Automation Applications Inc, LLC

together with

JMP Engineering

Optimization of Steam and Electric Generation Assets

Innovative Energy Management Solutions

Technical Focus Group

Discussion Items

- AAI-JMP Profile
- Power House Operating Challenges
- An Approach To Net Zero Electric Purchase

Automation Applications Inc, LLC
together with
JMP Engineering

AAI-JMP Profile

- Independent Full Service Turnkey Control Solutions Provider
- 9 North America Branches
- 120+ employees / $25Meg Annual Revenue
- Focused Solutions for Consumer Products, Energy, Food & Beverage, Petrochemical, Pharmaceutical, and Pulp & Paper
- Energy/Utility Solutions include:
  - Boiler Combustions Controls, BMS and Balance of Plant
  - Energy Management and Monitoring Solutions
  - Water and Waste Treatment

Automation Applications Inc, LLC
together with
JMP Engineering

Philadelphia Branch Profile

- Independent Full Service Turnkey Solutions Provider in Process Control, Manufacturing & Information Systems
- Process Control Solutions for the Consumer Products, Energy, Food & Beverage, Petrochemical, Pharmaceutical, and Pulp & Paper Markets
- Boiler Combustion Controls and Industrial Energy Management is Core Application Expertise
- Successfully Completed over 200+ Powerhouse Projects
- Industrial Energy Solutions Team Comprised of Individuals with Hands-On Background in Boiler Control Design, Start-Up and Operation

AAI-JMP Solutions

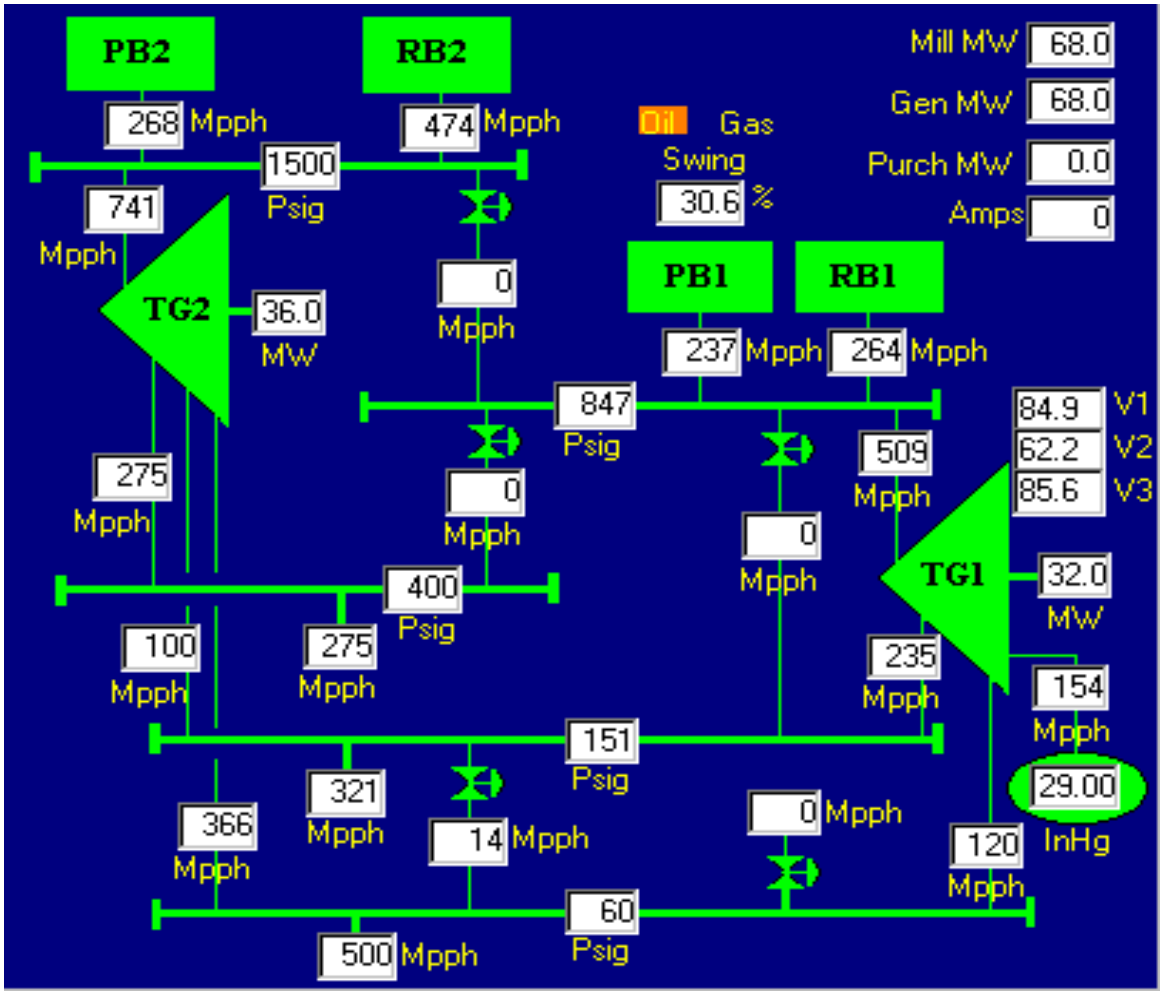
- Energy Management Solution
  - Boiler Load Allocation
  - Turbine Load allocation
  - Coordinated Header Pressure/Predictive Header Pressure Control
  - TieLine Control
  - Economic Load Shed
- Multi-Fuel Boiler Optimization
  - Independent Fuel Masters, e.g. BioMass, NG, Coal
  - Flexibility to Tune Each Master for Specific Fuel
  - Inferred Btu Control by Consumed Air
  - Coordinated Load Changes
    - Auto Air Distribution Control
    - Excess Air Control

