



Implementing PMAX & PEPSE with Improved Practices to Optimize CCGT Performance at Boston Generating - Mystic Station

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Today's Discussion Topics

- ✓ **Understanding Boston Generating Project Objectives/Approach**
- ✓ **Sciencetech's Fleet Asset Management & Optimization Solutions (FAMOS) Overview**
 - **Thermal Performance Solutions PMAX / PEPSE Overview**
 - **Condition Monitoring Solutions PdP/Rules Engine Overview**
- ✓ **Performance Improvement Project Plan**
- ✓ **Improved Practices/Findings**
- ✓ **The Business Case – Results**
- ✓ **Conclusions - Questions & Answers**

Implementing solutions with a business case



Boston Generating Situation Appraisal

- ✓ **Two Stations: Mystic and Fore River Stations**
 - Mystic 8 & 9 and Fore River 1 are CCGT units, 800 MW nominal; ~65% Capacity Factor
 - Mystic 7 unit is dual fuel fired (oil/gas), 560 MW nominal
 - 3000 MW Merchant Generation into the ISO New England
- ✓ **Legacy performance monitoring system (PMS)**
- ✓ **No formal performance improvement plan**
- ✓ **Limited operator awareness of Heat Rate (HR) goals**
- ✓ **No first principle thermal analysis models**
- ✓ **Fuel contract: competitive**





PMS Project Objectives:

- ✓ **Initiate Performance Monitoring System (PMS) Project:**
 - Improve performance of all units
 - Reduce Heat Rate / Increase MW Production
 - Lower GHG (Hg, NOx & SOx)
 - Minimize Carbon Footprint
 - Improve Reliability and Availability (Capacity)
 - Maximize Staff Productivity

- ✓ **Reliably monitor & predict system and equipment condition**

- ✓ **Achieve operational excellence with measurable benefits – using solutions with a value proposition**

Reduce Overall Cost of Production

Performance Improvement Plan

- ✓ Review thermal performance practices
- ✓ Integrate technology into daily work processes
 - Procure performance monitoring system
 - Award contract to lowest evaluated supplier
 - Interface with Pi plant data historian
- ✓ Update work processes with Performance Monitoring System (PMS) results
- ✓ Train operators and engineers
- ✓ Baseline initial plant performance (heat rate, etc.)
- ✓ Continuous evaluation of results
- ✓ Establish improved practices

PMS Selection = Scientech's FAMOS Platform

Fleet Asset Management and Optimization Solutions

- ✓ PMAX - Thermal Performance monitoring & optimization
- ✓ PEPSE - Sophisticated off-line, first-principle modeling tool to establish best achievable KPIs
- ✓ PdP - Predictive pattern recognition for identifying plant equipment and operation abnormalities
- ✓ Rules Engine - Automated assessment, diagnostics, and decision support tool
- ✓ R*TIME- Integrated data acquisition, archival/historian, display, and reporting system

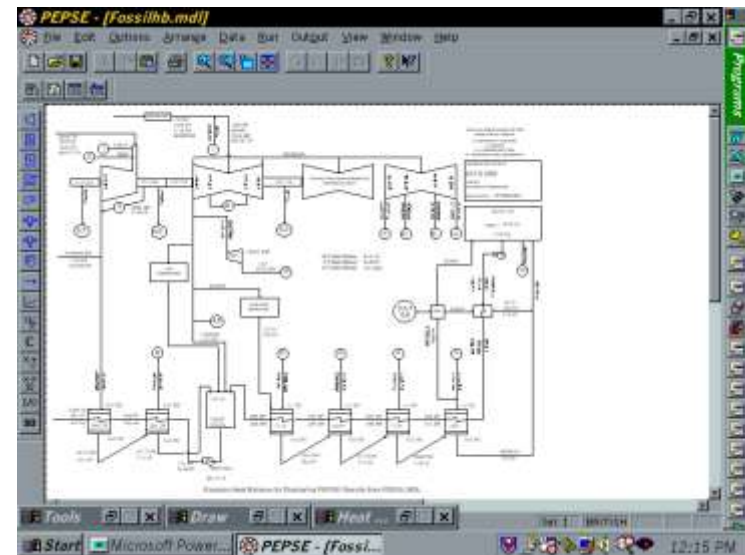


PEPSE

✓ **Performance
Evaluation of
Power
System
Efficiencies**

***Steady-state, 1st Principles energy
balance program***

- ✓ Design Mode
- ✓ Test Mode



- * Installed in over 200 facilities worldwide.***
- * Used by all major A-Es and EL&P Utilities***



