Collect the data and…
Make it Pay!

Presented by

Andy Gaither, NV Energy

Greg Dumas, DST Controls

Empowering Business in Real Time

PI Infrastructure for the Enterprise

NV Energy at a Glance

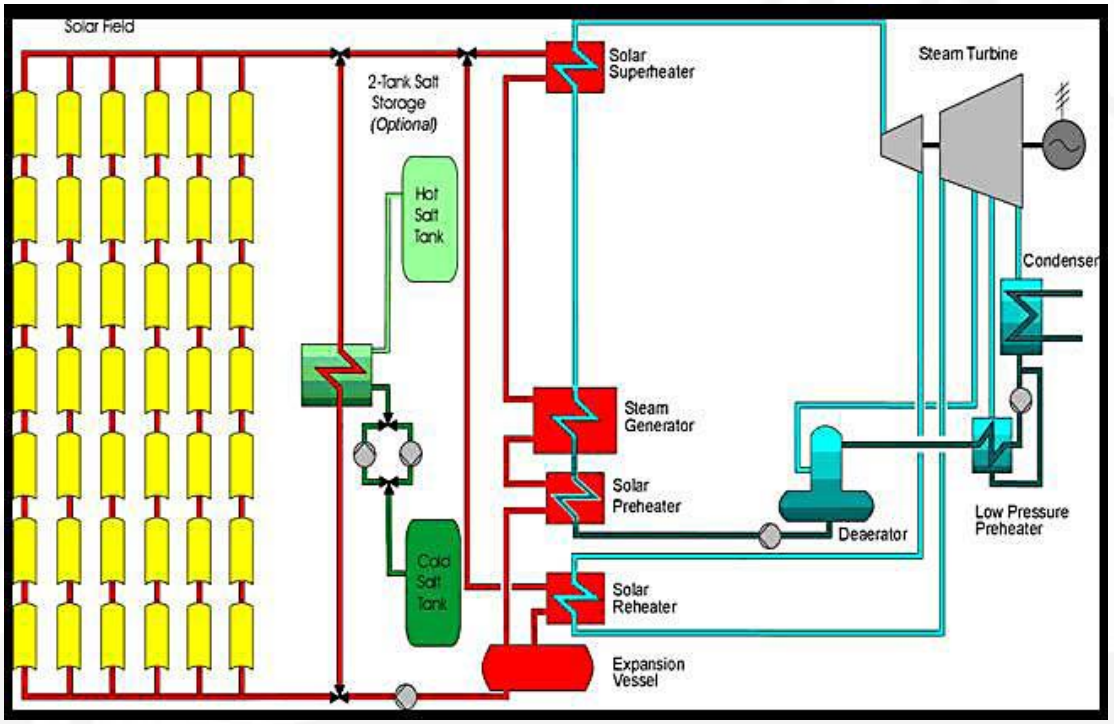
Serves 90% of all residences and businesses in Nevada

- 3.8% Customer CAGR (2000-2007)
- 54,500 square mile service territory
- 3,833 line miles of transmission line
- 5,558 MW of generation (2008)
- 2008 Consolidated peak demand: 7,151 MW

A 14-megawatt solar photovoltaic facility at Nellis Air Force Base. The PV arrays rotate as the sun moves.

Nevada's Renewable Portfolio Standard

Renewable Portfolio Standard is 12% of KW-hour sales increasing to 20 percent by 2015.



Nevada Solar One, a 64-megawatt, solar thermal plant developed by Acciona Energy[A]

NV Energy didn't ask for a PI system…

In today's competitive energy supply market, fundamental business questions are how to:

- Obtain maximum performance and best return on investments
- Monitor transformer performance under rapidly-changing loads
- Safely overload transformer to react to market opportunities
- Schedule maintenance based on incipient problem indicators
- Optimize transformer remaining useful life and life-cycle costs

NVEnergy™

NV Energy asked for valuable data !

What they said was..

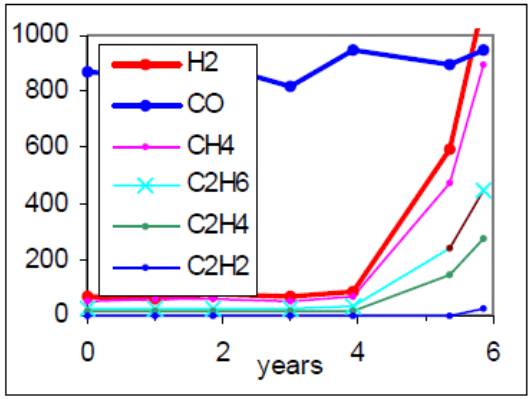
We want real time monitoring !

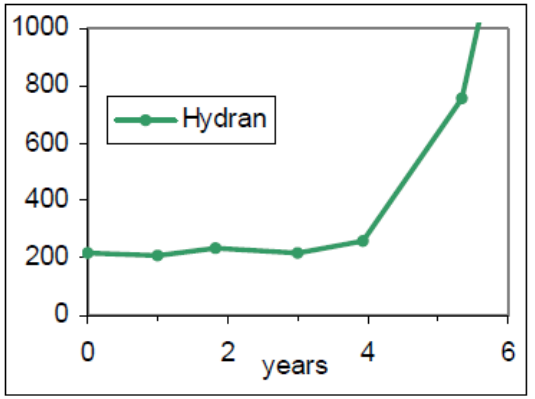
- Transformers are crucial to our operation
- Periodic inspections & tests are not enough
- Oil analysis alone cannot cover many failure modes

Show us the data!

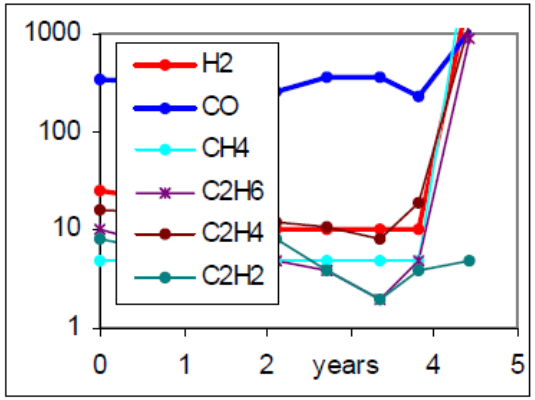
Monitoring H and C in real time

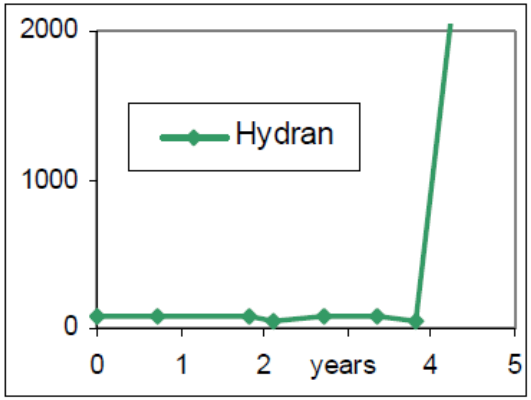
Different faults generate different gasses but always Hydrogen and/or CO are presents:





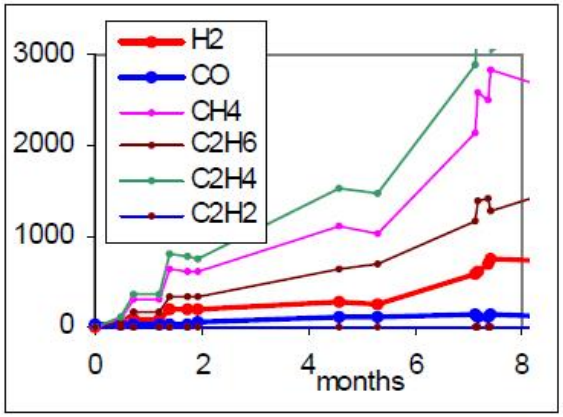
Typical gasses generated in case of tracking discharge in wet insulation