Utilities Operating Challenge

- Meet the Plant Steam & Electrical Demands
  - While Operating Smoothly, Reliably, Consistently, Safely
  - Meeting Environmental Constraints
  - Meeting Fuel and Electric Purchase Contracts
  - @ Lowest Possible Cost

Automation Applications Inc, LLC
together with
JMP Engineering

Powerhouse Overview



Innovative Energy Management Solutions

Operating Priorities

- Meet steam demand among fuels/boilers based on minimum costs while adhering to fuel, boiler, operational & environmental constraints
- Maximize steam supplied on a prioritized fuel(s) basis, e.g. Biomass, NG or coal
- Distribute steam economically among turbines and PRVs to maximize total power generated while minimizing the use of PRVs
- Manage purchased fuels and electric costs

Creating An Island

- Steam and Electric Generation Assets in Place
- Operating Objectives to a Net Zero Electric Purchase
- Operators Trained to Meet The Defined Objectives

- But Questions and Risks Remain….

How can you meet these objectives within the demands of a changing 7x24 operational environment?

Automation Applications Inc, LLC

together with

JMP Engineering

Energy Management Solution

- Multi-Fuel Boiler Optimization
- Boiler Load Allocation
- Turbine Load allocation
- Coordinated Header Pressure
  w/ Predictive Header Pressure Control
- TieLine Control
- Economic Load Shed

Real-time EMS

- Rule-based supervisory control system utilizing multi-variable, prioritized constraint control strategies
- Process equipment, operational constraints, environmental constraints and costs define the operating envelope
- The applications finds the most optimized point within the defined envelope

The Objective: Run the powerhouse as well or better than your best operators on their best day to the defined operational goals.