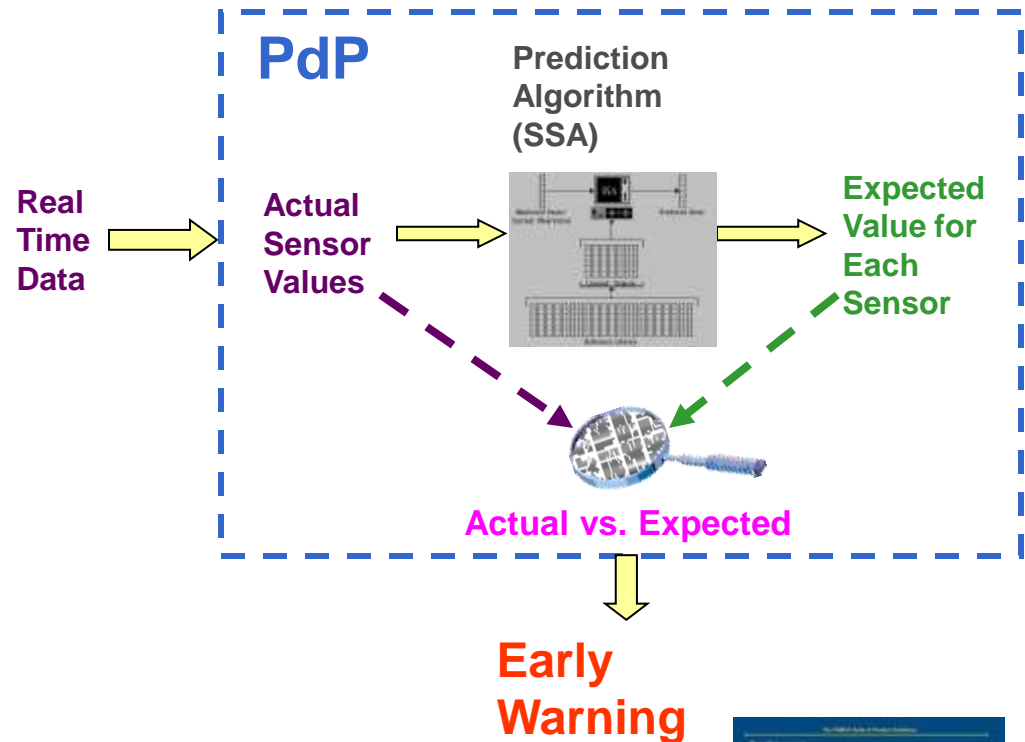
PMAX Value Propositions

- ✓ Real-time thermal performance monitoring
- ✓ Advanced Pattern Recognition / Rules Library
- ✓ A focus on actionable performance information
- ✓ FAMOS integration & hi-fidelity modules
- ✓ Superior engineering support of plant anomalies
– Life line and remote M&D services
- ✓ Advanced alarm processing & management
- ✓ Best achievable target & “What-if” analysis
- ✓ WebView - web based thin client
- ✓ Strong User Group / ~250 Installations

ID	Description	Unit	Value	Target	Unit	Value	Target	Unit	Value	Target
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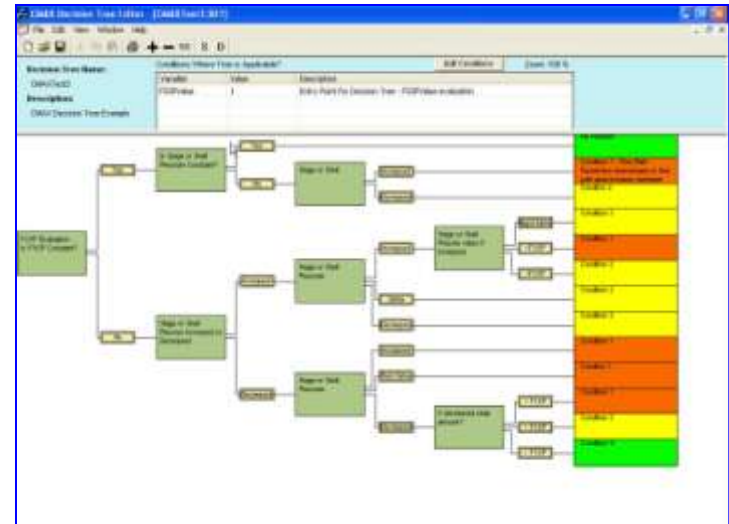
PdP – Predictive Pattern Recognition

- ✓ Utilizes a statistical state algorithm for analysis
- ✓ Compares current state to learned or referenced states based upon related historical information
- ✓ Used as a collective signal (model) monitoring tool for anomaly detection
- ✓ Can determine very subtle condition changes
- ✓ Model & signal status indications

