PSE&G CMMS

(Computerized Maintenance Management System)

Foundation for Smart Grid Modernization

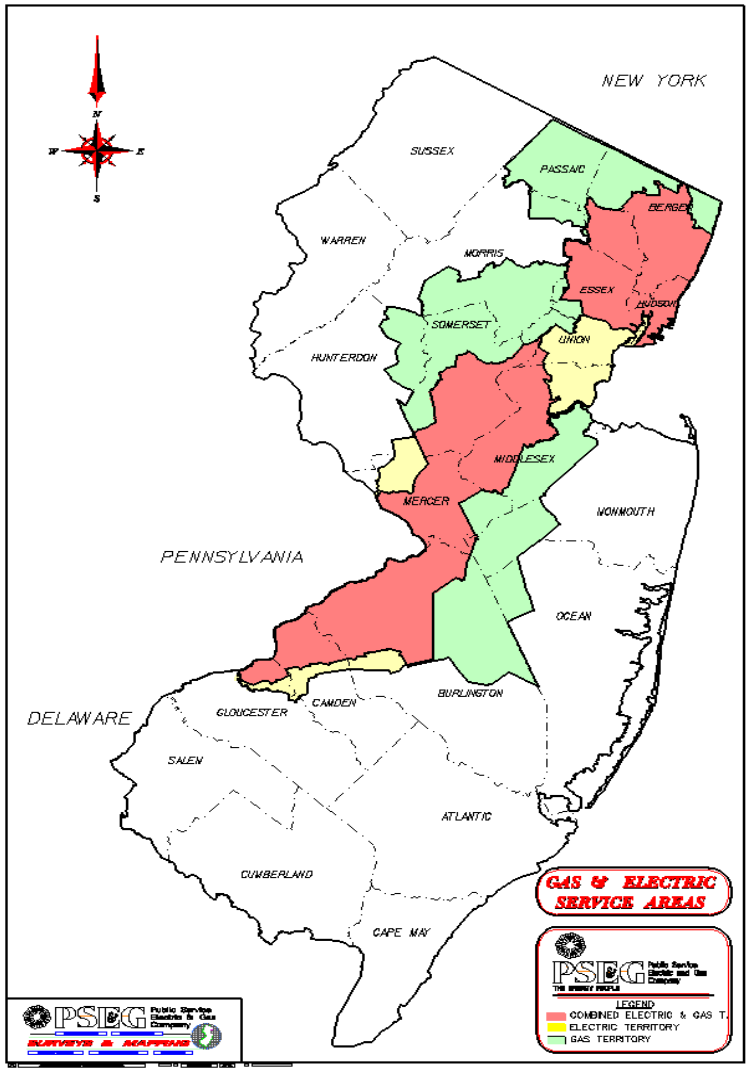
Presented by:

Richard Wernsing – Manager, Asset Strategy

Agenda

- About PSE&G
- Problem
- Functional Areas
- Substation (CBM) Conditioned Based Maintenance
- Benefits of CBM
- Engineering Desktop
- Expanding CBM to Underground Network

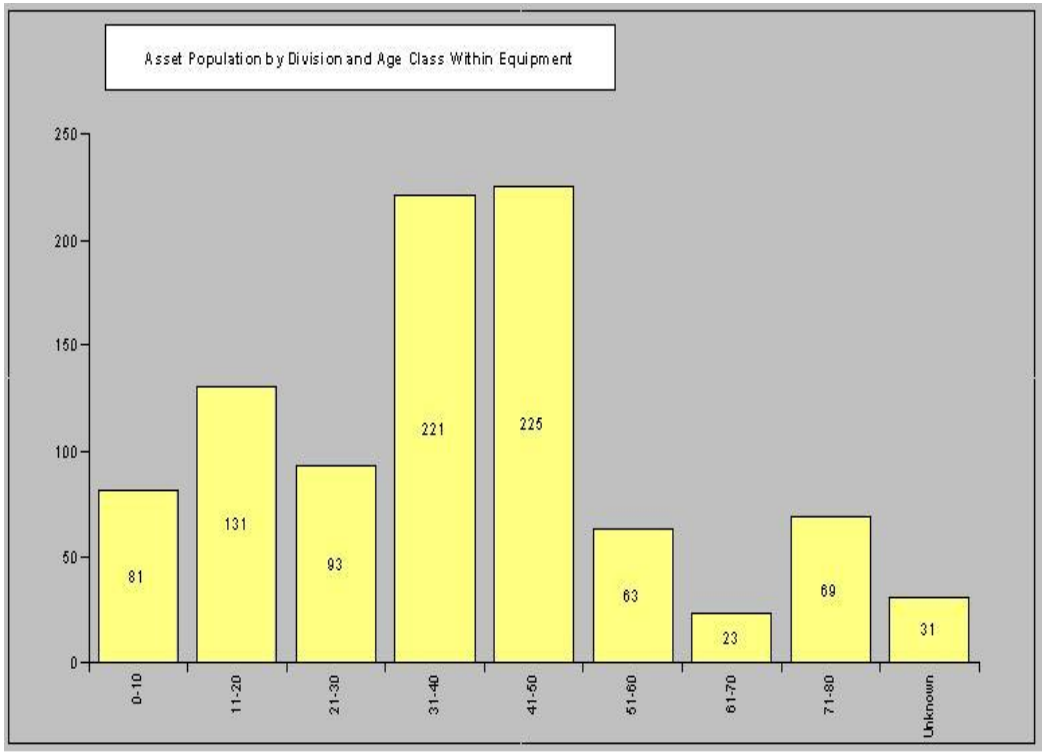
PSE&G Background



- **Utility Overview**
  - New Jersey Based
  - Total Assets ~ $14 Billion
  - Total Revenue ~ $7 Billion
- **Service Territory**
  - 323 Municipalities
  - 70% of New Jersey's population
  - 2.2 million Electric customers
  - 1.7 million Gas customers
  - 2,600 Square Miles

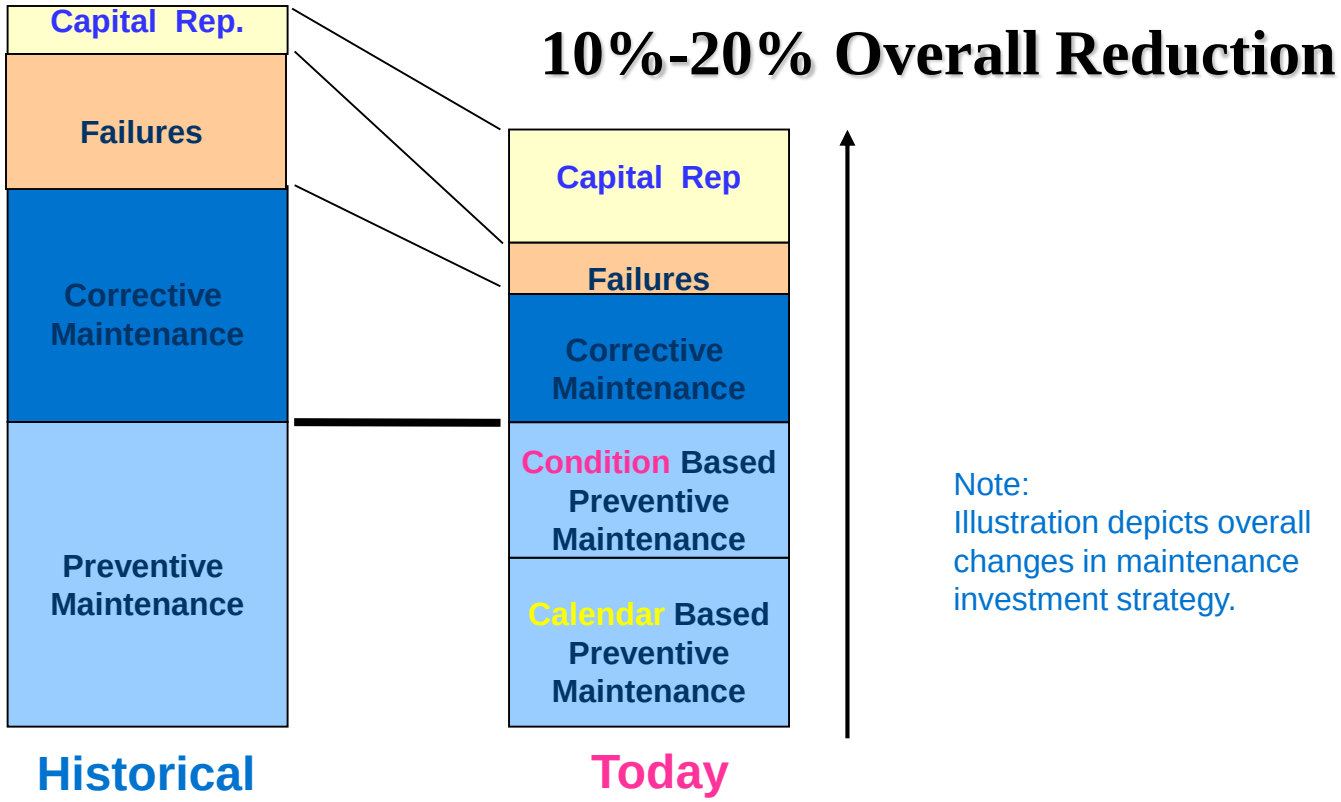
Problem

- No predictive maintenance program or strategy
- Significant liability risk and system outage potential from old equipment vulnerable to failure
- Limited assessment tools for determining asset condition
- Decreasing expertise in both field maintenance and engineering
- No formalized capital spending program
- Asset Information in a variety of disparate systems



Benefits Breakdown

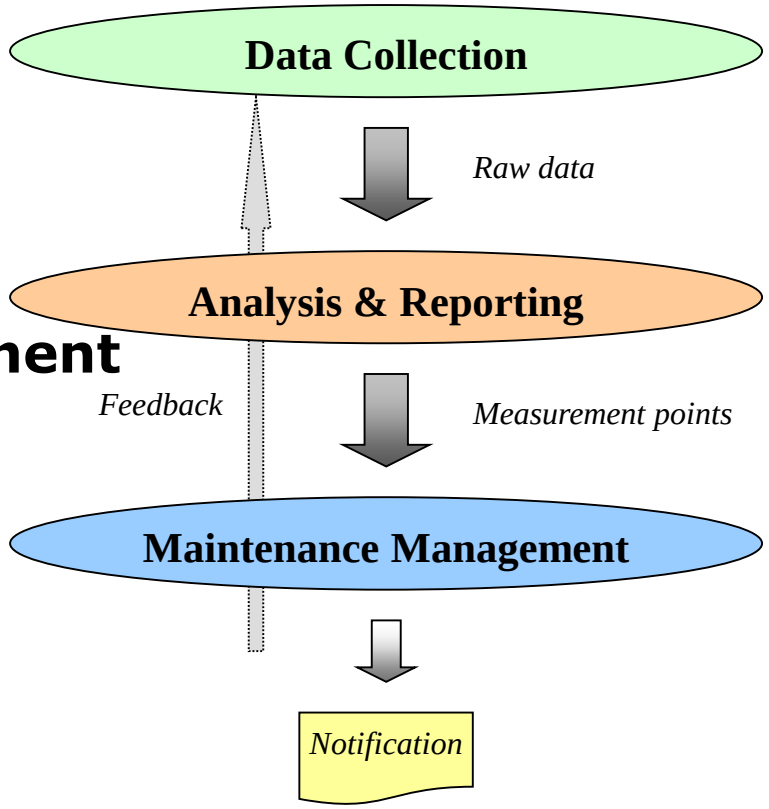
These annual expenditures protect $1.7 B of inside plant assets and full benefits after approximately five years.



Note:
Illustration depicts overall changes in maintenance investment strategy.

Functional Areas of CMMS

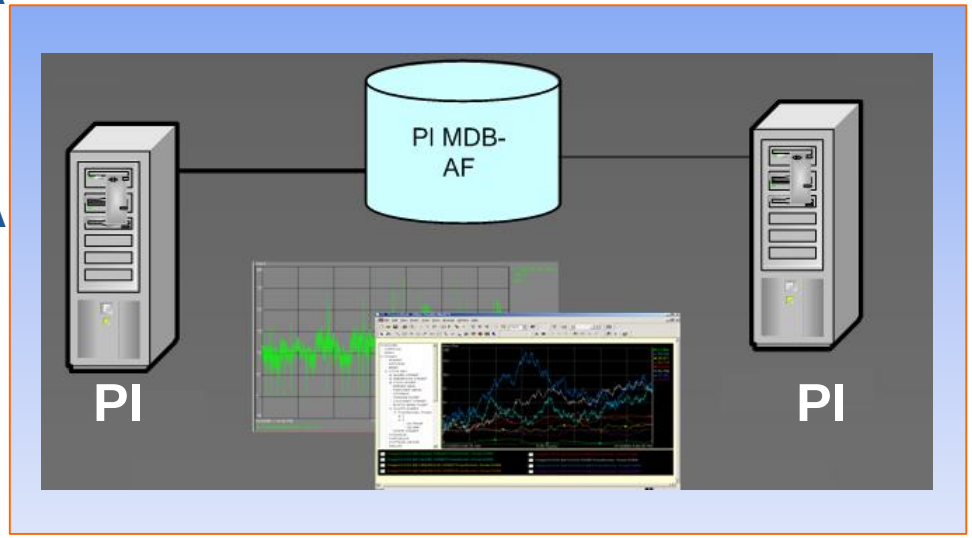
- Data Collection and Consolidation
  - **Diagnostic and Inspection Data**
  - **Time-series Data**
  - **Relational Data**
  - **Maintenance Data**
- Asset Analysis and Reporting
  - **Condition & Criticality Assessment**
  - **Equipment Ranking**
  - **Work Prioritization**
- Maintenance Management
  - **Measurement Points**
  - **Work Order Generations**
  - **Maintenance Planning**



Condition Based Maintenance (CBM)

- **Provides better insight into condition of assets based on available data**
  - **Operational**
  - **Diagnostic**
  - **Maintenance**
  - **Nameplate/Characteristic**
- **Support system that assists in making repair, maintain and replace decisions.**
  - **It is NOT a "crystal ball" that predicts failures**
  - **It does NOT put the process on "cruise control"**
  - **It is NOT a "budget slashing" tool**

