SmartProcess®

Plant Optimization & Performance Software

Samir Pandya

EMERSON™
Process Management

Power Industry Specialists

- Emerson Power and Water Solutions has over 50 years of experience in Power
- Unmatched Application expertise
- Boiler and Turbine controls for different equipment manufacturer's.
- With a rich experience in Power we are uniquely qualified to offer optimization solutions like advanced process control.

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Changing Face of the Industry

- Deregulation has spawned fierce market competition
  - Mergers, acquisitions and internal restructurings for increased cost competitiveness are common place
  - Independent power producers build, own and operate plants at highly competitive rates
- Government and environmental regulations are increasing
  - Power Producers have to reduce Nox to meet compliance

To stay ahead of the competition, it is imperative that power producers improve plant efficiency and increase output, decrease costs and maintain environmental & regulatory compliance.

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Improvement goal

SmartProcess®

- Heat rate improvements 1/2% to 1 1/2%
- NOx Reductions 15% to 35%
- Opacity Reductions 15% to 30%
- Increased Capacity 1% to 2%
- 1% of MCR per minute improvement in ramp rate
- Reduced tube leaks and associated forced outages
- Improve fleet management capabilities

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SmartProcess®

Environmental Management

- NOx / SO2 cap compliance
- NOx / CO minimization
- Opacity Reductions

Unit Performance

- Heat Rate
- Boiler Efficiency
- LOI

Generation Management

- Performance Advisor

Operational Flexibility

- Ramp Response

SmartProcess® Optimization Software

- Fleet Emissions Optimizer
- Economic Optimizer
- Combustion Optimizer (NOx, Heat Rate, Opacity)
- Cyclone Boiler Optimizer
- Steam Temperature Optimizer
- Sootblower Optimizer
- Global Performance Advisor
- Enterprise Data Server

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SmartProcess Features Two Types of Plant-Specific Modules That Use Intelligent Software Tools

Optimizers	Use knowledge-based software tools such as linear models, neural networks and fuzzy logic to model and optimize generating units and send set-points & biases directly to the existing plant DCS (closed-loop integration)
Advisors	Use state-of-the-art mathematical and modeling tools to analyze process performance and provide operator advisory messages identifying problem areas that are generating unnecessary costs (open-loop integration)

One of the few in the world to Offer closed loop optimizers

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What makes SmartProcess different?

TECHNOLOGY

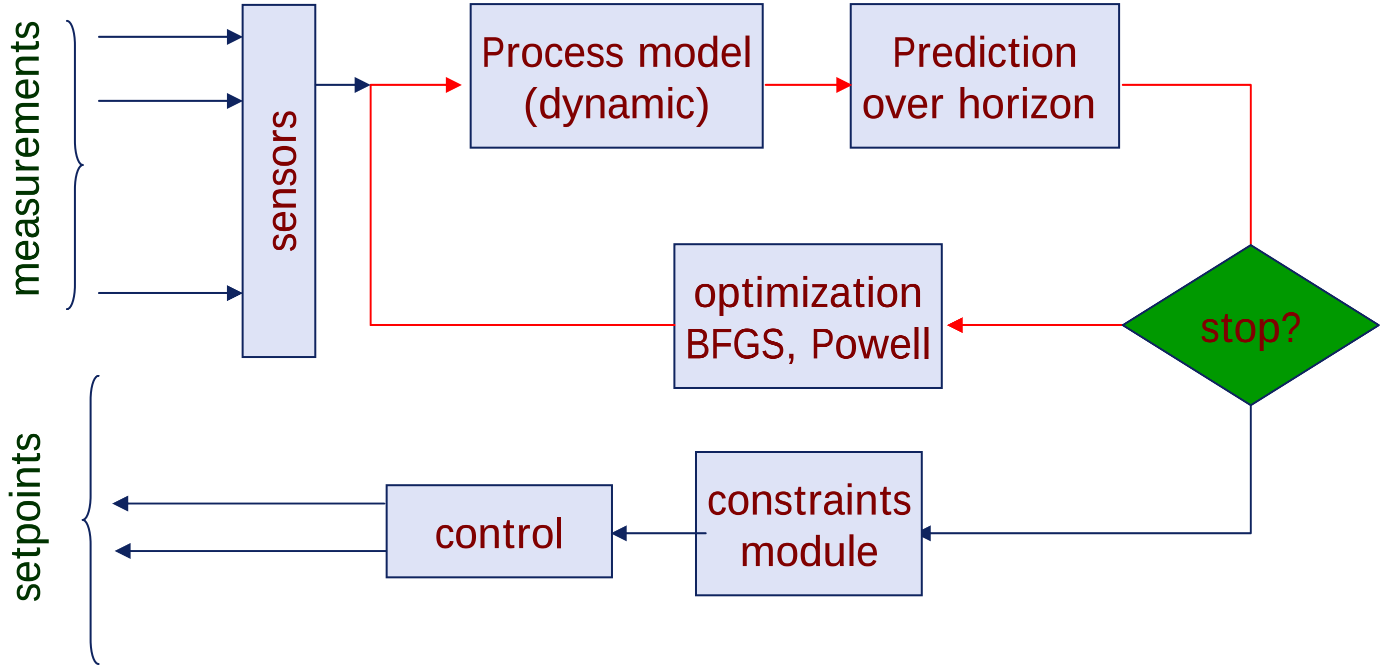
Advanced control and optimization solutions incorporate **fuzzy logic**, **neural networks**, **model predictive control**, and **optimization engines** designed specifically for the power industry needs

Browser-based user interfaces

Closed loop integration – Integrates directly with any DCS or can be deployed via other protocols like OPC or OSISoft PI

