UC2006 **OSISOFT USER CONFERENCE**

VALUE NOW, VALUE OVER TIME

SAN FRANCISCO
OSISOFT USER
CONFERENCES
2006
FRANKFURT

Condition-based Maintenance Across the Enterprise

Ann Moore and Curt Hertler

OSIsoft

OSIsoft.

AGENDA

- Objective & Evolution of Asset Management

- CBM Drivers

- Why use real-time data

- Implementation example & deployment results

- SDG&E RtCBM Program

- OSIsoft Enabling Technology

  - Business Process

  - Sample Capabilities

VALUE NOW, VALUE OVER TIME

Primary Objective and Related Goals for Asset Management

Maximize asset performance at lowest life-cycle cost

1. Reduce maintenance and corresponding O&M expense
   – *Dispatch skillful technicians for specific problems*
   – *Manage trouble response to minimize cost*
2. Maximize equipment performance
   - *utilization*
   - *reliability*
3. Optimize asset replacement strategy

   and

4. **Eliminate or reduce catastrophic equipment failures**

VALUE NOW, VALUE OVER TIME

Evolution of Asset Management

1. Traditional asset management approaches

   - *issues*
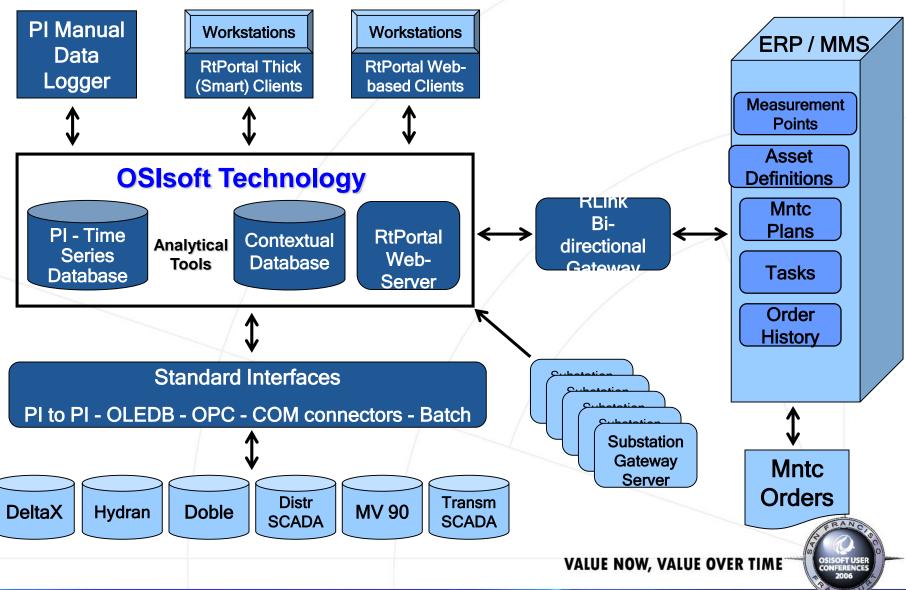
   - *limitations*

2. Evolution of maintenance practices

Future Present Past

- Interval based
  – *Time based*
  – *Counter based*
- Condition based
- Real-time Condition based
- Future Asset Management Practice

VALUE NOW, VALUE OVER TIME

Why Integrate Real-time Data?

- Better automated processes for CBM

- **Operations Benefits** – provides access to the real condition of the asset, better utilize the asset

- **Maintenance Benefits** – facilitates fine tuning of maintenance processes
  - Drill down to what is really driving the condition
  - Determine whether to send someone now or later

VALUE NOW, VALUE OVER TIME

Typical Implementation Overview

PSE&G's Estimated Savings with OSIsoft-based CBM Deployment

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 Projected ~ $2M**

Notification

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

With real-time data, we can do even better!