Consolidate Data



Distribution SCADA

Transmission SCADA

MV90

Transformer loads

MDT

PI Manual Logger

Substation Inspections

Hydran

Gas Results

OMS

POR and

PPC

GIS

Ratings, Solar &

Circuit Lengths

SAP-PM

SAP maintenance and equipment & locations

Delta-X

Gas & Oil analysis

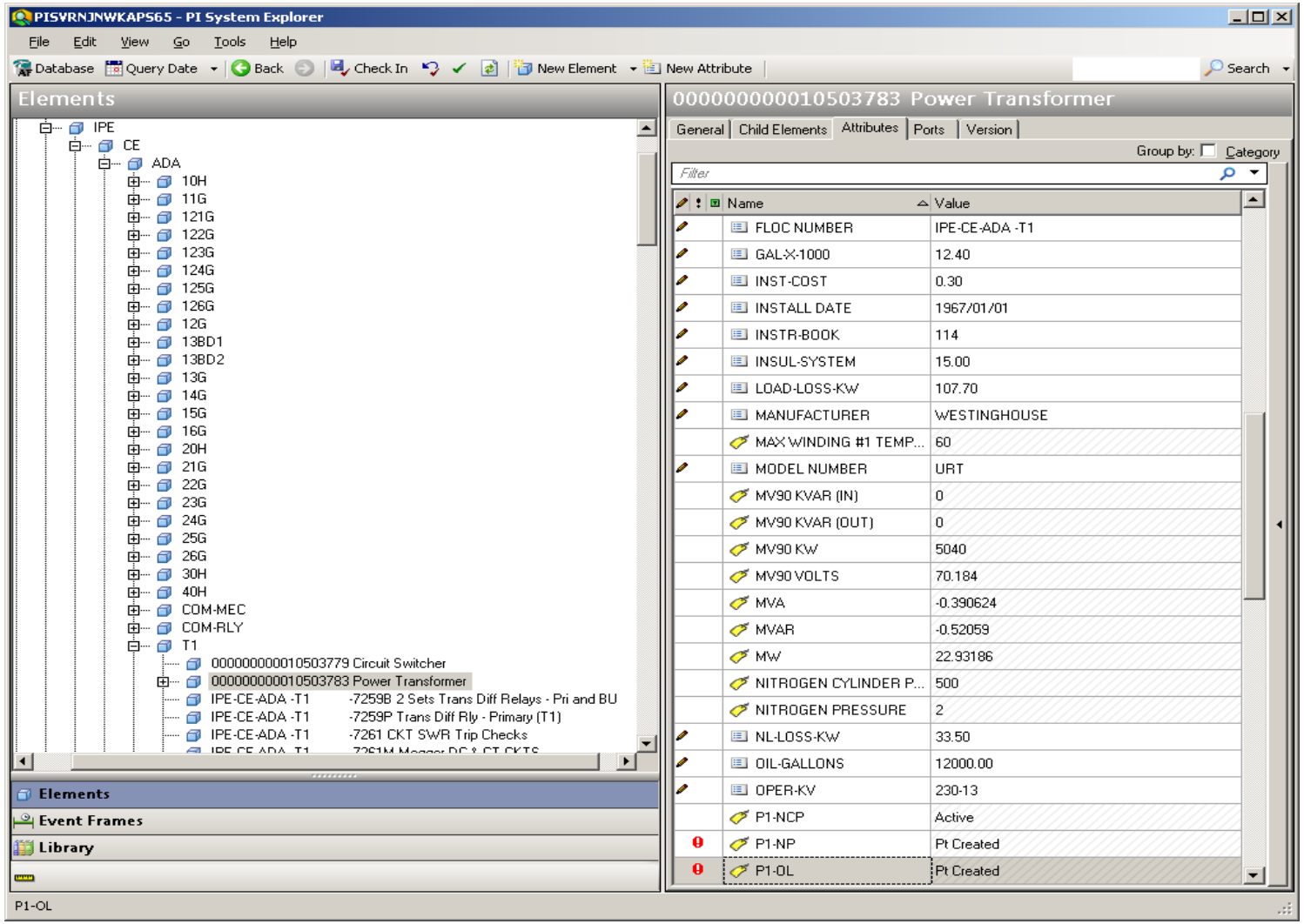
Diagnostic data

Breaker Tests

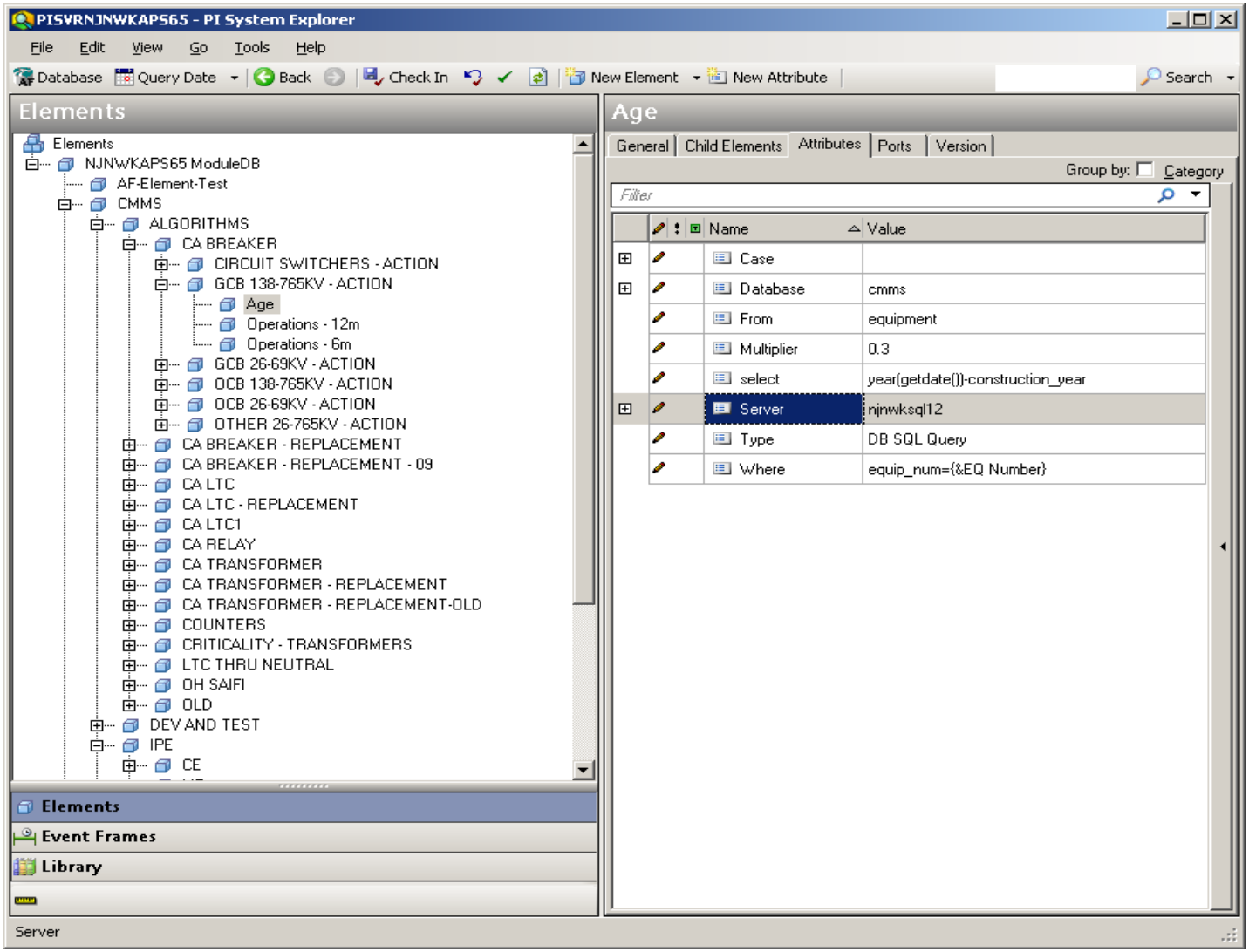
Doble

Electrical test results

Build Asset Model and Correlate Data in PI AF



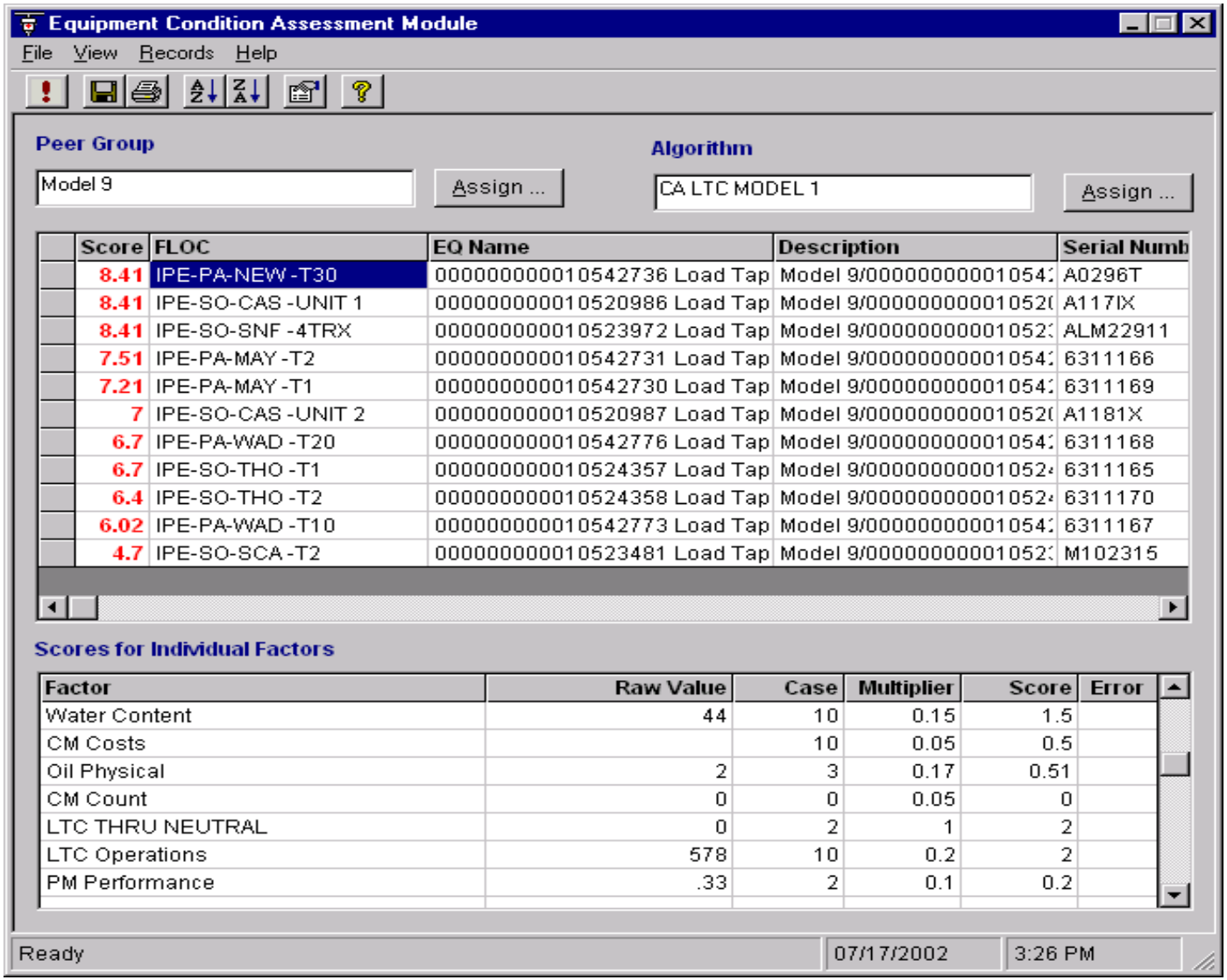
Build Algorithms in PI AF



Calculation Framework

- Calculation Structure
  - CA = F1(M1) + F2(M2) + F3(M3) + …
  - Factors driven by data available
  - Example Factors
    - CM Cost & Count for Past 6 Months
    - Count of Operations for Past 6/12 Months
    - Gas Analysis Change over time
    - Average Load over Time
- Peer Groups
  - Apply calculations by peer group; Voltage, Class, Type
  - Example Groups:
    - 26KV – 69KV GCB
    - 138KV+ Power Transformer
    - LTC Vacuum Tanks

Run Algorithms



CMMS Save helped avert an in service failure

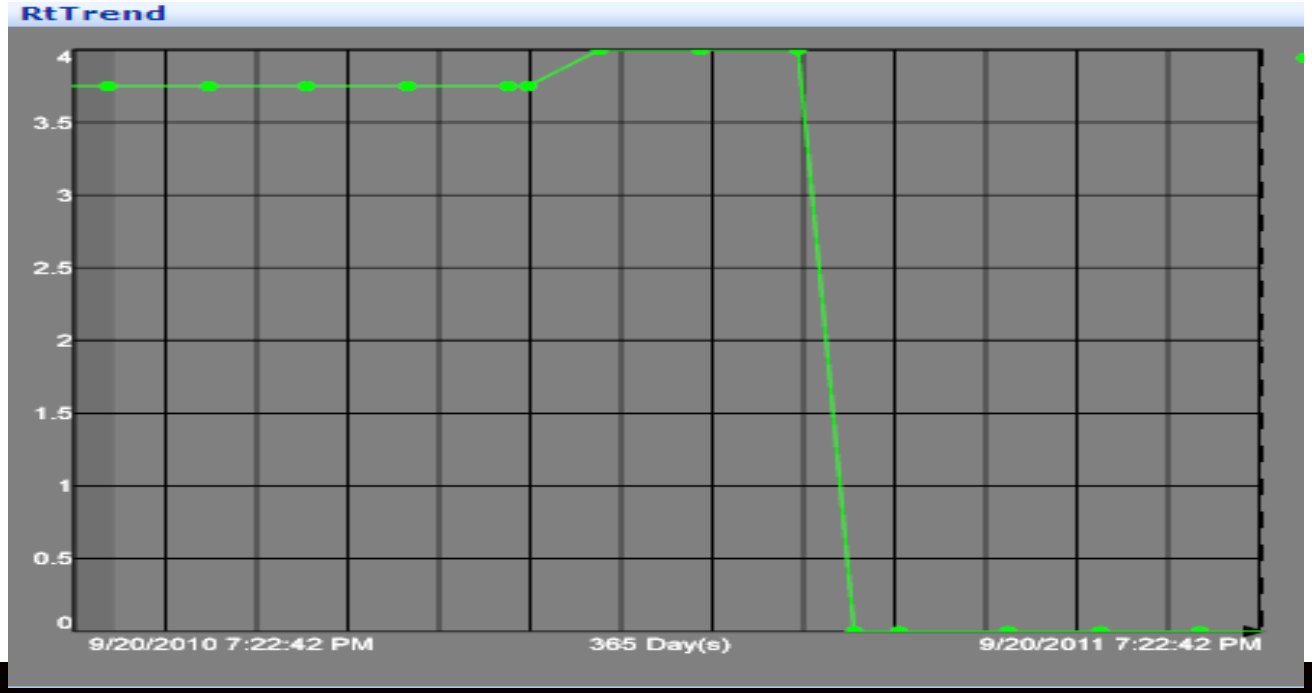
Excessive gassing and over heating found on 3/1//2011

DeltaX Total Combustible Gas

Details	ApprType	Sample Date	CO	H2	Acetylene	Ethane	Ethylene	Methane	Combustible Gas
	LTC	04/29/2011	66	148	243	2	36	30	525
	LTC	02/18/2011	175	14078	19653	761	6789	3273	44729
	LTC	02/16/2011	151	9888	19334	803	6860	3022	40058
	LTC	04/21/2010	280	17598	23836	655	6580	3585	52534
	LTC	06/25/2009	53	16588	23339	505	5100	3489	49074

Showing 1 to 5 of 23

History of CBM Score



Action and Results

- T20 LTC excessive gassing and overheating problem identified by CMMS on 3/1/2011
- Inspection showed coking contacts
- Assembly cleaned and new contacts installed
- Great find because T20 contacts would have failed when additional load was added during replacement of T10 transformer
- Conservative Failure Avoidance Cost Saving = $1.5M
  - **LTC = $150k cost & labor**
  - **Transformer = $1.5M cost & labor**
- Final CBM score after refurbishment

Algorithm Factors

Factor	Raw Value	Case Value	Weight %	Score
Detectable Acetylene	-277	0	25	0
Gas Rate of Change	-631.486	0	15	0
High Total Gas	525	0	20	0
High Water	23	0	10	0
Low Dielectric	54.8	0	10	0
LTC Operations	140	0	10	0
LTC THRU NEUTRAL	0	0	10	0

CBM Benefits

- Extremely valuable system when you have
  - **You have $1.6B of installed assets with a replacement value of $5.7B**
  - **Average age of the assets exceeds** 40 **years**
  - **All equipment is expected to be** used and useful **all the time**
  - **Maintenance expenditures** erode earnings **and capital replacement provides for no new revenue?**
- Justify millions of dollars in saving over past 7 years in equipment failure avoidance

Engineering Desktop Demo

CMMS Asset Information - Engineering Desktop

Home

Intellicast - Washington Park Weather Report in New Jersey (07102)

fri	sat	sun	mon	tue	wed	thu	fri	sat	sun
sep 16	sep 17	sep 18	sep 19	sep 20	sep 21	sep 22	sep 23	sep 24	sep 25
M Sunny	P Cloudy	P Cloudy	Sunny	P Cloudy	P Cloudy	Sct T-Storms	Sct T-Storms	P Cloudy	AM Clouds
68°	70°	70°	70°	72°	78°	79°	77°	77°	74°
51°	55°	55°	60°	63°	67°	63°	61°	63°	59°

Web Capture last updated at 9/16/2011 8:15 AM

CMMS Asset Information

- IPE Equipment Search
- Mechanical Work Prioritization
- IPE Equipment Characteristics
- DeltaX Gas and Fluid Tests
- Relay Work Prioritization
- ESOC System Load
- Temperature Sensitive Ratings By Circuit & Section
- Temperature Sensitive Ratings Limiting Components

Condition Assessment Summary Reports

- Transformer Action
- LTC Action
- Breaker Action
- Circuit Switcher Action
- Transformer & LTC Action Summary
- LTC Replacement
- GCB Breaker Replacement
- GCB Breaker Replacement By Voltage
- Transformer Replacment
- LTC NEW Action
- OCB Breaker Replacement
- OCB Breaker Replacement By Voltage
- LTC New Action By Peer Group
- Other Breaker Replacement
- Open Transformer/LTC CA Orders

Equipment/Other Reports

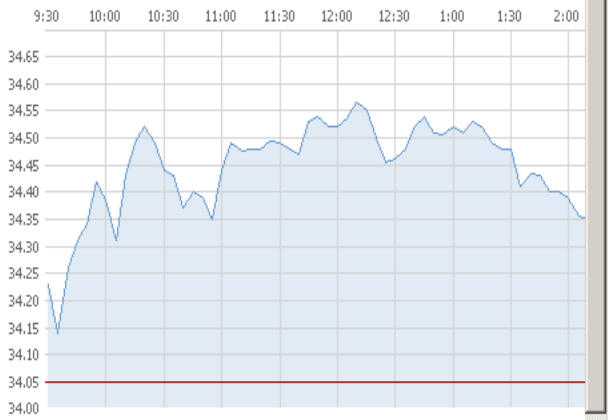
- DeltaX High Water Equipment
- DeltaX Overdue Gas Tests
- Transformer High Hydrogen
- Station Ground Tests By Division
- SAP Station List By Division
- SF6 Add Gas Total By FLoc - Statewide
- LTCs Not Thru Neutral
- DeltaX LTC Gas Analysis
- CA Cooling Performance Summary

Reports By Division

- Central Mechanical
- Central Operations
- Metro Mechanical
- Metro Operations
- Palisades Mechanical
- Palisades Operations
- Southern Mechanical
- Southern Operations

PSEG We make things work for you.

