PSE&G Condition-Based Maintenance with OSI Technologies

OSI 2002 Users Conference

Angela Rothweiler

Keith Pierce

Introduction

➢ Provide overview of PSE&G's condition-based maintenance project

➢ Discuss project, system architecture, implementation details

➢ Review some lessons learned

Background

➢ PSE&G is one of the largest combined electric and gas companies in the nation

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

➢ Recent implementation of SAP PM (last 2 years)
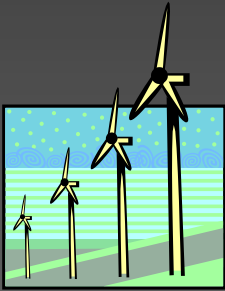
➢ Computer Aided Dispatch via RF project

Background

- ➤ This project focused on the electrical transmission and distribution (T&D) arm of the Delivery organization
- ➤ Primary assets are large transformers and breakers
- ➤ Market deregulation
- ➤ PSE&G experience with OSI technologies in other business areas

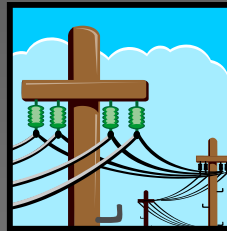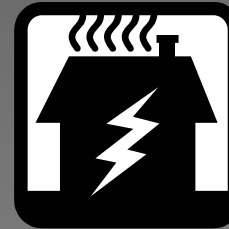

Electric System Components
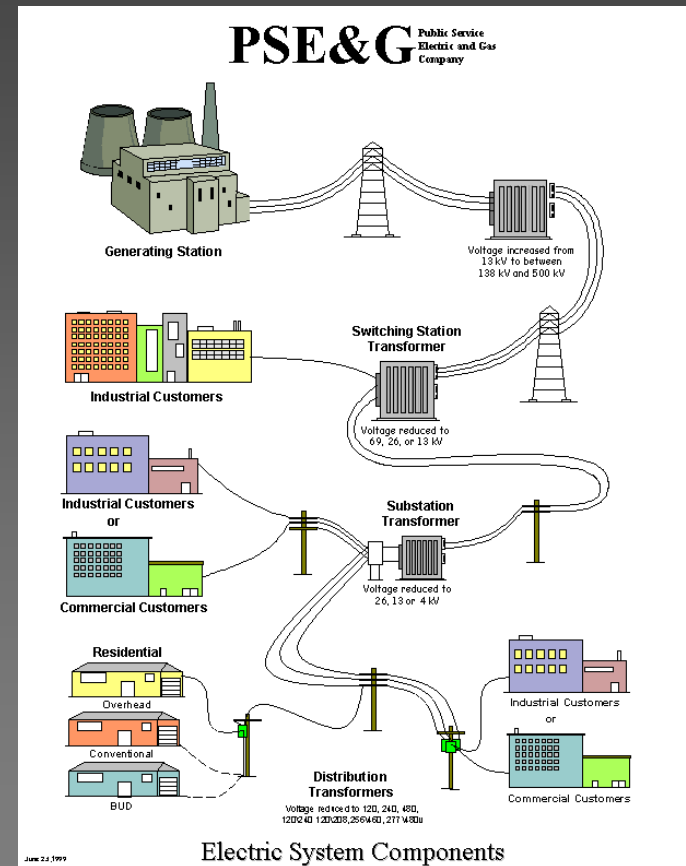
Where Electricity Comes From

Generation
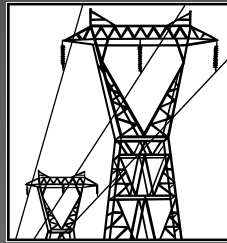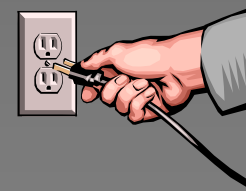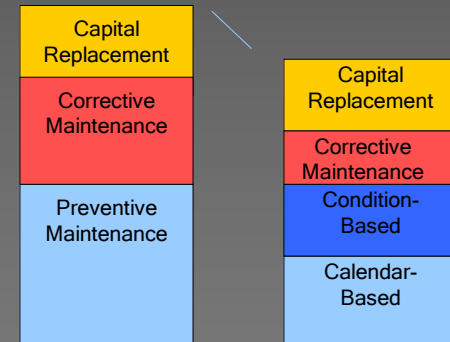
Transmission