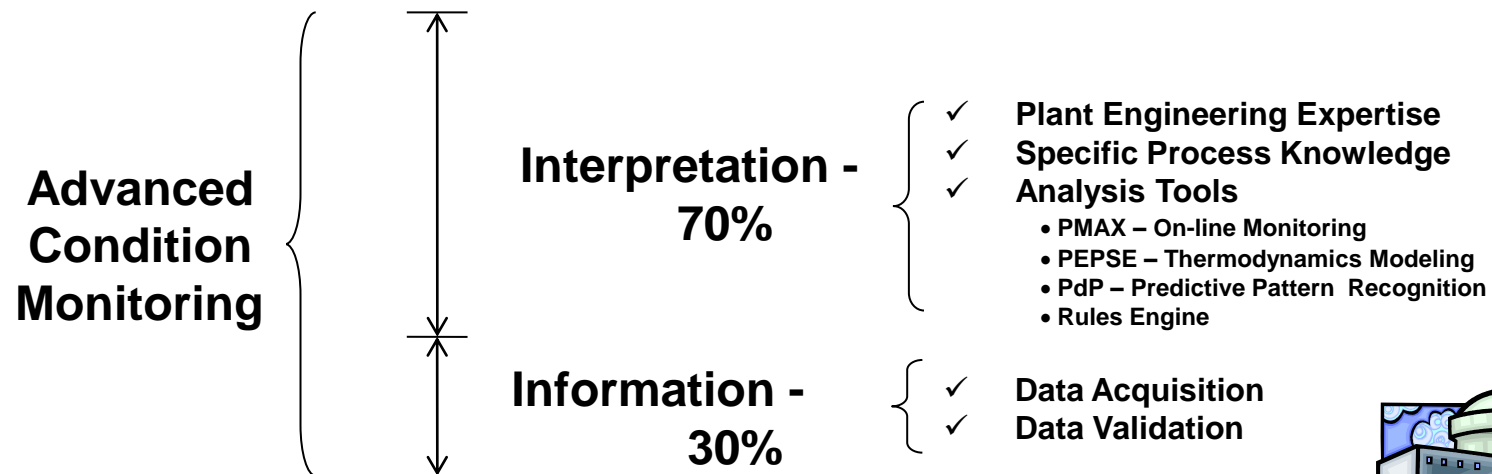


Rules Engine - Automated Assessments

- ✓ Turns data and information into knowledge
- ✓ Application is dynamic, real-time process
- ✓ Utilizes decision tree analysis processing
- ✓ Assessment rules utilize specific component real-time information & results
- ✓ Integrates with and can be applied to FAMOS products – PMAX & PdP