Public Service Enterprise Group Inc (US:PEG) - Stock chart, Index c



Web Capture last

Databases

- IPE New Equipment Database (NED)
- JM Transformer Database
- CBM Orders
- IPE Breaker Codes
- CMMS Documentation & Measures

Other Links

- Information Central
- Consolidated Manager
- PSEG Online Applications

Summary of Worst Performing LTCs

Home Documents and Lists Create Site Settings Help

PSEG LTC CA-Action New Summary Report

CA Records

Details	Division	Floc	Floc Descr	Equipment	Equip Descr	Score	Person	Status	Manufacturer	Type	ApprType	Serial Number	Tin
	SO	IPE-SO-MAD -T2	# 2 Transformer	000000000010522665	Load Tap Changer	6.7	Mark Stoughton	Awaiting Maint.	WESTINGHOUSE	UTTA	LTC	RBP39133	Se
	ME	IPE-ME-SNW -1TRH	132-1 Transformer	000000000010510407	LTC/Selector and Transfer 13 Kv	5	Paul Morakinyo	No Action	WESTINGHOUSE	URT2	TS	7001829-13	Se
	ME	IPE-ME-SNW -1TRH	132-1 Transformer	000000000010510410	LTC/Selector and Transfer 26 Kv	5	Paul Morakinyo	Awaiting Maint.	WESTINGHOUSE	URT2	TS	7001829-26	Se
	ME	IPE-ME-SNW -3TRH	132-3 Transformer	000000000010510415	LTC/Selector and Transfer 13 Kv	5	Paul Morakinyo	No Action	WESTINGHOUSE	URT2	TS	6537551-13	Se
	ME	IPE-ME-SNW -3TRH	132-3 Transformer	000000000010510418	LTC/Selector and Transfer 26 Kv	5	Paul Morakinyo	Awaiting Maint.	WESTINGHOUSE	URT	TS	6537551-26	Se
	CE	IPE-CE-ADA -T1	# 1 Transformer	000000000010503781	Load Tap Changer (URT)	4.75	Shirish Patel	Awaiting Maint. Results	WESTINGHOUSE	URT	SS	RAR66902	Se
	CE	IPE-CE-SOS -T2	# 2 Transformer	000000000010503189	Load Tap Changer (URT)	4.6	Mark Stoughton	Awaiting Maint.	WESTINGHOUSE	URT	SS	6994649	Se
	CE	IPE-CE-ADA -T1	# 1 Transformer	000000000010503781	Load Tap Changer (URT)	4.3	Shirish Patel	Awaiting Maint. Results	WESTINGHOUSE	URT	TS	RAR66902	Se
	ME	IPE-ME-SNW -2TRH	132-2 Transformer	000000000010510413	LTC/Selector and Transfer 26 Kv	4.25	George	OK	WESTINGHOUSE	URT2	TS	6537553-26	Se
	CE	IPE-CE-SOS -T2	# 2 Transformer	000000000010503189	Load Tap Changer (URT)	4	Mark Stoughton	Awaiting Maint.	WESTINGHOUSE	URT	TS	6994649	Se
	CE	IPE-CE-BEN -T2	# 2 Transformer	000000000010503858	Load Tap Changer (URT)	4	Mark Stoughton	Awaiting Maint.	WESTINGHOUSE	URT	TS	RAR66905	Se
	CE	IPE-CE-GBK -T2	# 2 Transformer	000000000010504122	Load Tap Changer (TC 546)	4	NA		FEDERAL PACIFIC	TC546	LTC	502362	Se
	ME	IPE-ME-LAU -T1	# 1 Transformer	000000000010507675	Load Tap Changer-Main Tank	4	George Arthur	Awaiting Maint.	WESTINGHOUSE	UTT	LTC	UGP50682	Se
	ME	IPE-ME-SNW -2TRH	132-2 Transformer	000000000010510411	LTC/Selector and Transfer 13 Kv	4	Don Fallon	Pending Action	WESTINGHOUSE	URT2	TS	6537553-13	Se
	SO	IPE-SO-BEA -T1	# 1 Transformer	000000000010520910	Load Tap Changer	4	Geoge Arthur	Awaiting Maint.	FEDERAL PACIFIC	TC546	LTC	502222	Se
	SO	IPE-SO-LAW -T1	# 1 Transformer	000000000010522331	Load Tap Changer	4	NA		WESTINGHOUSE	UTTA	LTC	RBP39131	Se
	SO	IPE-SO-MAR -T4	# 4 Transformer	000000000010522900	Load Tap Changer	4	NA		GENERAL ELECTRIC	LRT65	LTC	F961854B	Se
	CE	IPE-CE-SBR -1TRH	220-2 Transformer	000000000010505100	Load Tap Changer 220-2 26Kv	3.5	Mark	Pending Action	MOLONEY	SRTMHD	TS	P670632	Se
	SO	IPE-SO-SLA -T1LTC	220-1 Transformer Tap Changer	000000000010526193	Load Tap Changer SEL 220-1	3.5	Angela Rothweiler	Awaiting Maint.	MOLONEY	SRTMHD	SS	P680443	Se
	CE	IPE-CE-GSE -1TRH	220-1 Transformer	000000000010501563	Load Tap Changer	3.25	Mark	Pending Action	WESTINGHOUSE	UTH	TS	7001753	Se
	SO	IPE-SO-LAW -T2	# 2 Transformer	000000000010522332	Load Tap Changer	3.25		No Action	FEDERAL PACIFIC	TC546	LTC	501092	Se
	SO	IPE-SO-MAR -T1	# 1 Transformer	000000000010522897	Load Tap Changer	3.25	NA	Awaiting Maint. Results	GENERAL ELECTRIC	LRT65	LTC	D596044	Se
	CE	IPE-CE-SPF -T1	# 1 Transformer	000000000010540523	Load Tap Changer (UTT-A)	3.25			WESTINGHOUSE	UTTA	LTC	UGP50673	Se
	CE	IPE-CE-SAL -4TRH	220-4 Transformer	000000000010502666	Load Tap Changer	3			PENNSYLVANIA	394	SS	C0407351	Se
	CE	IPE-CE-SBY -20TR	220-1 Transformer	000000000010502885	Load Tap Changer	3			GENERAL ELECTRIC	LR500	LTC	D572025	Se
	CE	IPE-CE-POH -T2	# 2 Transformer	000000000010504695	Load Tap Changer (UVT)	3	Don Fallon	2010 Replacment	WESTINGHOUSE	UVT	LTC	SLM54093	Se

SME Knowledge of Asset

Home Documents and Lists Create Site Settings Help Up to PSE&G Delivery

PSEG Condition Assessment Remarks/Comments Modify Shared Page

PSEG We make things work for you.

CA Comments

Date	Comment	Person	Status	Due Date
07/23/2008	Request new sample	Paul	Pending Action	08/23/2008
09/03/2008	New Sample in Delta X on Aug 7, 2008 - Score on Sept 1 was 0 (New Algorithm)	Paul	OK	
10/08/2008	Request physical sample for the TS and SS	George	Pending Action	11/08/2008
12/13/2008	Reviewed moisture and based on the last fluid sample it was determined that its moisture reading was ok. Reading was 34 for fluid sample.	George	OK	01/13/2009
01/12/2009	New Fluid Data in Delta X for TS on 10/15/2008	George	Needs Review	01/13/2009
01/15/2009	New Sample generated a score of 1.9 in January of 2009 which is acceptable.	George	OK	
07/21/2010	AR: Refurbishment scheduled for fall, we need George to review latest gas samples taken on 6/16/2010; all gases are up from previous sample taken on 5/20/2010 and recommend action.	George Arthur	Pending Action	
08/12/2010	AR: Review all data prior to refurbishment and plan action	Don Fallon	Pending Action	
07/23/2011	AR: Division (Mike Duffy) checked the Newark Sw 13 & 26KV CMV's on 7/23/11. Techs tell him they are functioning correctly.	Paul Morakinyo	No Action	01/01/1900
07/23/2011	AR: I had them raise the 13 & 26 tap changers just above its high limit, the CMV brought the tap changer back within its limit then they lowered the voltage just below the low range and the CMV brought the voltage back in range.	Paul Morakinyo	No Action	01/01/1900
07/23/2011	AR: 13kv TS and SS are not a problem, on the top of the list becuase tanks where drained and cleaned last year and gases where close to 0; gas rate of change is high because of this. All 13kv LTCs look ok.	Paul Morakinyo	No Action	01/01/1900

Algorithm Details

Home Documents and Lists Create Site Settings Help — Up to PSE&G Delivery

PSEG — LTC CA New Action Algorithm Details — Modify Shared Page

Nameplate

Oneline	Division	Station Code	Station	Station Type	Floc Descr	Equipment	Equipment Descr	Equipment Type	Construction Year	Serial Number	Manufacturer	Model Number
	Southern	MAD	MAPLE SHADE	H	# 2 Transformer	000000000010522665	Load Tap Changer	E-LTC	1973	RBP39133	WESTINGHOUSE	UTTA

Content Editor Web Part

- Equipment Home Page
- SAP Order Details
- View and Trend Equipment PI Points
- CA LTC New Action Algorithm Rules
- CA Comment History

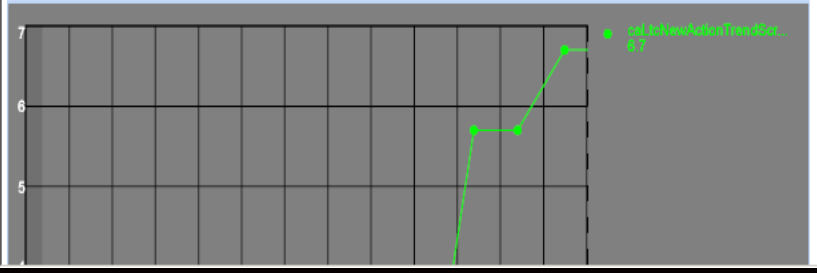
Algorithm Factors

Factor	Raw Value	Case Value	Weight %	Score
Detectable Acetylene	18	10	25	2.5
Gas Rate of Change	1085.28	10	15	1.5
High Total Gas	107989	10	20	2
High Water	72	7	10	0.7
Low Dielectric	49.1	0	10	0
LTC Operations	1829	0	10	0
LTC THRU NEUTRAL	0	0	10	0

CA Score

Score	maxScore	Ranking(%)	Peer Group
6.7	6.7	100	TS+LTC

RtTrend



DeltaX Total Combustible Gas

Details	ApprType	Sample Date	CO	H2	Acetylene	Ethane	Ethylene	Methane	Combustible Gas
	LTC	09/14/2011	806	6271	7047	13655	63588	19469	1.1084E+05
	LTC	08/26/2011	909	1979	1927	13739	69662	20494	1.0871E+05
	LTC	08/10/2011	792	3514	2185	11892	66163	23443	1.0799E+05
	LTC	06/28/2011	972	2414	1391	7082	36359	13104	61322
	LTC	06/22/2011	887	2618	1223	6725	34789	12999	59241

Showing 1 to 5 of 25

DeltaX Water

Details	Apprtype	Sample Date	Fluid Temp (C)	Water
	LTC	09/14/2011	64	96
	LTC	08/26/2011	47	68
	LTC	08/10/2011		72
	LTC	06/28/2011	48	71
	LTC	06/22/2011	47	75

Showing 1 to 5 of 25

DeltaX Fluid

Details	Apprtype	Sample Date	Fluid Temp (C)	D877	D1816
	LTC	09/14/2011	64	31.4	
	LTC	07/09/2007		49.1	
	LTC	07/02/2007		48.1	
	LTC	08/25/1999		49.3	
	LTC	08/25/1999		50	

Showing 1 to 5 of 7

History

Home Documents and Lists Create Site Settings Help

PSEG DeltaX Diagnostic Data

Nameplate

Location	Designation	Equipment	Serial_Num	Equipment Type	Manufacturer Year	Model	Rated Kv
COXS CORNER	No. 2 LTC	100200302	100200302	LTC	2002	3 PHASE	230
COXS CORNER	No. 2	100200302	100200302	TRN	2002	3 PHASE	230