Distribution

Household

Outlet

Project Overview

➢ Business Drivers

- Determination of asset health to focus maintenance activities

- Provide an analysis platform for engineering activities

- Perform condition-based maintenance

- ROI in < 3 years

| Capital Replacement |
| Corrective Maintenance |
| Preventive Maintenance |

| Capital Replacement |
| Corrective Maintenance |
| Condition-Based |
| Calendar-Based |

Project Overview

➢ Motivational Factors

- Increased reliance on aging assets
- Information on asset health in a variety of systems
- Expensive replacement projects
- Retention of expertise

Asset Population by Division and Age Class Within Equipment
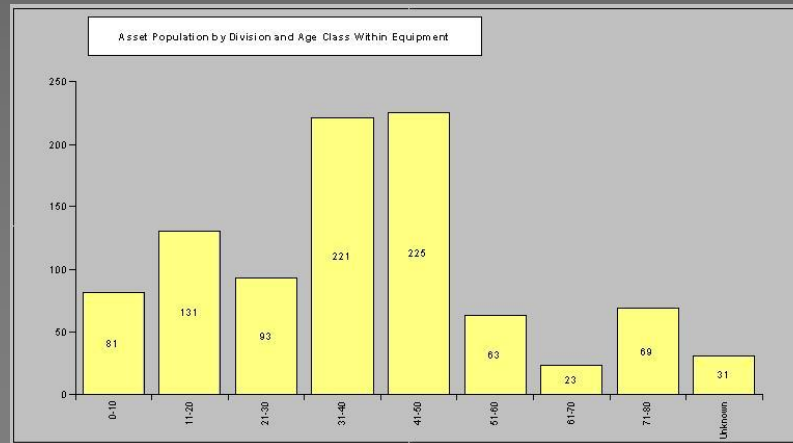
Project Scope

➢ Asset Scope - T&D Substation

- Transformers

- Breakers

- Related Equipment (Relays, LTC, etc)

➢ Work Process Scope

- Substation Inspections

- Diagnostic Data Collection

- Preventive Maintenance Prioritization

Project Scope

- ➤ System Interfaces
  - SAP PM historical data
  - SAP PM measurement documents (RLINK)
  - Transmission SCADA (PI-to-PI)
  - Distribution SCADA (ETL & PI Batch)
  - MV-90 Load Monitoring (ETL & PI Batch)
  - Lab Systems – DeltaX & Doble (ETL & PI Batch)
- ➤ Condition Assessment
  - Equation Builder
  - Diagnostic Displays

Project Scope

➢ Condition-Based Maintenance Analysis

- Counter-based Conditions

- Volume Additions

- Condition Indicator

➢ Maintenance Program Effectiveness

- Asset Cost Profile

- Asset Maintenance Profile (performance)

- Failure Code Analysis

- Key Performance Indicators

Functional Areas

➢ Data Collection
  - Remote Time-Series Data Collection Application
  - Diagnostic and Inspection Data
  - Automated Interfaces
  - SAP Data Collection

➢ Asset Analysis and Reporting
  - Condition Assessment
  - Preventive Maintenance Ranking
  - Reports

➢ Maintenance Management
  - Measurement Points
  - Maintenance Plan Modifications