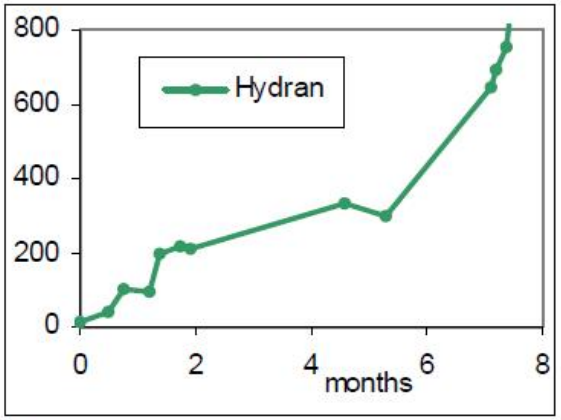




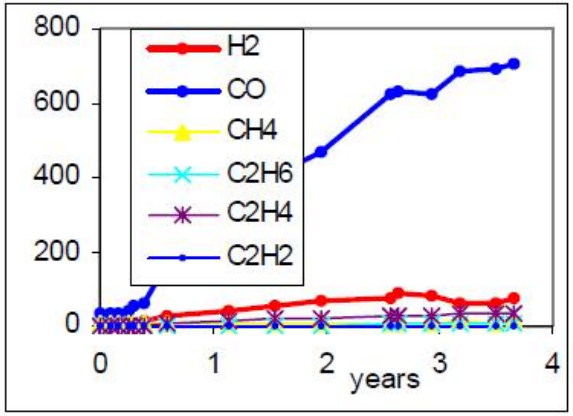
Typical gasses generated in case of current circulation in the core

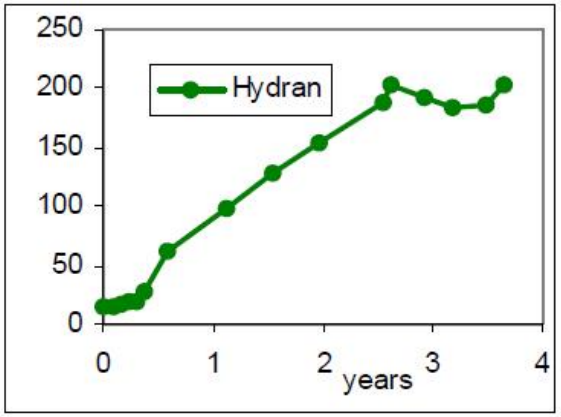
H and C signature- Overheating





Typical gasses generated in case of overheated connection





Typical gasses generated in case of winding overheating

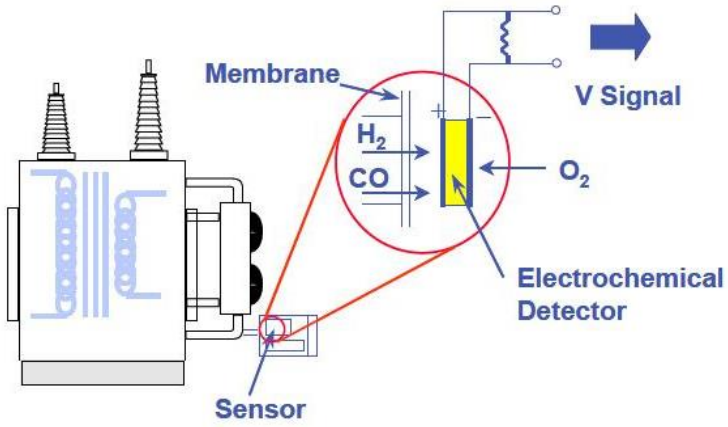
Opportunity: Real time Gas Analysis

Hydran Technology

Continuously monitors the evolution of hydrogen and carbon

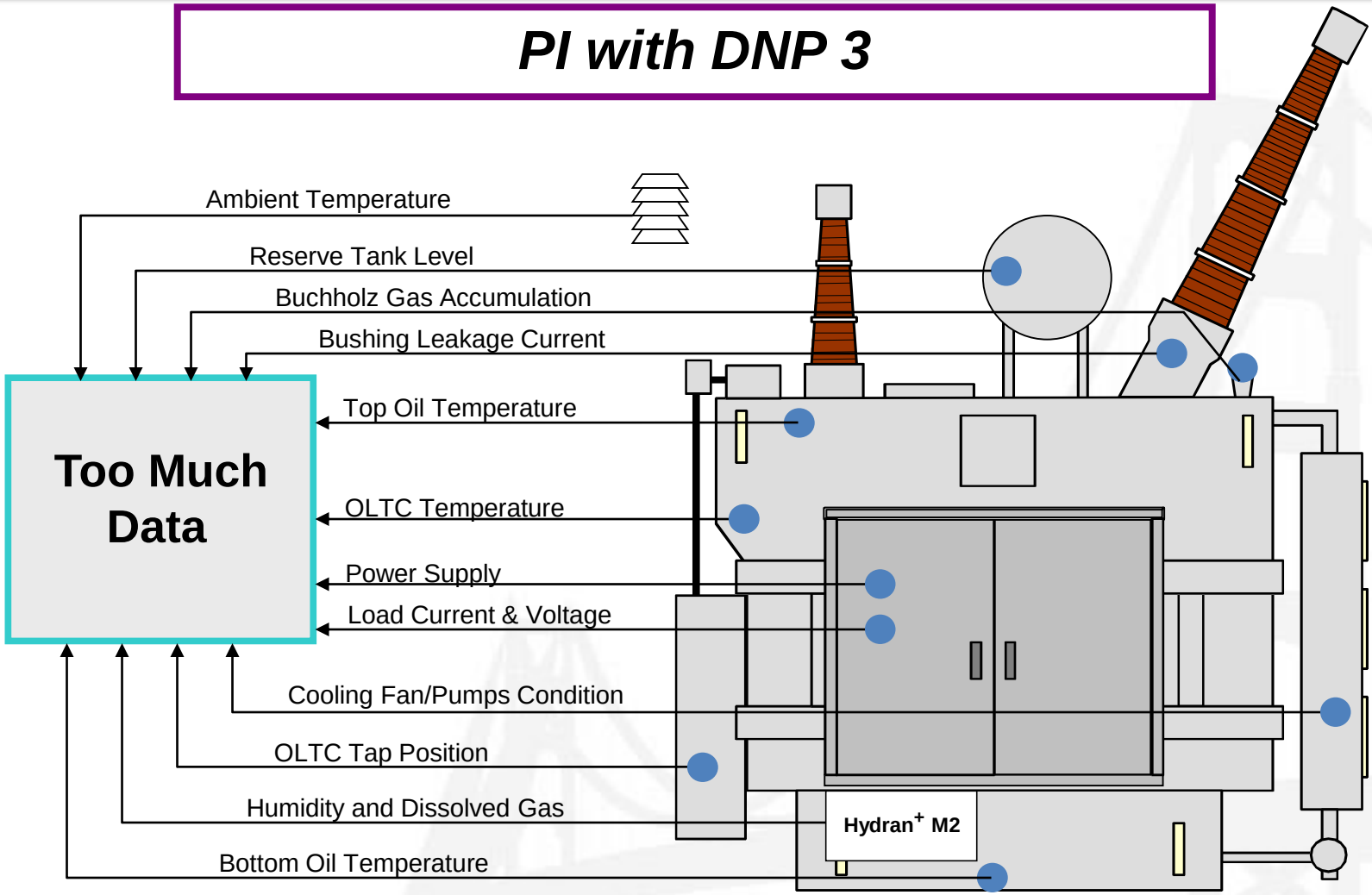
Dissolved gas Level, Temperature
Dissolved gas Level Hourly Trend
Dissolved gas Level Daily Trend
Relative Humidity
H2O PPM Level
H2O PPM Hourly Average
Dissolved gas Sensor Temp

Baseplate Temperature
Heater Power
System Fault Alarm



imagination at work

Collecting the data



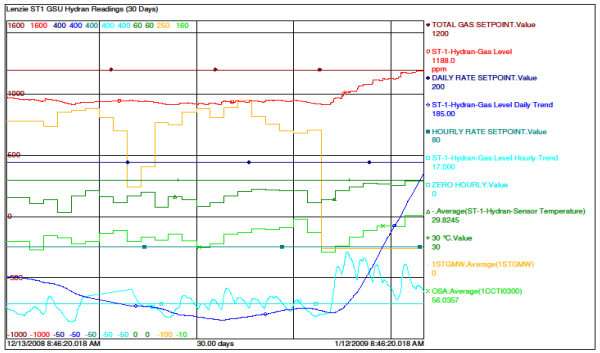
Implementing Real time monitoring

Before we arrived:

Transformer oil measurements recorded on paper forms, stacked high on engineer's desk