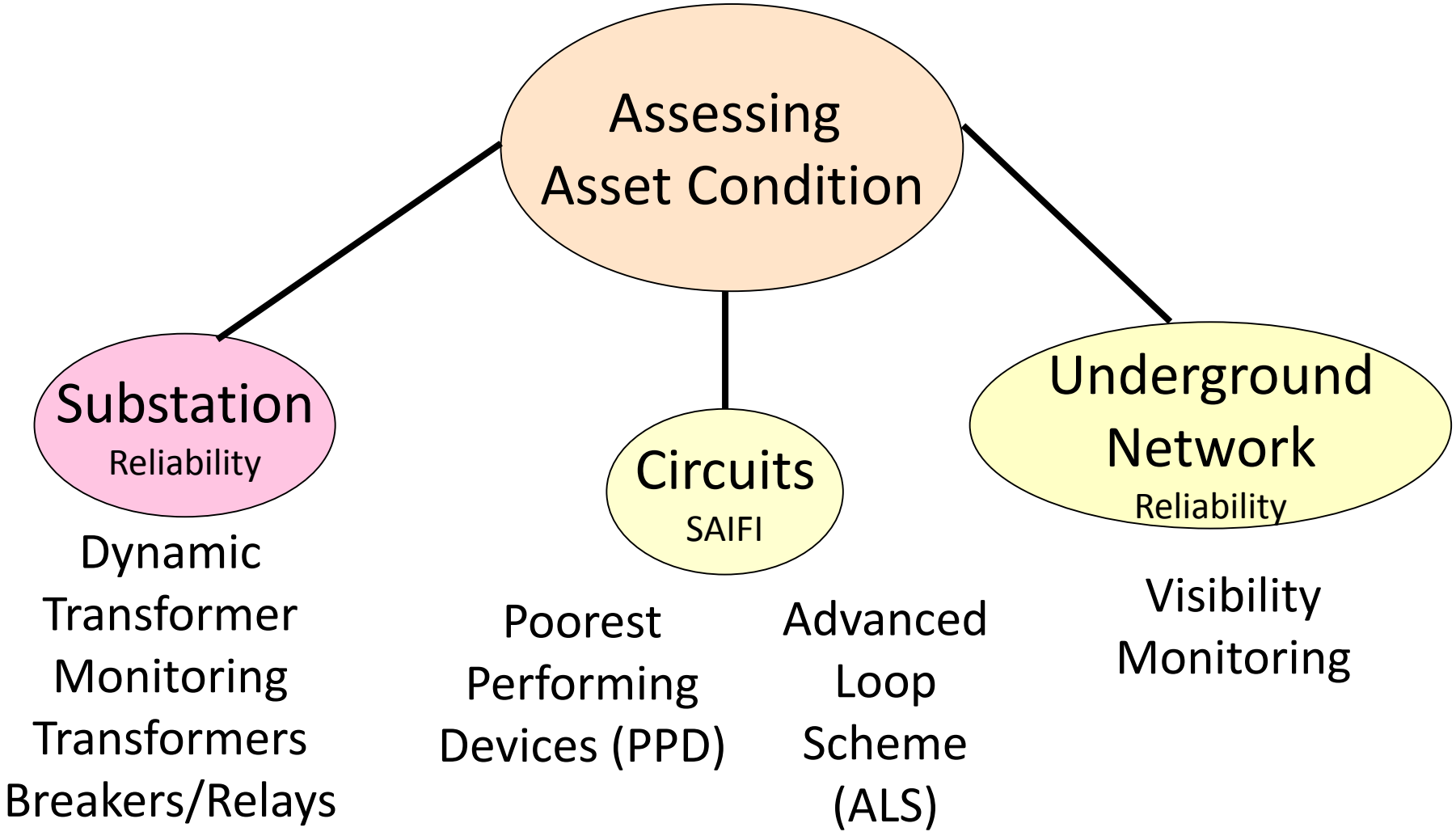
DeltaX Fluid Test Results

ApprType	Equipment	Designation	Sample Date	Fluid Condition	IFT	PF25	D1816	D877	PF100	Water	Comment
LTC	100200302	No. 2 LTC	05/13/2010	2	43.3	0.007		48.4		25	
LTC	100200302	No. 2 LTC	03/06/2009	1	35.6	0.026		48.9		14	
TRN	100200302	No. 2	03/06/2009	1	42.4	0.046	40.4			11	LT 8
TRN	100200302	No. 2	05/19/2008	1	35.2	0.064	43.6			19	
TRN	100200302	No. 2	05/12/2006		39.2	0.069	31.1			24	LT 30
LTC	100200302	No. 2 LTC	12/07/2005	1	48.5	0.027		51.7		15	
LTC	100200302	No. 2 LTC	10/17/2005	2	48.5	0.027		50		21	LT 20
LTC	100200302	No. 2 LTC	10/03/2005	2	39.3	0.057		53.7		27	LT 28
LTC	100200302	No. 2 LTC	06/10/2004	1	37.9	0.058		53.4		12	LT 32 > 16036 > 6050 > 1471 > 214 > 20 > 1
TRN	100200302	No. 2	06/10/2004	1	38.2	0.048	37.5			9	LT 32 . > 3 16710 > 5 7512 > 10 1897 > 20 253 > 50 13 > 100 1
LTC	100200302	No. 2 LTC	04/23/2004	2	31.5	0.034		53.7		30	
TRN	100200302	No. 2	04/23/2004	2	32.5	0.032	33.1			30	
LTC	100200302	No. 2 LTC	12/02/2002	1	39.2	0.038		53.6		3	
TRN	100200302	No. 2	12/02/2002	1	39.3	0.035	37.1			2	
LTC	100200302	No. 2 LTC	08/20/2002	1	38.3	0.042		49.7		18	
TRN	100200302	No. 2	08/20/2002	1	41.6	0.019	35			16	>3 microns= 8956 >5 microns= 4291 >10 microns= 1429 >20 microns= 275 >50 microns= 12 >100 microns= 0

DeltaX Gas Test Results

ApprType	Equipment	Designation	Sample Date	Fluid Temp (C)	Equipment Condtion	CO	CO2	N2	H2	O2	Acetylene	Ethane	Ethylene	Methane	Combustible Gas	Water	Total Gas	Comment	Samp
LTC	100200302	No. 2 LTC	06/21/2011	32	1	8	241	85411	25	13059	12	8	23	13	89	22	0.09	LT=32 ; RS=24.5% Repaired LTC Mechanism	MARk
LTC	100200302	No. 2 LTC	06/16/2011	45	4	714	4041	68288	2527	8079	602	9835	37887	22427	73992	50	47.923	LT=45 ; RS=34.4%	ED FC
LTC	100200302	No. 2 LTC	05/02/2011	40	4	783	3017	72063	1503	5775	554	2208	11909	6988	23945	34	22.849	LT=40 ; RS=28.0%	CURT
TRN	100200302	No. 2	05/02/2011	40	1	51	1269	93781	0	1232	0	10	35	22	118	4	0.123	LT=40 ; RS=3.3%	CURT
LTC	100200302	No. 2 LTC	09/29/2010		4	24	711	76895	66	28256	325	10	80	33	538	20	0.506	LT=N/A ; RS=N/A	ED FC
LTC	100200302	No. 2 LTC	08/26/2010		4	33	697	81607	101	27901	311	12	87	52	596	31	0.537	LT=N/A ; RS=N/A	ED FC
LTC	100200302	No. 2 LTC	07/29/2010	50	4	35	706	1.0478E+05	217	39806	297	13	86	58	706	35	0.484	LT=50 ; RS=20.2%	ED FC
LTC	100200302	No. 2 LTC	07/13/2010	42	4	21	599	73841	161	33114	155	10	59	40	446	37	0.413	LT=42 ; RS=28.3%	ED FC
LTC	100200302	No. 2 LTC	06/28/2010	53	2	11	507	74683	19	32734	14	5	18	10	77	36	0.071	LT=53 ; RS=18.7% ; Processed oil	CURT

Assessing Asset Condition



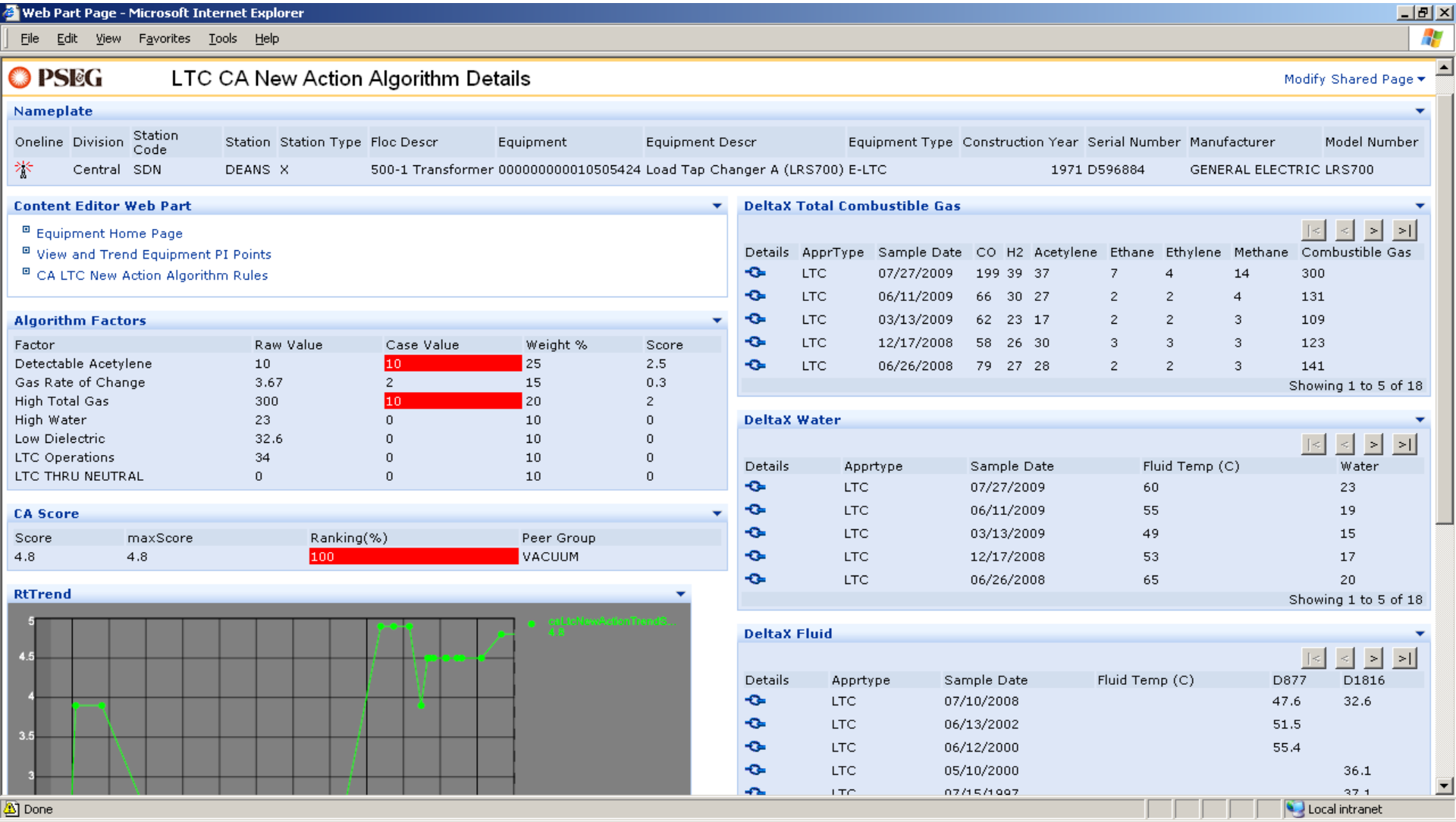
PSEG

LTC CA-Replacement Summary Report

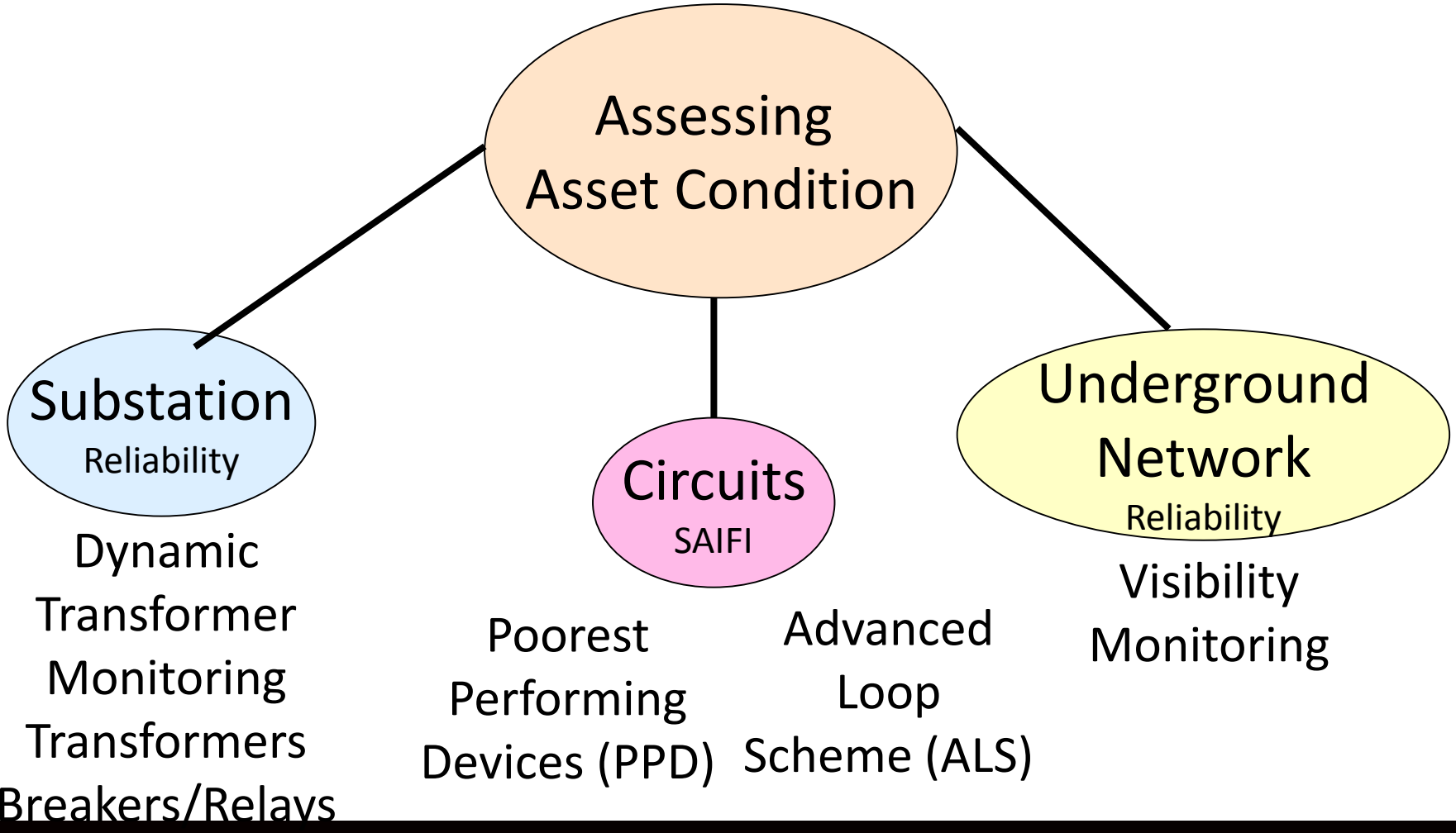
CA Records

ails	Division	Floc	Floc Descr	Equipment	Equip Descr	Score	Person	Status
	CE	IPE-CE-NED -T1	# 1 Transformer	000000000010023053	Load Tap Changer	5.7	NA	No action
	CE	IPE-CE-SOS -T1	# 1 Transformer	000000000010503188	Load Tap Changer (URT)	5.7	Shirish Patel	Awaiting Ma
	CE	IPE-CE-SMN -2PM	132-2 Transformer	000000000010023219	Load Tap Changer 132-2	5.7	Mark	OK
	CE	IPE-CE-SMV -T2	# 2 Transformer	000000000010505774	Load Tap Changer T2	5.3	Lenny Torchia	Complete
	PA	IPE-PA-NRB -T1	# 1 Transformer	000000000010637892	Load Tap Changer	5.3		
	ME	IPE-ME-SES -2TRH	220-2 Transformer	000000000010509861	Load Tap Changer PHASE 1	5.2		
	ME	IPE-ME-SES -1TRH	220-1 Transformer	000000000010509859	Load Tap Changer	5.2	George Arthur	Awaiting Ma
	PA	IPE-PA-BAO -T40	# 40 Transformer	000000000010542685	Load Tap Changer	5.2	George Arthur	No Action
	SO	IPE-SO-DVB -T2	# 2 Transformer	000000000010542963	Load Tap Changer	5	Angela Rothweiler	Thru Neutra
	ME	IPE-ME-SBV -2TRHB	220-2B	000000000010509499	Load Tap Changer	4.5	Angela Rothweiler	Thru Neutra
	PA	IPE-PA-WAD -T10	# 10 Transformer	000000000010542773	Load Tap Changer	4.4		
	PA	IPE-PA-LEO -T3	# 3 Transformer	000000000010542721	Load Tap changer	4.4		
	CE	IPE-CE-SAL -4TRH	220-4 Transformer	000000000010502666	Load Tap Changer	4.4	George Arthur	Awaiting Ma
	CE	IPE-CE-SAL -4TRH	220-4 Transformer	000000000010502666	Load Tap Changer	4.4	George Arthur	Awaiting Ma
	CE	IPE-CE-FRA -T1	#1 Transformer	000000000010671654	Load Tap Changer	4.4		
	CE	IPE-CE-SLI -132-5	132-5 Transformer	000000000010023211	Load Tap Changer 132-5 26Kv	4.3	Paul	OK
	ME	IPE-ME-SBV -1TRH	220-1 Transformer	000000000010509496	Load Tap Changer 1 A	4.3	George	OK