Data Collection

Raw data

Analysis & Reporting

Feedback *Measurement points*

Maintenance Management

Notification
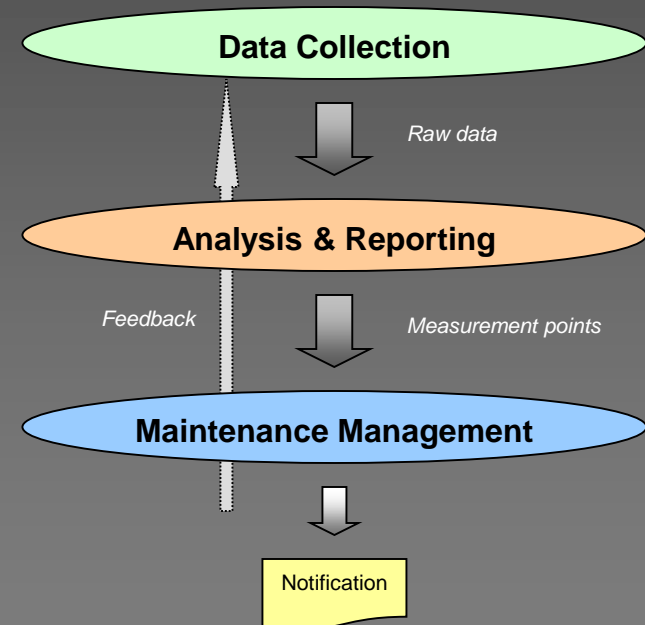
System Model
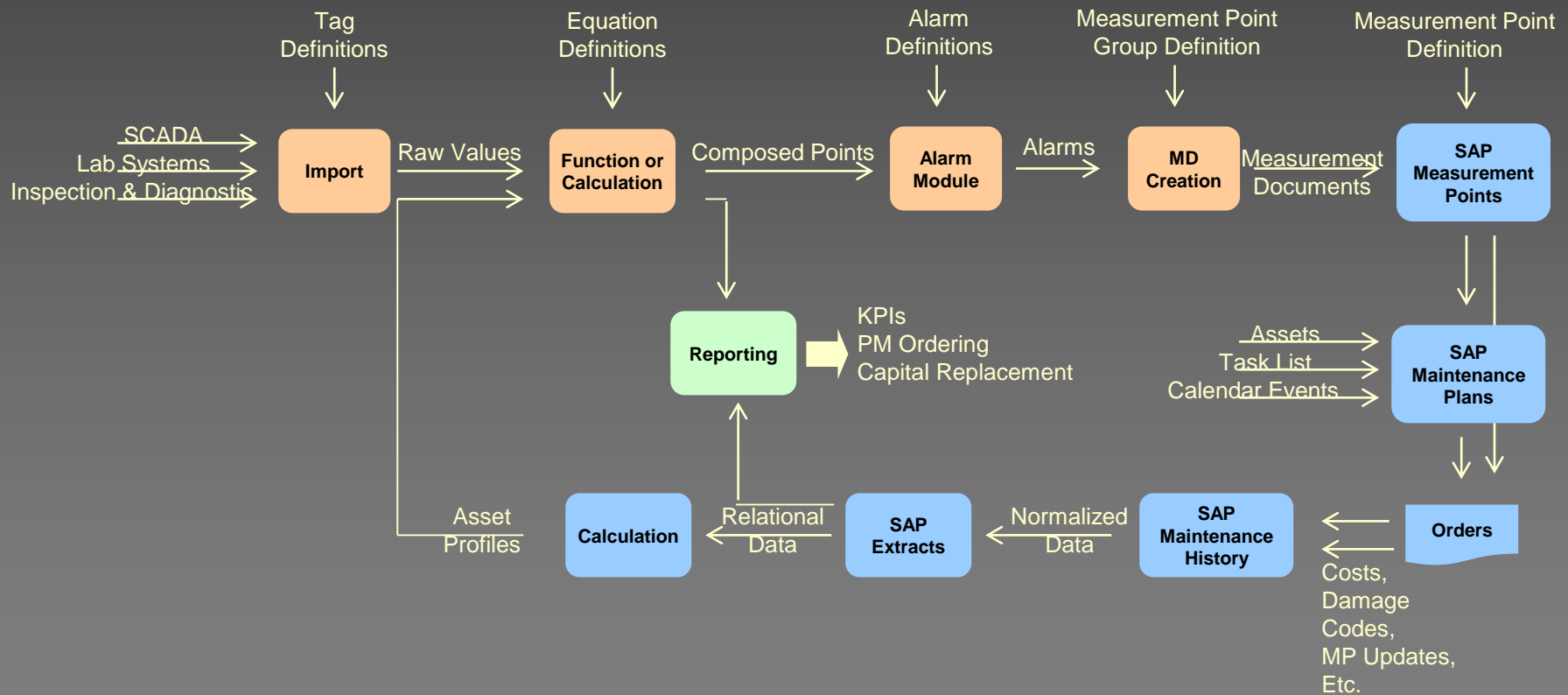
Conceptual Design

