Optimizing Strategies Through Effective Modeling

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Background

• 100% power, heating and cooling requirements for 20 million sf and 150+ buildings
  $60 million Annual Budget

• Power Plant
  • 135MW of on-site Combined Heat and Power (65 MW Peak)
  • 1.2 million lb/hr of steam generation (300K Peak)

• Chilled Water
  • 60,000 tons capacity in 5 plants (33K Peak)
  • 9.5 Million Gallons - 2 Thermal Energy Storage Tanks

• 9 miles of distribution tunnels
• 30 Miles of electrical ductbanks
• 5 campus wide outages in 54 years
• 84% to 87% Average Annual Thermal Efficiency
NATURAL GAS PURCHASED
3,811,562 MMBTU

ELECTRICITY DISTRIBUTED
335,944,000 KWH

CO$_2$e RELEASED
209,636 TONS

CAMPUS SIZE
20,000,000 Square Feet - 160 BUILDINGS

NATURAL GAS PURCHASED
3,811,562 MMBTU

ELECTRICITY DISTRIBUTED
335,944,000 KWH

CO$_2$e RELEASED
209,636 TONS

Gas Savings 1996 vs 2016
17,130,000 MMBTU
Cumulative

CO$_2$e Avoided = 1,017,000 tons
Cumulative

5 Chilling Stations
2 CW Thermal Storage Tanks

At 1976 Fuel & Emissions Levels
With 9 million more square feet
Performance Features

• Largest Microgrid in the United States
• Ability to 100% Island all Power at will
• Net Zero Power to ERCOT Grid plus
  • Real-Time Load Balancing for Steam and Chilled Water
• 25 MW Stand-By power from Grid
• N+2 Redundancy for Power via Substation and Stand-By
• 2 Independent High Pressure Gas Mains to Plants
• Instantaneous Load-Shed built in for
  • Excess Steam
  • Excess Power
  • Chilled Water Thermal Storage (for back-up and load shifting)
Performance Features

• Real Time Energy Modeling
• Chilled Water Distribution
• Overall Energy Balance
• Optimization
  • Chilled Water System (Average .65 kW/Ton Annual Average)
  • Heat Rate (9,140 Btu/kW Annual Average)
• Real Time Plant Condition Monitoring (BNF Plant Health Index)
• All Buildings - Dual Connections for Electricity, Steam & Chilled Water
• Meter 95% of all Campus Facilities (900 meters – electricity, steam, chilled water and domestic water)
UT AUSTIN UTILITY PLANT OVERVIEW

25 MW Standby

Inlet Air Cooling

Air

Natural Gas

Two Gas Turbines, 74 MW

Two Heat-Recovery Steam Generators

Air

Natural Gas

Four Boilers

Four Steam Turbines, 60 MW

Electric Power

Chilled Water

Eighteen Electric Chillers, 60,600 tons

Five Chilling Stations

80,000 ton-hrs TES

Heating Steam

Hot Water Plant

Heating Water

Campus
Modeling/Optimization

• Termis
  • “Real Time” Chilled Water Model
  • Static Steam Model

• Optimum Energy
  • OptiCx – “Real Time” Chilled Water production and distribution optimization

• Energy Portal
  • “Real Time” and historic metering for 95% of space for electricity, chilled water, heating and domestic water
  • Track Energy Utilization Indices, CO2e and Annual Cost for 160 buildings

• Hanara
  • Prism Historian
  • Plant Health Index – “Real Time” Asset Condition Monitoring

• Other Models
  • Domestic & fire water distribution
  • Sewer, storm water hydraulic
Holistic Approach to Total Energy

Power Production

Fuel & Water

Heating

Cooling

Distribution System

Building Design
Chilled Water Model at Peak Conditions
Indicating Pressure Zones
Chilled Water Production/Distribution Optimization
Historian Objectives

Avoid This

1. Deficient Data Agility Hindering Efficient Operation
   Historian engines not only collect and deliver real-time data generated from sensors embedded in each piece of equipment, but historians also store all of the collected data in servers. Despite the highly advanced hardware at the Hal C. Weaver Power Plant, the traditional historian software often took minutes to load recorded data or execute analytics. When abnormal equipment behavior or accidents occur during plant operation, operators, engineers, and managers often load months or years of historical data for detailed analysis. With limited capabilities, the existing historian took too much time to load, search, and analyze the data.

2. Missing Critical Operational Data Leading to Misguided Decisions
   Every second of a power plant's operation is critical. Assets across the plant floor transmit vast amounts of data. Historians continuously collect and store this abundant data. Plant operators monitor and analyze the process data to draw intelligence. Therefore, every piece of data must be collected without loss. The accuracy and completeness of data directly impacts the stability of the power plant. Existing historian software occasionally displayed incomplete and fragmented data records. Incomplete data sets may have critical ramifications for gaining accurate intelligence.

3. Limited Scalability, Limited Intelligence
   Process plants utilize various tools to improve their operational process and efficiency. A plant needs a variety of third-party applications to monitor and analyze data collected from the historian. Therefore, a historian must deliver the process data to external systems to help the plant gain additional intelligence. The existing historian software provided a limited bridge to external systems. With limited scalability, the UT Austin energy complex had limited access to intelligence and operational efficiency.

Get This

- Collect real-time plant operation data
- Accurately archive the data in the historian server
- Visualize operational data in various ways
- Analyze real-time data with built-in tools
- Effectively collaborate with your team

Collect
Archive
Visualize
Analyze
Collaborate
“Real Time” Asset Management

HanPHI, a powerful predictive analytics software, identifies impending equipment failure days, weeks, or months in advance. This intelligent software learns, models, and analyzes data to provide actionable early warnings to plant operators, engineers, and managers before a catastrophic failure occurs. With HanPHI, plant personnel implement predictive maintenance, keeping their valuable assets in optimal condition.

HanPHI allows you to monitor the condition of all your equipment at a glance. HanPHI continuously monitors and identifies anomalies across assets and provides early warnings of impending equipment failures.

Our intelligent predictive-modeling and health-indexing technologies make HanPHI a powerful solution that has significant benefits for plant operations. Early warnings identify areas for predictive maintenance, reducing maintenance costs, unscheduled downtime, and equipment failures. With HanPHI, you can eliminate potential operational risks, extend equipment lifecycles, and increase asset reliability, efficiency, and safety within your limited budget.

Plants are constantly exposed to the risk of unscheduled downtime. Failure to identify the point of equipment failure in advance requires extra time and resources to locate the cause. Other technologies provide warnings only seconds or minutes before imminent failure. With limited warning time, the plant may not have enough time to successfully react to critical failures.

With HanPHI’s actionable information about the time and point of potential and hidden failures given well before an incident, HanPHI users can thoroughly prepare for impending failures.

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Learn

Learn historical data

Model

Build models based on acquired intelligence

Index

Index plant and equipment condition

Early Warning

Provide warnings in advance

Optimize

Optimize plant with actionable intelligence
Predictive Monitoring Solution

DCS/PLC/SCADA

Process Variable

Predictive Data Modeling

Expected Values

Residuals

Equipment Health Index

SuccessTree

Plant Health Index

Early Warning

Tracing a Cause of Anomalies

Entire Plant Monitoring

YOU
Domestic Water Model