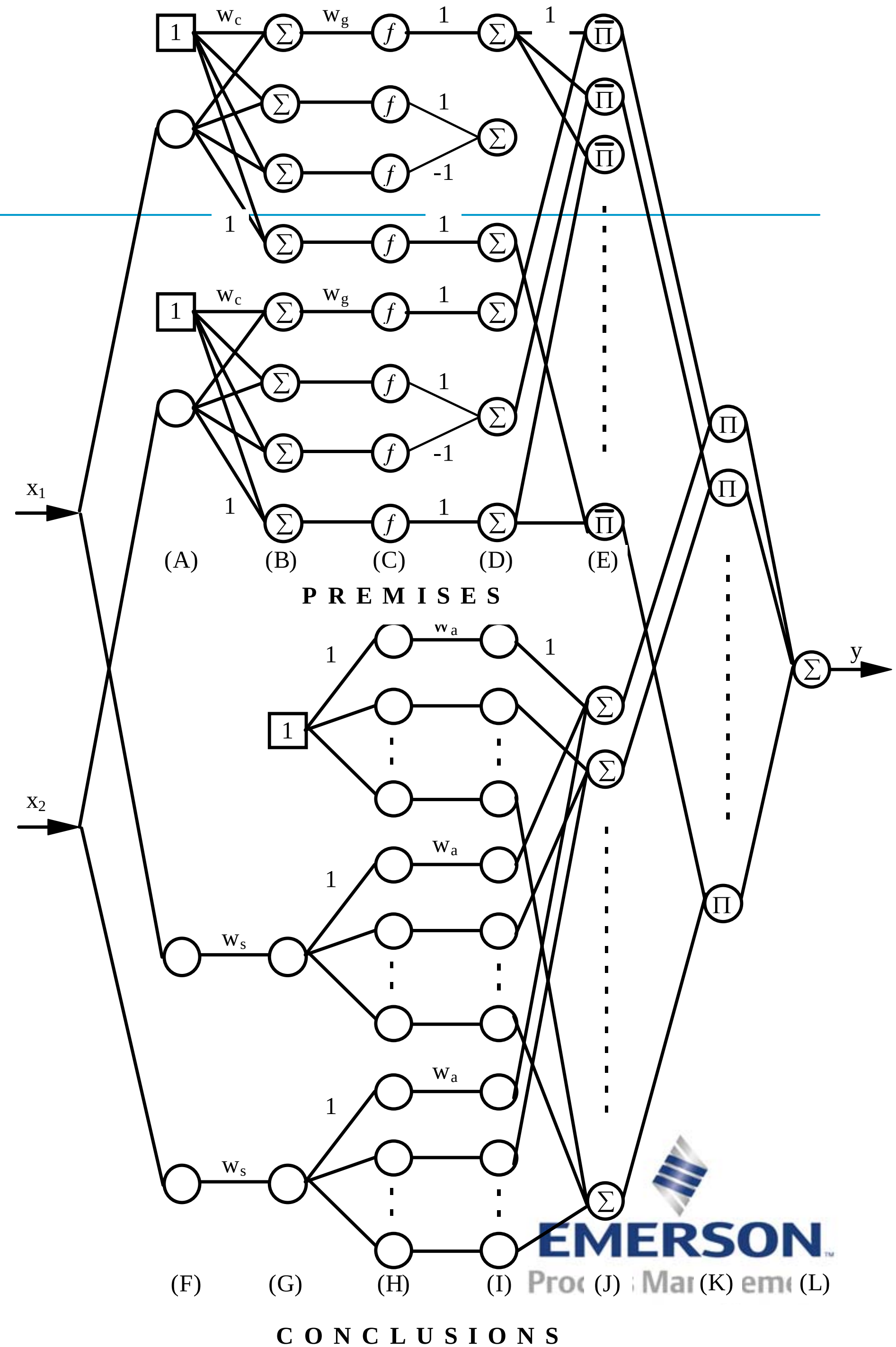
Automated testing tools for quick, efficient implementation

Model Predictive Control



Neuro-Fuzzy Architecture

- The way to combine NN's learning properties with qualitative knowledge of fuzzy systems



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What makes SmartProcess different?

FLEXIBILITY

Versatility to optimize for **multiple objectives** under **varying conditions**

Dynamic routines that steady-state approaches cannot match – Optimizer runs every 10 to 20 seconds, outperforming all other comparable products

Adapts and **learns** changing plant conditions

DCS platform independent

What makes SmartProcess different?

ADAPTABILITY

No daily maintenance – SmartProcess **self adapts** to the subtle long term changes in the plant dynamics

Data validation tools and **comprehensive support** capabilities available

Easily upgraded with base plant control system upgrades/migrations

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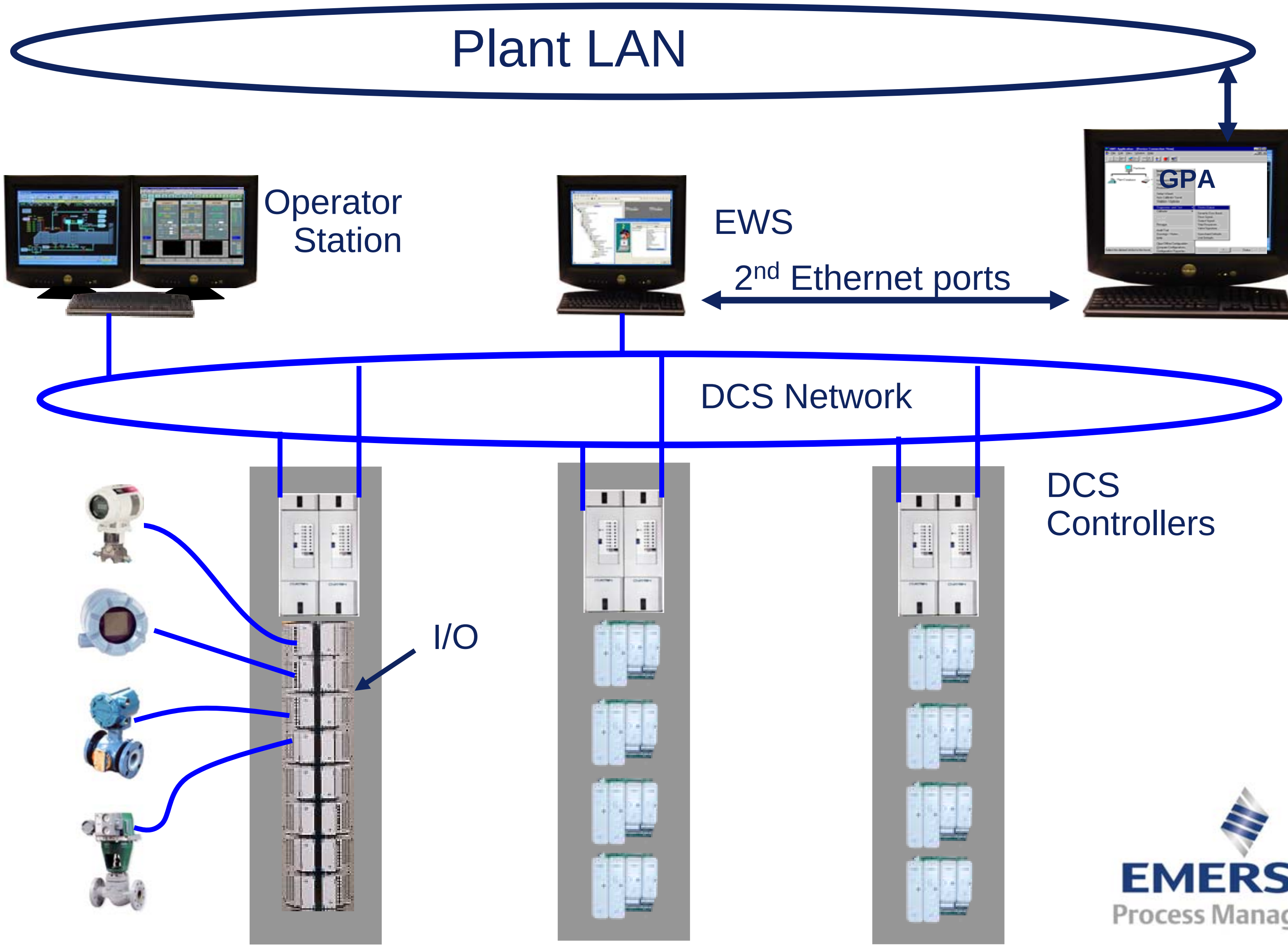
Typical SmartProcess Architecture