SAP PM
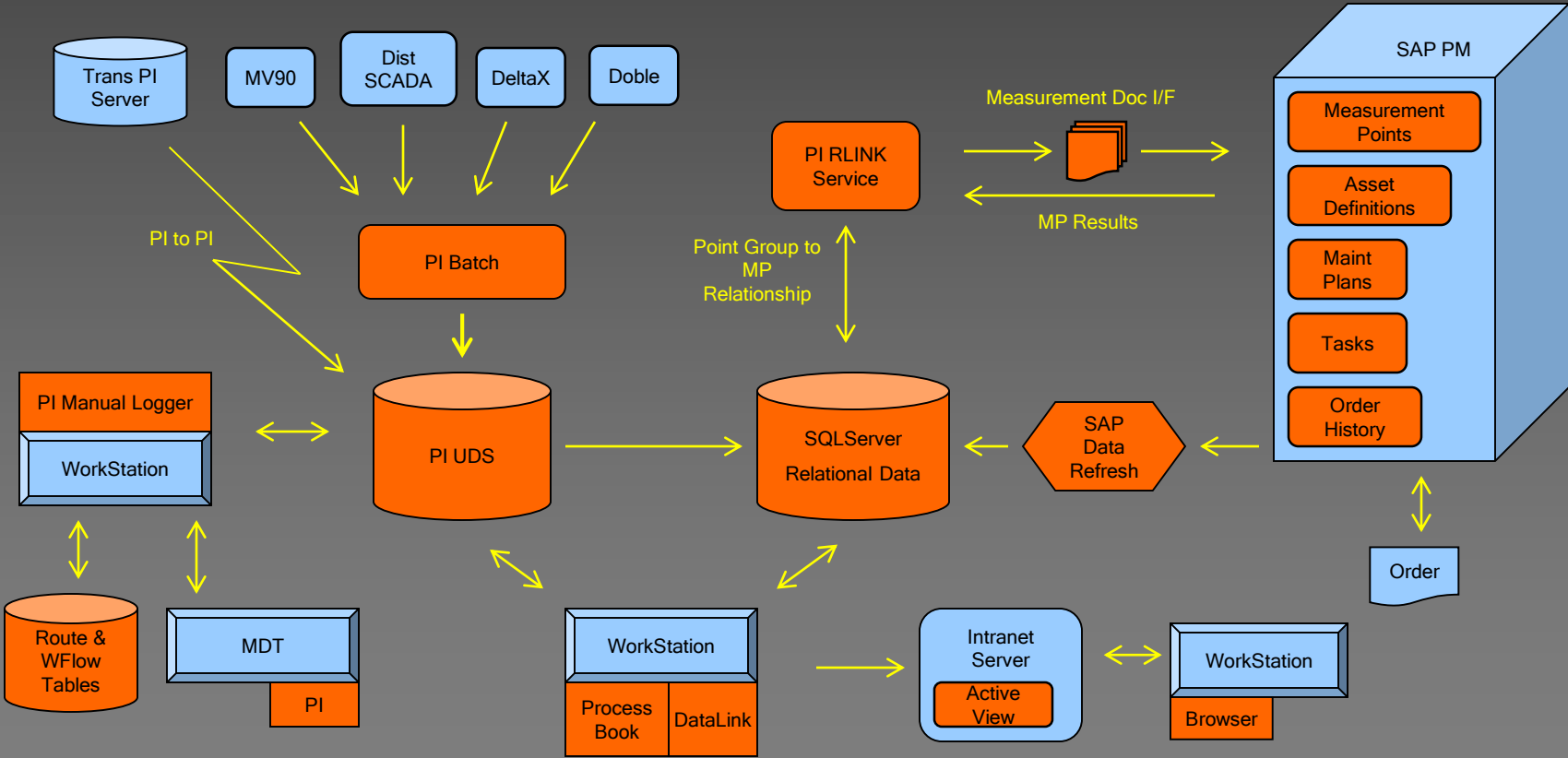
PM Equipment Hierarchy

Functional Location   Substation

  └── Functional Location   Transformer Pad

        ↑
        └── Equipment   Transformer

              ↑
              └── Equipment   LTC
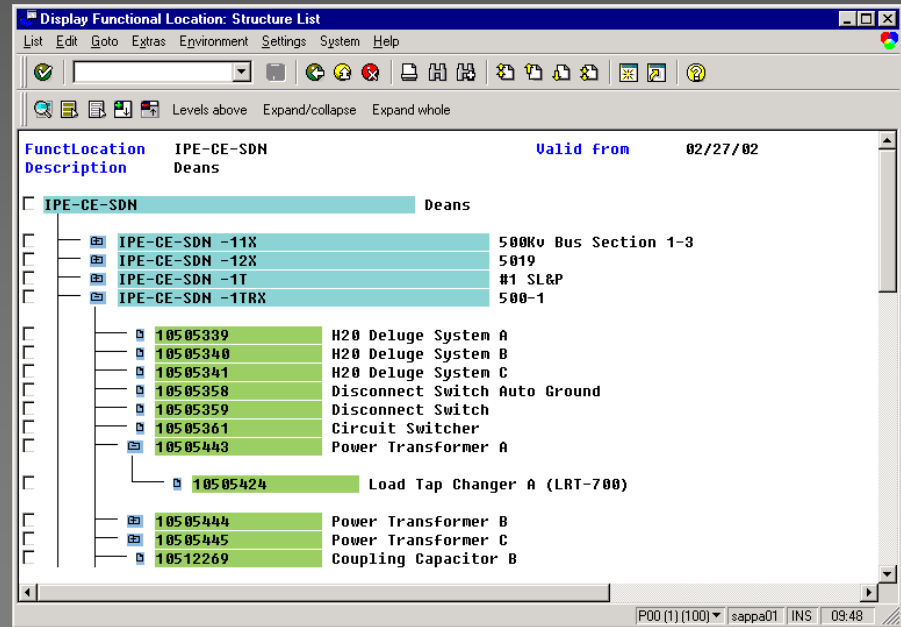
SAP MP Overview

➢ Measurement Point Types
- Qualitative ("Real Hot")
- Quantitative (> 220°F)

➢ Measurement Point Definition
- Type
- Association
- Unit of Measure

➢ Measurement Document
- Absolute vs. Differential
- Notification Generation

SAP PM - RLINK Interface

RLINK Service → **Measurement Document**

Alarms & Current Value

Tag references

PI - UDS

RLINK Configuration

Measurement Document → **Measurement Point** ← **FLOC or Equipment**

Measurement Point → **Maintenance Plan** ← Calendar Event

FLOC or Equipment → **Maintenance Plan**

Maintenance Plan → **Notification or Order**

RLINK Configuration

-Alarm tag for when to send MD

-Tag value for MP

-Generate Notification with MD

-Text, priority, type of Notification

PI RLINK Overview

➢ Approximately 1,000 measurement points

➢ 1 Equation tag for each MP driven by RLINK

➢ 1 Equation Tag for each rate change check

➢ 1 Equation Tag for each limit check

➢ Functional Uses

- Counter Readings
- LTC Movements
- Runtime Hours
- Breaker not operating
- LTC not crossing neutral
- Rate of Change