VALUE NOW, VALUE OVER TIME

OSISOFT USER CONFERENCES 2006 SAN FRANCISCO FRANKFURT

SDG&E

(San Diego Gas & Electric)

RtCBM Program

VALUE NOW, VALUE OVER TIME

SDG&E – System Statistics

- *2 Generation Facilities (590 MW)*
- *1,805 Electric Transmission Miles*
- *18,000 Transmission Structures*
- *120 Substations*
- *906 Distribution Circuits*
- *7,941 Underground Circuit Miles*
- *6,875 Overhead Circuit Miles*
- *220,362 Distribution Poles*
- *145,764 Distribution Transformers*
- *1,315,134 Electric Meters*

VALUE NOW, VALUE OVER TIME

SDG&E RtCBM Objectives

- **Minimize personnel dependency (resources & training needed for asset data analysis)**

- **Provide a equipment monitoring and analysis platform for access to all data**

- **Provide drill down navigation abilities through data integration**

- **Notify personnel to respond to equipment conditions**
  - **Automated analysis**
  - **Automated trigger**
  - **Automated notification**
    - **Pager, Email, & Investigating Work Orders**
  - **Reporting capabilities**

VALUE NOW, VALUE OVER TIME

RtCBM Process Enhancement and More
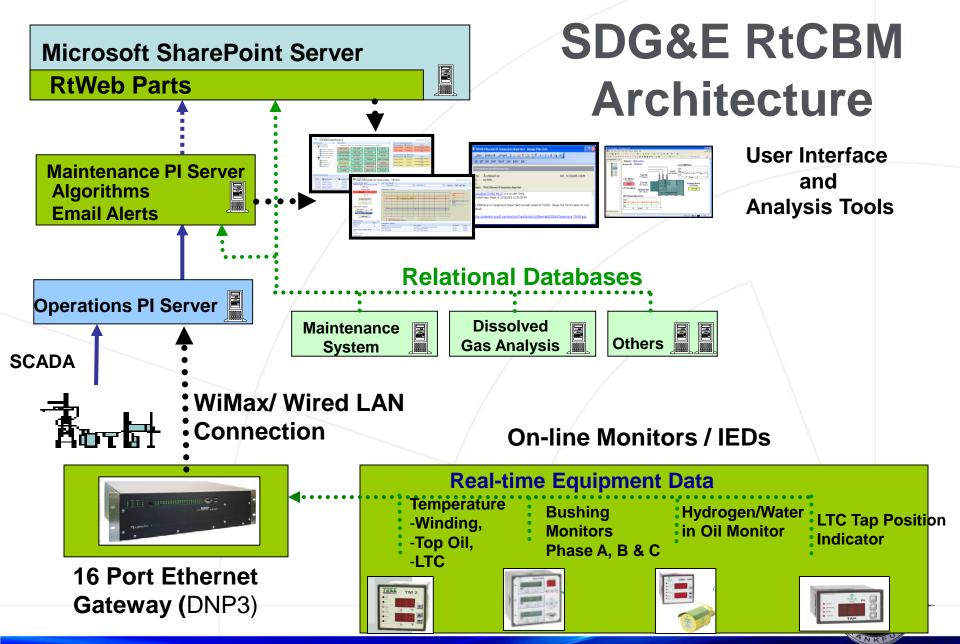
- **Equipment benchmarks (with normalized data)**

- **Refining equipment specifications design validation and new equipment procurement practice**

- **Provide insights into substation design & configuration geographical variations**

- **Standardization of analysis – designing & adopting trigger algorithms**

- **Flexible application of numerous factors like asset age, environment, customer impact**

- **Enhance operational and planning decision support – e.g. equipment impact due to load transfer**

- **Further define equipment utilization, performance trade-offs**

VALUE NOW, VALUE OVER TIME

RtCBM – Data Integration

- Weekly general inspections
  - *LTC operations*
  - *Alarms, temperature, visual*

- Monthly equipment inspections
  - *Operation counters*
  - *Temperature, Pressure*
  - *Voltage*
  - *Functional check*