Economic Optimizer

The Economic Optimizer enhances energy allocation and plant operation, based on a number of factors, including operating costs, equipment efficiencies, and operating schedules.

Unify islands of optimization with an overall plant model

- Applications
  - Fleet wide economic analysis
  - Reduces operating costs on multiple equipment type plant configurations
  - CHP, Combined cycle plants, Co-generation facilities
  - Pumping networks
  - Fuel blending strategies
  - Cooling tower optimization

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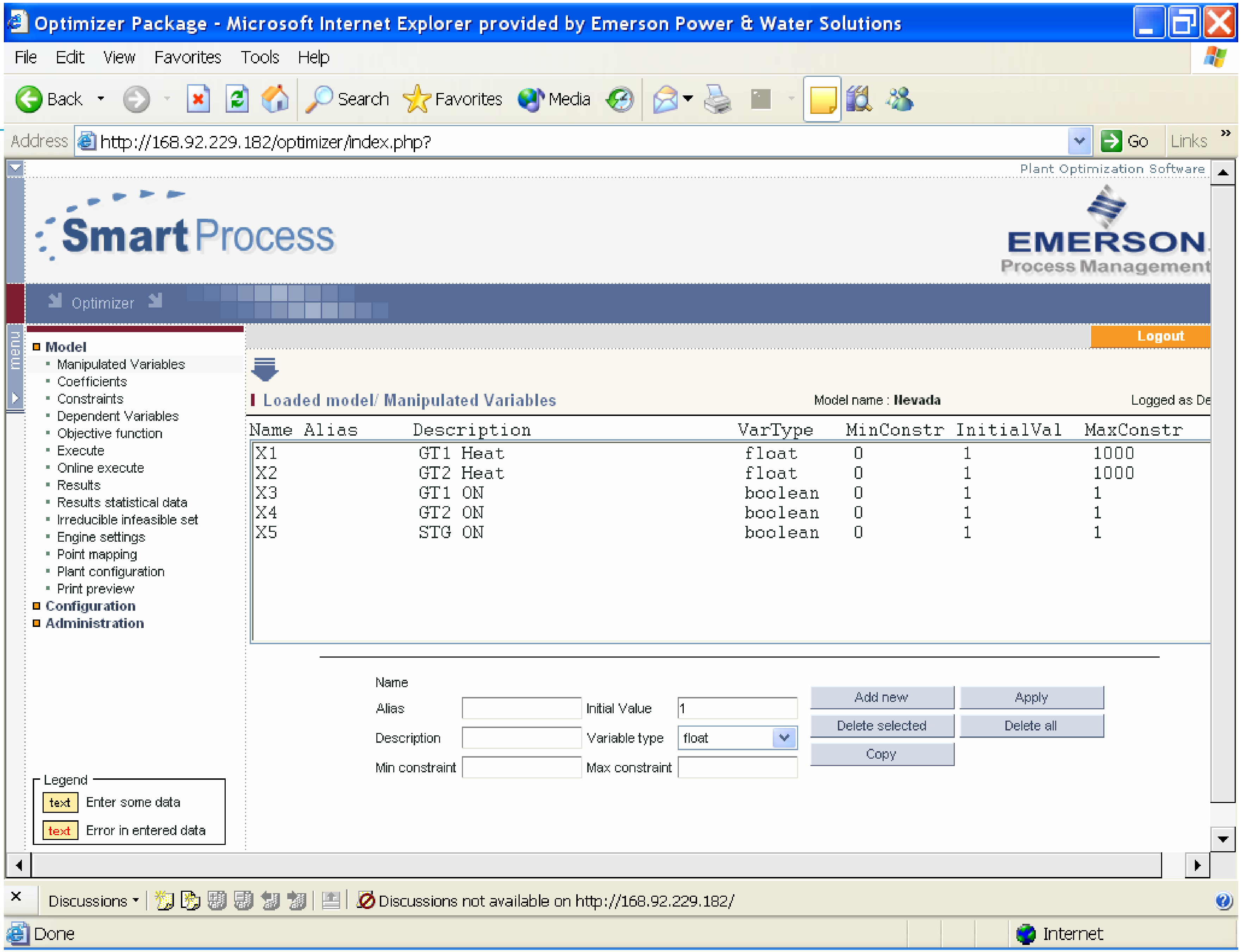
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Plant configuration
Print preview
Configuration
Administration
Loaded model/ Manipulated Variables
Model name : Nevada
Logged as De
Name Alias Description VarType MinConstr InitialVal MaxConstr
X1 GT1 Heat float 0 1 1000
X2 GT2 Heat float 0 1 1000
X3 GT1 ON boolean 0 1 1
X4 GT2 ON boolean 0 1 1
X5 STG ON boolean 0 1 1
Name
Alias
Initial Value
1
Description
Variable type
float
Min constraint
Max constraint
Add new
Apply
Delete selected
Delete all
Copy
Legend
text Enter some data
text Error in entered data