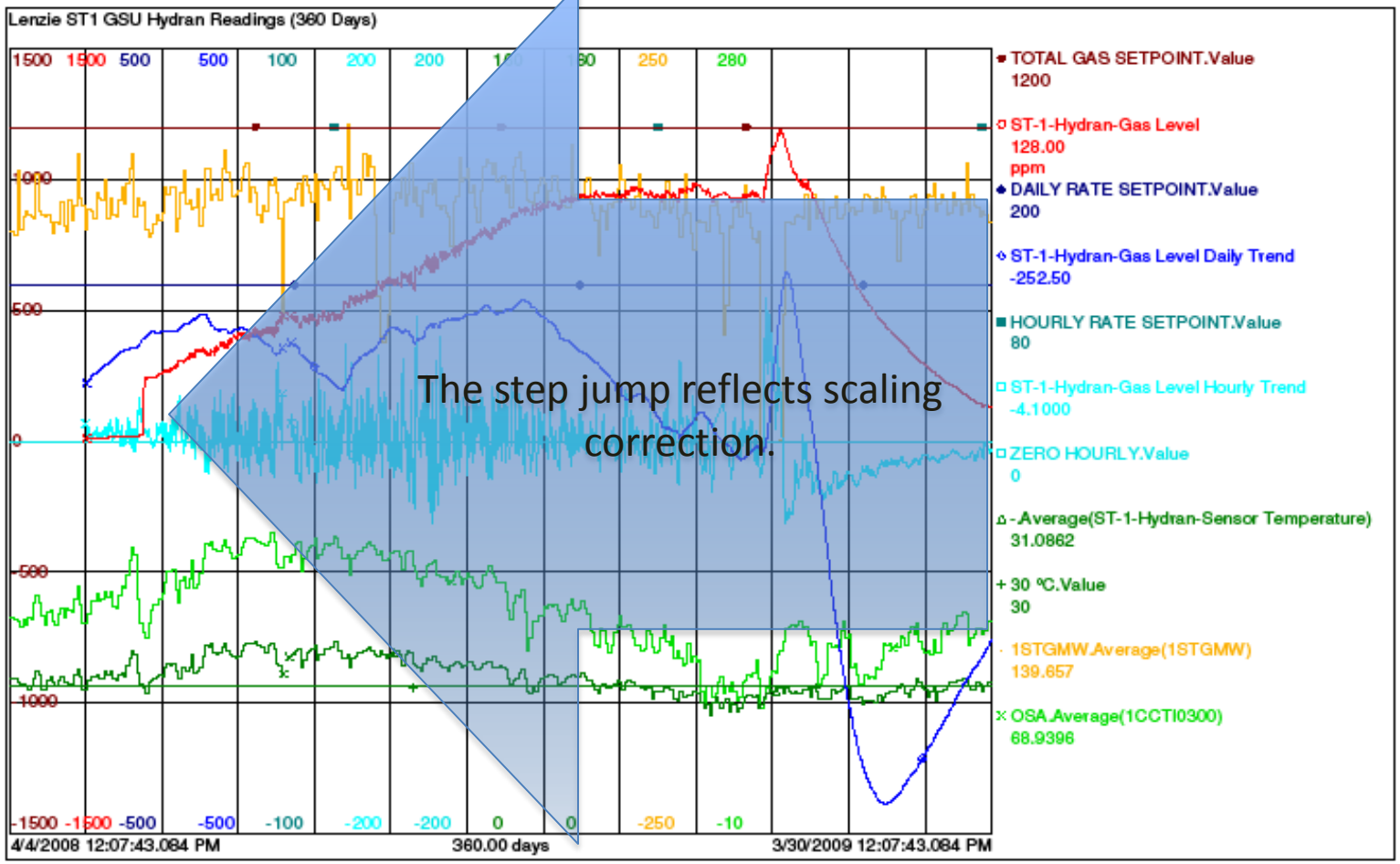
After four days:

Plant operator glanced at screen to check transformers



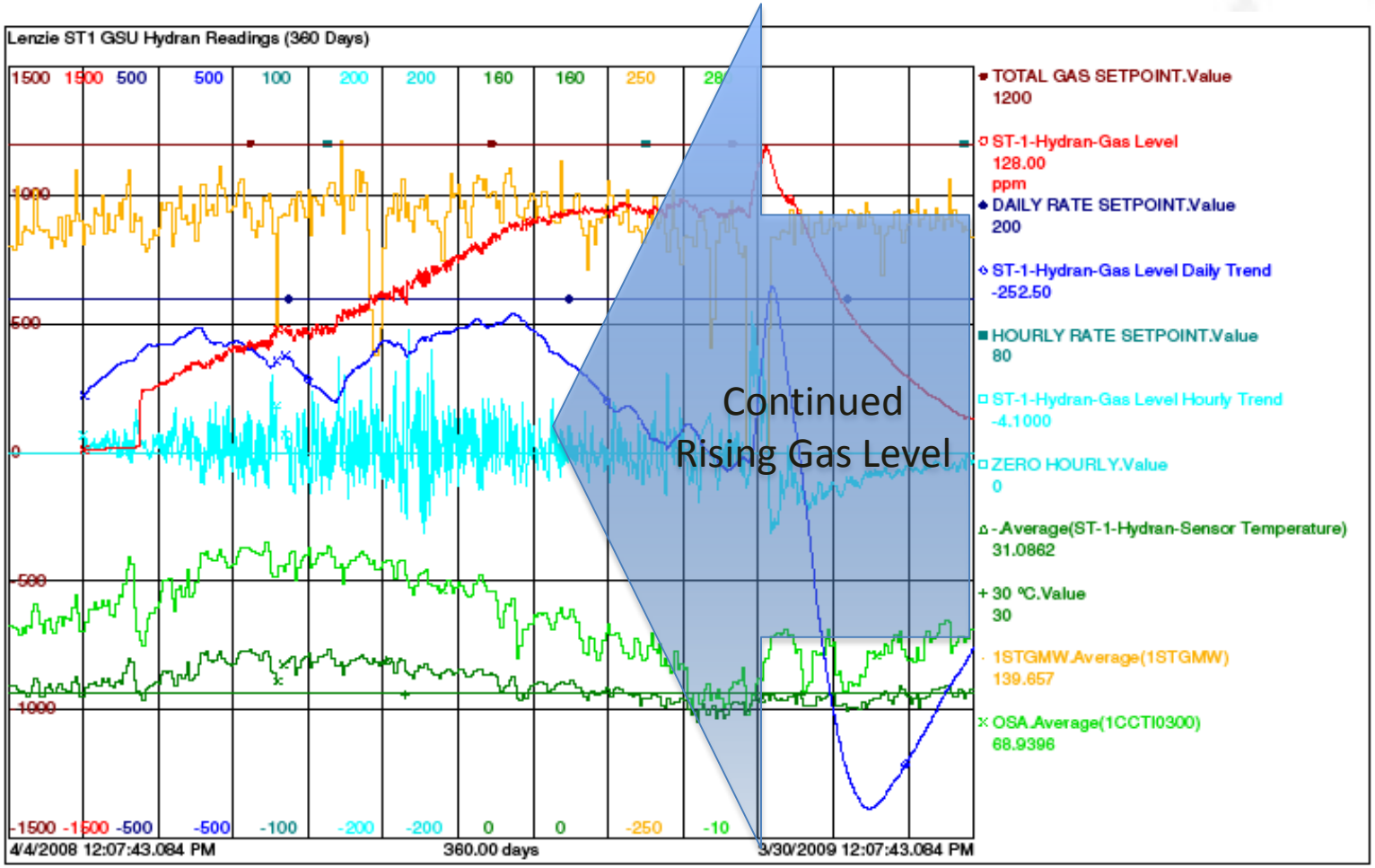
Two weeks later…

Plant operator noticed Hydran gas level was not stabilizing



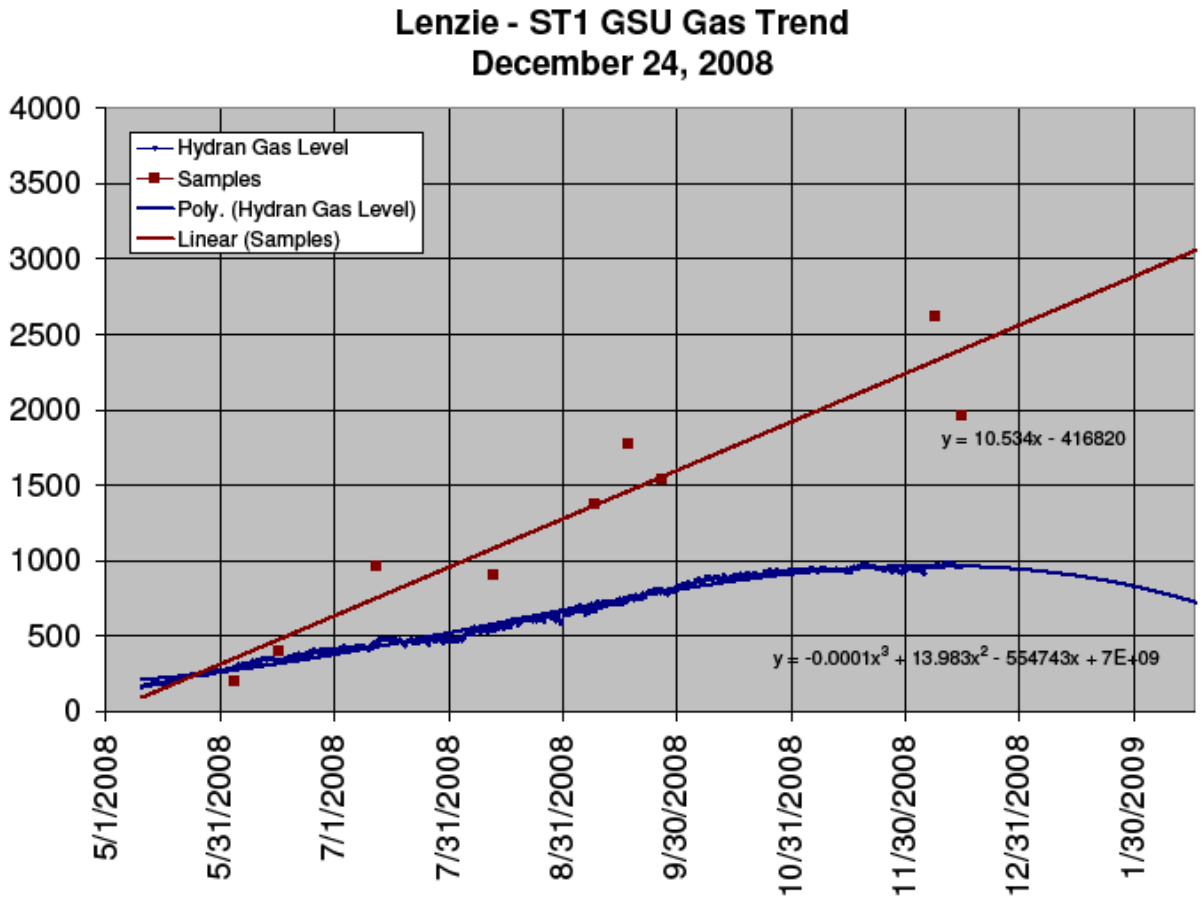
Three Months later…

Plant operator noticed Hydran gas level was not stabilizing



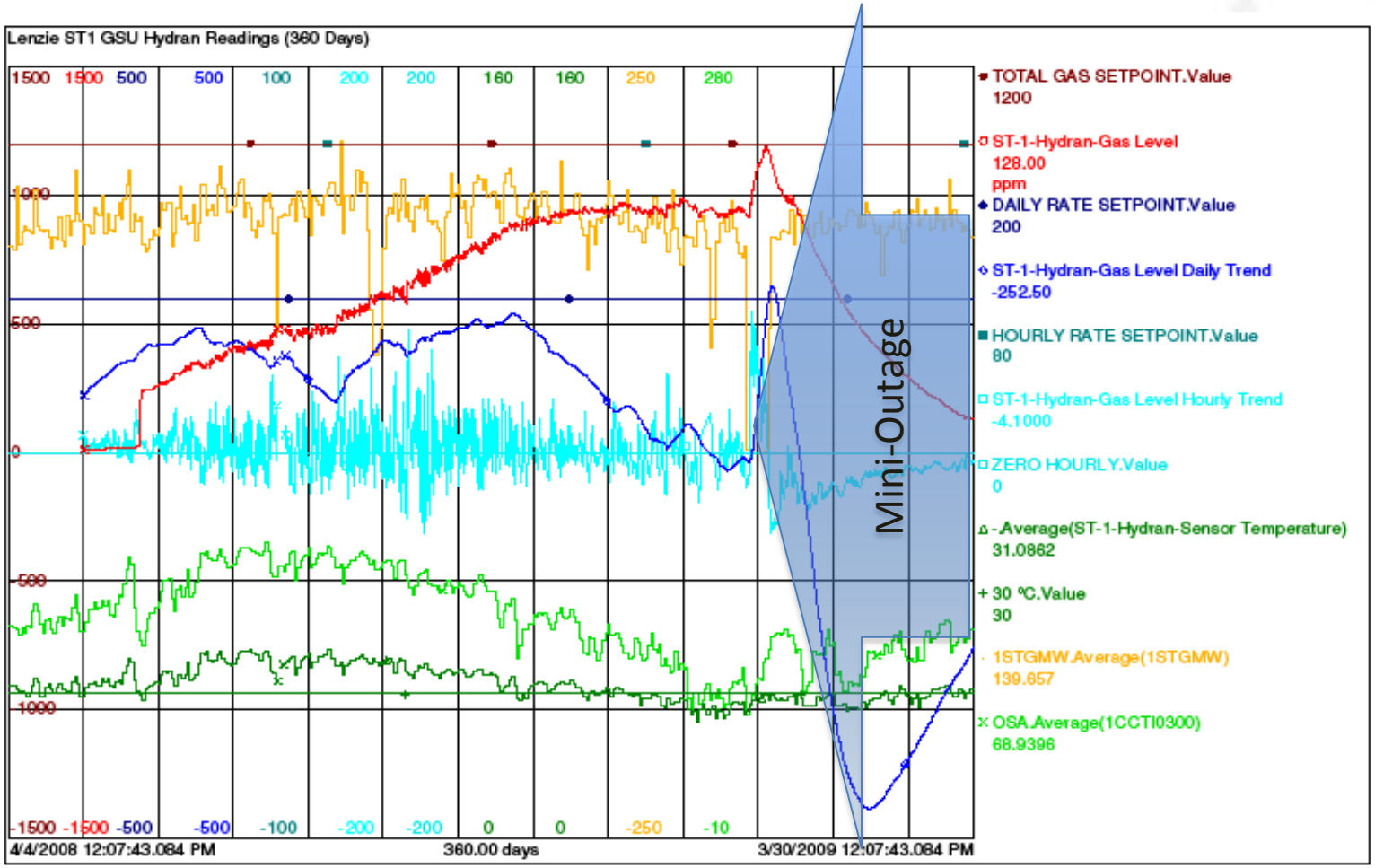
Stepped up Lab Testing…

Validated gassing behavior observed with Hydran



Eight Months later…

Deployed online gas purifier



What Value did we produce?

A month later:

- One transformer showed a constant slow rise in Hydran reading
- Data eliminated load fluctuations and weather related causes
- We discovered a transformer with a problem !

Repair performed while transformer operational

- *Power outage avoided*
- *Payback time for PI system: 45 days*

Cleaning oil AND producing power !

What Changed at NV Energy

Transformer Incident converted to preventive maintenance action

Replaced "management by spreadsheets" with real-time, user generated reports

Converted a potentially large and costly IT project into several inexpensive integration projects.

Where to from here…

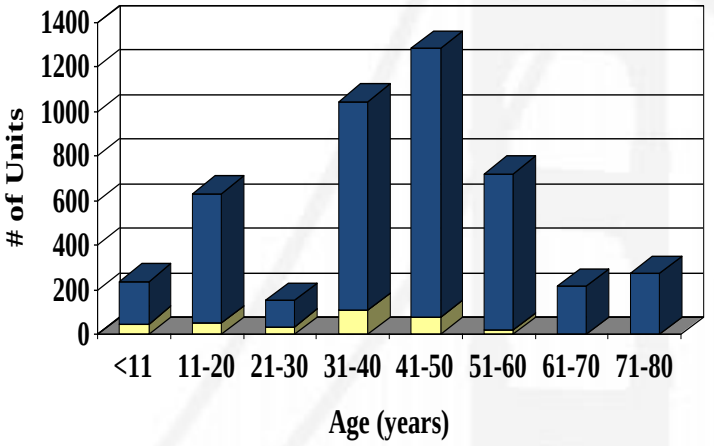
What do you do when you have:

- Aging assets
- Expected to be in service all the time
- Can't be replaced at will

You increase service life !