- General asset
  - *Rating*
  - *Age, Type, Design*
  - *Operating limits*
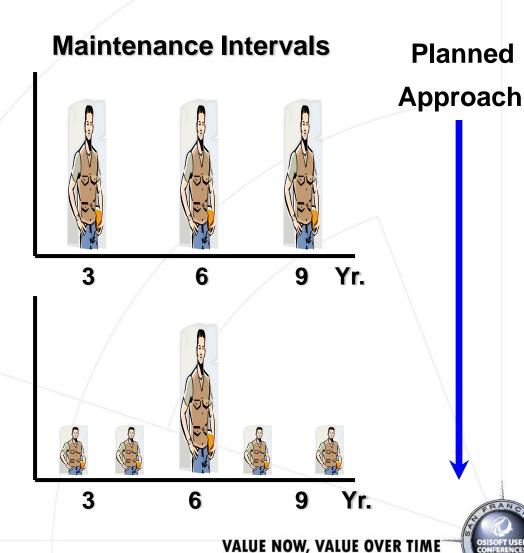
- Operational
  - **Relays & Digital fault recorders**
  - **PQ Monitors**

- Specific equipment
  - *Operating conditions*
  - *Stress factors*
  - *Trouble history*
  - *Maintenance data*
  - *Oil test data*
  - *Electrical test data*
  - *Operating speed*

- Real-time
  - *Voltage & Current*
  - *Temperature*
  - *Bushing On-line Power Factor*
  - *Hydrogen in Oil*

- Simulated

- System & Engineering

VALUE NOW, VALUE OVER TIME

SDG&E RtCBM Architecture

Microsoft SharePoint Server

RtWeb Parts

Maintenance PI Server
Algorithms
Email Alerts

Operations PI Server

SCADA

User Interface
and
Analysis Tools

Relational Databases

Maintenance System

Dissolved Gas Analysis

Others

WiMax/ Wired LAN Connection

On-line Monitors / IEDs

16 Port Ethernet Gateway (DNP3)

Real-time Equipment Data

Temperature
-Winding,
-Top Oil,
-LTC

Bushing Monitors Phase A, B & C

Hydrogen/Water in Oil Monitor

LTC Tap Position Indicator

Time-based to RtCBM – Circuit Breakers

Data Available

- **Weekly safety inspections**
- **Monthly equipment insp.**
- **Asset Data**
- **Historical Data**
  - **Operating conditions**
  - **Stress factors**
  - **Trouble**
  - **Maintenance data**
  - **Test data (insul & elec)**
- **Operational data**
  - **Relays & Digital fault recorders**
  - **PQ Monitors**
- **Real-time data**
  - **Voltage & Current**
  - **I^{2}T and Contact Wear**
  - **Operations Counter**

Maintenance Intervals

Planned Approach

3   6   9   Yr.

3   6   9   Yr.

VALUE NOW, VALUE OVER TIME

Circuit Breaker Operations
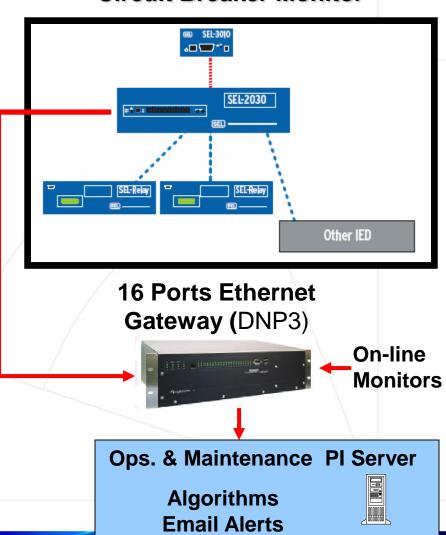
Concerns

- Proper fault clearing
- Fault testing with a circuit breaker
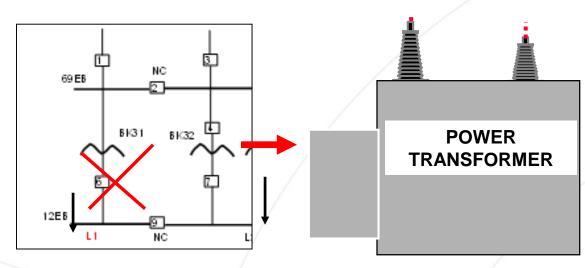
Solution

- Verify the health of CB
  - Contact wear
  - Insulation medium integrity
  - Bushings and accessories
  - Operating history
- Use historical and real-time contact wear data (I^2T) to make a decision