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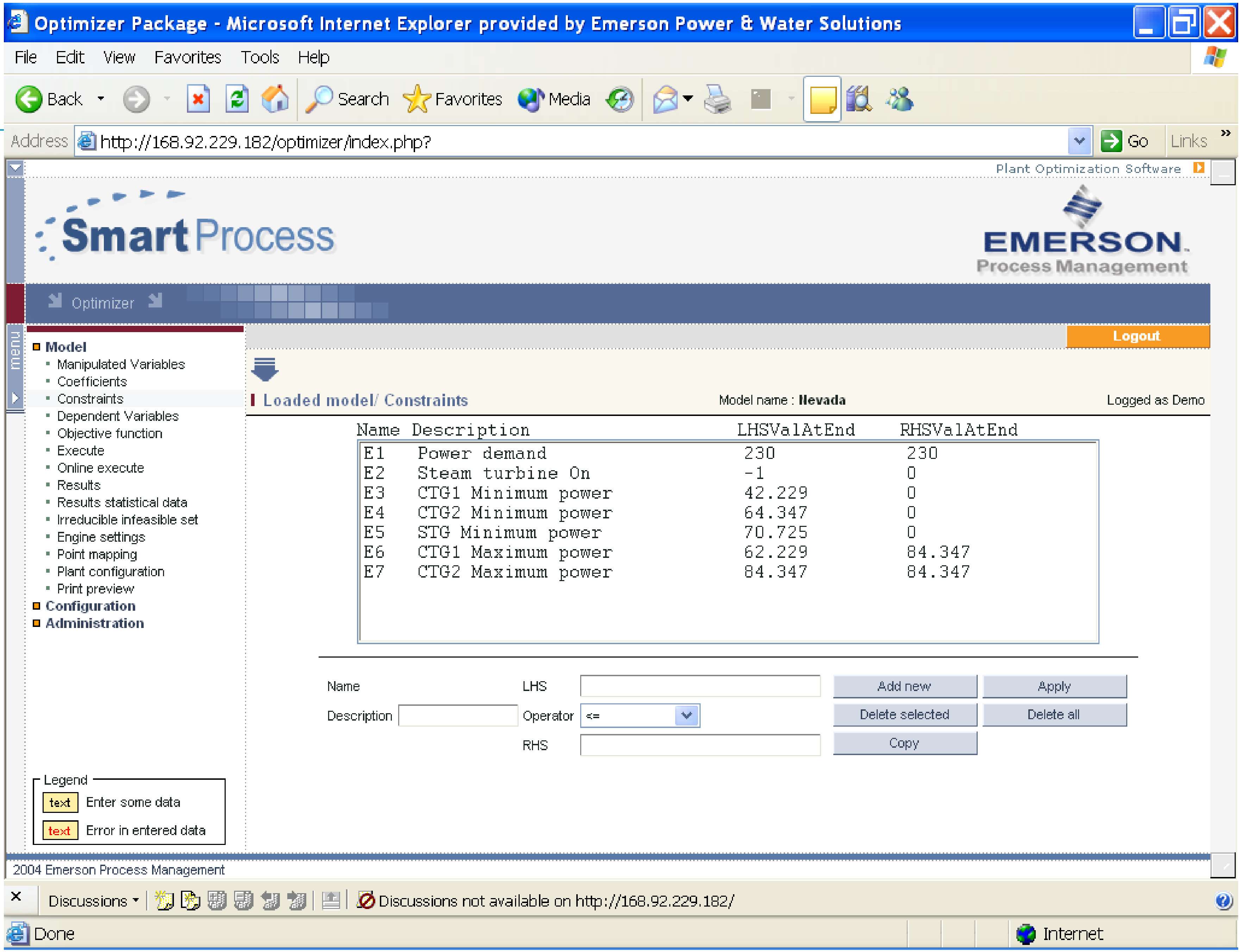
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Model
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Model name : Nevada
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Name Description LHSValAtEnd RHSValAtEnd
E1 Power demand 230 230
E2 Steam turbine On -1 0
E3 CTG1 Minimum power 42.229 0
E4 CTG2 Minimum power 64.347 0
E5 STG Minimum power 70.725 0
E6 CTG1 Maximum power 62.229 84.347
E7 CTG2 Maximum power 84.347 84.347
Name
LHS
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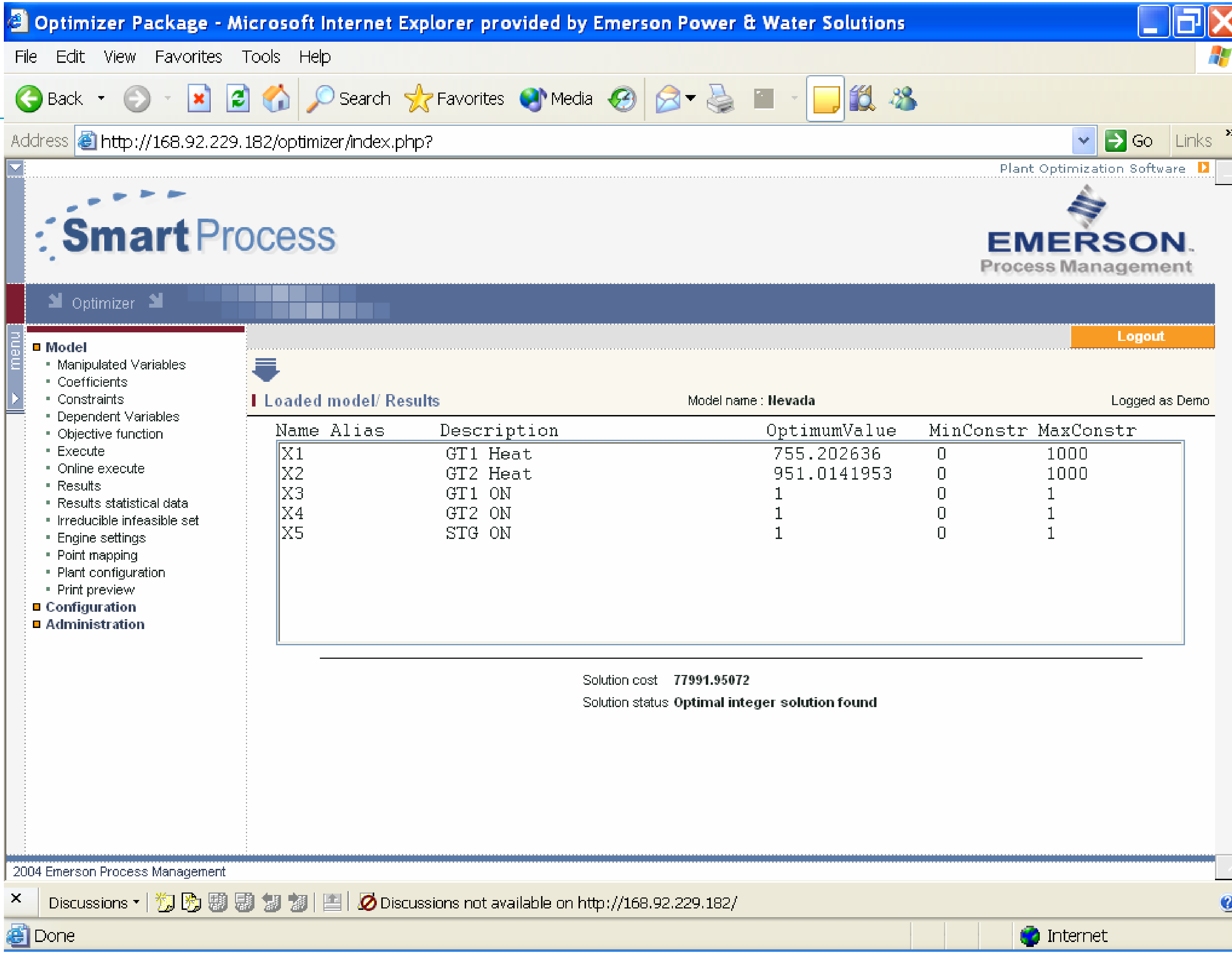
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Engine settings
Point mapping
Plant configuration
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Loaded model/ Results
Model name : Nevada
Logged as Demo
Name Alias Description OptimumValue MinConstr MaxConstr
X1 GT1 Heat 755.202636 0 1000
X2 GT2 Heat 951.0141953 0 1000
X3 GT1 ON 1 0 1
X4 GT2 ON 1 0 1
X5 STG ON 1 0 1
Solution cost 77991.95072
Solution status Optimal integer solution found
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Discussions
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Fleet Optimizer