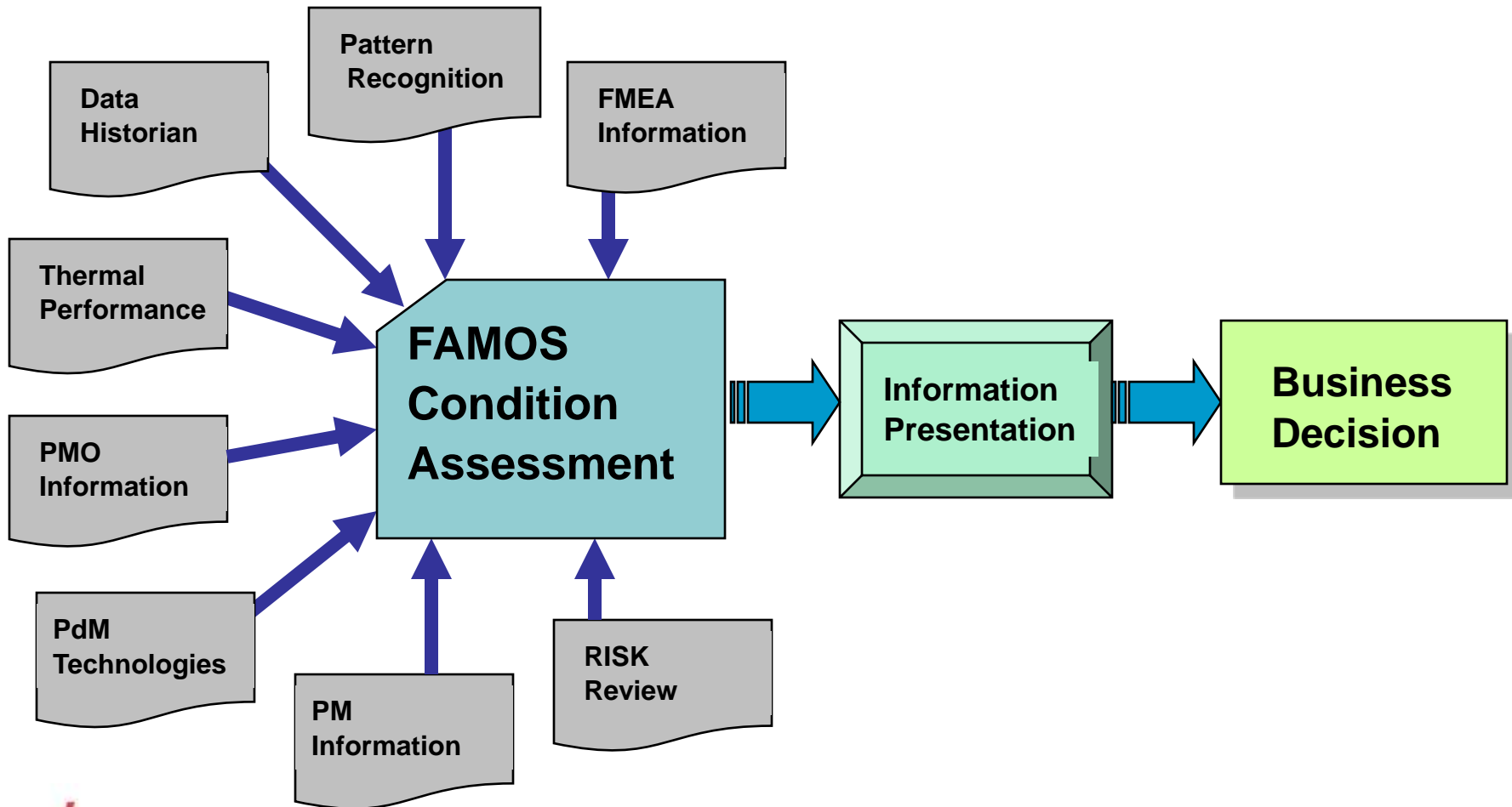


FAMOS – Transforming Plant Data into Business Value



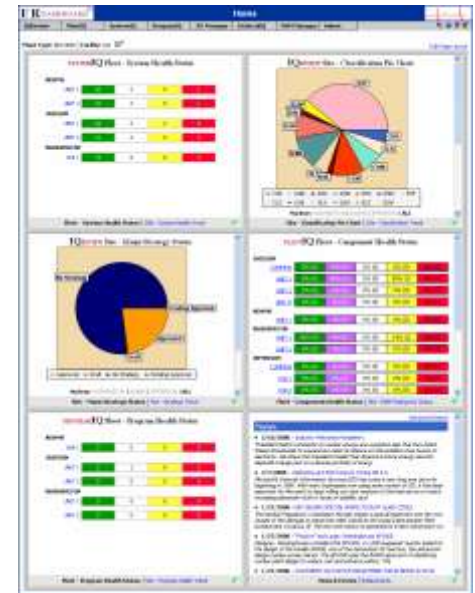
“It’s all about the Model & SME’s”

FAMOS Information Integration



Key Performance Indicators

- ✓ **Measurement & Control of Plant Assets is defined by KPIs: “The Tall Poles Under Tent”**
 - **Thermal Efficiency**
 - Heat rate, Fuel Cost, Power Output, GHG
 - **Equipment Reliability**
 - Availability, Maintenance Costs, Equipment Life