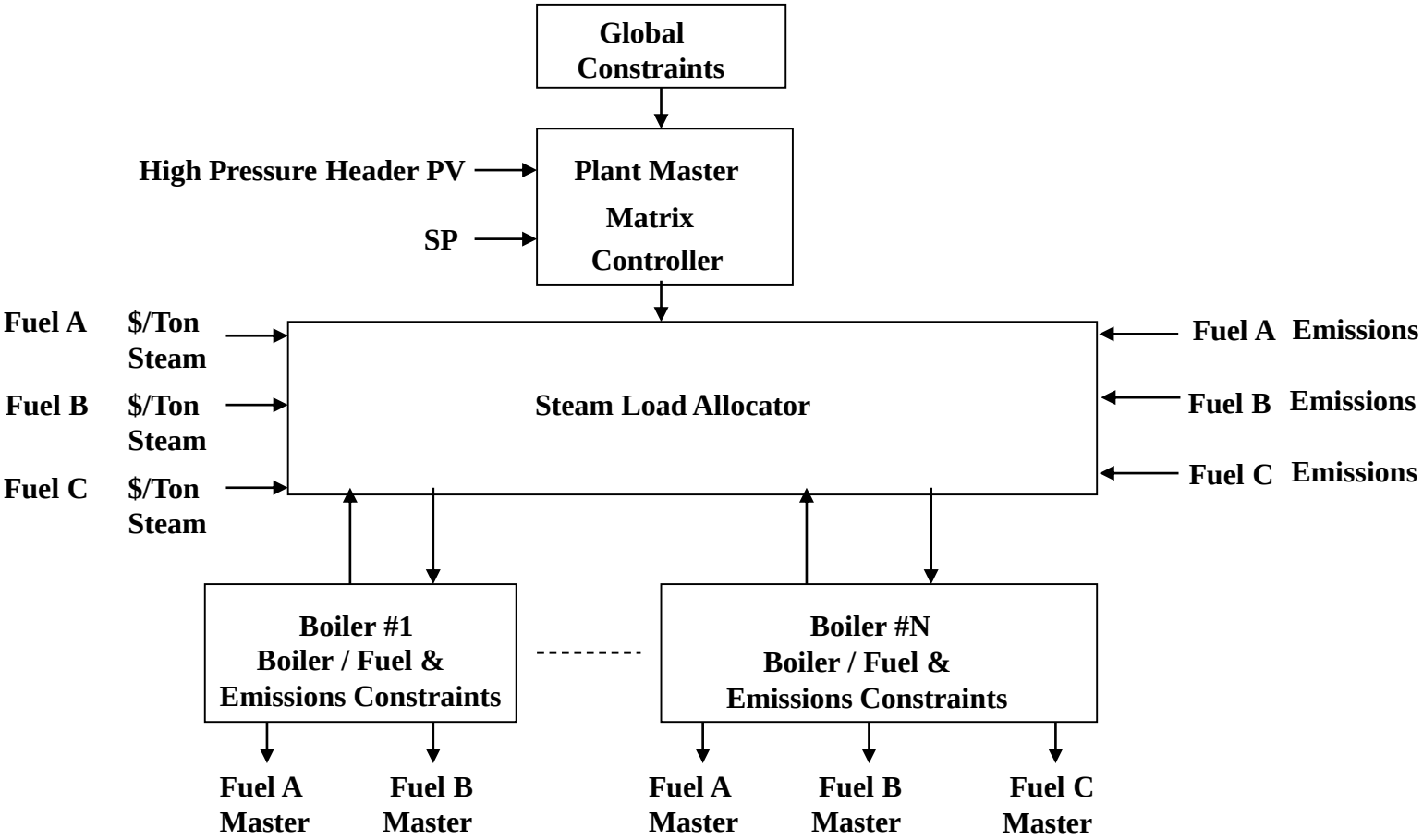
Multi-Fuel Boiler Optimization

- Independent Fuel Masters, e.g. BioMass, NG, Coal
- Flexibility to Tune Each Master for Specific Fuel
- Inferred Btu Control by Consumed Air
- Coordinated Load Changes
  - Auto Air Distribution Control
  - Excess Air Control

Advanced Boiler Load Allocation

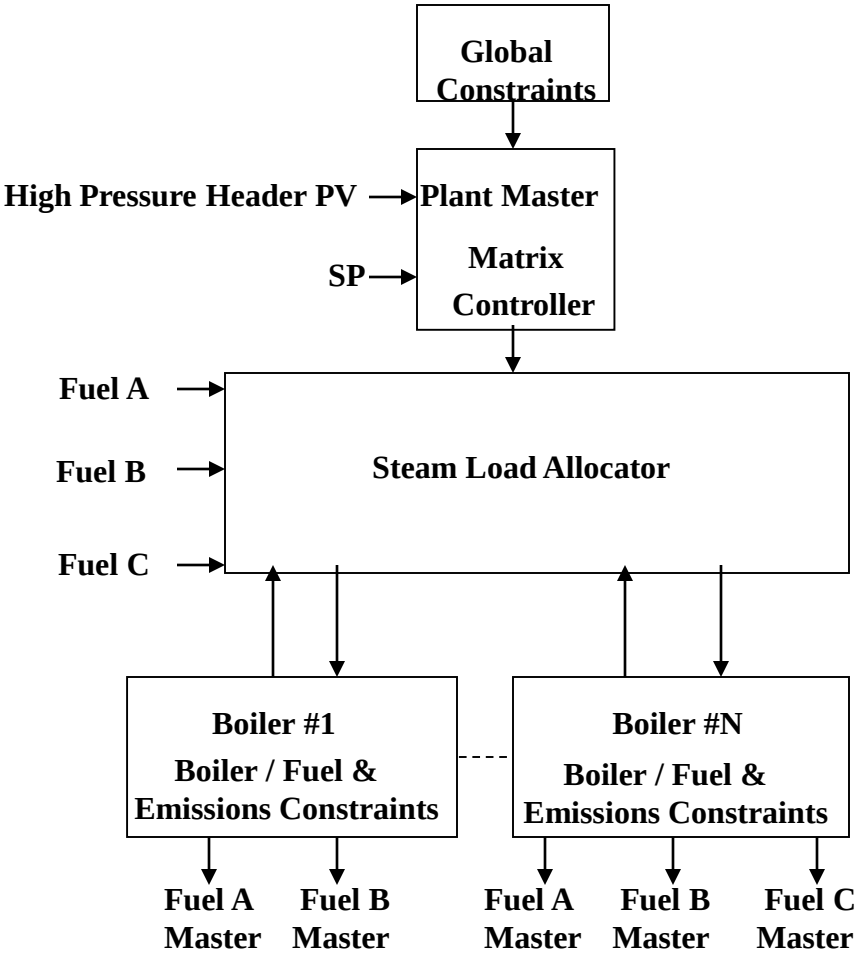
- Generate Steam at the possible the lowest possible impact to emissions and operating costs
- Allocates the total steam demand among multiple fuels/boilers based on defined fuels, emissions and cost constraints
- Incremental emissions and costs for the next unit of steam
- Fuels & Boilers with lower incremental emissions and steam costs are favored more than boilers & fuels that produce higher resulting emissions and costs
  - Lowest impact boilers & fuels take most of the load