Operate cost-effectively while achieving SO2 or NOx compliance.

- Results
  - Replicates and/or diversifies calculations used for business decisions
  - Provides reporting for O&M costs and real time heat rate
  - Predicts emission cap compliance based on load forecasts
  - Actively optimizes plant settings to achieve desired compliance target margins
  - Provides data redundancy of key variables

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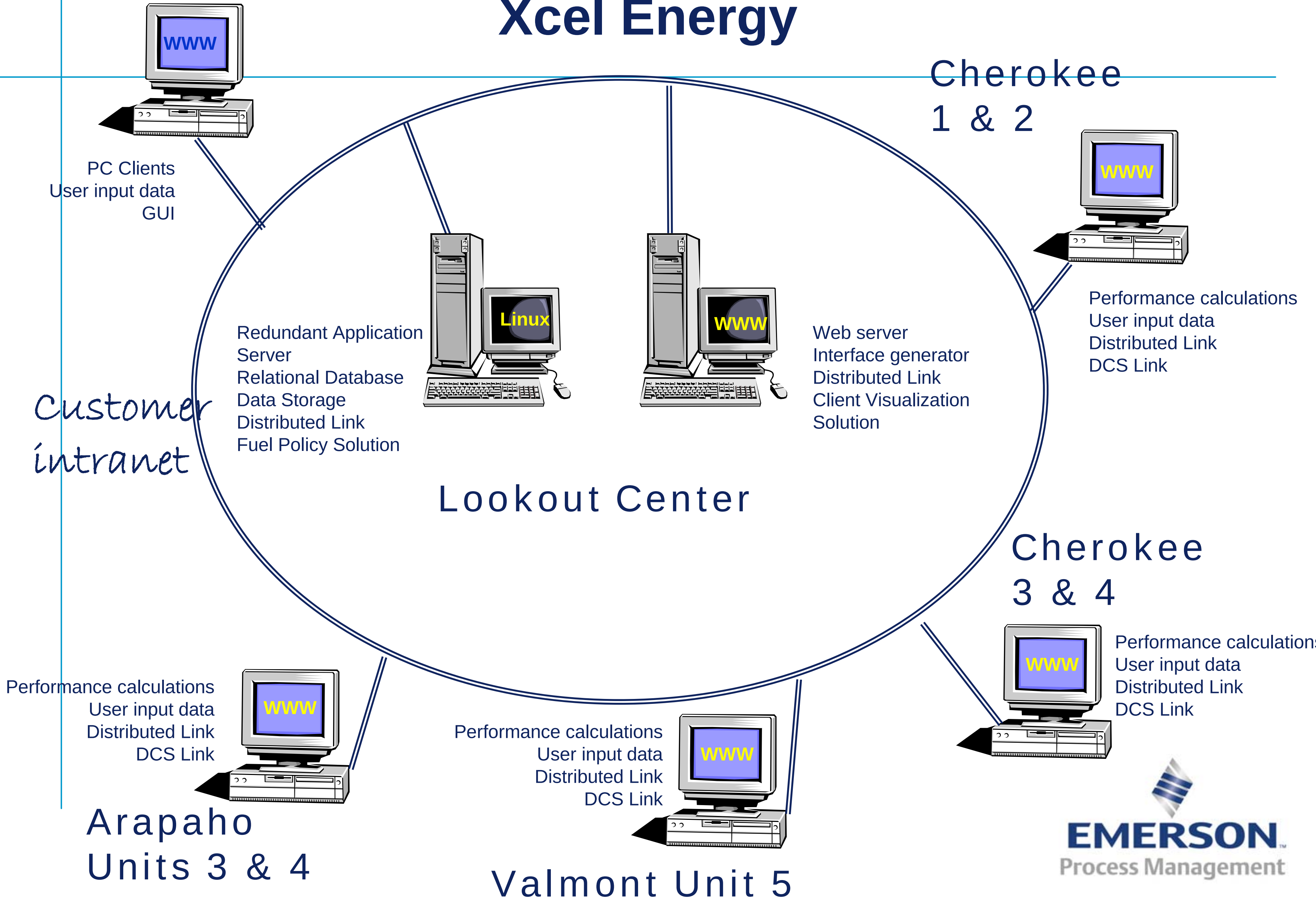
Xcel Energy