 - **Other Production Costs**
 - Overhead
 - **Staffing**
 - Resource Costs, Personnel Effectiveness





Implementation Plan

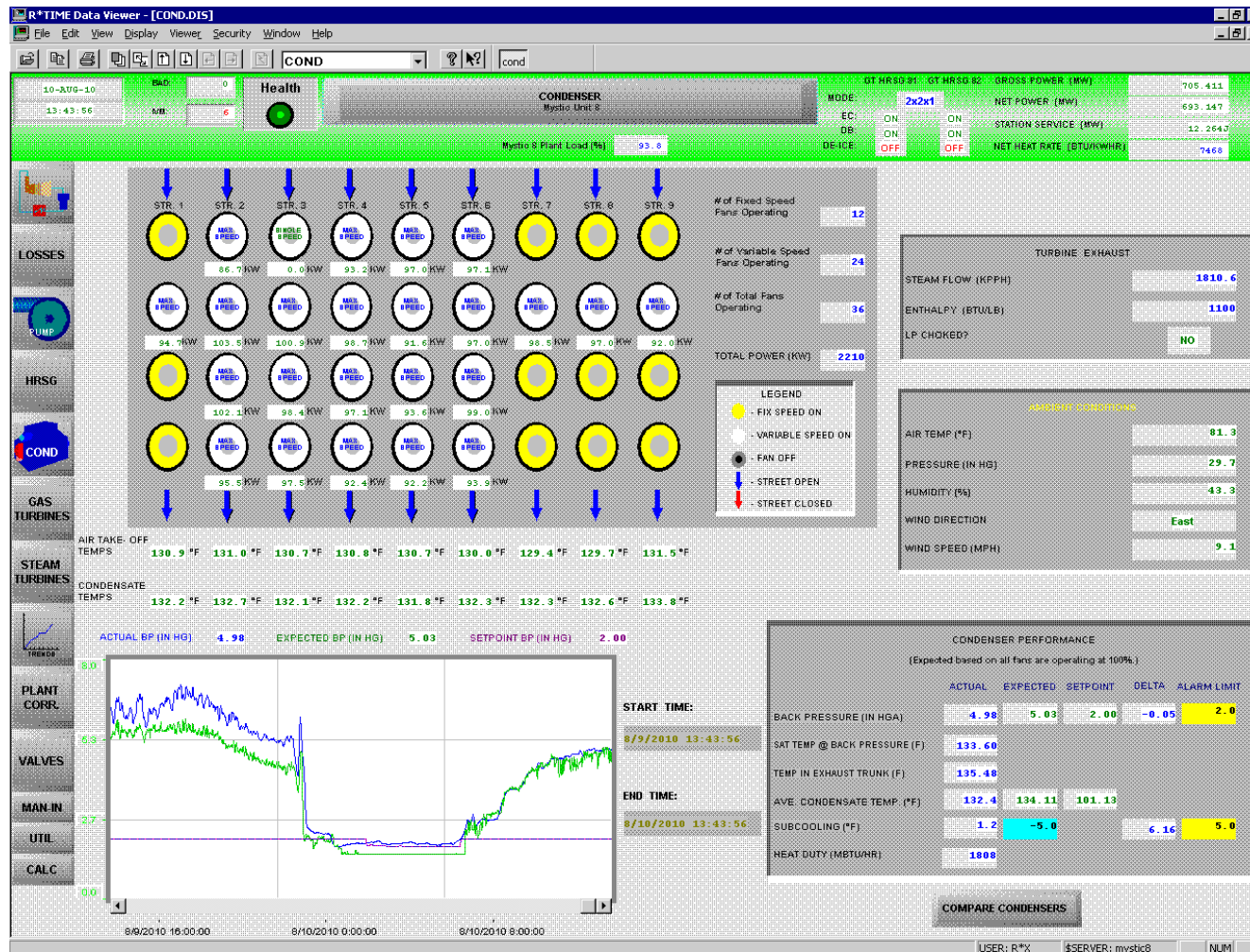
- ✓ **PMAX and PEPSE selected for PMS installation: December, 2008**
- ✓ **Obtain plant thermal kit and prior test data**
- ✓ **Build PMAX and PEPSE models**
- ✓ **Tune models**
- ✓ **Establish “set-points” from PEPSE analysis**
- ✓ **Perform 6 months Monitoring & Diagnostics**
- ✓ **Evaluate data**
- ✓ **Present findings**