Substation Relays with Circuit Breaker Monitor

16 Ports Ethernet Gateway (DNP3)

On-line Monitors

Ops. & Maintenance PI Server

Algorithms Email Alerts

Transformer at Emergency Rating

POWER TRANSFORMER

TRANSFORMER Health Indices

• **Insulation Power Factor**

• **LTC Application & Design**

• **Oil Conditions**

• **Bushing & Accessories**

• **Operating History & Conditions**

Paper Insulation Health
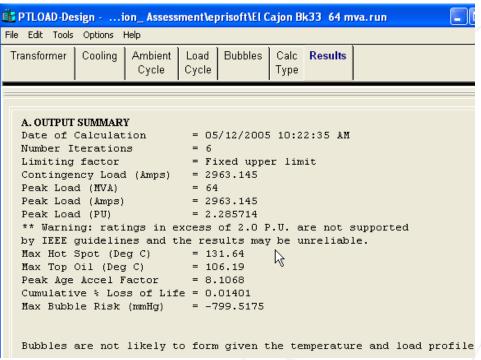
Location of Paper Sample	Degree of Polymerization (DP)
NLTC – Phase A	586
NLTC – Phase B	737
69kV Bushing C	688

New Insulation Paper: $1000 < DPv < 1300$
Middle Aged Insulation Paper: $DPv = 500$
Old Age Insulation Paper: $DPv < 251$
Severely Degraded Insulation Paper: $DPv < 151$
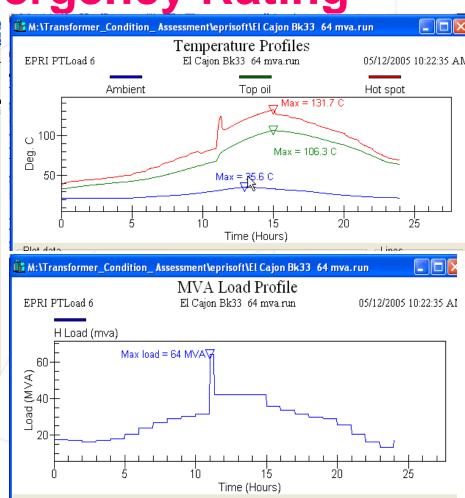
VALUE NOW, VALUE OVER TIME

Transformer at Emergency Rating

PTLOAD-Design - ...ion_ Assessment\eprisoft\El Cajon Bk33 64 mva.run

File Edit Tools Options Help

| Transformer | Cooling | Ambient Cycle | Load Cycle | Bubbles | Calc Type | **Results** |

A. OUTPUT SUMMARY
```
Date of Calculation       = 05/12/2005 10:22:35 AM
Number Iterations         = 6
Limiting factor           = Fixed upper limit
Contingency Load (Amps)   = 2963.145
Peak Load (MVA)           = 64
Peak Load (Amps)          = 2963.145
Peak Load (PU)            = 2.285714
** Warning: ratings in excess of 2.0 P.U. are not supported
by IEEE guidelines and the results may be unreliable.
Max Hot Spot (Deg C)      = 131.64
Max Top Oil (Deg C)       = 106.19
Peak Age Accel Factor     = 8.1068
Cumulative % Loss of Life = 0.01401
Max Bubble Risk (mmHg)    = -799.5175


Bubbles are not likely to form given the temperature and load profile
```

Comparison of hot spot rise over top oil simulated versus actual

	Top Oil	Hot Spot	LOL
IEEE	105	176	.149
Ptload	105	145	.039
Actual HS rise	106	131	.014

Decision: Based on Transformer Unit Health and Real Time Conditions

VALUE NOW, VALUE OVER TIME

Summary of RtCBM Expected Results

- **Operations Benefits**
  - Avoid potential equipment failure
  - Increase asset availabilities
  - Respond to equipment alarms according to priorities
  - Maximize asset loading capabilities

- **Maintenance Benefits**
  - Early warning and indication to address conditions
  - Reduce overtime on reactive maintenance
  - Minimize equipment outages

- **Asset Planning Benefits**
  - Improve future equipment specification and application to maximize utilization and performance.