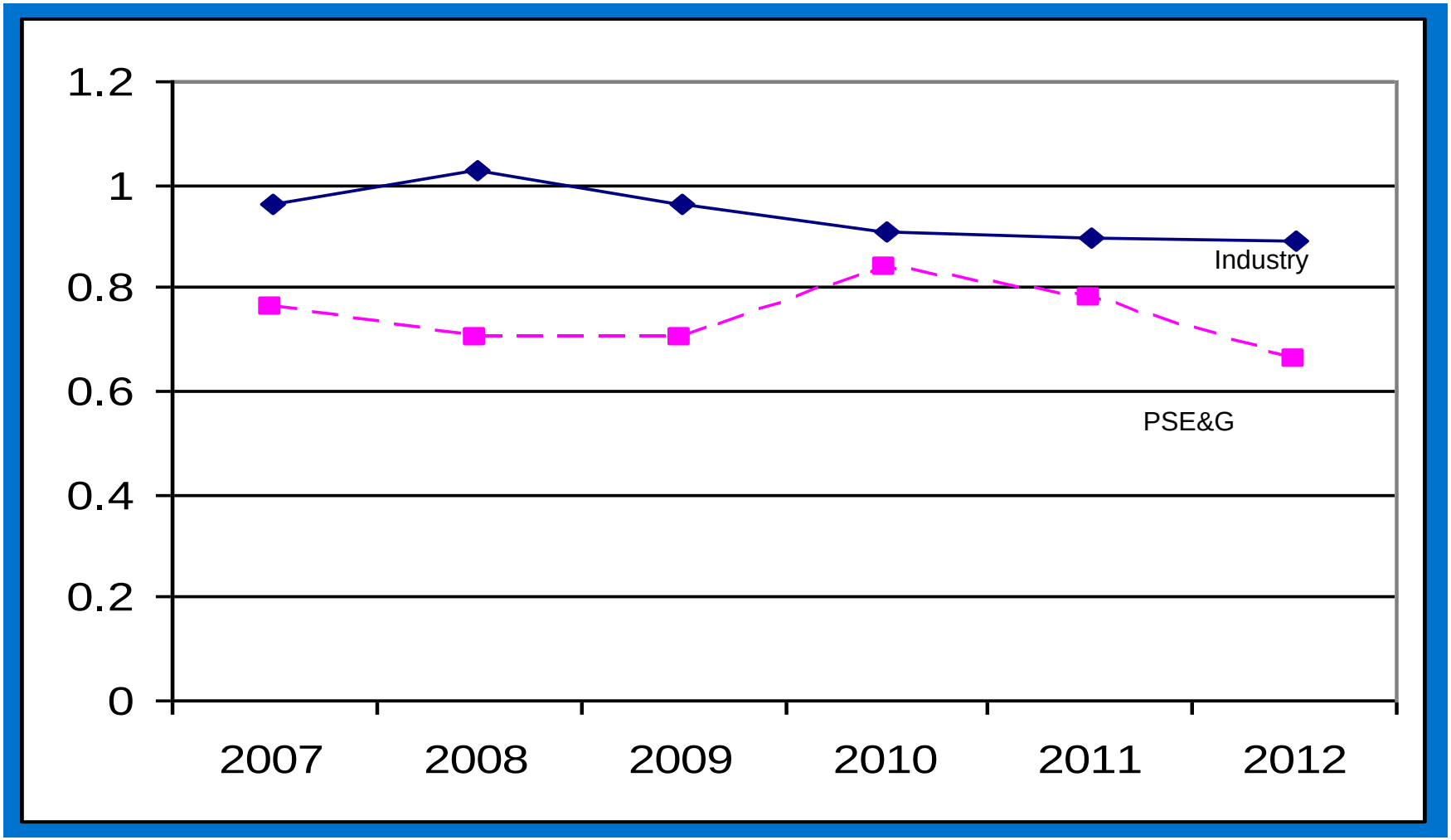
Asset Health Score – Drill down



Assessing Asset Condition

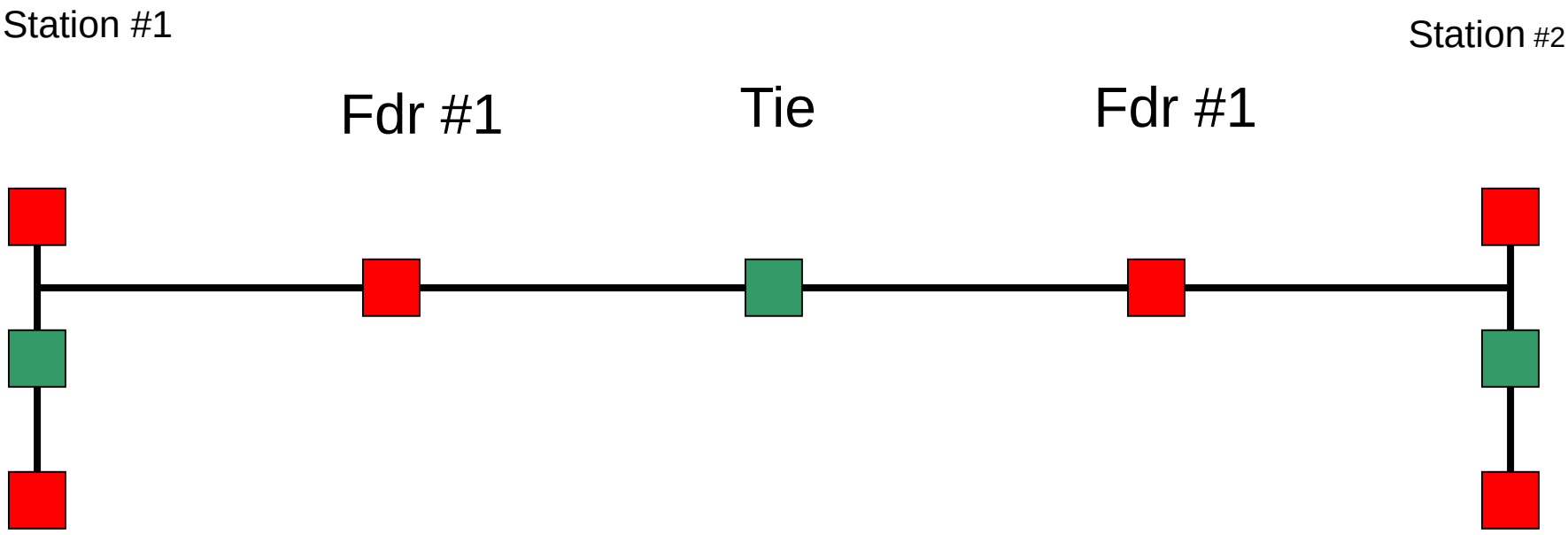


SAIFI
Industry vs. PSE&G



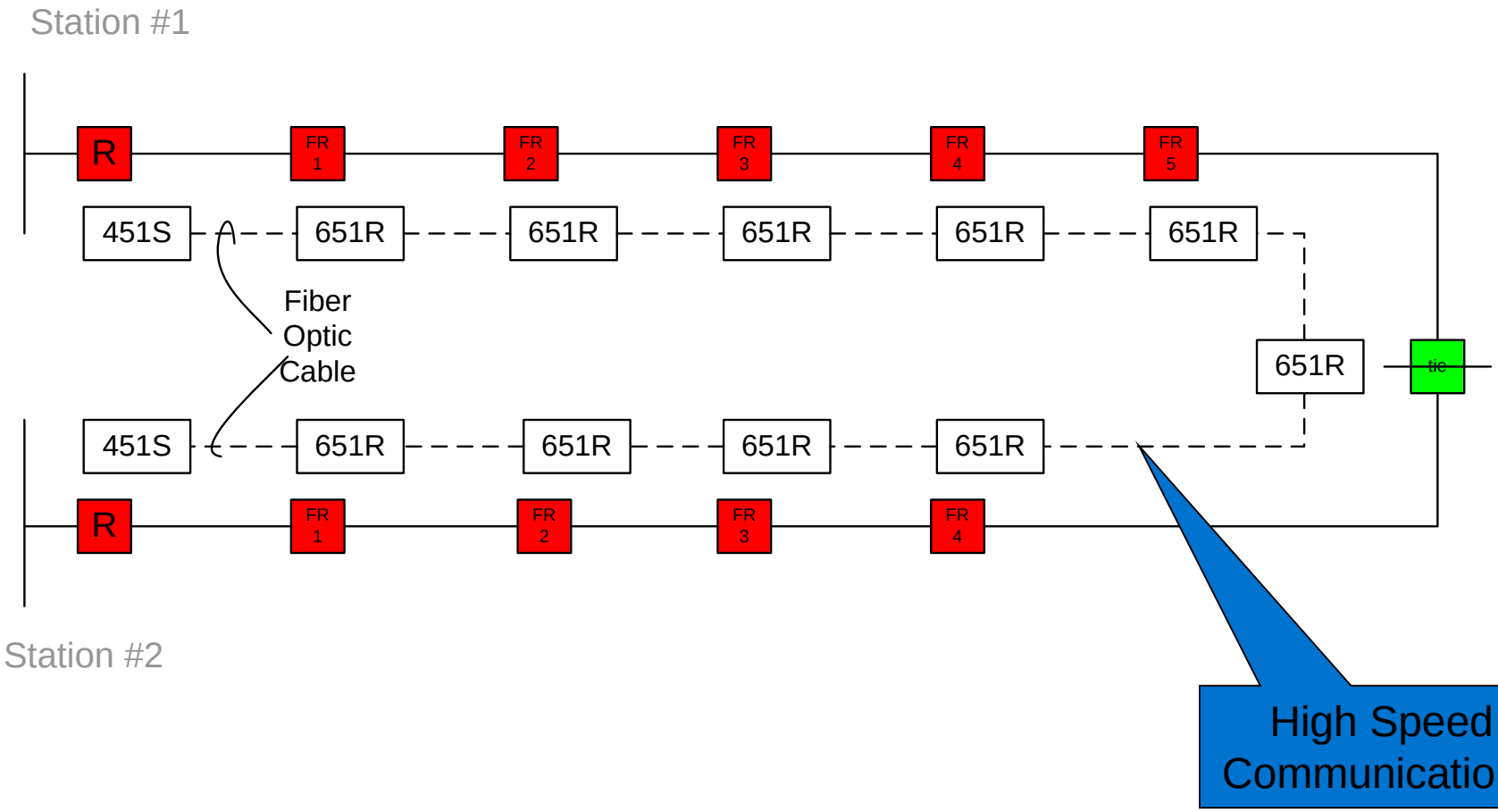
Traditional 13 kV Recloser Loop Scheme

Self-Healing Loops



Existing Configuration

Advance Loop Scheme (ALS)



Summary of Reliability Benefits

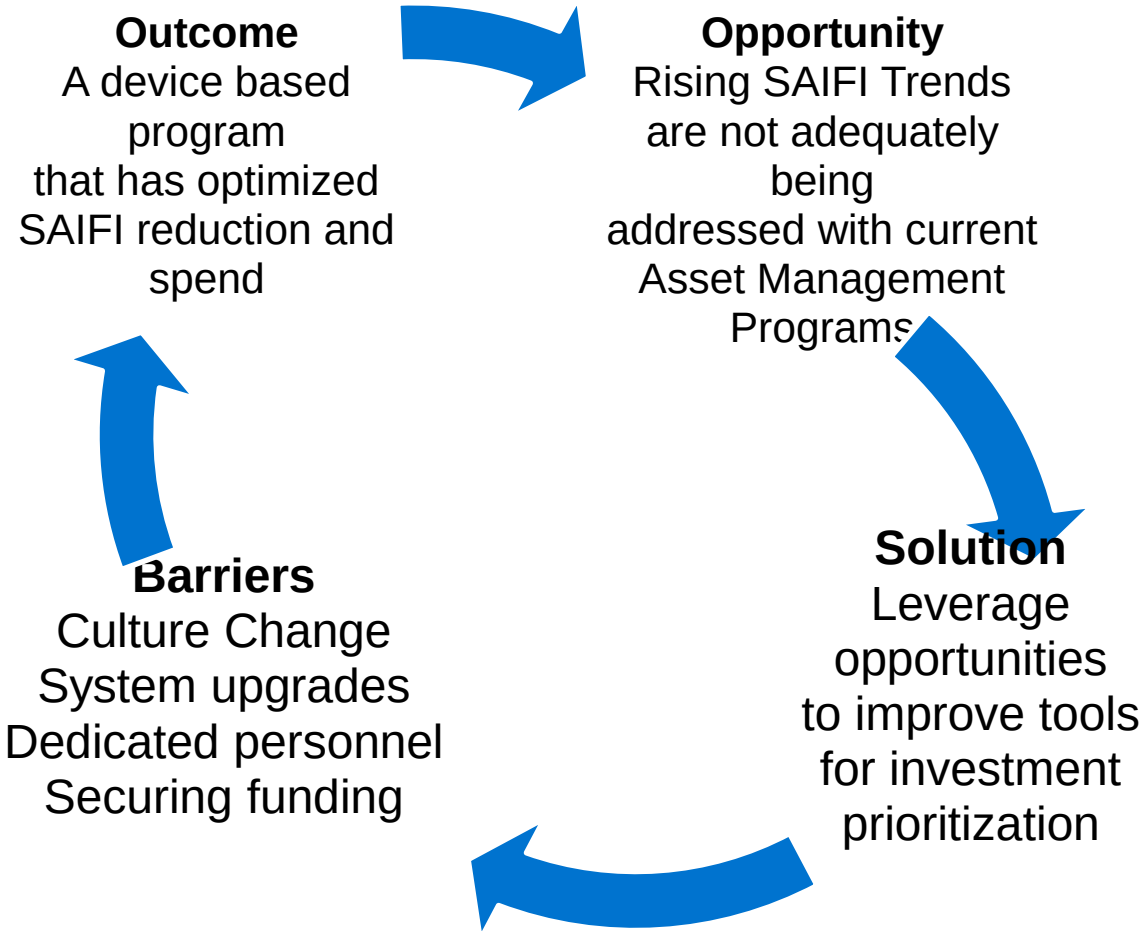
Innovations	Current System	Smart Grid
Customer Segmentation (SAIFI) System Average Interruption Frequency Index	Average **1500** customers Impacted per outage	Average **500** Customers Impacted per outage
Single Phase Tripping (SAIFI) < 5 Minutes System Average Interruption Frequency Index	Not Implemented Average **1500** customers Impacted per outage	Average **167** single phase customers impacted per outage
Make Before Break (MAIFI) >5 Minutes Momentary Average Interruption Frequency Index	Momentary Interruption **30-60 seconds**	No Momentary Interruptions

Comparing – SAIFI Improvements

Options	Cost
Traditional Approach Trim tree's, replace equipment	$6 - 12 M per loop
Smart Grid Technology Limit risk, add communications (fiber), and leverage technology	$2 - 4 M per loop

Both options produce similar SAIFI results for the **first year**

Enhancements to SAIFI assessment and asset management programs…



…will mitigate rising electric distribution SAIFI trends.

Poorest Performing Device (PPD) Program

Targeting extended customers interrupted, a two part asset evaluation algorithm was developed, modeled after our current inside plant CMMS system structure.