Condenser Improvements Realized

- ✓ **Optimize back pressure (subcooling) vs. fan operation**
 - Fan throttling during in cooler weather
 - Full bore in warm weather
- ✓ **Detect ACC air blanketing – give operators heads-up regarding potential air in-leakage**
 - Add air removal equipment to control air in-leakage while source of in-leakage is identified

Mystic Station – Condenser Performance

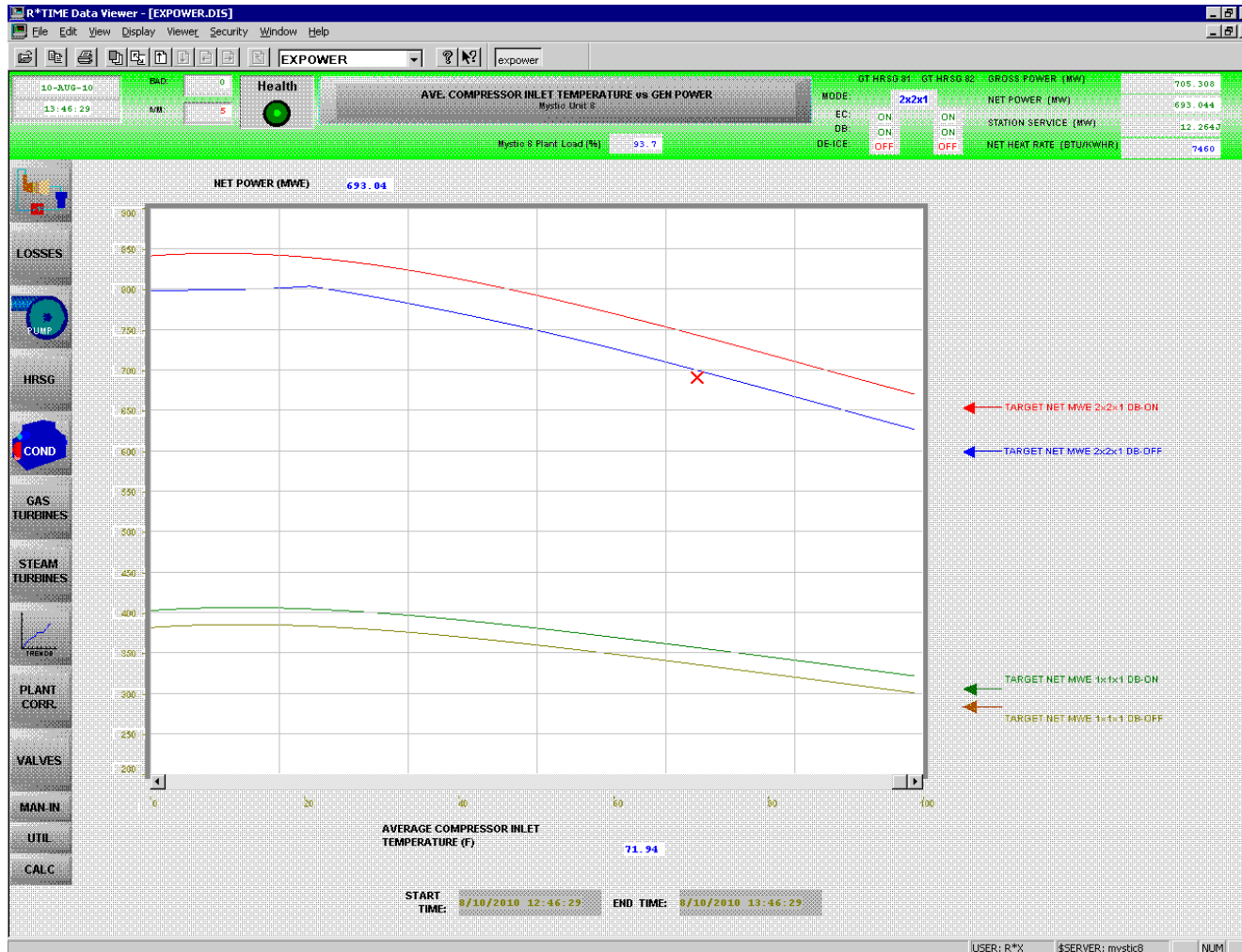




Gas Turbine/HRSG Improvements Realized

- ✓ **Gas Turbines are operating on the firing curve more often**
 - Actual vs. design firing curve
 - Optimize evaporative cooler and duct burner operation vs. heat rate
- ✓ **Attemperator sprays operation corrected**
 - Identified potential control system tuning issues
- ✓ **HP Superheat was low**
 - Solution: Limit Attemperator sprays
 - Cause: Potential valve leakage/position