You implement Conditions Based Maintenance

Equipment Age Profile



Transformers, Breakers, Relays

CBM - one user's estimate of saving

Assessment

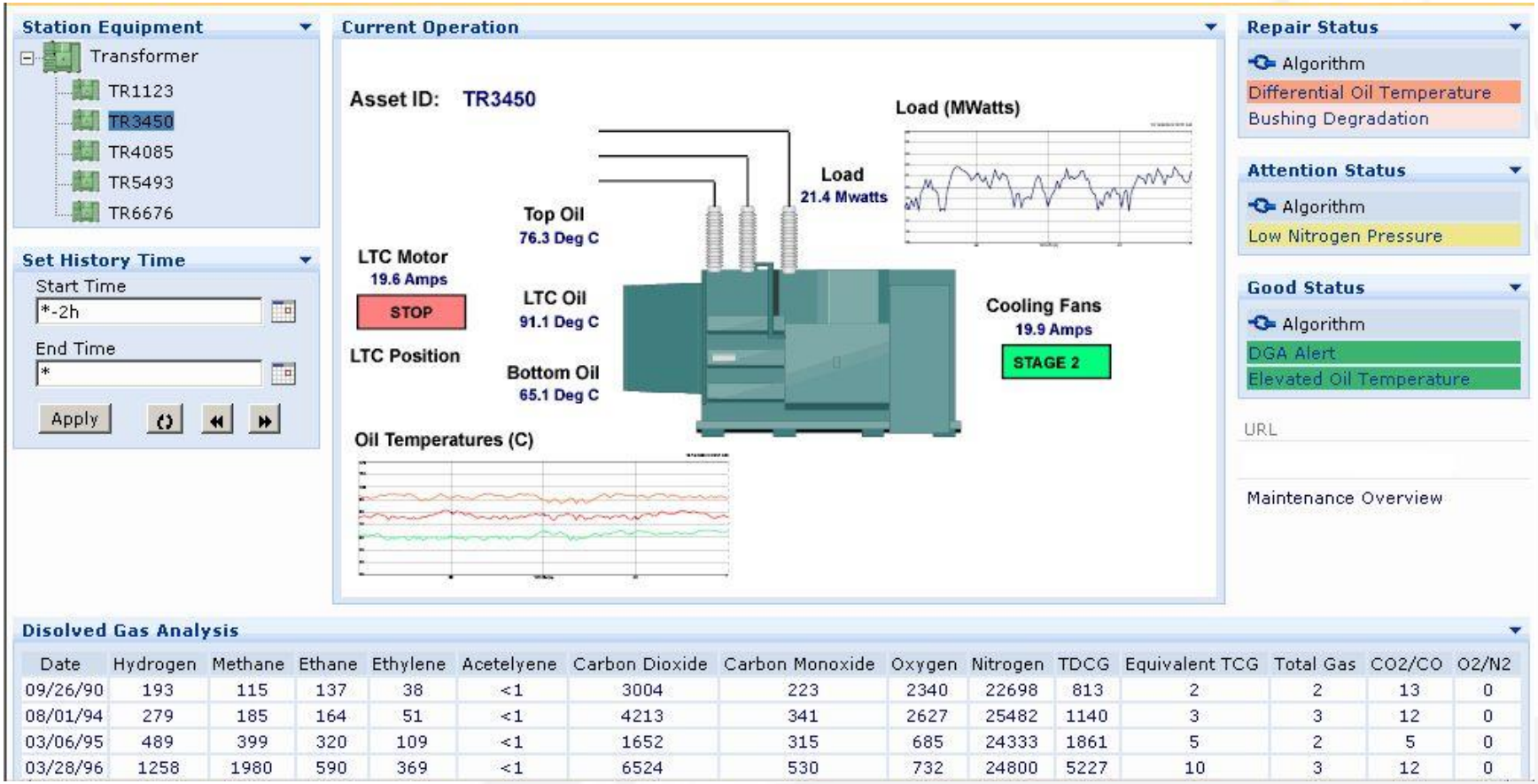
- **2003 - $300,000**
  - Oil Diagnostics targeted 16 LTC's, 5 had contact problems
- **2004 - $1.2M**
  - 5 Transformers were targeted and 2 were identified to have major issues
  - 10 LTC's were targeted and 1 had the potential to create major damage.
- **2005 & 2006 > $2M**

Notification

- **2003 - $264,600**
  - 9 LTC's and 2 GCB's
- **2004 - $800,000**
  - 5 Transformers
- **2005 & 2006 > $1M**

Note: Data courtesy of PSE&G

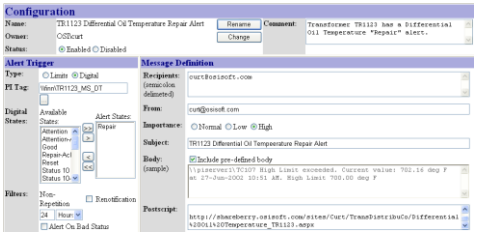
Real Time Asset Monitoring – Phase 1



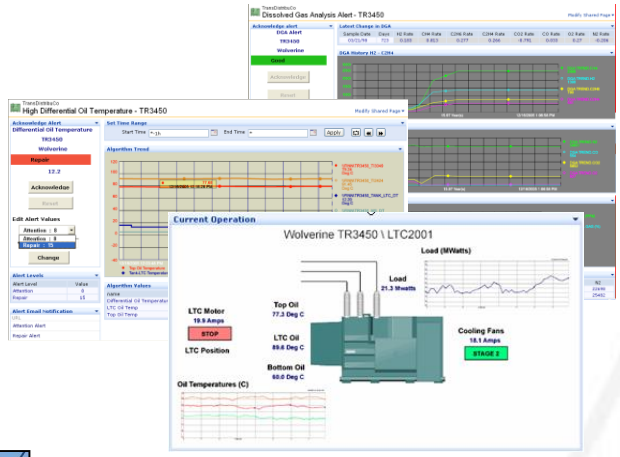
Disolved Gas Analysis

Date	Hydrogen	Methane	Ethane	Ethylene	Acetelyene	Carbon Dioxide	Carbon Monoxide	Oxygen	Nitrogen	TDCG	Equivalent TCG	Total Gas	CO2/CO	O2/N2
09/26/90	193	115	137	38	<1	3004	223	2340	22698	813	2	2	13	0
08/01/94	279	185	164	51	<1	4213	341	2627	25482	1140	3	3	12	0
03/06/95	489	399	320	109	<1	1652	315	685	24333	1861	5	2	5	0
03/28/96	1258	1980	590	369	<1	6524	530	732	24800	5227	10	3	12	0

Phase 2: CBM Platform



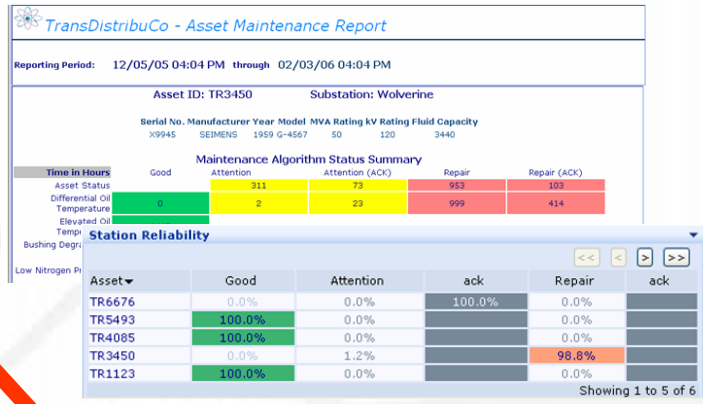
Alert Notification (RtAlerts)
Work Order Generation (RLINK)



Integrated Asset Information (RtWeb Parts)

Disolved Gas Analysis

Sample Date	H2	CH4	C2H6	C2H4	C2H2	CO2	CO			
09/26/90	193	115	137	38	<1	3004	223			
08/01/94	279	185	164	51	<1	4213	341			
03/06/95	489	399	320	109	<1	1652	315			
03/28/96	1258	1980	590	369	<1	6524	530			
03/21/98	1390	2568	790	561	<1	5952	554	927	24651	6361