Advanced Boiler Load Allocation



Innovative Energy Management Solutions

Advanced Boiler Load Allocation

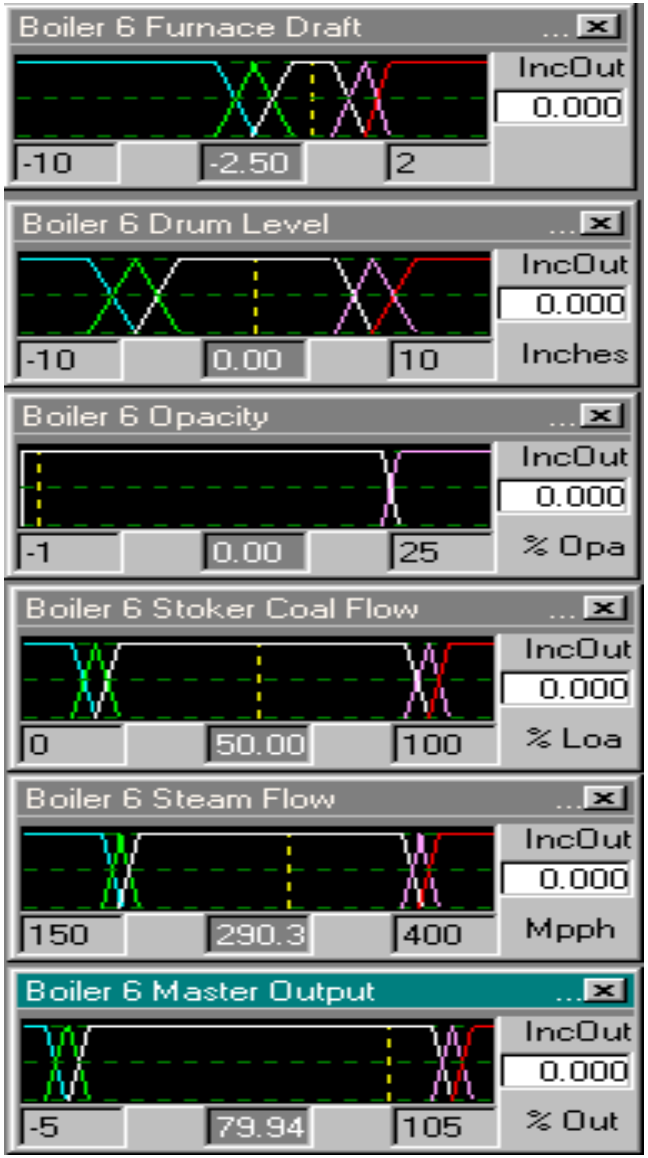


- Boiler Fuel Optimizer
  - Maximizes lower cost fuels and minimizes more expensive fuels
  - Works with constraints to minimize the emissions and cost of steam/electrical power
- Constraint Controllers
  - Create an operating/environmental (process envelope)
  - Constraints prioritized on order of importance
  - Global constraints have precedence
  - Operating & Emissions Constraints have priority over cost decisions