Mystic Station – Turbine Performance

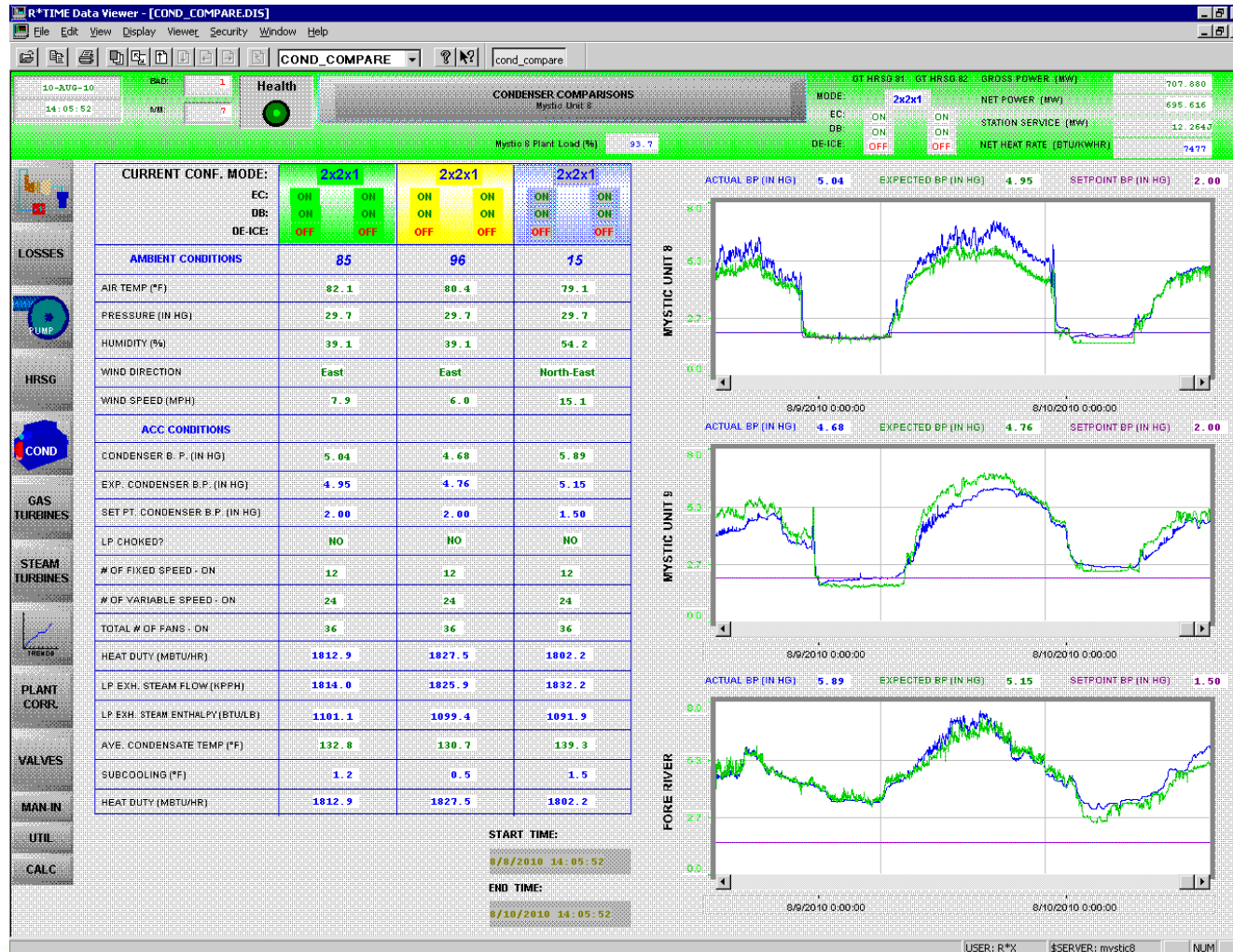




Process Improvements Realized

- ✓ Having good comparison screens from unit to unit is important.
- ✓ Validate the quality of all data points is imperative (IVM)
- ✓ HRA training of operators (use PMAX and Foxboro DCS)
- ✓ Consultant provides periodic performance reports
- ✓ 6 months of M&D services (good value established, but discontinued; re-evaluating decision)