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Xcel Energy™

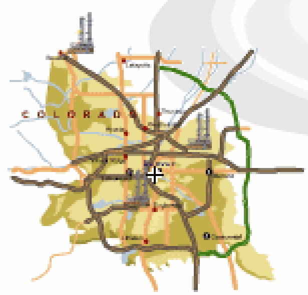
merp system

ARAPAHOE CHEROKEE VALMONT

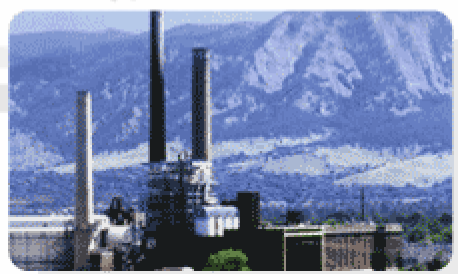
Arapahoe power plant

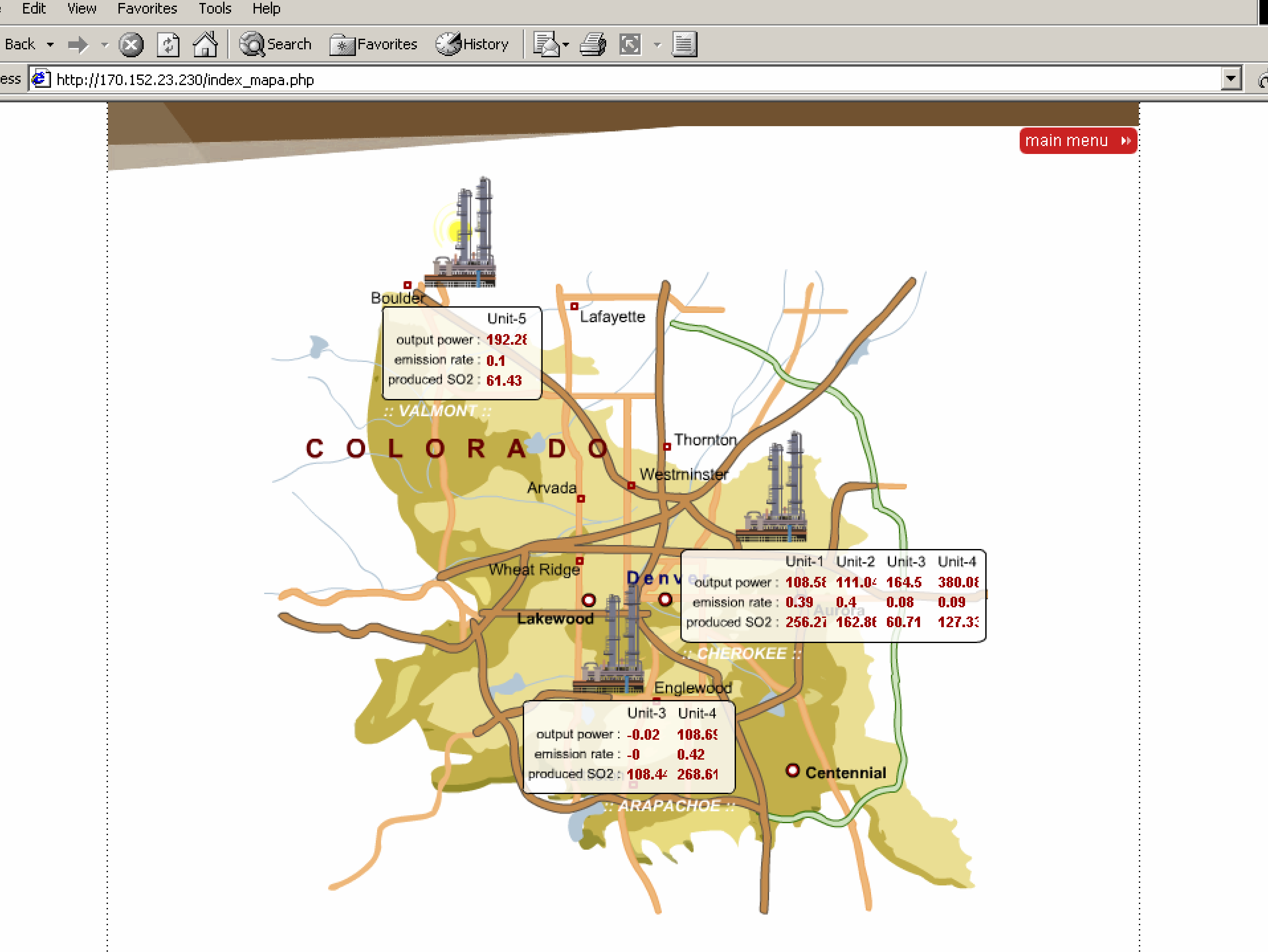
Cherokee power plant

MERP system



Valmont power plant

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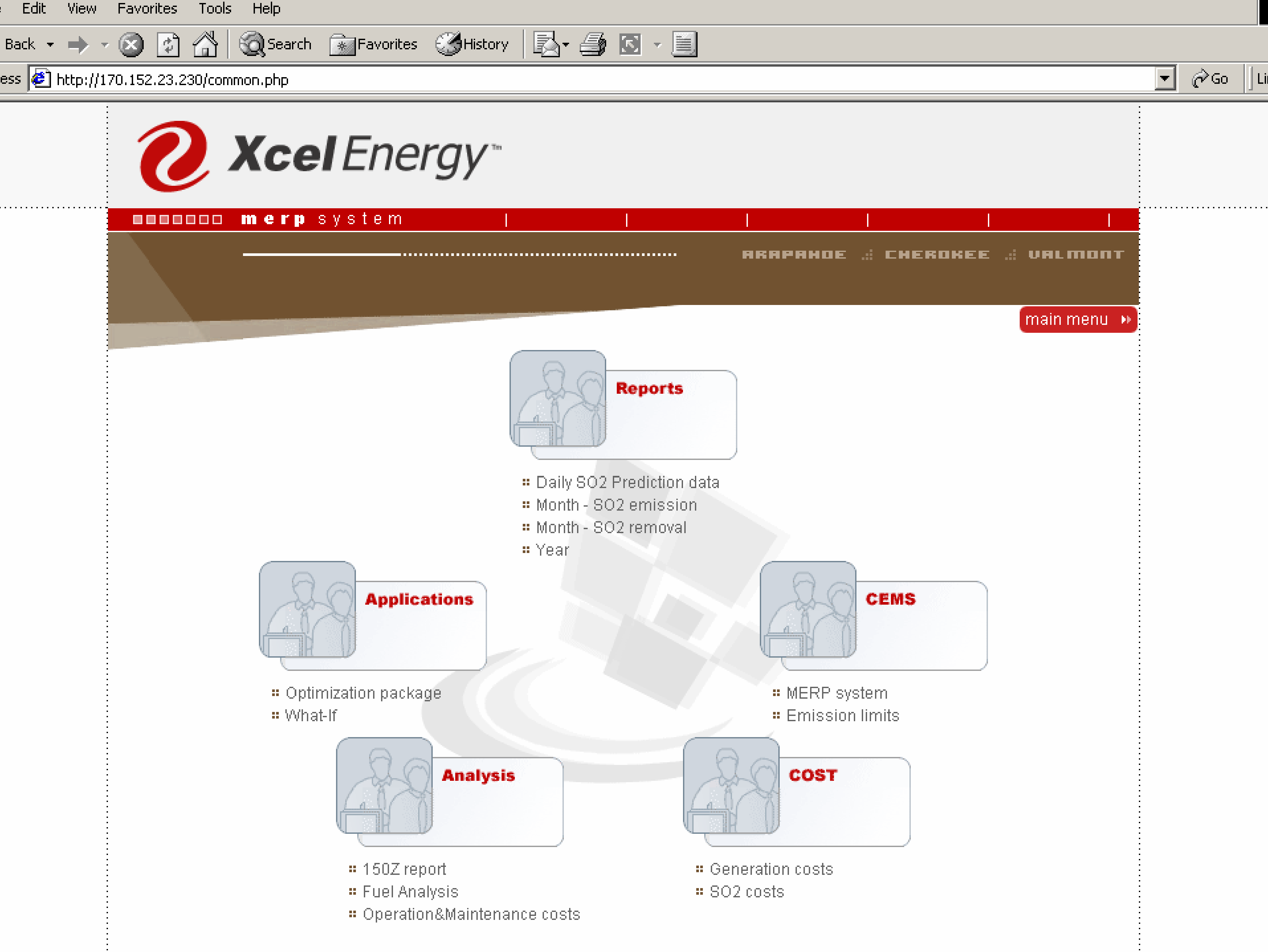
main menu
Boulder
Unit-5
output power : 192.28
emission rate : 0.1
produced SO2 : 61.43
:: VALMONT ::
Lafayette
C O L O R A D O
Thornton
Westminster
Arvada
Wheat Ridge
Lakewood
Unit-1 Unit-2 Unit-3 Unit-4
output power : 108.58 111.04 164.5 380.08
emission rate : 0.39 0.4 0.08 0.09
produced SO2 : 256.27 162.86 60.71 127.33
:: CHEROKEE ::
Englewood
Unit-3 Unit-4
output power : -0.02 108.69