MP Use at PSE&G

Counter → Tag → PE Tag → Alarm Tag → Counter

Counter			Tag	PE Tag	Alarm Tag	Counter
2	0	1	201	Time Check	State	MD

Rate Check → Notification Tag: **Y**
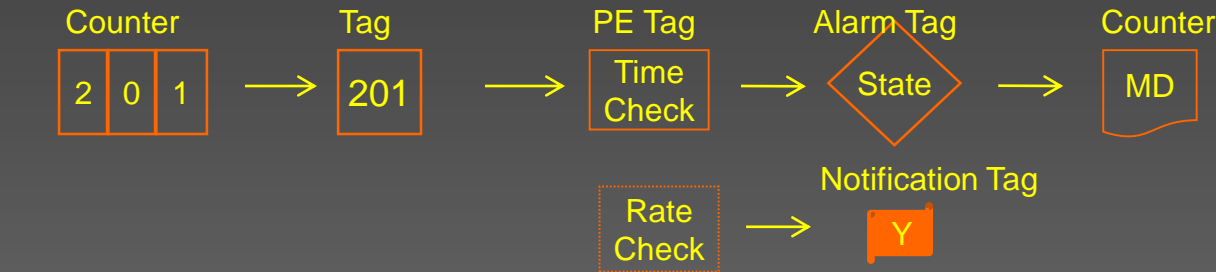
1. Tag changes state
2. PE Tag is evaluated on next cycle
3. PE tag changes state
4. Alarm changes state
5. PE Tag resets on next cycle
6. If rate check test positive, notification set

Tag Value

PE Cycle

PE Tag Value

Alarm Tag Value

RLINK MD
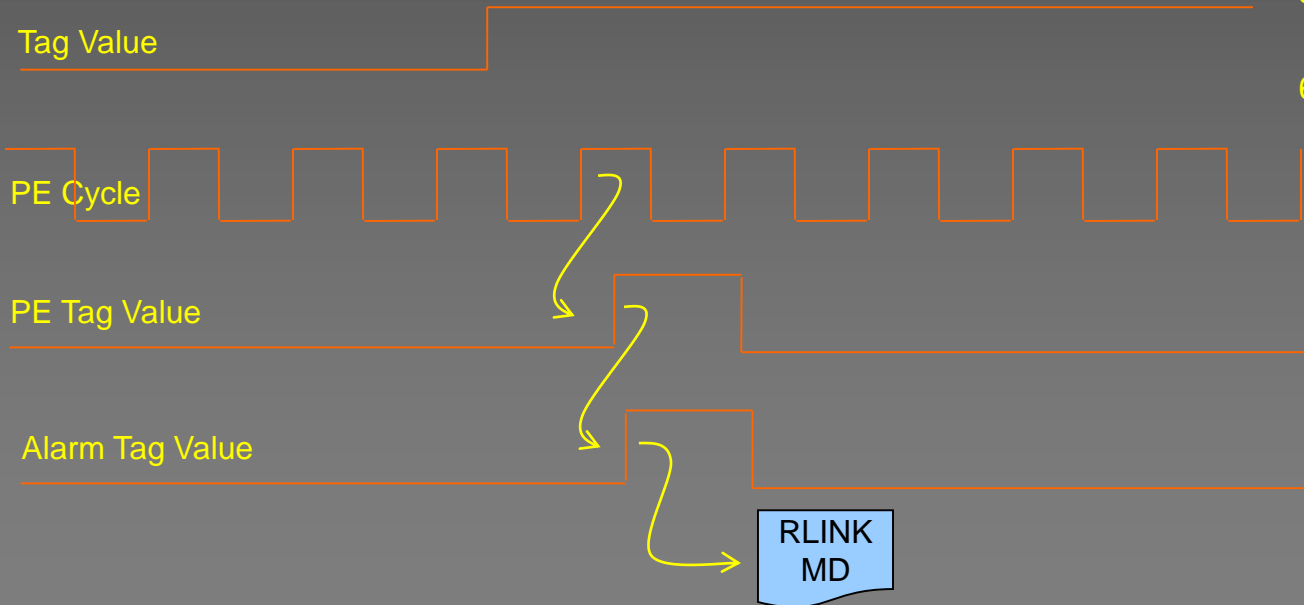
PI RLINK Configuration Screen

PI Manual Logger

- ➢ Substation Inspections
- ➢ 300 Substations – Weekly and Peak Inspections
- ➢ 20 – 500 points per station
- ➢ Scheduled in SAP PM
- ➢ Dispatched using CAD Dispatch over RF and CDPD
- ➢ XML file transfers of tour definition and data
- ➢ Equipment Oriented Point Collection