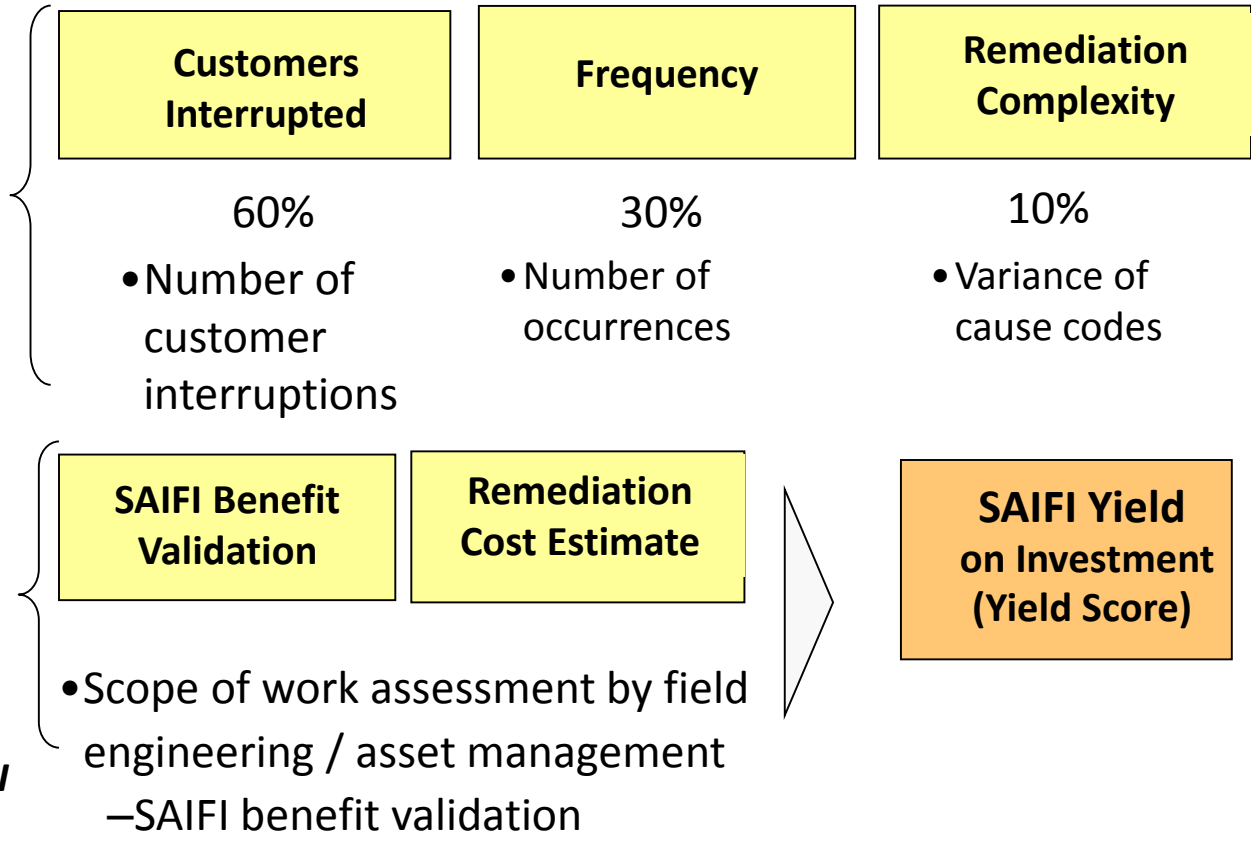
I. Incident Evaluator Algorithm:

Device Health Score provides the basis for an initial prioritization of potential projects, subject to further field inspections and cost estimates as described below.

II. Field Inspection, SAIFI validation and Cost Estimates:

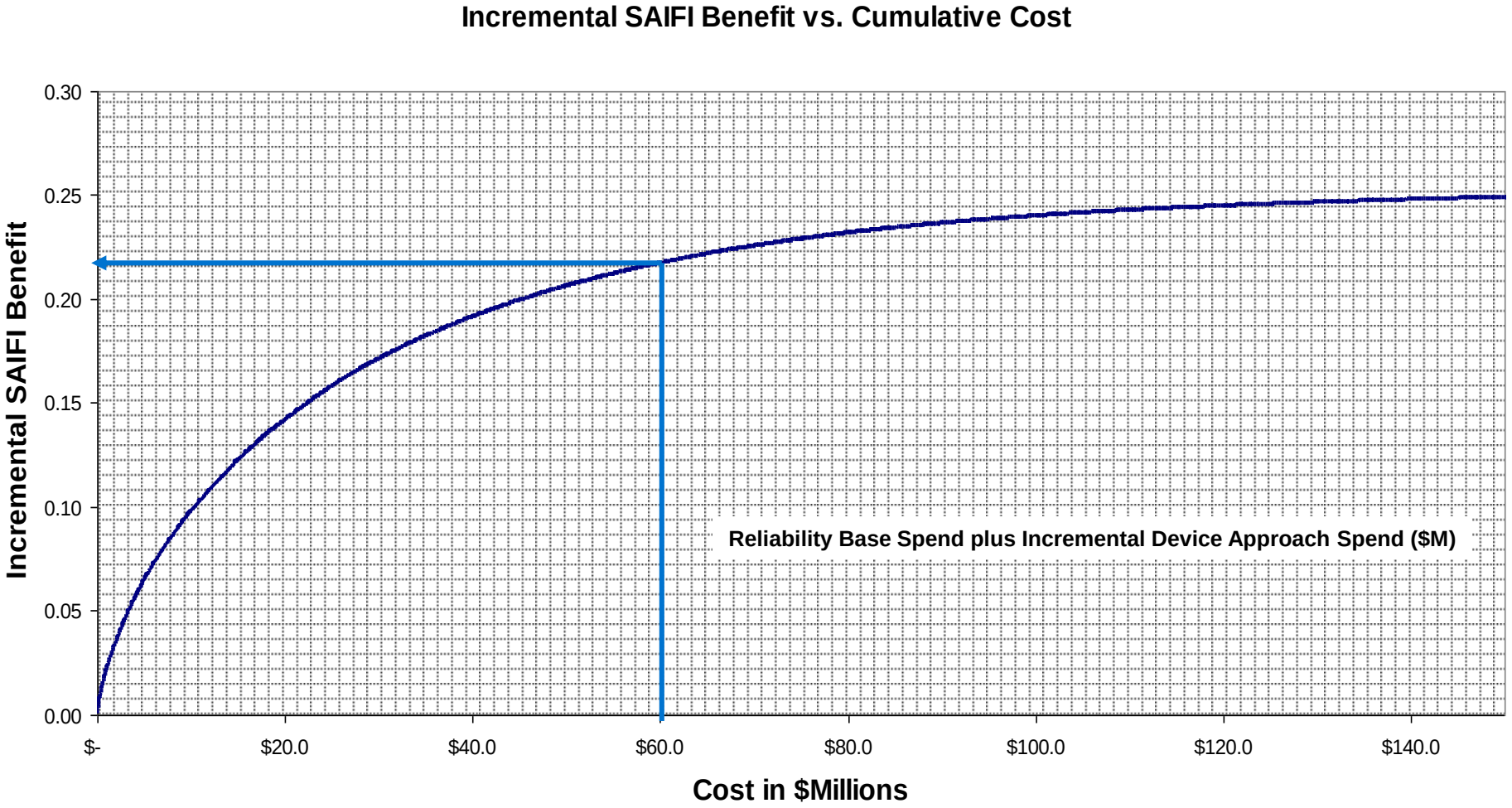
Scope of work assessment in field provides basis for cost estimate and validation of SAIFI benefit.

Benefits and costs form basis for ***SAIFI Investment Yield*** calculation and final



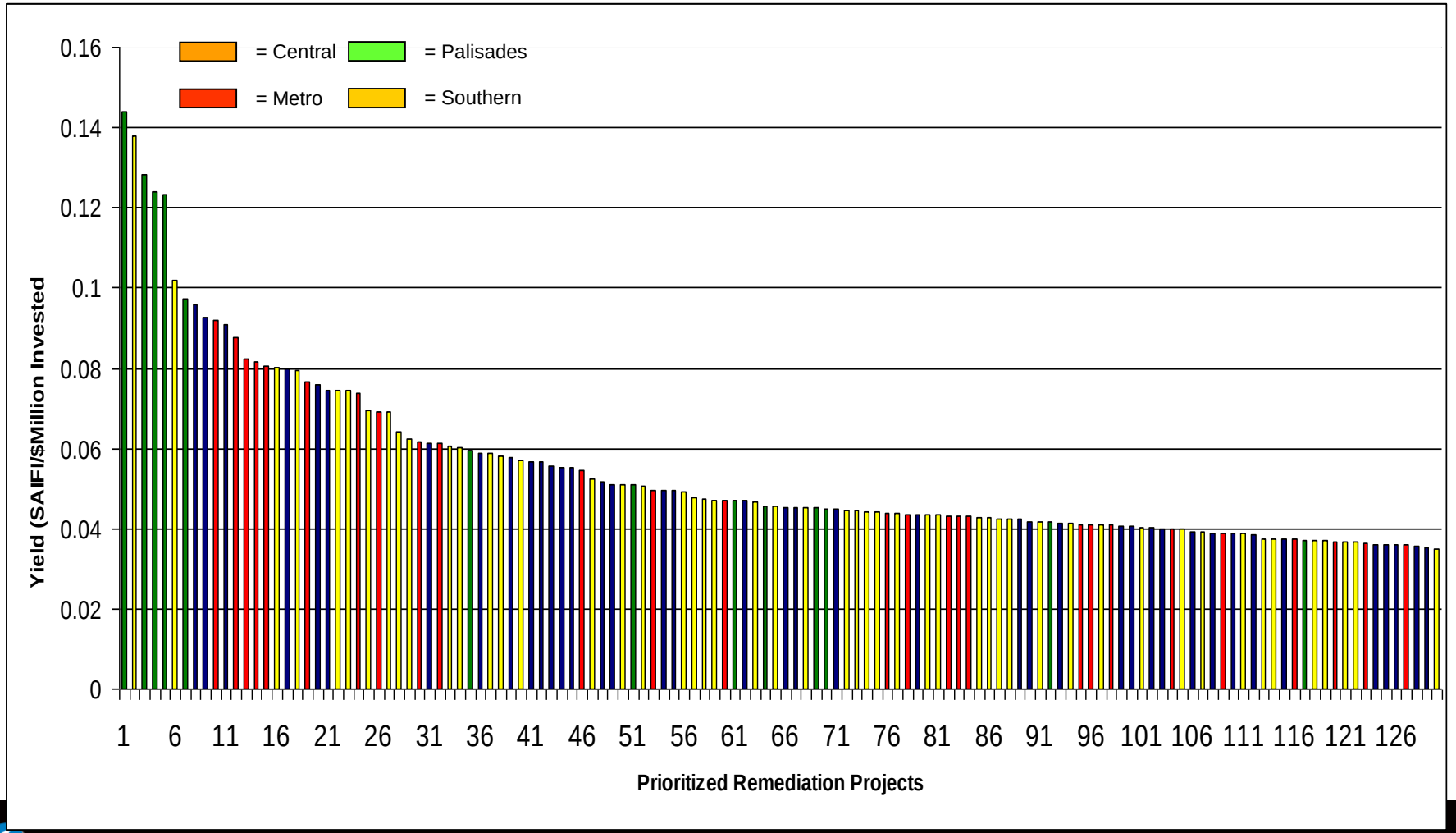
SAIFI Benefit

attained from Incremental Spend



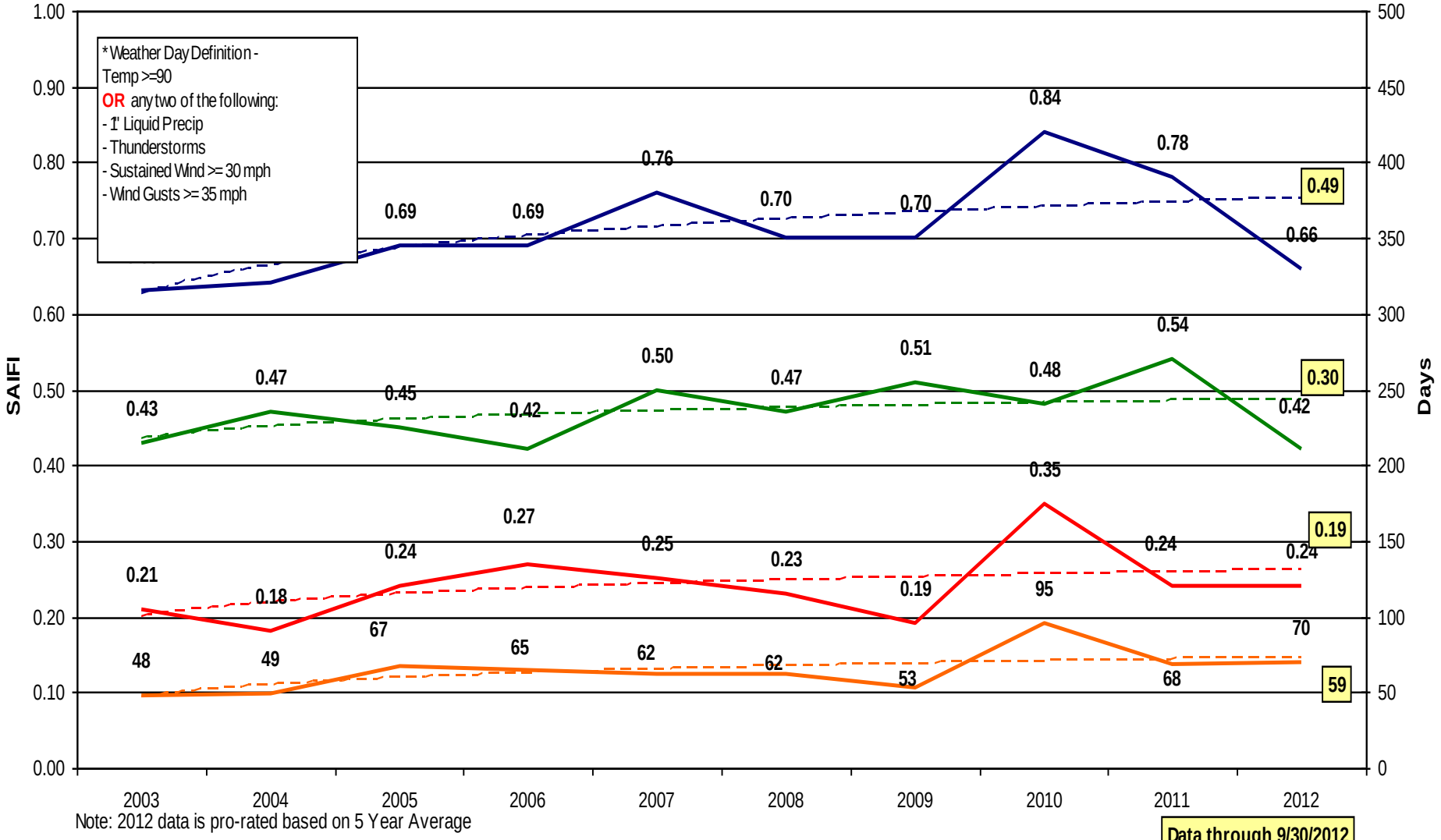
Remediation Options Prioritized by SAIFI Yield

SAIFI Yield (SAIFI Benefit/ $ Invested)