Mystic Station – Condenser Comparisons



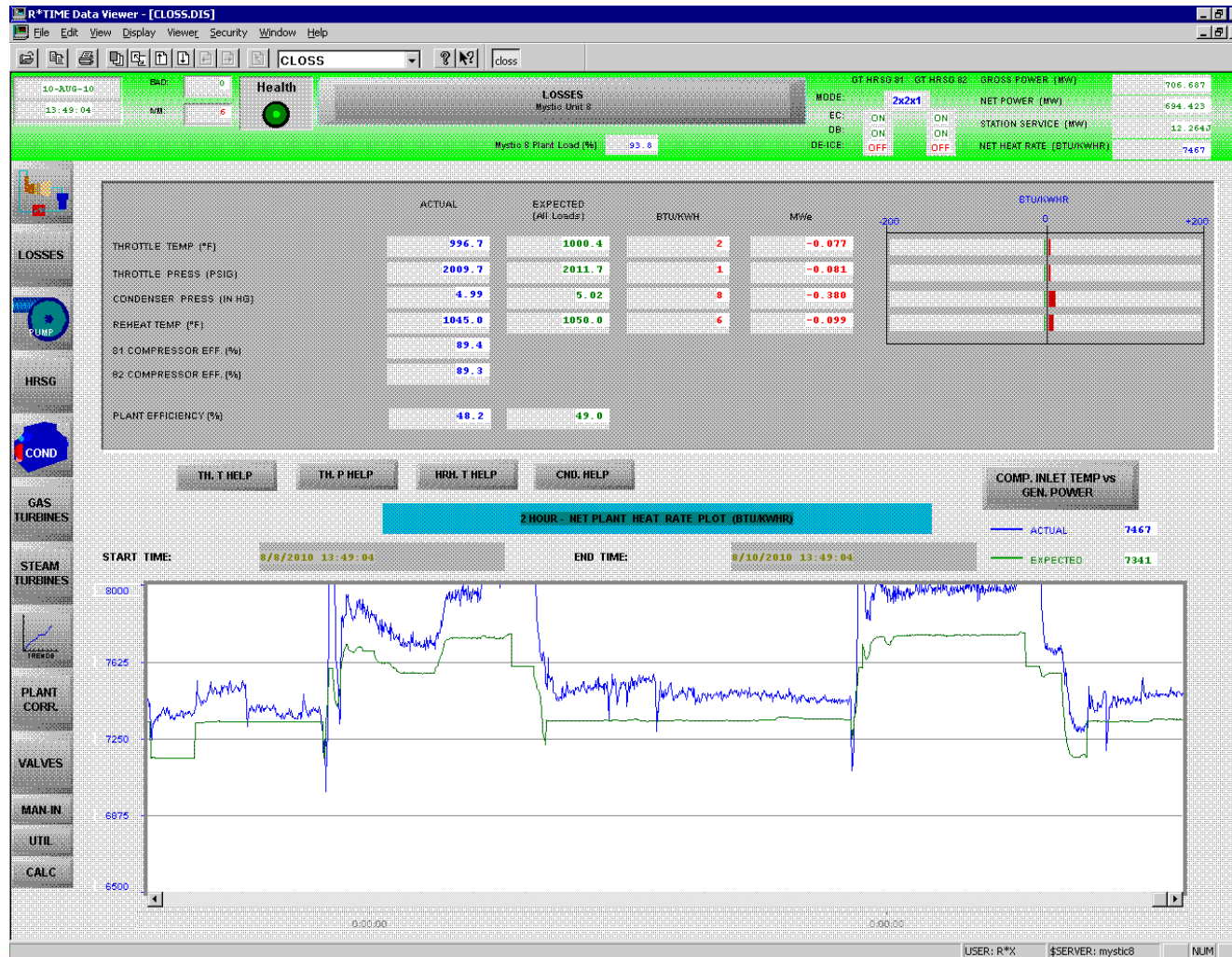


PMAX / PEPSE Business Case

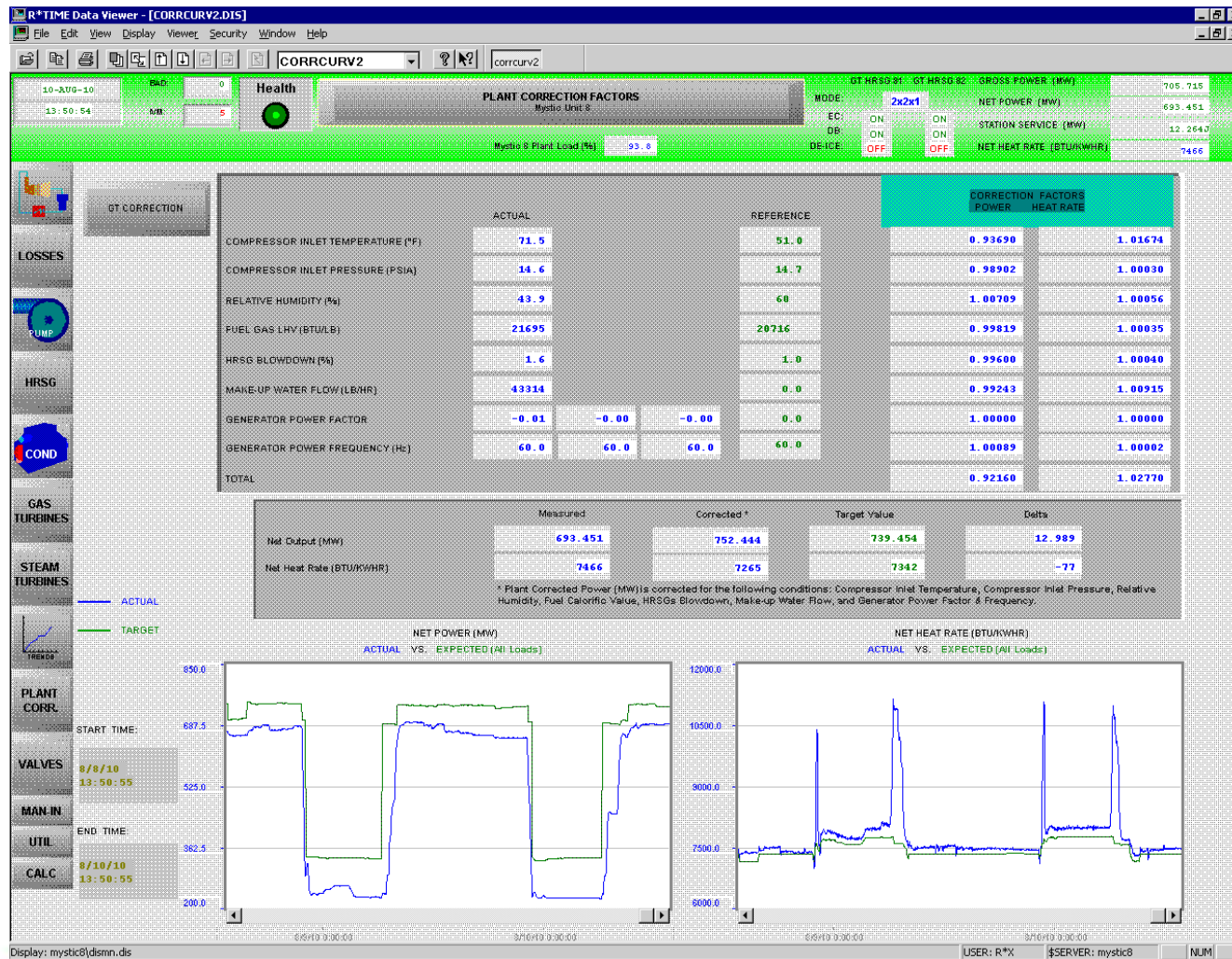
- ✓ **0.7% HR improvement = ~\$1,000,000 / yr**
 - **Basis: Mystic 9 @ 700 MW; \$5/mmBTU gas; 65% capacity factor; HR = 7150 BTU/MW (no duct burners)**

- ✓ **Payback = < 6 months**

Mystic Station – Controllable Losses



Mystic Station – Correction Factors





Fuel Flow Measurement Issue

- ✓ **Fuel input (flow measurement – main meter at each unit)**
 - **Plant instrumentation (turbine meters) not in agreement w/gas supplier ultrasonic meter - 1 ½ to 2% low**
 - **Consultant retained for resolution:**
 1. **Turbine meters – reviewed calibration procedure**
 2. **Updated reference corrections for temperature & pressure**
 3. **Updated configuration files**
 - **Plant flow meters now within ½% supplier**
 - **Increased fuel flow value in HR calculations**



Lessons Learned

- ✓ **Accurate PMS mandatory**
- ✓ **Need reliable, validated data/instrumentation**
- ✓ **Continuous monitoring and diagnostics**
- ✓ **Continuous interpretation of information**
- ✓ **Continuously updating practices**
- ✓ **Training, training, training**



Summary

- ✓ Questions?
- ✓ Thanks for your time!