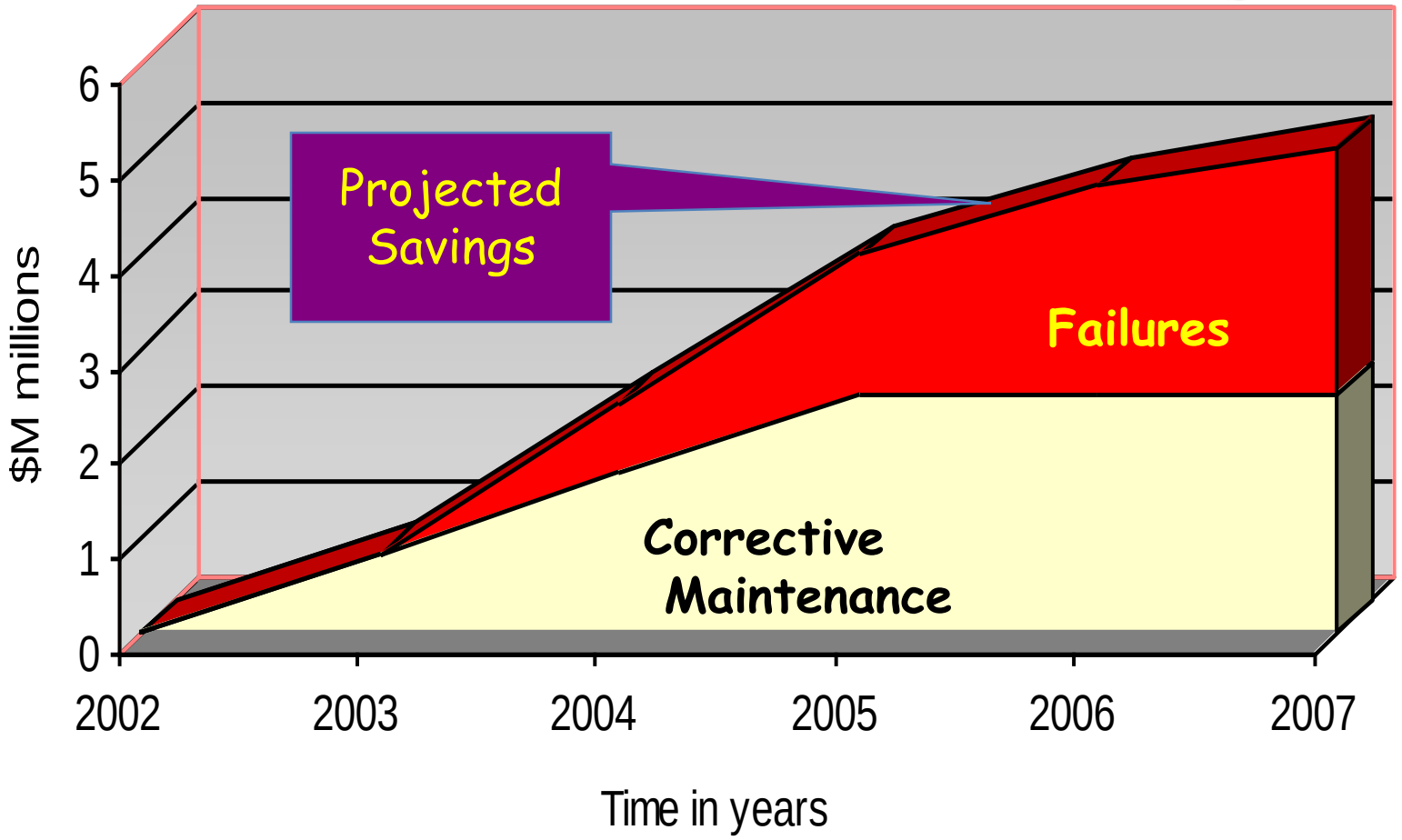
Real-time Rule Assessment (PI ACE)

Asset Information Structure (PI and RDB)

Asset Reliability (PI OLEDB and RtReports)

Improve Reliability

Asset Monitoring Result



Conclusions:

Transformer Incidents converted to preventive maintenance actions

Plant engineers can assess operating situations without becoming computer experts.

Replaced "management by spreadsheets" with real-time, user generated reports

What surprised us…

Many small CBM projects are

- Easier to justify and purchase
- Less specification cost
- Less cost to vendor to learn site specifics- i.e. “on-the-job” training.
- Easier to execute

than a single big CBM project

NVEnergy™

Thanks

GE Energy
transformermonitoring@ge.com
www.ge.com/energy

PSE&G provided the Aging Asset Economic Analysis.

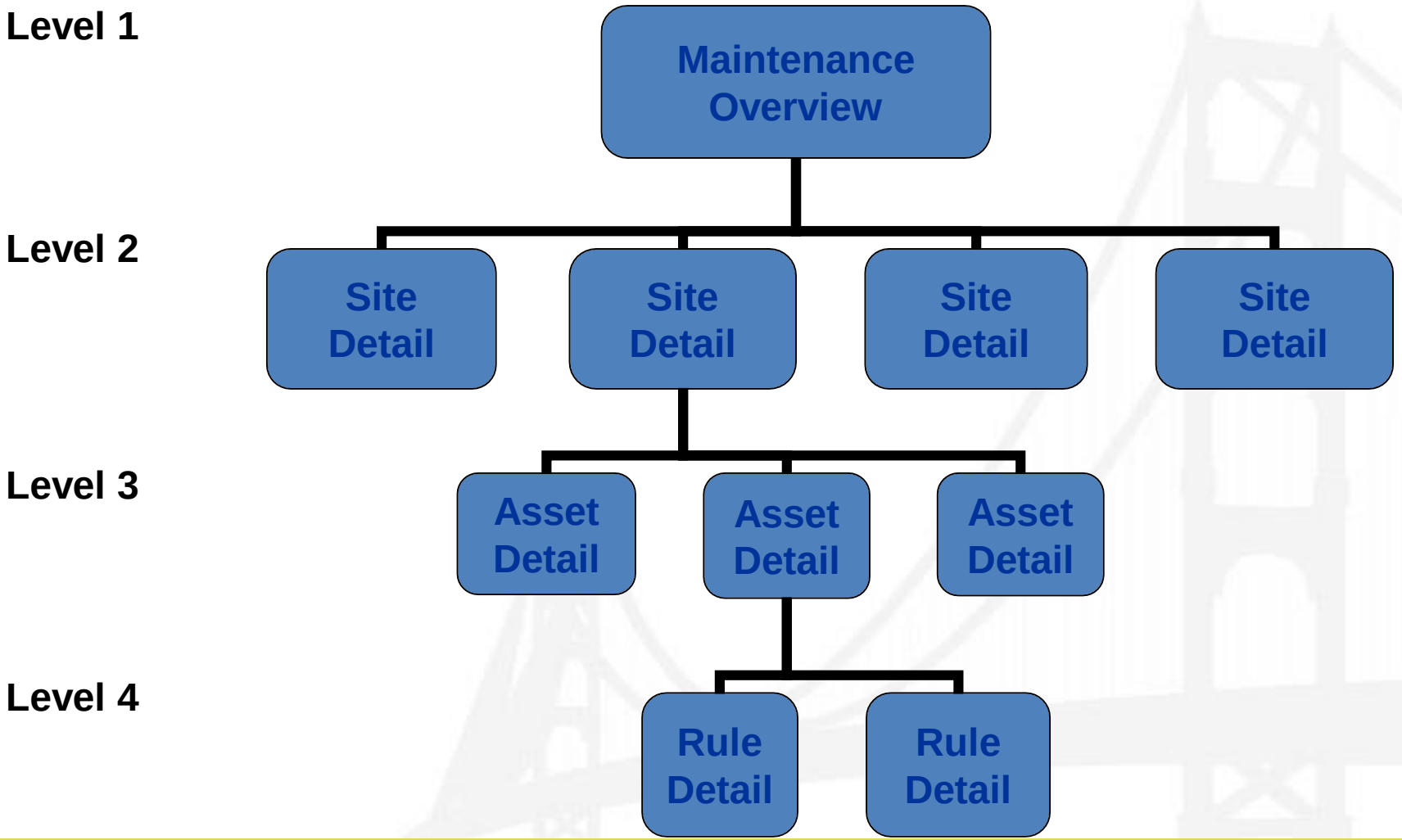
PSE&G currently serves about ¾ of the population of New Jersey across a 2,600 square mile service area.