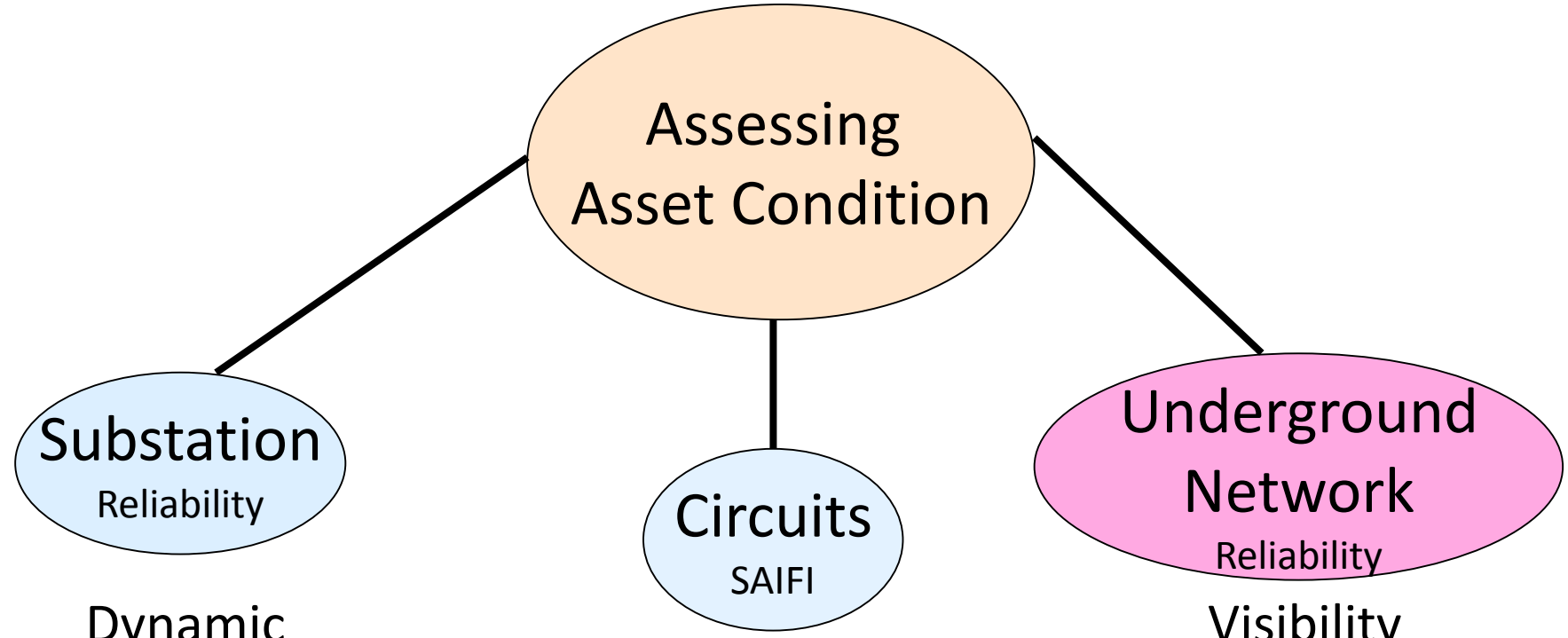


SAIFI Trending

Non-Weather Day (Blue Sky) vs Weather Day



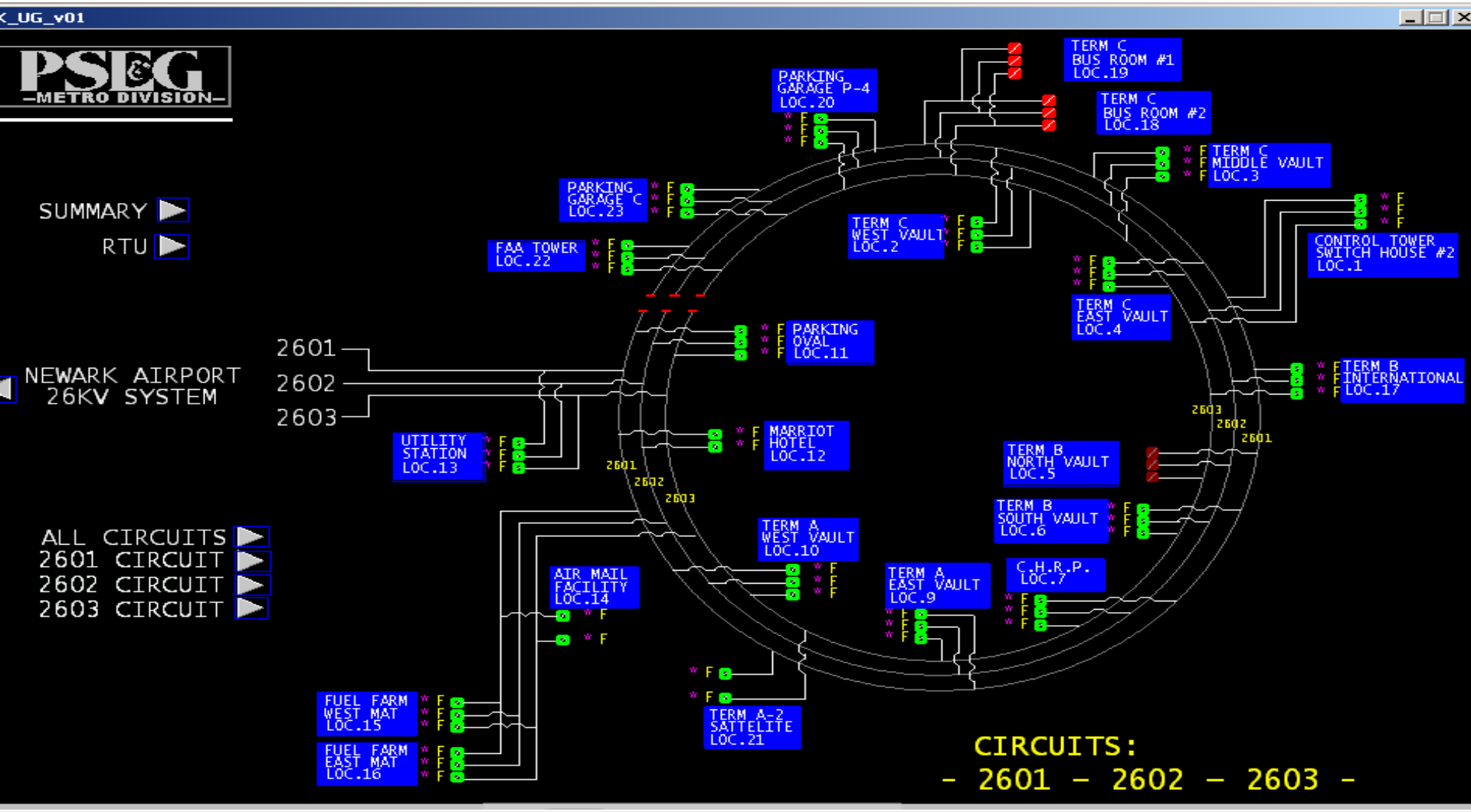
Assessing Asset Condition



Networking Monitoring System (NMS)

- Reduce restoration time for underground cables.
- Pattern recognition to determine type of fault.
- Visibility to all key underground network assets
- Consolidated asset inspection, test and maintenance data
- Consistent information base for comparative analysis

System Visualization



Vault Summary KVA, Amps and Status

Newark Airport Vault Summary

Data as of: 9/6/2011 4:20:08 PM

	NWP status					2601 Amps			2602 Amps			2603 Amps			kVA		
	2601	2602	2603	XFMR kVA	I(FL) AMPS	A	B	C	A	B	C	A	B	C	2601	2602	2603
Loc 01 Tower Switch House				1500	1804	60	66	78	0	0	0	54	60	72	57	0	52
Loc 02 Terminal C West				2000	2406	1236	1212	1152	1206	1206	1146	1248	1194	1116	960	948	949
Loc 03 Terminal C Middle				2000	2406	1236	1290	1158	1218	1122	1128	1320	1356	1272	1004	906	1033
Loc 04 Terminal C East				2000	2406	906	930	846	888	882	774	720	822	750	715	679	614
Loc 05 Terminal B North				2500	3007	854	854	805	868	861	805	791	819	763	694	692	653
Loc 06 Terminal B South				2500	3007	588	588	574	539	581	560	539	588	595	470	510	465
Loc 07 CHRP				2000	2406	372	342	330	0	0	0	318	306	312	288	0	262
No location #8																	
Loc 09 Terminal A East				2000	2406	492	516	510	498	510	474	594	570	540	403	400	456
Loc 10 Terminal A West				2000	2406	714	684	642	612	600	594	720	678	630	548	679	546
Loc 11 Parking Oval				750	902	41	38	36	31	31	31	41	41	38	28	22	29
Loc 12 Marriott Hotel				1500	1804	465	455	455	500	480	490				380	403	
Loc 13 Utility Station 197				750	902	54	54	42	58	64	51	58	54	48	40	46	42
Loc 14 Air Mail Facility				750	902	0	0	0				0	0	0	0		0
Loc 15 Fuel Farm West 196				750	902	99	96	86	89	86	79	77	77	80	72	63	61
Loc 16 Fuel Farm East 196				1500	1804	70	65	65	70	75	70	65	60	65	56	57	52
Loc 17 Terminal B International				2000	2406	816	834	792	840	846	792	834	870	804	705	681	679
Loc 18 Terminal C-3 Bus Room 2				2000	2406	678	666	690	708	666	672	708	672	678	576	576	584
Loc 19 Terminal C-3 Bus Room 1				2000	2406	696	606	648	702	732	606	666	612	624	553	574	539
Loc 20 Parking Garage P-4				750	902	145	155	150	160	150	140	165	175	160	128	129	143
Loc 21 Terminal A-2 Satellite				1000	1203	202	186	205				205	186	198	169		168
Loc 22 FAA Tower				750	902	110	125	115	105	100	95	90	96	90	101	85	79
Loc 23 Parking Garage C				750	902	180	180	140	185	185	145	185	170	135	144	147	139

Protector Backfeed

Newark Airport Backfeed Analysis

	NWP status			Backfeed Status			2601 Amps			2602 Amps			2603 Amps			2601 Phase Angle			2602 Phase Angle			2603 Phase Angle		
	2601	2602	2603	2601	2602	2603	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Loc 01 Tower Switch House	■	■	■	●	●	●	60	66	78	0	0	0	54	60	72	-24	-9	-19	61	-27	-113	-19	3	-10
Loc 02 Terminal C West	■	■	■	●	●	●	1236	1212	1152	1206	1206	1146	1248	1194	1116	-32	-34	-32	-32	-33	-33	-32	-34	-32
Loc 03 Terminal C Middle	■	■	■	●	●	●	1236	1290	1158	1218	1122	1128	1320	1356	1272	-33	-34	-33	-35	-41	-35	-33	-35	-35
Loc 04 Terminal C East	■	■	■	●	●	●	906	930	846	888	882	774	720	822	750	-30	-34	-34	-30	-33	-35	-38	-40	-46
Loc 05 Terminal B North	■	■	■	●	●	●	854	854	805	868	861	805	791	819	763	-34	-35	-36	-33	-34	-35	-33	-35	-37
Loc 06 Terminal B South	■	■	■	●	●	●	588	588	574	539	581	560	539	588	595	-27	-28	-30	-32	-34	-38	-33	-34	-37
Loc 07 CHRP	■	■	■	●	●	●	372	342	330	0	0	0	318	306	312	-4	-3	1	32	177	15	-10	-11	-4
No location #8																								
Loc 09 Terminal A East	■	■	■	●	●	●	492	516	510	498	510	474	594	570	540	-40	-42	-40	-37	-37	-35	-34	-36	-30
Loc 10 Terminal A West	■	■	■	●	●	●	714	684	642	612	600	594	720	678	630	-33	-35	-34	-30	-33	-35	-36	-35	-33
Loc 11 Parking Oval	■	■	■	●	●	●	41	38	36	31	31	31	41	41	38	-37	-44	-34	-19	-30	-20	-39	-44	-36
Loc 12 Marriott Hotel	■	■		●	●		465	455	455	500	480	490				-32	-33	-26	-48	-42	-41			
Loc 13 Utility Station 197	■	■	■	●	●	●	54	54	42	58	64	51	58	54	48	-23	-30	-30	-14	-30	-24	-30	-32	-33
Loc 14 Air Mail Facility	■		■	●		●	0	0	0				0	0	0	176	168	165				-59	-37	-63
Loc 15 Fuel Farm West 196	■	■	■	●	●	●	99	96	86	89	86	79	77	77	80	-31	-34	-32	-29	-31	-31	-30	-29	-30
Loc 16 Fuel Farm East 196	■	■	■	●	●	●	70	65	65	70	75	70	65	60	65	-31	-27	-27	-31	-33	-29	-32	-29	-26
Loc 17 Terminal B International	■	■	■	●	●	●	816	834	792	840	846	792	834	870	804	-39	-39	-36	-41	-39	-36	-21	-19	-15
Loc 18 Terminal C-3 Bus Room 2	■	■	■	●	●	●	678	666	690	708	666	672	708	672	678	-26	-24	-25	-27	-26	-24	-28	-29	-26
Loc 19 Terminal C-3 Bus Room 1	■	■	■	●	●	●	696	606	648	702	732	606	666	612	624	-23	-28	-18	-16	-21	-16	-23	-30	-24
Loc 20 Parking Garage P-4	■	■	■	●	●	●	145	155	150	160	150	140	165	175	160	-12	-12	-13	-13	-15	-10	-9	-8	-10
Loc 21 Terminal A-2 Satellite	■		■	●		●	202	186	205				205	186	198	-28	-30	-24				-28	-31	-24
Loc 22 FAA Tower	■	■	■	●	●	●	110	125	115	105	100	95	90	96	90	-39	-38	-40	-40	-46	-42	-33	-42	-44
Loc 23 Parking Garage C	■	■	■	●	●	●	180	180	140	185	185	145	185	170	135	-22	-24	-29	-19	-21	-28	-21	-20	-28

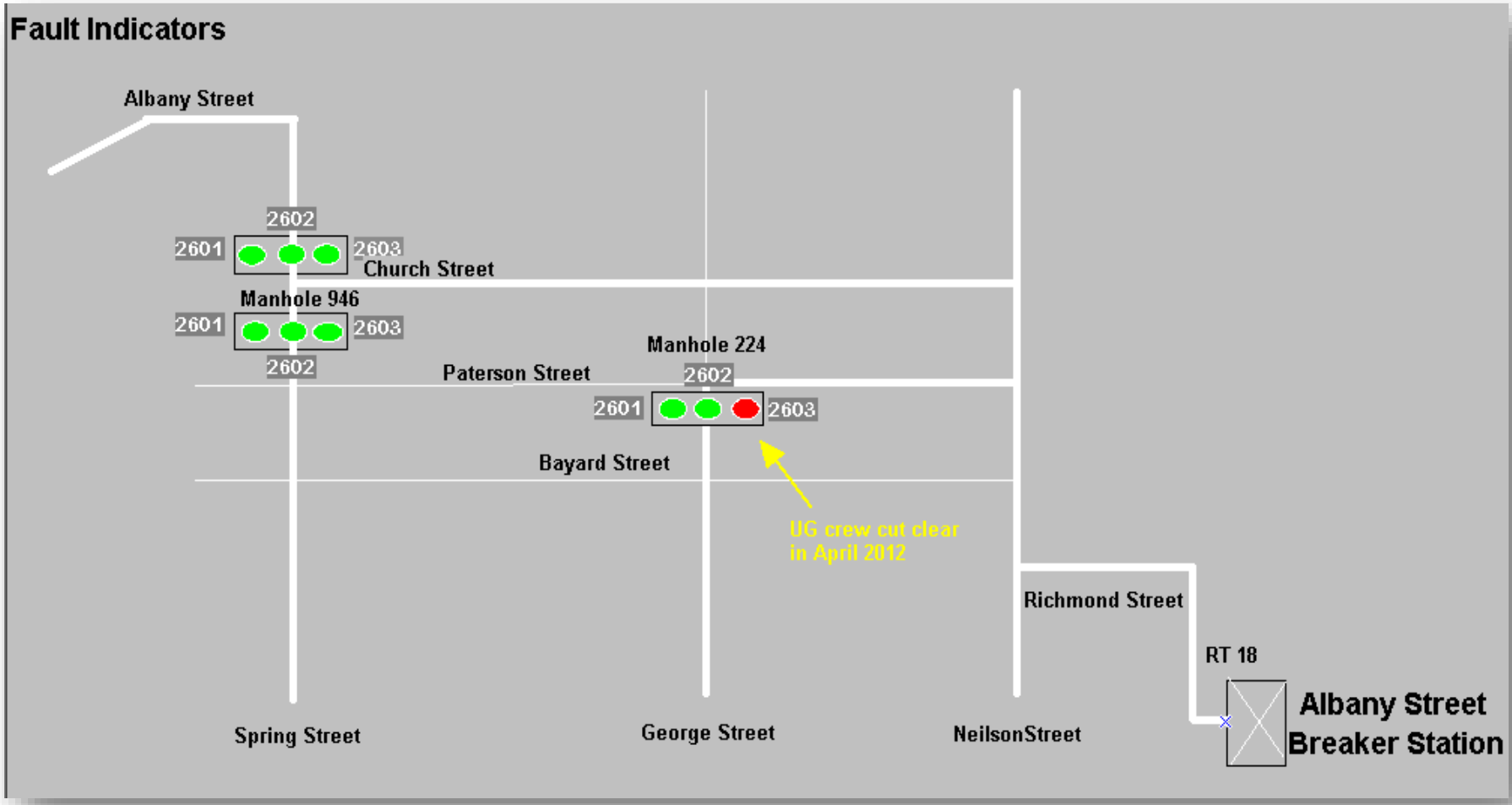
■ = Closed
■ = Open
● =Normal Operation
● =Open Breaker