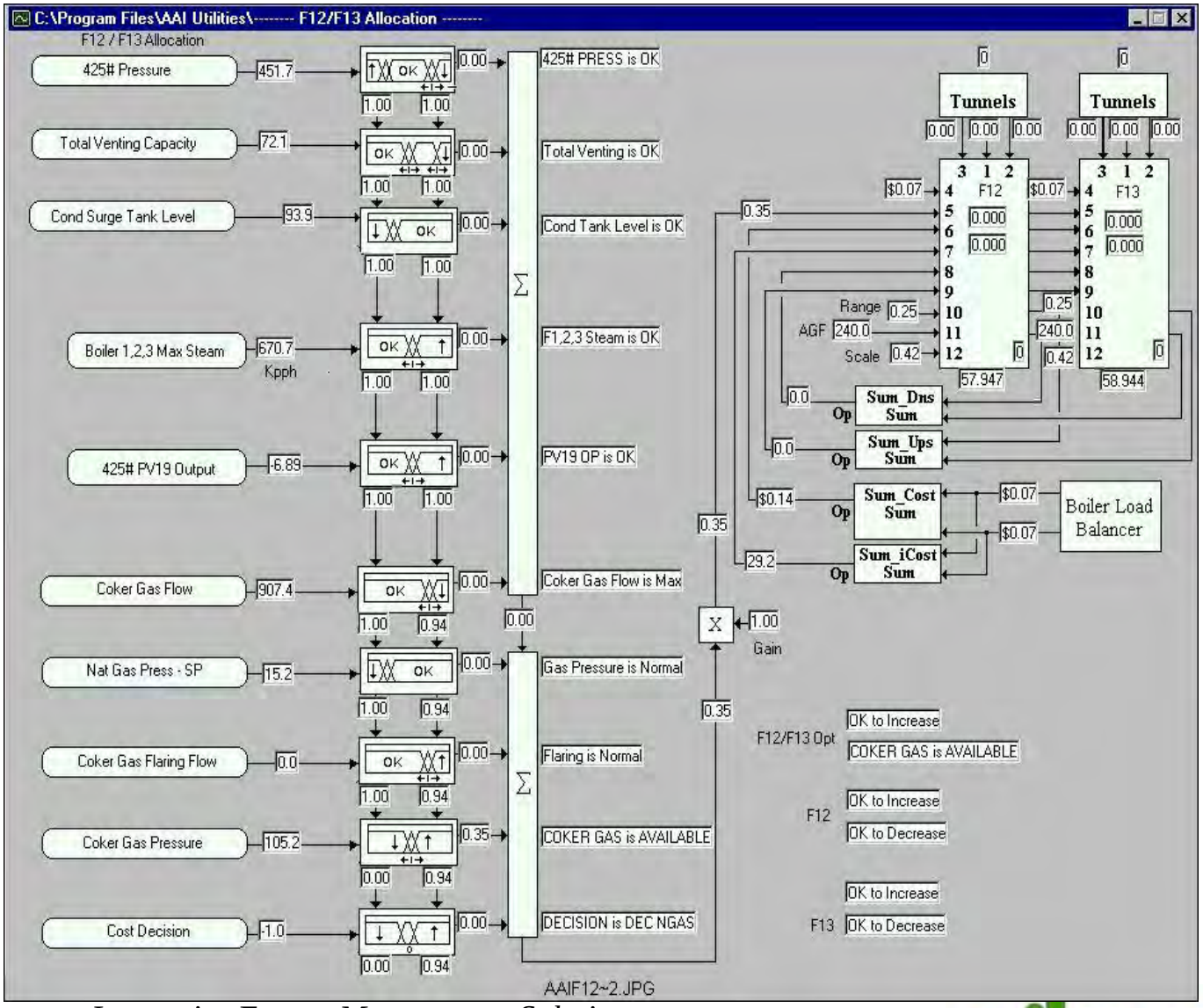
Boiler Constraints

Rule Based Constraints

- Furnace Draft
- Drum Level
- O2, CO, NOx, Opacity
- Fuel Flow Limits
- Steaming Limits
- Boiler Master Limits
- Others as required

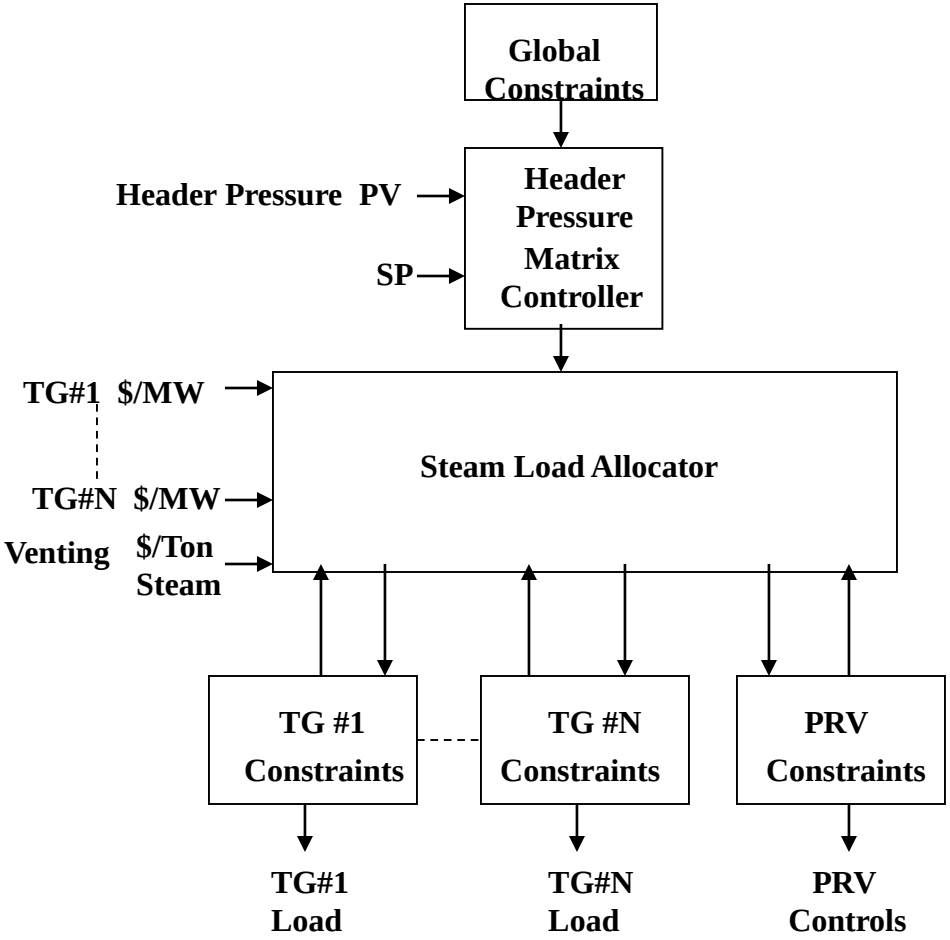


Global Constraints



Innovative Energy Management Solutions

Advanced Turbine Load Allocation



- Allocates steam among turbines and PRVs while adhering to constraints to minimize:
  - The cost of producing electricity
  - Steam venting
- Benefits
  - Minimum cost of self generated electricity
  - Cost savings from reduced steam venting & condensing