VALUE NOW, VALUE OVER TIME

OSIsoft Enabling Technology

VALUE NOW, VALUE OVER TIME
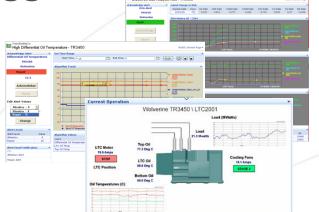
Real-time CBM Process

Alert Notification (RtAlerts) Work Order Generation (RLINK)

Integrated Asset Information (RtWeb Parts)

Asset Information Structure (PI and RDB)
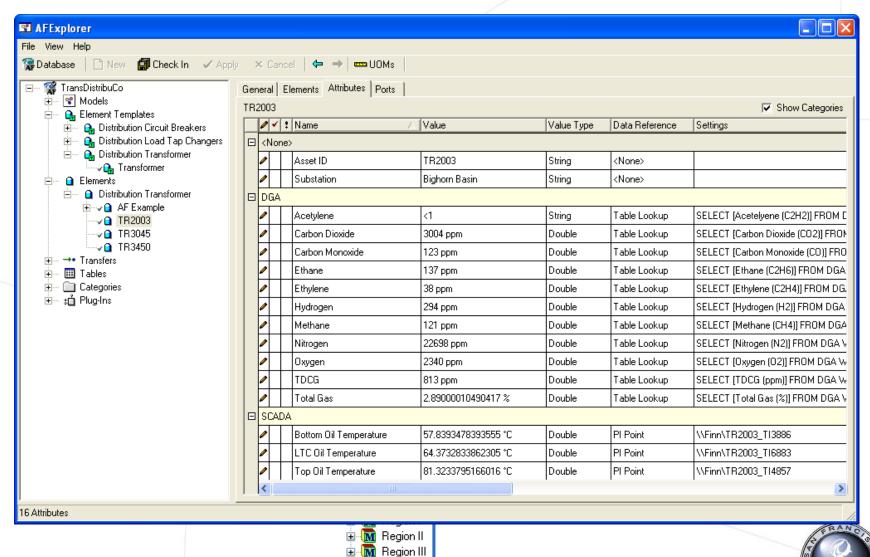
Asset Reliability (PI OLEDB and RtReports)

Real-time Rule Assessment (PI ACE)