Refreshes every minute
Backfeed Calculation done every 10 minutes

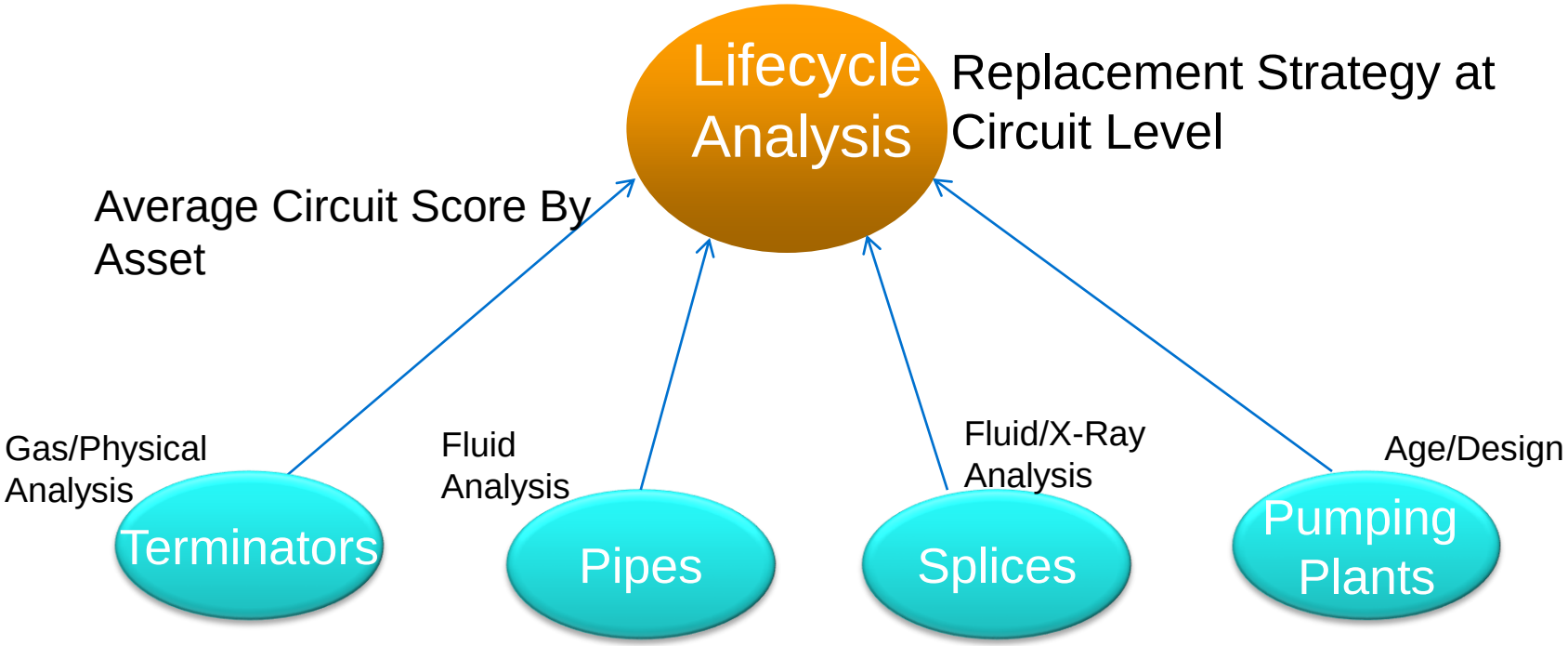
Networking Monitoring System (NMS) Benefits

- Provides control and indication
- Provides Condition Assessment for transformers and network protector
- Remote access to network relays for settings and validation.
- O&M savings
  - OT savings (5% reduction in CM)
  - “Day priors” can be done via system rather than by field crew
  - Improved response & turnaround during faults

26KV Underground Network Display

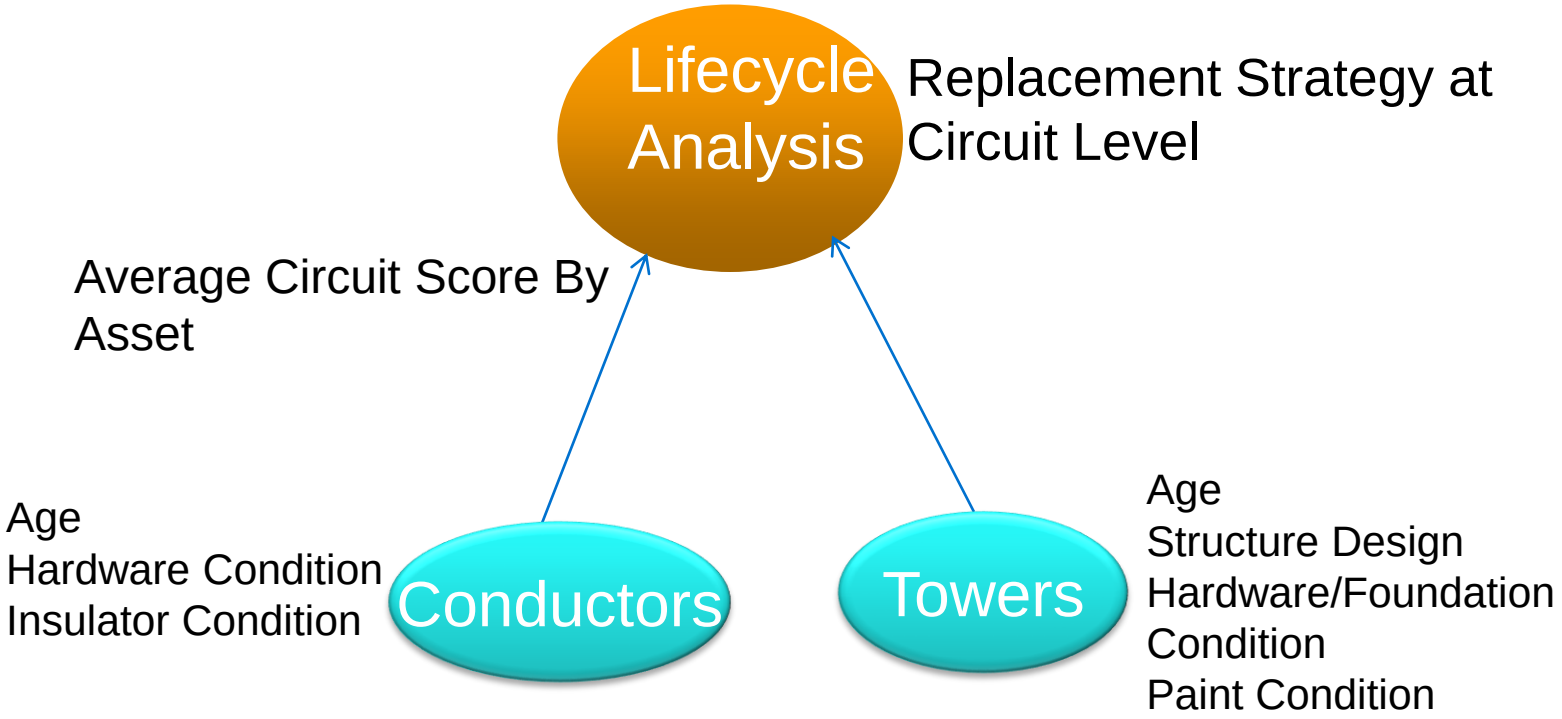


UG Transmission Action & Lifecycle Strategy



Condition Assessment at Asset Level to identify troubled assets

OH Transmission Action & Lifecycle Strategy



Condition Assessment at Asset Level to identify troubled assets

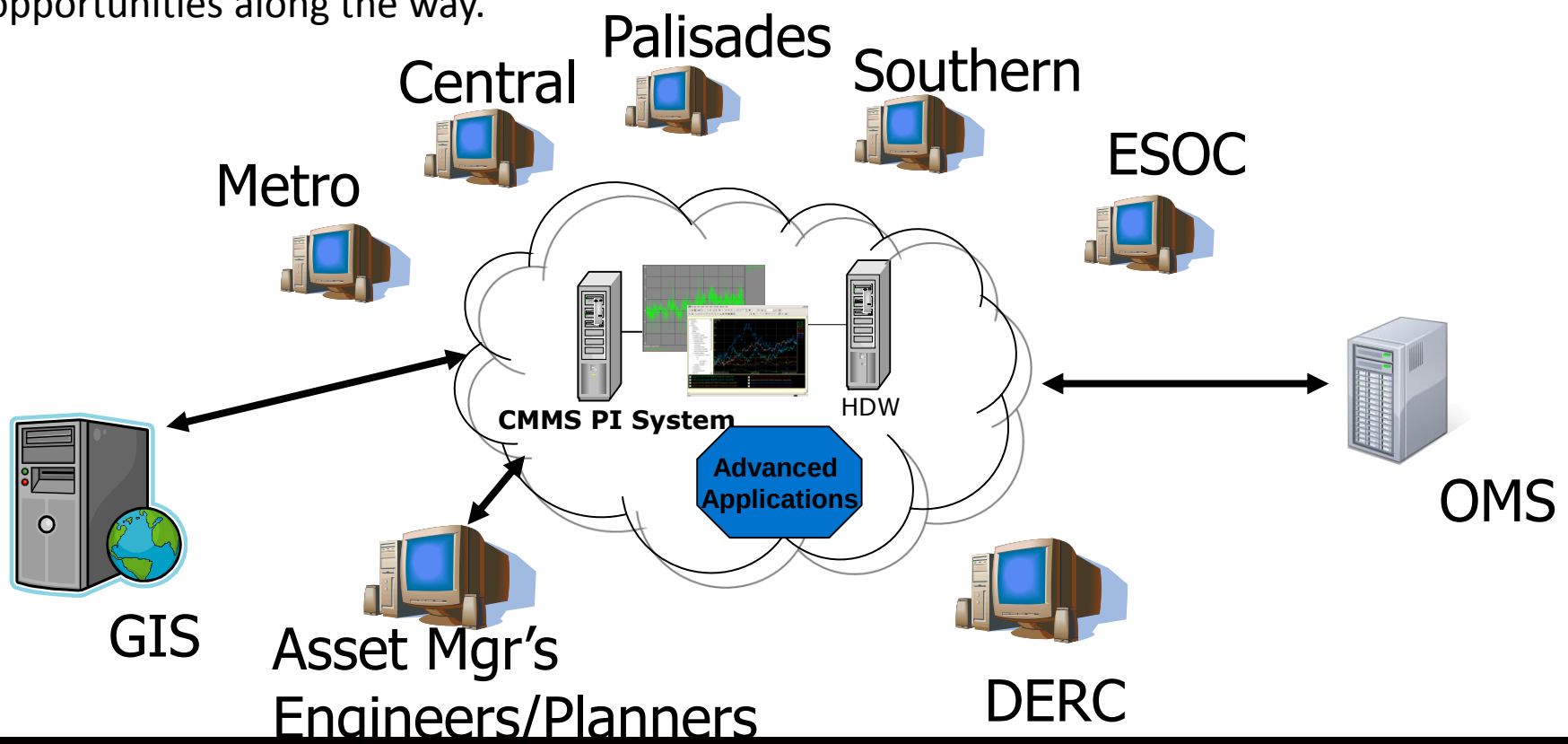
Future Vision

- Cyber Security
- Asset Reliability Management System
- Outage Management
- Graphic Information System
- Mobile Data
- Risk Management

Asset Reliability Management System

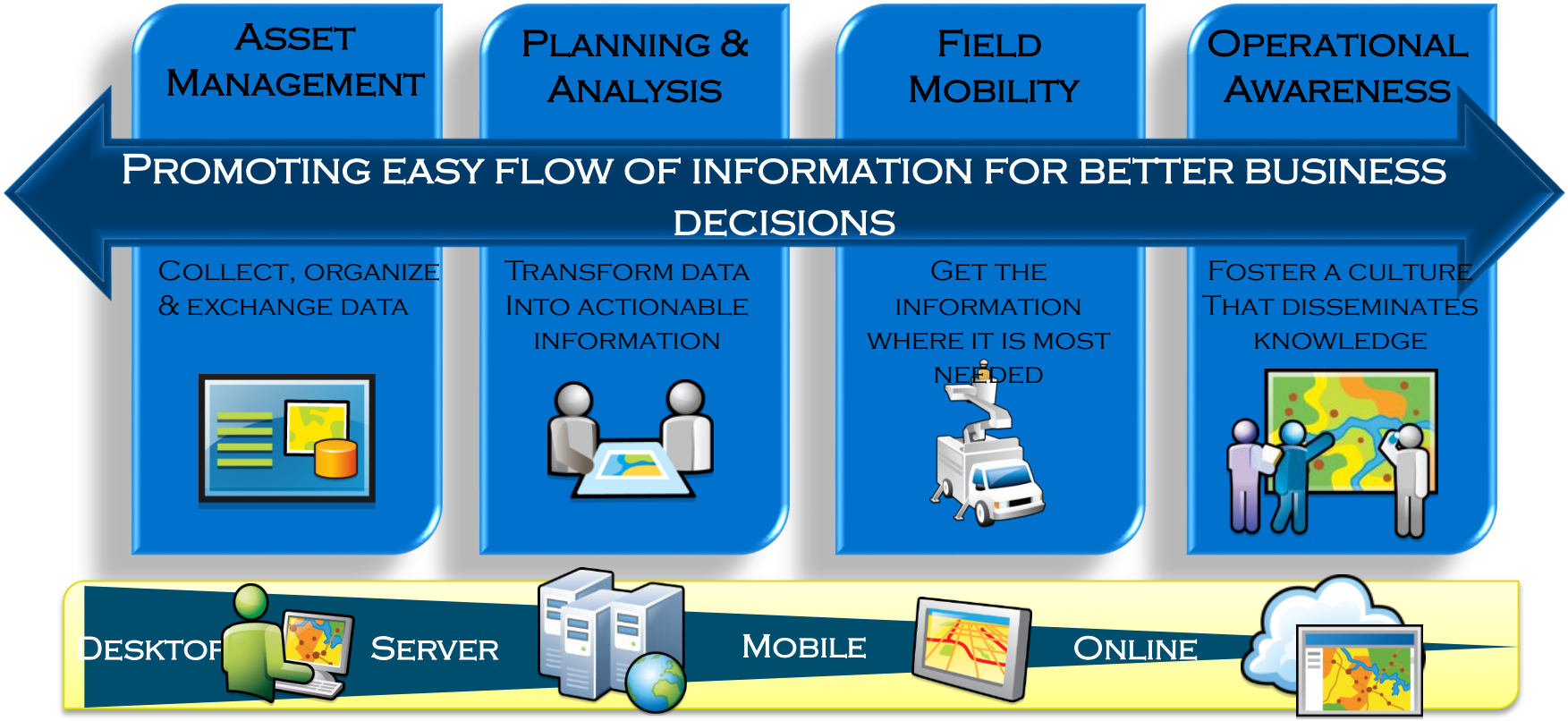
To Be Virtual Dispatch Center

The overall initiative focuses on utilizing, improving and augmenting the overall capabilities of the Transmission Operation System while incorporating new technology, methodology, recognizing and capitalizing on business drivers and opportunities along the way.



The Future of GIS and OMS

A Fully Integrated, Reliable and Robust GIS and OMS Enterprise Systems!



Thank you

777 Davis St., San Leandro, CA 94577