Inspection Design Overview

SAP PM Module

Completion Records

Orders

CAD Module

Job and Status

Route and Values

XML

MDT

CAD PI

Operator

CDPD over RF

Route Requests

PI Manual Logger

XML

Chief Operator

Point Values

Point Definitions

ML Database

PI UDS

PI Archive

Engineer doing analysis

1. Create SAP Order
2. Create CAD job
3. Get PI-ML Tour
4. Send Job to MDT
5. Accept Job
6. Send Tour
7. Conduct Tour
8. Send Tour to CAD
9. Complete order in SAP
10. Send Tour to PI-ML
11. Update PI UDS

PI-ML Sample Screen

PI Module Database

➤ PI Module Overview

- Define Module
  - Descriptive Information
  - Properties
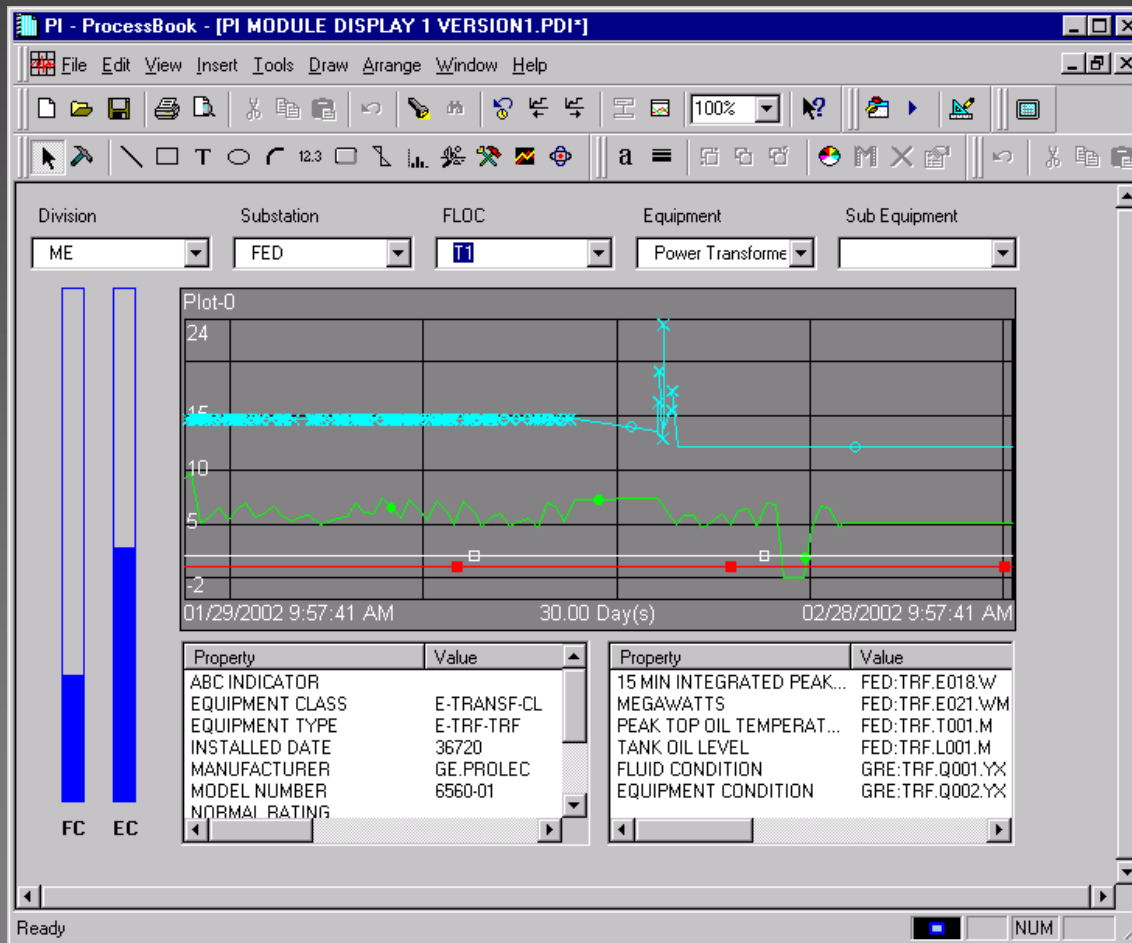 - Tag Alias