SDG&E San Diego Gas & Electric
Leaders in OSIsoft RtCBM Architecture

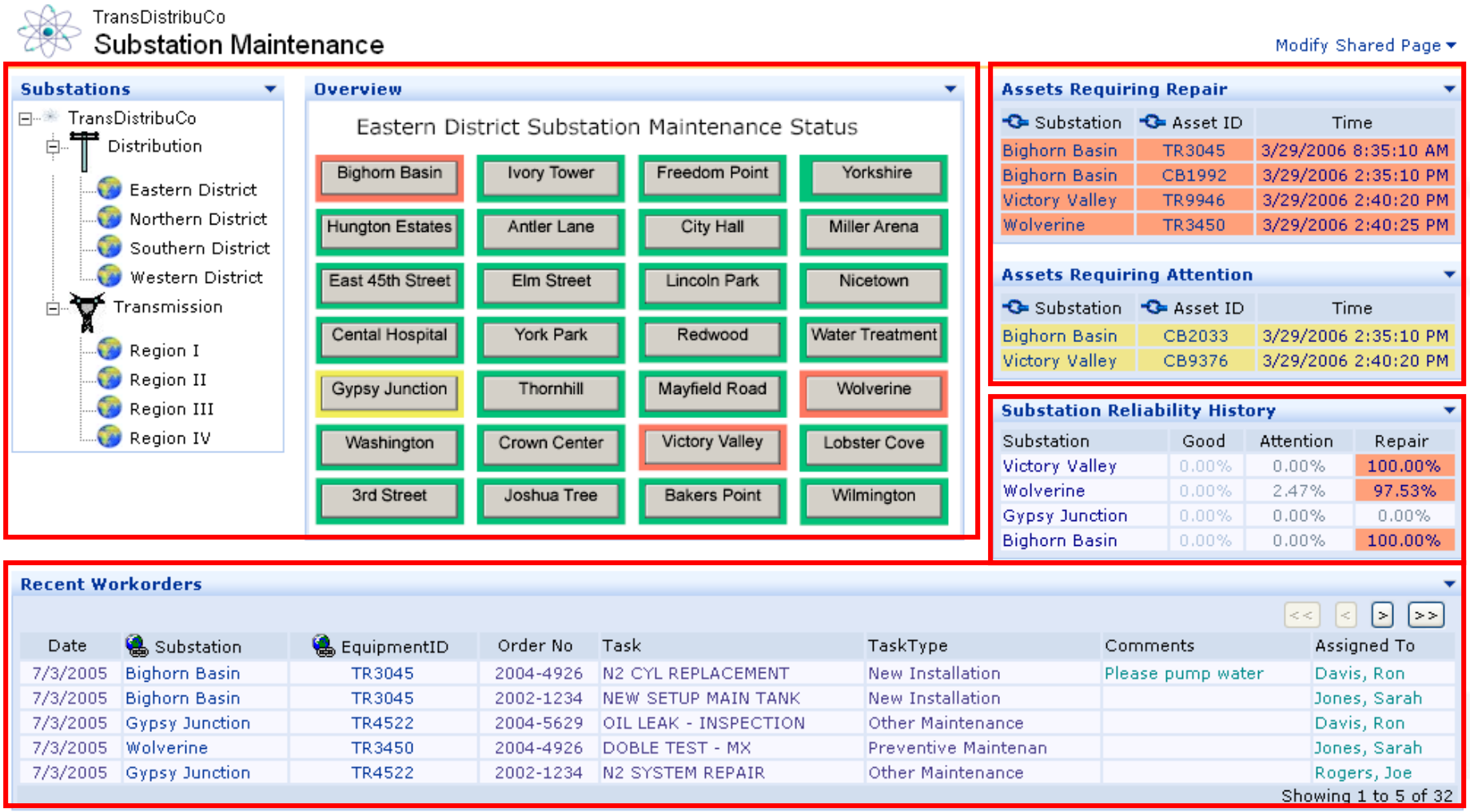
Questions?


Chuck Lenzie
Nevada Power Company
Chairman and CEO
1989-1999
IN RECOGNITION OF HIS DISTINGUISHED SERVICE TO NEVADA POWER SPANNING A TOTAL OF 25 YEARS AND FOR HIS CONTINUING CONTRIBUTIONS AS A HIGHLY-RESPECTED CITIZEN IN THE SOUTHERN NEVADA COMMUNITY, THIS CHUCK LENZIE GENERATING STATION WAS NAMED IN HIS HONOR ON OCTOBER 21, 2004
Nevada Power

CBM Architecture



CBM Overview – Level 1 Screens



Site Detail – Level 2

Trans
Wol

Modify Shared Page

Station Assets

- Circuit Breaker
- Load Tap Changer
- Transformer
  - TR1123
  - TR3450
  - TR4085

Field Inspection

Type	Date
	9/30/1989
	4/11/1972
	7/18/1963
	2/7/1958

Add new document

Station Contacts

First	Last	Mobile
lbert	Fredericks	(440)-555-1212
ill	Jones	(440)-555-1120

Add new item

RL
Maintenance Overview
Wolverine Substation
lgorithm E-Mail Alerts

Adobe Reader - [TR1123_9_30_89[1].PDF]

File Edit View Document Tools Window Help

50%

Help

Pages

Attachments

Comments

1 of 1

Recent Wolverine Workorders

Date	Equipme	Assigned To
1/5/2005	CB5095	Jones, Sarah
1/16/2005	TR3450	Davis, Ron
1/16/2005	CB5095	Saumuels, Tom
2/2/2005	TR3450	Rogers, Joe
2/5/2005	TR3450	Krupp, Robert

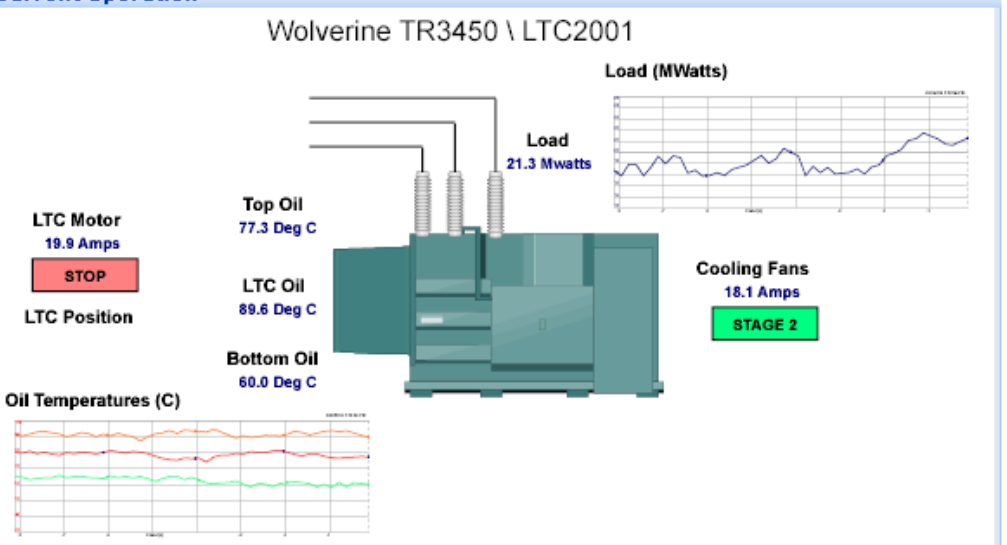
Asset Detail – Level 3

Manufacturer	Model	Year
SEIMENS	G-4567	1959

Station Equipment

- Wolverine
  - Batteries
  - Capacitor
  - Circuit Breaker
    - CB5095
  - Load Tap Changer
  - Transformer
    - TR1123
    - TR3450
    - TR4085
    - TR5493

Current Operation



Repair Status

Algorithm
- Differential Oil Temperature
- Bushing Degradation

Attention Status

Algorithm
- Low Nitrogen Pressure

Good Status

Algorithm
- Elevated Oil Temperature
- DGA Alert

URL
- Maintenance Overview
- Wolverine Substation
- Algorithm E-Mail Alerts

Set History Time

Start Time: *-30d

End Time: *

Apply

Asset Alert History

Algorithm	Good	Attention	ack	Repair	ack
Elevated Oil Temperature	100.0%	0.0%		0.0%	
High Temperature Differential	0.0%	0.8%	0.1%	98.8%	0.2%
DGA Alert	100.0%	0.0%		0.0%	
Low Nitrogen Pressure	0.0%	100.0%		0.0%	
Bushing Degradation	0.0%	0.0%		0.0%	100.0%