Advanced Header Pressure Control

- Maintains stable header pressures for all combinations of boilers, fuels and equipment conditions
- Minimizes header pressure disturbances
- Handles several pressure upsets on different headers concurrently in a **coordinated** fashion with minimum upset to the overall steam system
- Provides multiple control strategies depending on the severity of the upset

Advanced Tie Line Control

- **Objective: Manage Purchased Power**

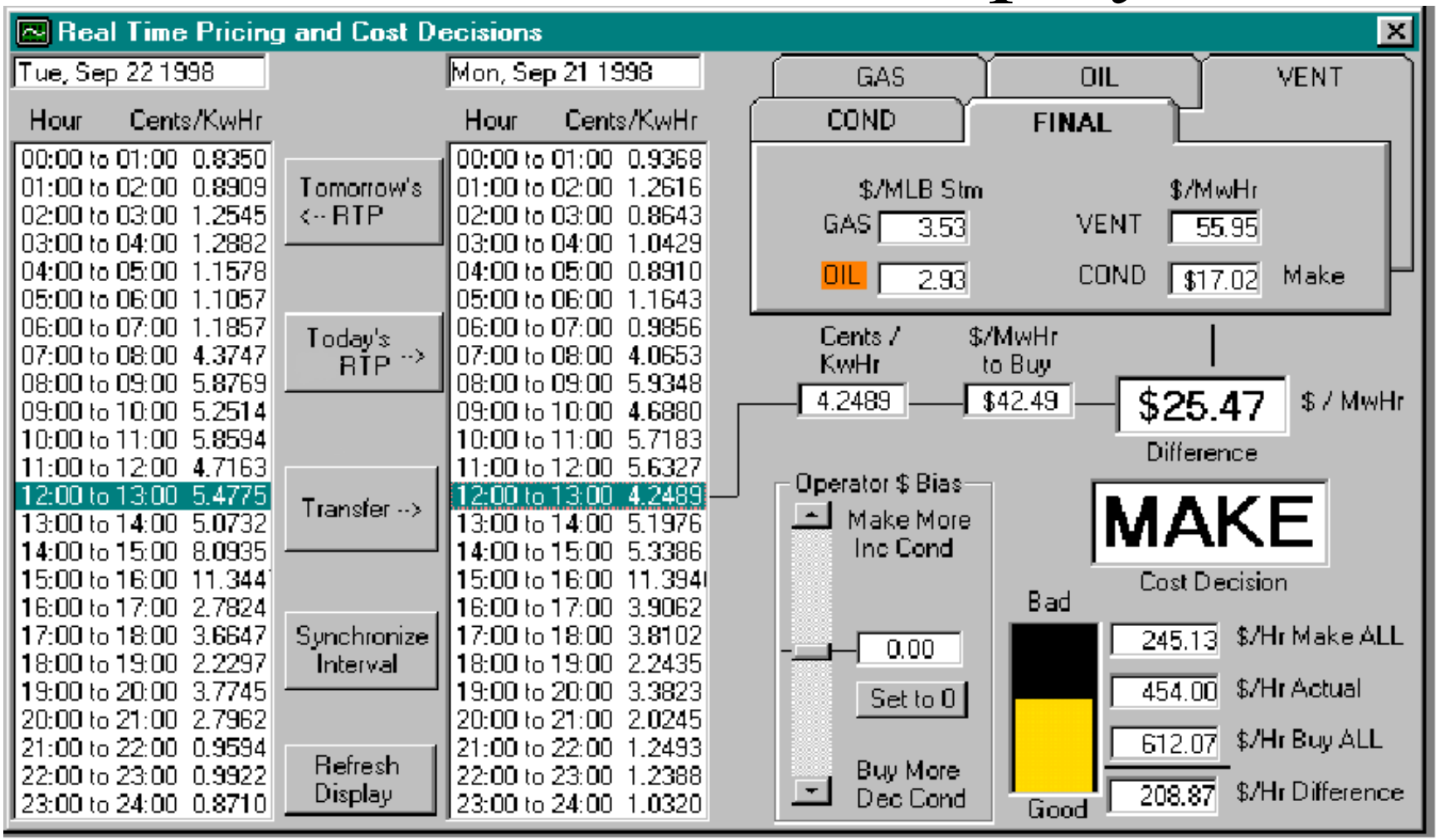
- **Control Strategies**
  - Real Time Pricing Tie Line Control for Buying or Selling Power
  - Purchase Megawatt Control
  - Interval Demand Megawatt Hour Purchase Control
  - Load Shedding