Improve Reliability

VALUE NOW, VALUE OVER TIME

Asset Information Structure
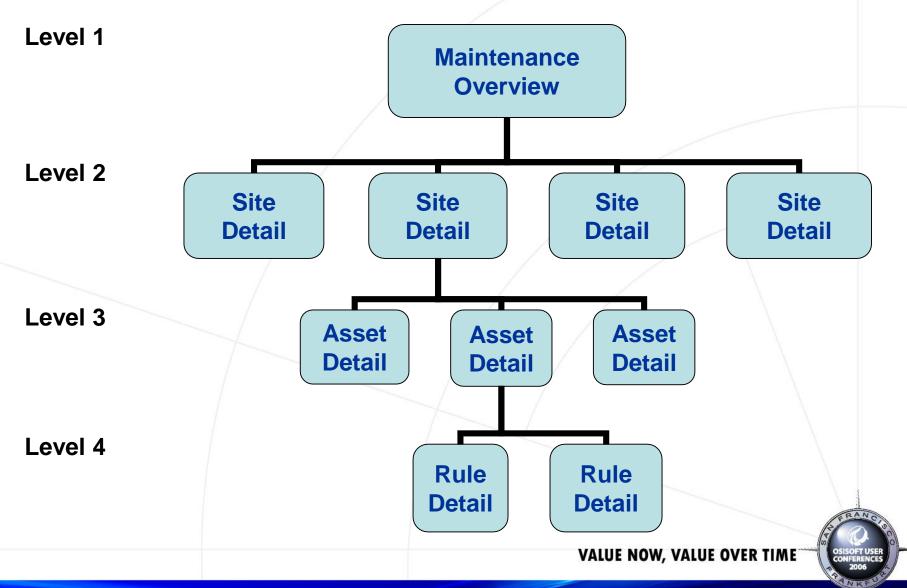
Asset Information Integration Hierarchy
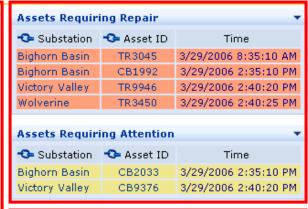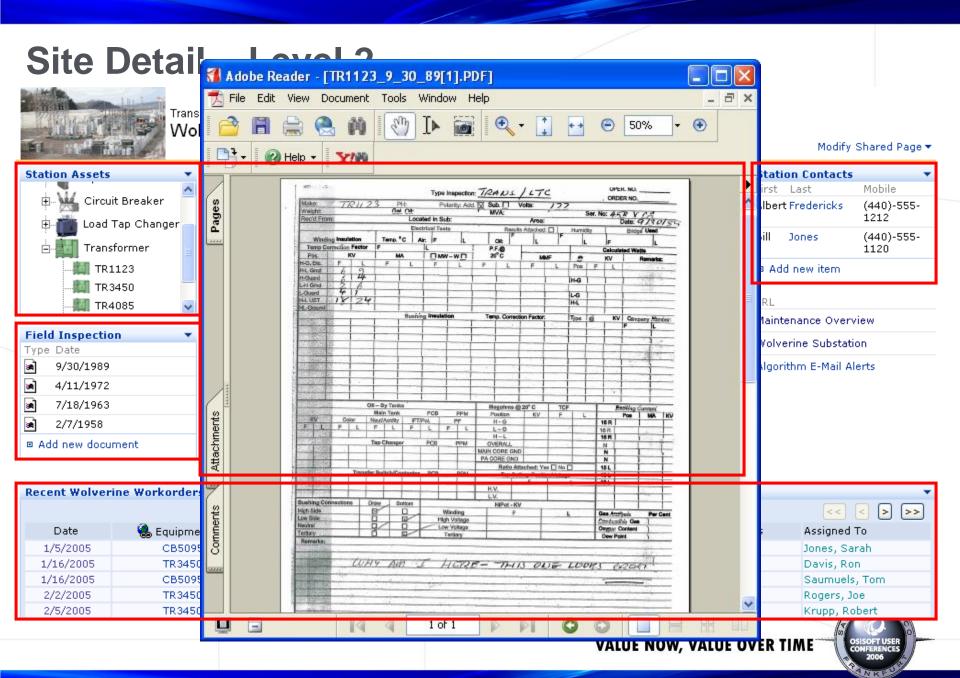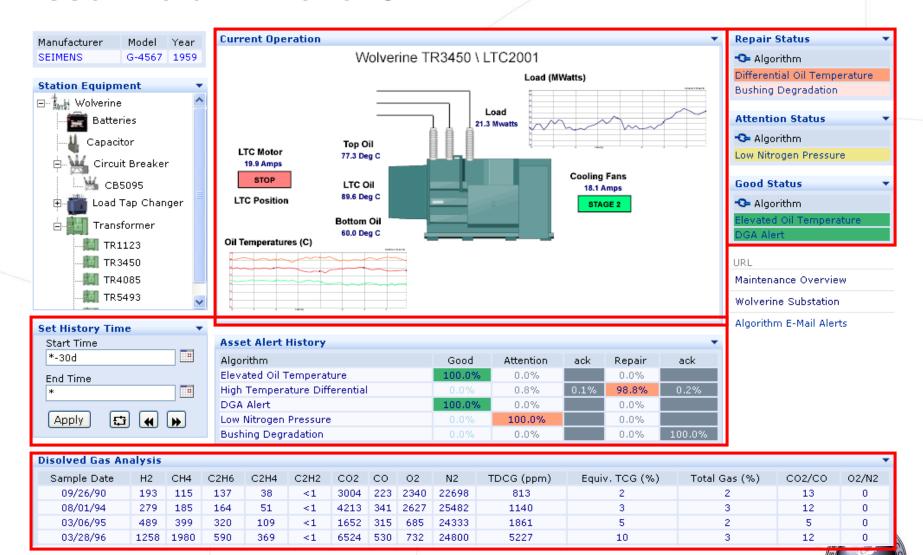
Level 1