Disolved Gas Analysis

Sample Date	H2	CH4	C2H6	C2H4	C2H2	CO2	CO	O2	N2	TDCG (ppm)	Equiv. TCG (%)	Total Gas (%)	CO2/CO	O2/N2
09/26/90	193	115	137	38	<1	3004	223	2340	22698	813	2	2	13	0
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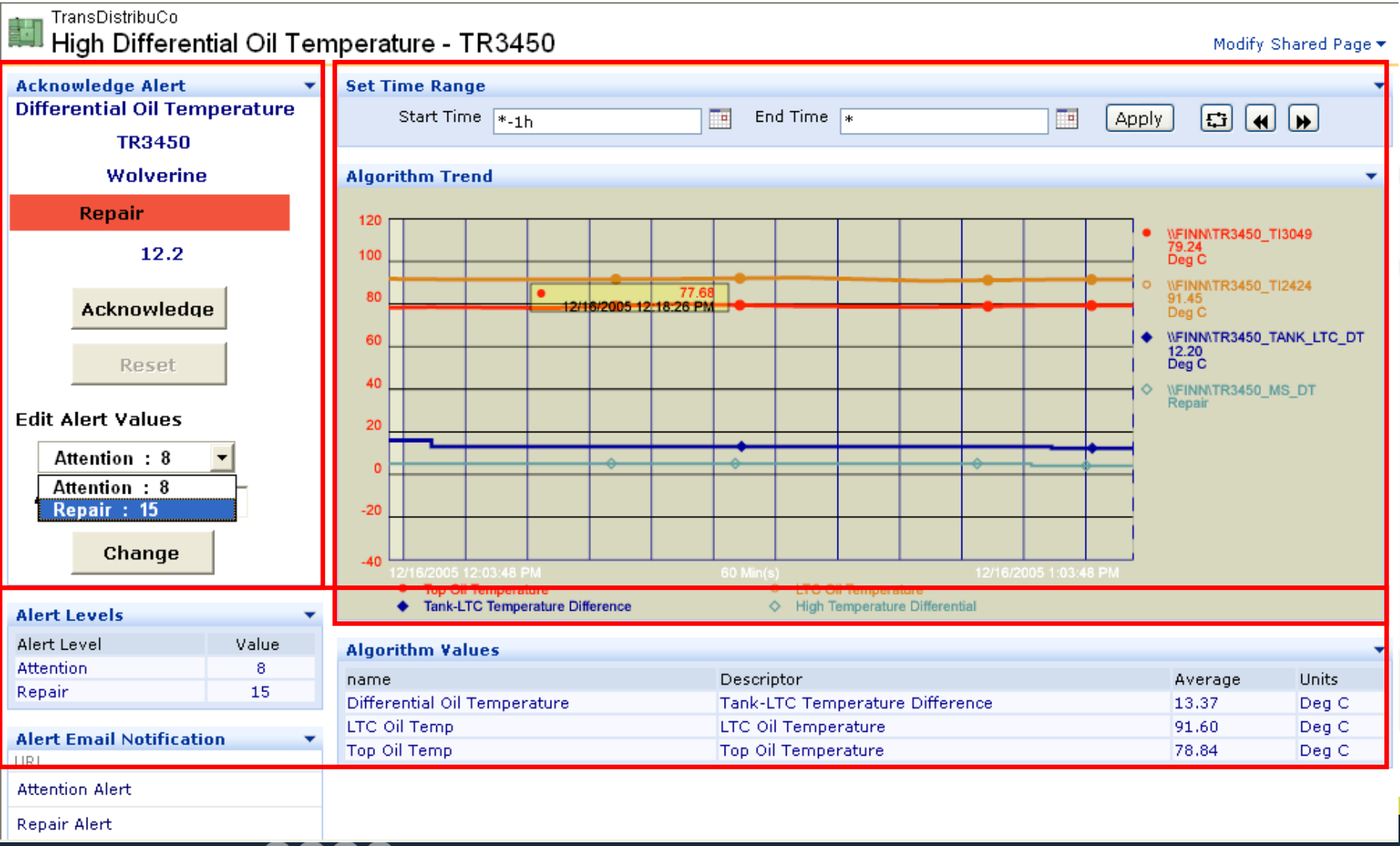
03/06/95	489	399	320	109	<1	1652	315	685	24333	1861	5	2	5	0
03/28/96	1258	1980	590	369	<1	6524	530	732	24800	5227	10	3	12	0

Rule Detail (PI) – Level 4



Asset Reliability Report

TransDistribuCo - Asset Maintenance Report

Reporting Period: 12/05/05 04:04 PM **through** 02/03/06 04:04 PM

Asset ID: TR3450 **Substation: Wolverine**

Serial No.	Manufacturer	Year	Model	MVA Rating	kV Rating	Fluid Capacity
X9945	SEIMENS	1959	G-4567	50	120	3440

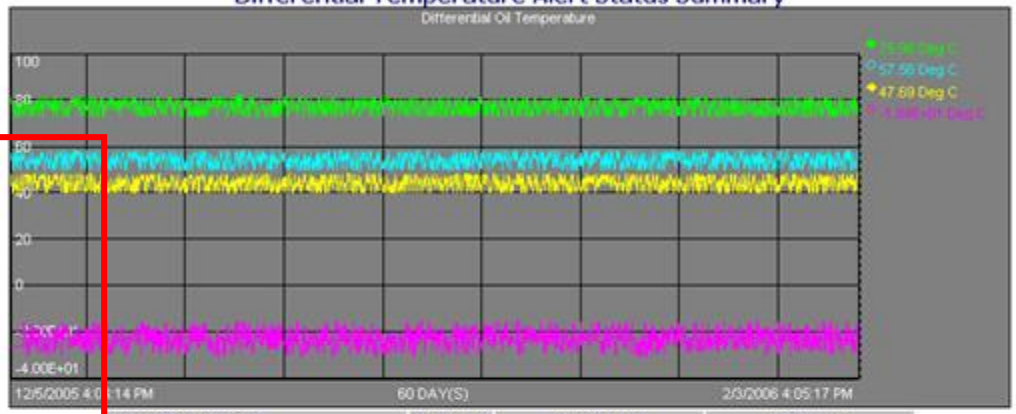
Maintenance Algorithm Status Summary

Time in Hours	Good	Attention	Attention (ACK)	Repair	Repair (ACK)
Asset Status		311	73	953	103
Differential Oil Temperature	0	2	23		
Elevated Oil Temperature	1440				
Bushing Degradation	90				
DGA	1440				
Low Nitrogen Pressure	261	1179			

Work Orders

Date	Work Order No	Task	Task Type	
7/11/2005	2004-1120	DOBLE TEST - MX	Preventive Maintenan	
7/7/2005	2003-1034	N2 TANK ADDED	Preventive Maintenan	
7/7/2005	2005-3999	DGA OIL SAMPLE	New Installation	
7/3/2005	2004-4926	DOBLE TEST - MX	Preventive Maintenan	
7/3/2005	2004-5629	TCG TEST - MAIN TANK	Other Maintenance	
7/2/2005	2003-1034	TCG TEST - MAIN TANK	New Installation	
6/2/2005	2003-1034	TCG TEST - MAIN TANK	Preventive Maintenan	
4/13/2005	2002-1234	N2 SYSTEM REPAIR	Other Maintenance	
4/13/2005	2002-1234	DOBLE TEST - MX	Other Maintenance	
3/5/2005	2003-1034	NEW SETUP MAIN TANK	Other Maintenance	
3/3/2005	2003-1034	N2 SYSTEM REPAIR	Other Maintenance	
3/3/2005	2002-1234	TCG TEST - MAIN TANK	New Installation	
3/3/2005	2004-5629	OIL QUALITY SAMPLE	Other Maintenance	
2/5/2005	2004-5629	OIL LEAK - INSPECTION	Other Maintenance	Davis, Ror
2/5/2005	2005-3999	OIL QUALITY SAMPLE	Preventive Maintenan	Krupp, Robert
2/2/2005	2004-1120	N2 CYL REPLACEMENT	Other Maintenance	Rogers, Joe
1/16/2005	2004-1194	OIL QUALITY SAMPLE	New Installation	Davis, Ror

Differential Temperature Alert Status Summary



Algorithm Input	Average	Maximum	Minimun
Top Oil Temperature	78.26	82.00 22-Jan-06 00:01	74.00 25-Dec-05 12:07
LTC Oil Temperature	91.22	95.00 24-Dec-05 01:07	87.00 30-Jan-06 21:16
Bottom Oil Temperature	62.13	66.00 11-Jan-06 18:07	58.00 18-Jan-06 09:27
Tank-LTC Temperature Difference	12.93	20.61 22-Dec-05 11:37	5.14 18-Jan-06 16:27

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