Advanced Tie Line Control

- **Real Time Pricing for Buying Power**
  - Downloads utility purchase price
  - Continuously calculates cost of producing power
  - Compares with cost of buying power from utility
  - Adjusts turbine condensing loads to control purchased power while adhering to prioritized constraints

Automation Applications Inc, LLC
together with
JMP Engineering

Cost Decision Display



Innovative Energy Management Solutions

Advanced Tie Line Control

- **Real Time Pricing for Buying or Selling Power**
  - Downloads power company's purchase and sell prices
- **Economic Sell Advisor**
  - Compares current purchase and sell prices against incremental generation costs to determine optimal equipment loading
  - Advises how much electricity should be bought or sold and the optimum turbine extraction, condensing and venting mix to produce additional generation needed
  - Can make closed loop decisions for control

Advanced Tie Line Control

- **Purchase Megawatt Control**
  - Instantaneous purchase MW target is maintained
  - Power Company interval demand may be exceeded
  - Used to conserve fuel

- **Interval Demand Megawatt Hour Purchase Control**
  - Optimizes buying electricity to **exactly** reach the MW target at the end of the interval
  - Prevents extra expense of exceeding interval demands

Advanced Tie Line Control

- **Load Shedding**
  - Prevents import power penalties during:
    - A boiler Trip
    - A turbine generator failure
  - Trips a list of breakers and motors divided into groups
  - Groups are prioritized according to effect on production

Implementation

- Based on Proven Technology
- Rule-Based supervisory control system utilizing multi-variable, priority constraint control strategies
- Process equipment & operational constraints, as well as environmental constraints, define a safe operating envelope
- Powerhouse usually operates on the boundary of constraints
- Customer Quote: “EMS runs our powerhouse as well or better than our best operator on his best day”

Integration with Existing Controls

- Client/Server Based or Imbedded Application
- Works in Concert w/Major Control System Platforms
  - DCS, Hybrid, PLC, Turbine Controllers
- Utilizes Industry Data Interface Standards
  - OPC, DDE, Modbus
- Database Open to Third Parties
- Standard Operating & Engineering Displays
- Tailored to Specific Steam Generation Functions

Application of the Controls

- Quick & Easy to Implement
  - Function Blocks Configured to Form Tailored Solution
    - **No Programming Required**
    - **No Models to be Developed & Maintained**
- Easy to Maintain, Modify, Expand