PI Module Database Screen

➢ **Define Module Taxonomy**

- Define Hierarchies
- Each level has a parent-child relationship
- Any module can appear many times in the hierarchy
- Load the hierarchies
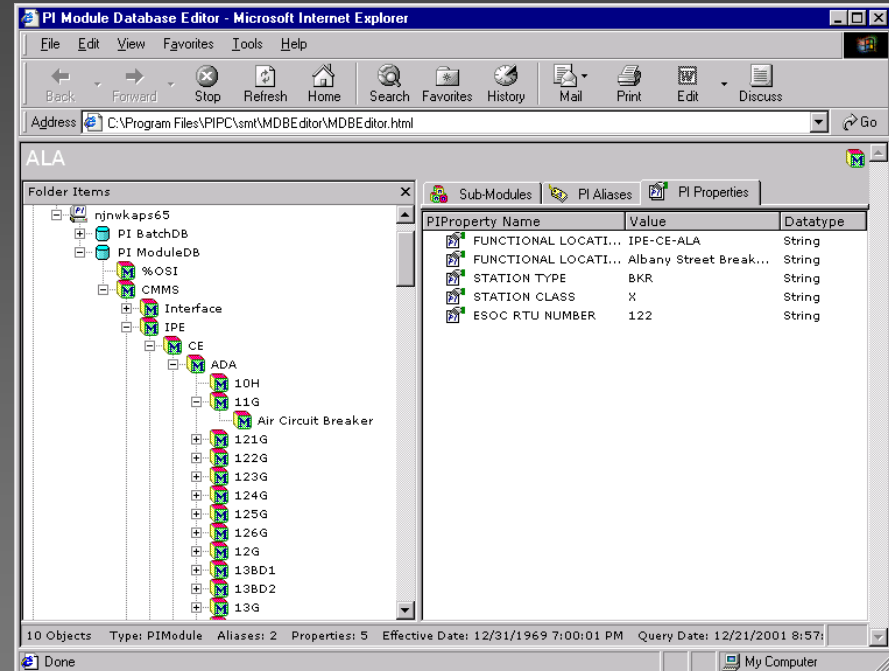
PI Module Database Display

Condition Assessment Overview

- ➢ Equations
  - $CA = F_1(M_1) + F_2(M_2) + F_3(M_3) + \ldots$
- ➢ Example factors include:
  - Average Load over time period
  - Last oil test results
  - Maintenance cost data
  - Number of operations
- ➢ Factor components dependent on peer group
- ➢ Multiplier used to weight the factor result
- ➢ Must be flexible in terms of definition and composition

Condition Assessment

➢ Our Use of PI Module

- Module for each level of the SAP PM hierarchy and installed functional locations and equipment

- Defined peer groups and installed equipment modules

- Defined factors and equations

- Created Module for each equation and for each equation factor

- Developed displays using PI Module

PI Module Database Factor 1

➢ Average MVA (load) factor

- Type: PI Calc
- Alias: Load in MVA
- Start Time = *
- End Time = *-30d
- Mode: Average
- Case: Assign value to factor
- Multiplier = 0.2

PI Module Database Factor 2

➢ Last Oil Test Result Factor

- Type: DeltaX CV
- Select: equipcond
- From: equipment
- Where: serialnum = '&Serial Number'
- Case: Assign value to factor
- Multiplier = 0.25

Condition Assessment Sample

Lessons Learned

➢ Helps to have good vision

➢ Concepts are difficult for many users

➢ Data, data, data – start early with knowledgeable, dedicated resources

➢ Lots of data required for meaningful representations – consider backfile

➢ It's going to change, start with a flexible foundation – don't fixate on initial equations, displays or reports

➢ Train on Displays, not ProcessBook – Use ActiveView or ICE

➢ Many spin-offs from initial deployment, hard to manage scope creep

➢ The software is not the issue, culture and data are

Q&A