emission rate : -0 0.42
produced SO2 : 108.44 268.61
:: ARAPACHOE ::
Centennial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Applications
Optimization package
What-If
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MERP system
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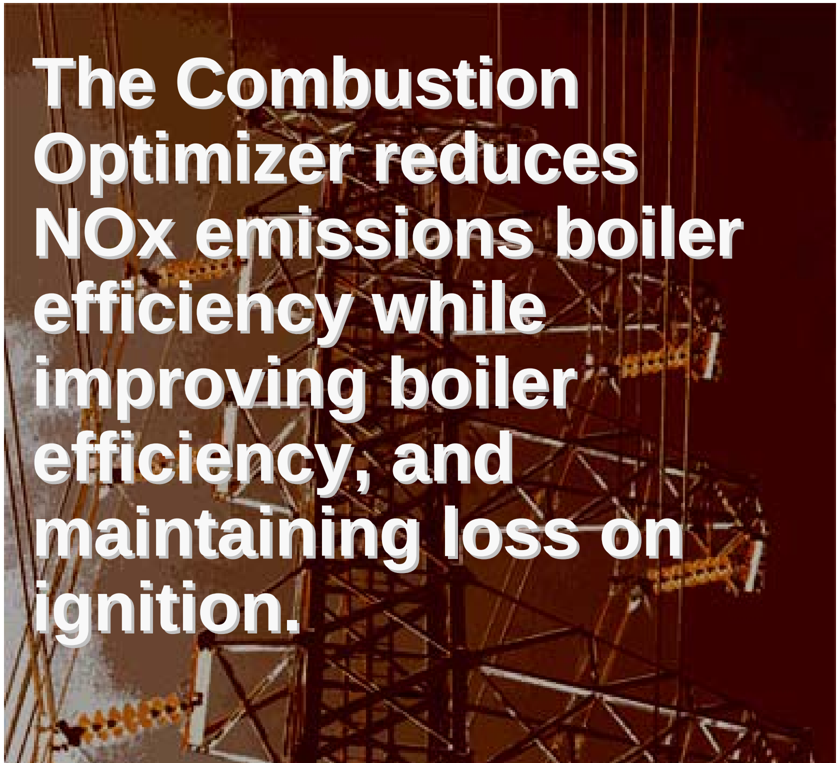
Generation costs
SO2 costs

Combustion Optimizer



The Combustion Optimizer reduces NOx emissions boiler efficiency while improving boiler efficiency, and maintaining loss on ignition.

Increase the efficiency of your boiler combustion process.

- Results
  - Reduces NOx and CO emission levels
  - Improves heat rate up to 1.5%
  - Reduces plant maintenance costs
  - Maximizes staged combustion efficiency
  - Controls and reduces measured opacity levels