Maintenance Overview

Level 2

Site Detail | **Site Detail** | **Site Detail** | **Site Detail**

Level 3

Asset Detail | **Asset Detail** | **Asset Detail**

Level 4

Rule Detail | **Rule Detail**

VALUE NOW, VALUE OVER TIME

Maintenance Overview – Level 1

VALUE NOW, VALUE OVER TIME

Site Details - Level 2
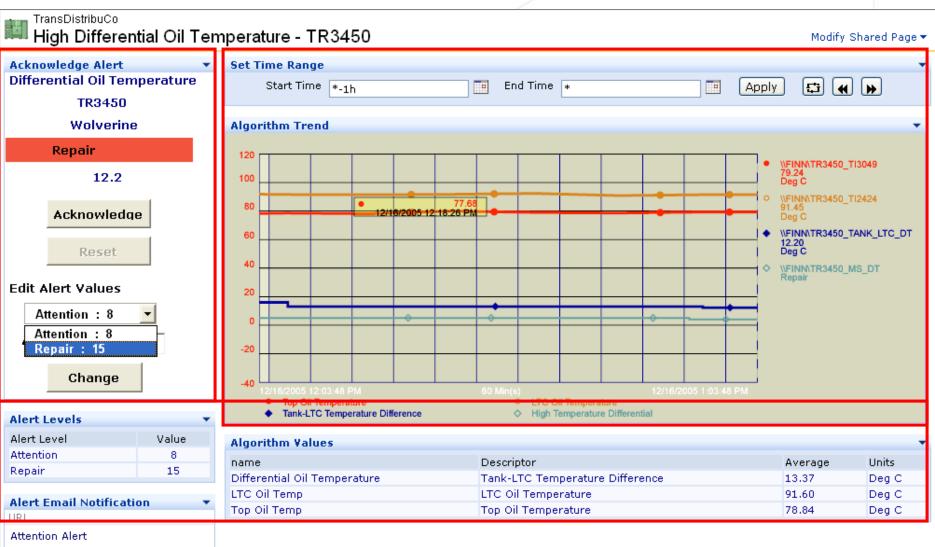
Asset Detail – Level 3

VALUE NOW, VALUE OVER TIME

Rule Detail (PI) – Level 4
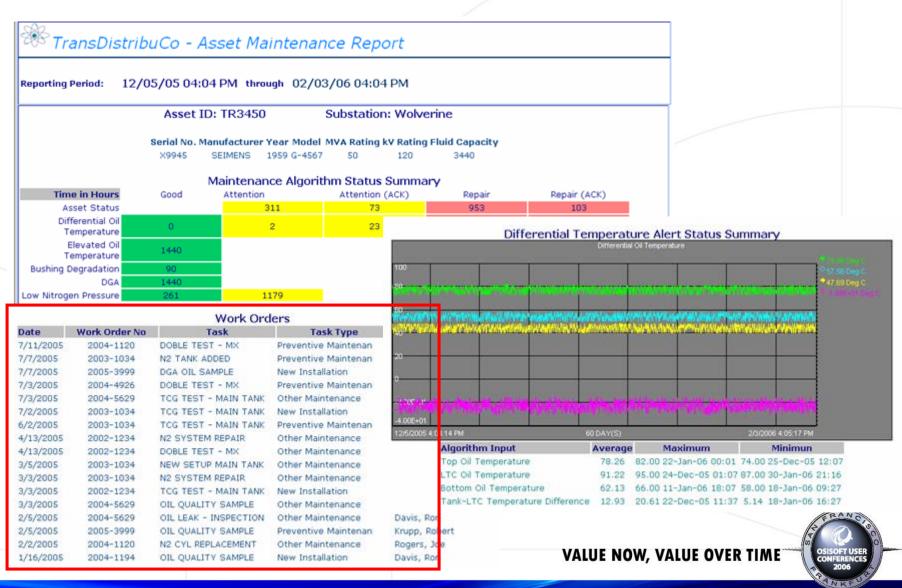
Rule Detail (RDB) – Level 4

Maintenance Alert Notification

Asset Reliability Report

QUESTIONS ?

VALUE NOW, VALUE OVER TIME