Hours Needed: 0		Hours Unavailable: 0				Sort Order: 0					
Condition Directed												
TTR, Megger and Winding Resistance Tests	AR	AR	AR	AR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Failure Mode												
	Man Hours Needed: 0		Hours Unavailable: 0				Sort Order: 0					
Time Directed												
Dissolved Gas Analysis (DGA)	1.00 Y	1.00 Y	1.00 Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Failure Mode												
	Man Hours Needed: 0		Hours Unavailable: 0				Sort Order: 0					
Oil Screening Tests	2.00 Y	2.00 Y	2.00 Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Failure Mode												
	Man Hours Needed: 0		Hours Unavailable: 0				Sort Order: 0					
Periodic												
Transformer Doble Testing	3.00 Y	5.00 Y	7.00 Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Failure Mode												
	Man Hours Needed: 0		Hours Unavailable: 0				Sort Order: 0					

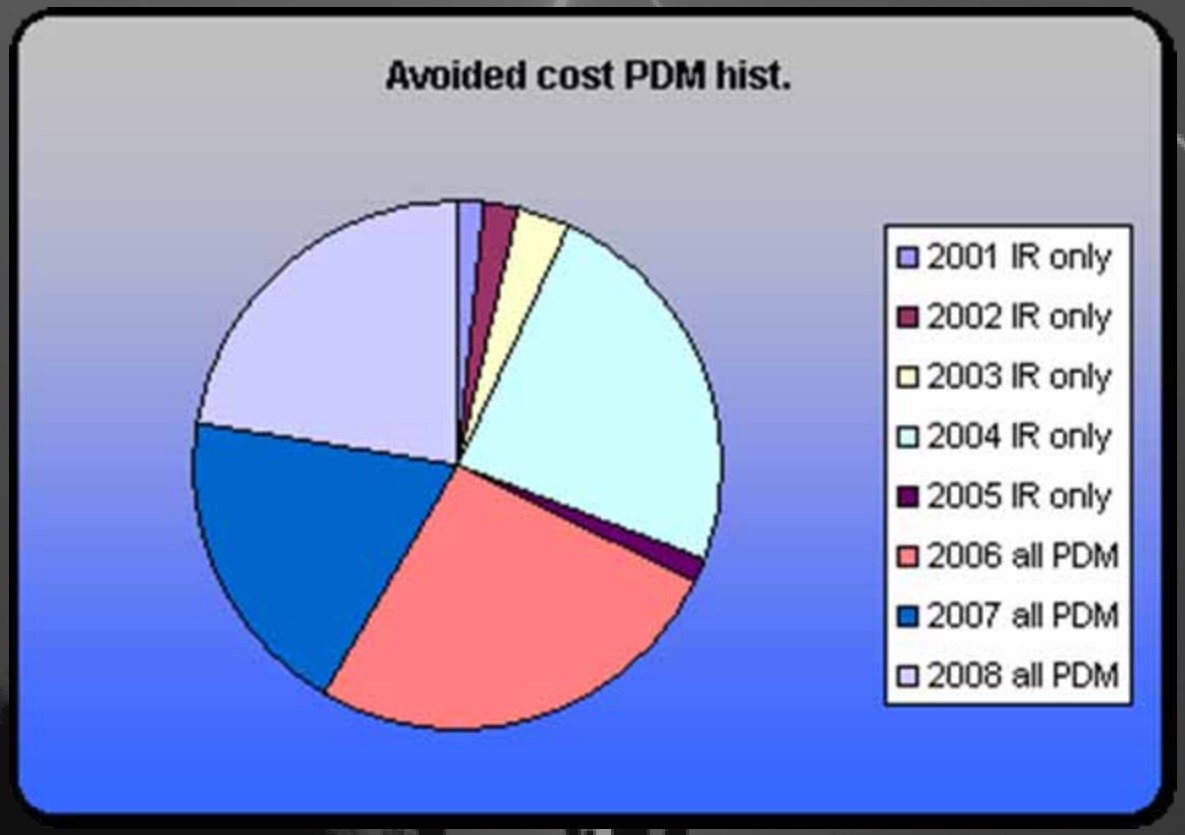
IQ REVIEW™

Improved Ratio of Predictive and Preventative Maintenance to Corrective Maintenance



Avoided Repair Costs

Year	Avoided
2001 IR only	$ 126,027.00
2002 IR only	$ 150,688.00
2003 IR only	$ 236,786.00
2004 IR only	$1,723,292.00
2005 IR only	$ 115,015.00
2006 all PDM	$1,889,257.00
2007 all PDM	$1,401,910.00
2008 all PDM	$1,636,070.00
Total	$7,279,045.00



Maintenance Warehouses

2006 Corporate Audit resulted in “in auditable” status; as a result, both SUBM and SUBE Warehouses underwent major changes, some examples include:

- **Repaving and re-striping the Deer Valley South 40 area; as well as creating new signage to define “locations” for material storage.**
- **New material “staging” and “re-stock” areas created at Building C to ensure material for projects gets charged out properly and excess material gets credited and put back into inventory correctly.**
- **Creating new Lay-down area at the West Phoenix Storage yard for transformer storage.**
- **New “locations” for transformers assigned at West Phoenix, and MLIS updated; (over 50 transformers have been relocated to the new lay-down area).**
- **New transformer “Scrap” area created at WPHX, obsolete transformers can be stored in this area, out of inventory, until they are scrapped, since 2006 over 60 obsolete transformers have been scrapped resulting in over $825,000 returned to APS**

Maintenance Warehouses

- 2008 Corporate Audit; both SUBM and SUBE were given very favorable results, the audit showed great improvement in the organization and labeling of materials stored. Cycle count tests were 100% accurate and the “Floor to Sheet” and “Sheet to Floor” samples taken showed only a few minor items that were easily corrected.
- The West Phoenix storage yard overhaul continues and will include reworking the “old ” transformer storage area to accommodate more equipment in an organized manner, new MLIS locations will be assigned to this area which will not only keep us in compliance but will make locating equipment easier. This area will be re-audited end of first quarter 2009.