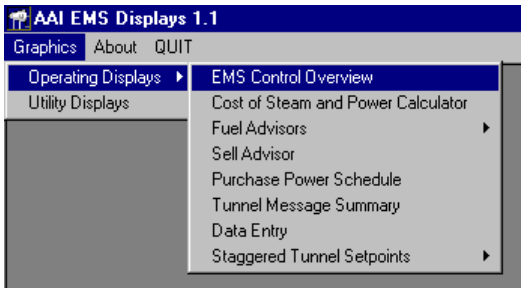
Automation Applications Inc, LLC

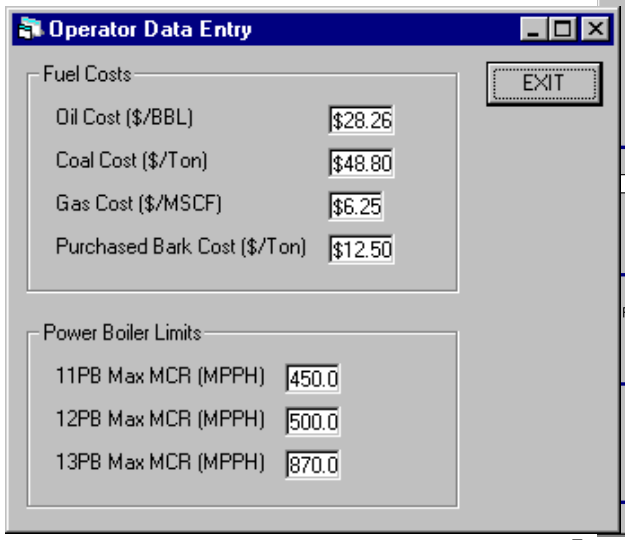
together with

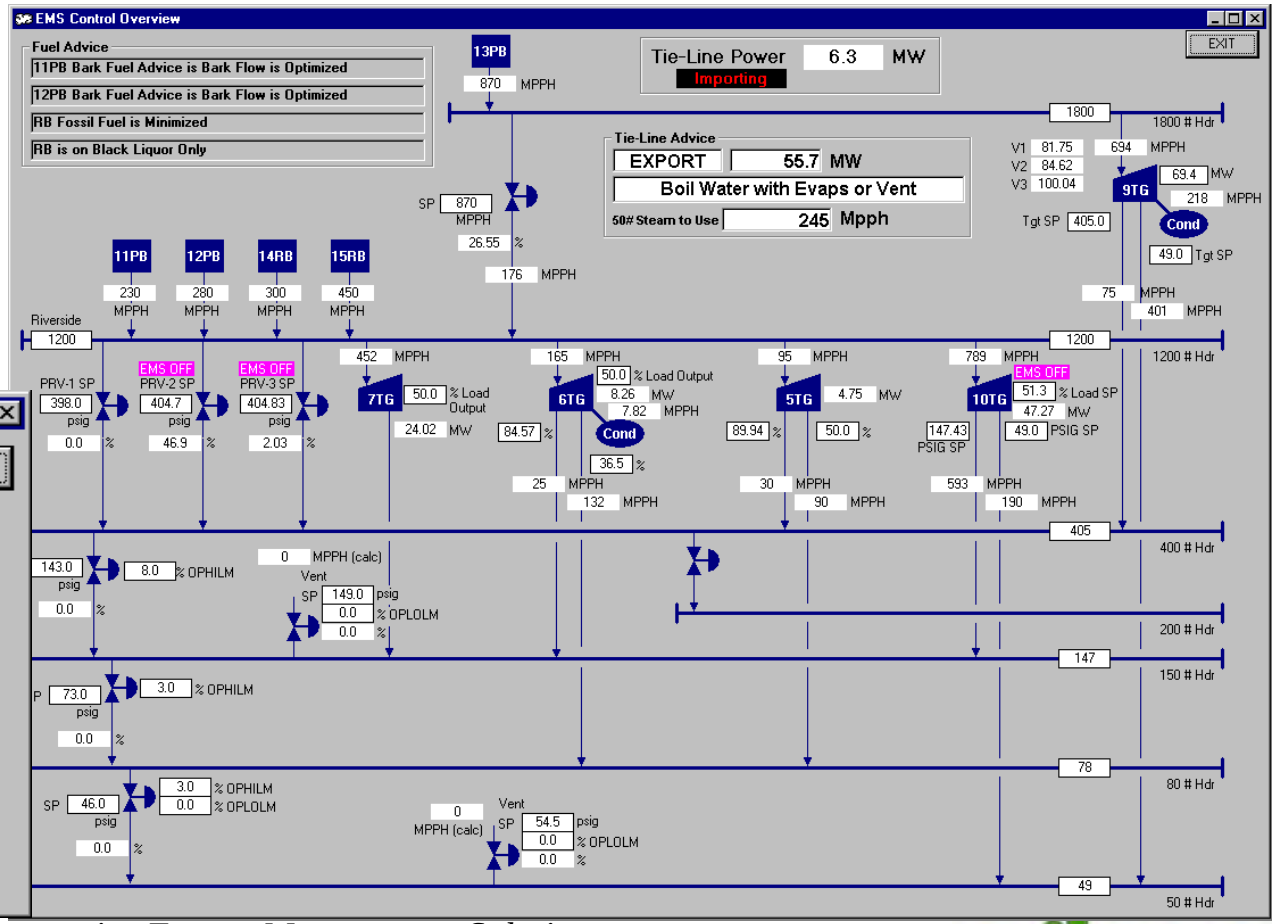
JMP Engineering

EMS Intuitive Look & Feel

Easy for Operating Personnel to Understand & Use







Innovative Energy Management Solutions

Operational Benefits

- Improved Demand Side Operations
- Greater Operating Stability & Reliability
- Reduced Steam Venting & Condensing
- Prioritized Fuel Use
- Identification of Bottlenecks for Improved Efficiency
- Maximum Asset Utilization
- Minimized Emissions and Operating Costs
- Potential for Creation of Virtual Island

Some Typical Installations

Alberta - Multi-fuel Boiler Control, Coordinated Header Pressure Control, Demand & RTP Tie Line, Load Shedding, Power Factor Control

Texas - Multi-fuel Boiler Control, Boiler Load Allocation , Coordinated Header Pressure Control, Demand Tie Line and Power Factor control

Alabama - Demand & RTP Tie Line

Alberta - Multi-fuel Boiler Control, Coordinated Header Pressure Control, Demand and RTP Tie Line Control, Load Shedding, Boiler Load Allocation

British Columbia - Multi-fuel Boiler Control, Boiler Load Allocation Coordinated Header Pressure Control

Georgia - Multi-fuel Control, Boiler Load Allocation, Coordinated Header Pressure Control

Mississippi - Multi-fuel Control, Coordinated Header Pressure Control, Boiler Load Allocation

Automation Applications Inc, LLC

together with

JMP Engineering

Creation of a Virtual Island Through Optimization of Steam & Electric Generation Assets

Innovative Energy Management Solutions