Tools and Tests

- Thermography
- Corona
- Acoustic
- DGA
- Oil quality
- SFRA
- Leakage Reactance
- TTR
- Megger
- SF_6 leak detection
- Alber
- Cellcorders
- Digital hydrometers
- Breaker timers

SF_6 Reduction Program

- Partnership with US EPA
- APS recognized by EPA in 2009 for efforts
- Improved handling and maintenance practices
  - 100,000 lbs saved between 1999 & 2007
  - Reduced emissions by 83% since 2001
  - $880,000 savings (leak correction and purchases)

Spill Prevention, Control, and Countermeasure Program

- Purpose it to prevent any discharge of oil into navigable waters or adjoining shorelines.
  - it must be non-transportation-related;
  - it must have an aggregate aboveground storage capacity greater than 1,320 gallons or a completely buried storage capacity greater than 42,000 gallons; and
  - there must be a reasonable expectation of a discharge into or upon navigable waters of the United States or adjoining shorelines.

Fire Mitigation

- Firewalls
- Oil/water retention pits
- Spacing
- Deluge systems

T629 – FC U4 GSU

- 345/199kV, 308MVA single phase
- Acoustic monitoring indicated activity in multiple locations
- DGA indicated abnormalities
- Thermography noted some hot spots
- Cooling systems test were performed
- Internal inspection noted a charred no-load tap changer


2006 6 9

T542 – FC 1AA XFMR

- 345/230kV, 625MVA 3 phase
- DGA indicated abnormalities
- Thermography did not note any hot spots
- Acoustic monitoring indicated activity in multiple locations
- One location was particularly promising
- Internal inspection was performed
- Discovered an overheating splice on a tertiary winding CT

Single Point of Failure Review

- Corrective actions as a result of Westwing fire
  - Added redundant batteries
  - Added redundant bus differential schemes
  - Added redundant transformer differential and leads schemes
  - Added transformer backup relays

APS Transmission System

Reactive Power Compensation Replacement/Upgrade

Year	SR#	Location	Line to	Comments
2006	72	Navajo	Westwing	***Replace existing 3-single phase 70 MVAR each reactors with a single 3-phase 170 MVAR reactor (SR204). Use existing single phase reactors as spares.***
	73	Navajo	Westwing	
	74	Navajo	Westwing	
2007	80	WWG	Yavapai	Replace two existing 3-phase 57 MVAR reactor with one 3-phase 170 MVAR switchable reactor (SR228). Keep both existing 57 MVAR 3-phase reactor as spare at Westwing.
	81	WWG	Yavapai	
2009	71	Navajo	Crystal	Replace existing 3 single phase 70 MVAR each reactors with a single 3-phase 170 MVAR reactor (SR237). Use the 3 best out of 6 existing single phase reactors as spares. Dispose of the remaining 3.
	72	Navajo	Crystal	
	74	Navajo	Crystal	
2009	77	WWG	Navajo	Replace existing 3-single phase 57 MVAR reactors with a one 3-phase 170 MVAR reactor (SR235) at Dugas. Dispose of the existing single phase reactors at Westwing.
	78	WWG	Navajo	
	79	WWG	Navajo	
2010	76	Moenkopi	Yavapai	Replace existing 3-phase 57 MVAR reactor with a one 3-phase, switchable 170 MVAR reactor (SR238). Keep the existing 57 MVAR reactor as spare at Moenkopi.
2011		WWG	BUS	Spare, switchable 170MVAR reactor for the Navajo System to be connected to Westwing bus - Cost to be shared. Dispose of the 57 MVAR reactors at Westwing and Moenkopi.

Reactive Power Compensation Replacement/Upgrade

Year	Bank #	Amps	Ohms	MVAR	Bank Description
2002	C2	Dismantled			At Navajo, in line to Moenkopi
2002	C5	1,880	31.72	336	At Moenkopi, in line to Navajo
2004	C17, C18	1,380	24.66	Each	
2005				141	At Cholla, in lines to Four Corners
2006	C7	1,810	25.0	246	At Moenkopi, in line to Four Corners
2006	C8	Dismantled			At Four Corners, in line to Moenkopi
2006	C6	1,750	16.5	152	At Moenkopi, in line to Yavapai
2006	C19	2,250	33.7	512	Upgrade N. Gila Cap to 2200 A
2007	C9	2,250	25.7	390	At Westwing, in line to Yavapai
2008	C1	2,200	57.5	835	At Navajo, in line to Crystal
2008	C3	1,750	40.5	372	At Navajo, in line to Westwing
2009	C10	1,750	40.5	372	At Dugas, in line to Navajo
2010	C15	1,750	43.0	395	At Cholla, in line to Saguaro
2010	C6	2,250	25.7	390	At Moenkopi in line to Yavapai
2013	C4	2,200	44.9	652	At Moenkopi, in line to Eldorado