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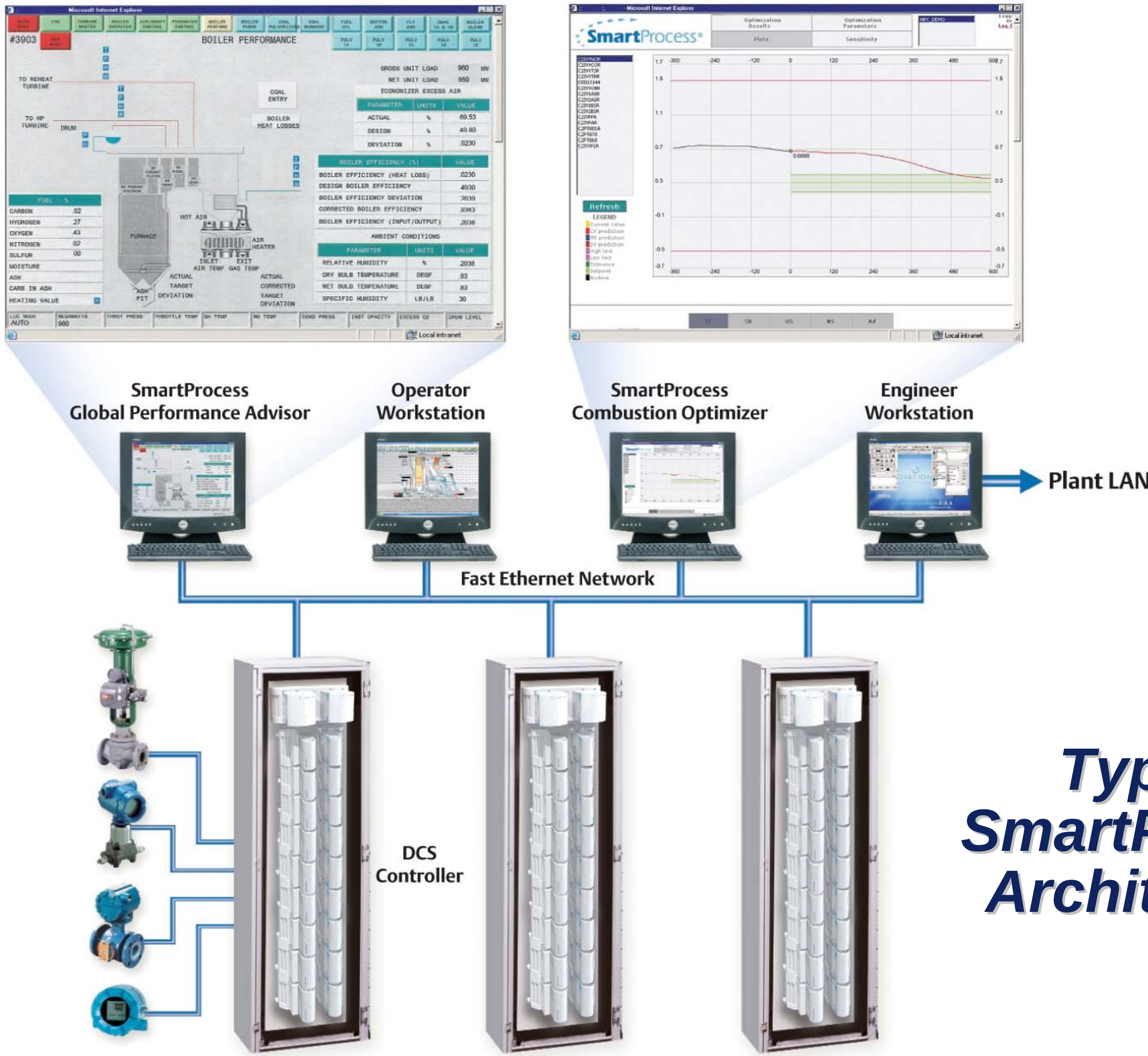
SmartProcess Boiler Optimizer dynamically adjusts and coordinates the combustion process

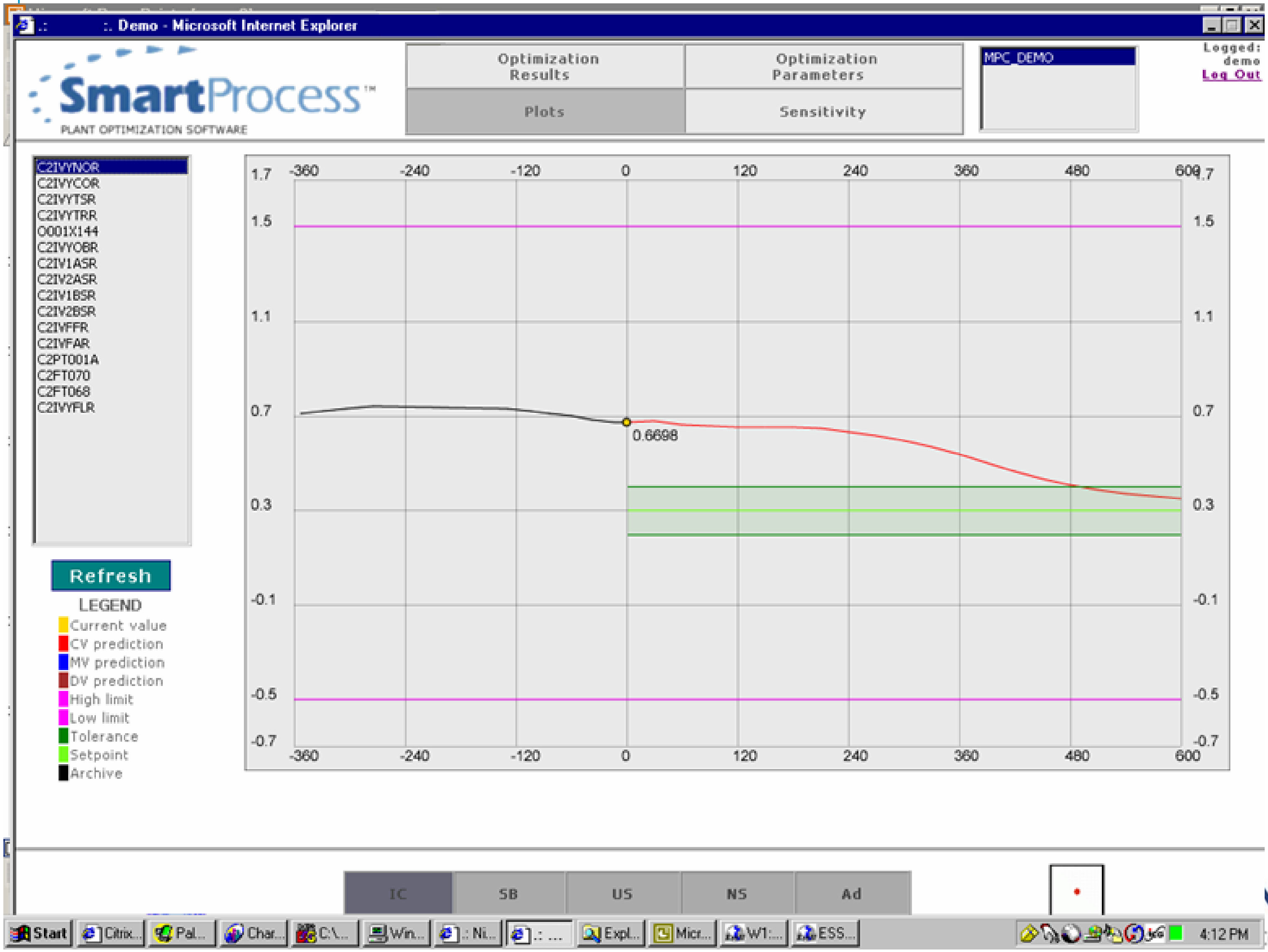
- Stoichiometry
  - Primary air flow
  - Secondary air flow
  - Tertiary air flow
  - Fuel flow bias
- Elevation Windbox DP
- Excess oxygen
- Over fire air flow or damper position bias
- Forced draft fan bias
- Induced draft fan bias

Typical SmartProcess Architecture

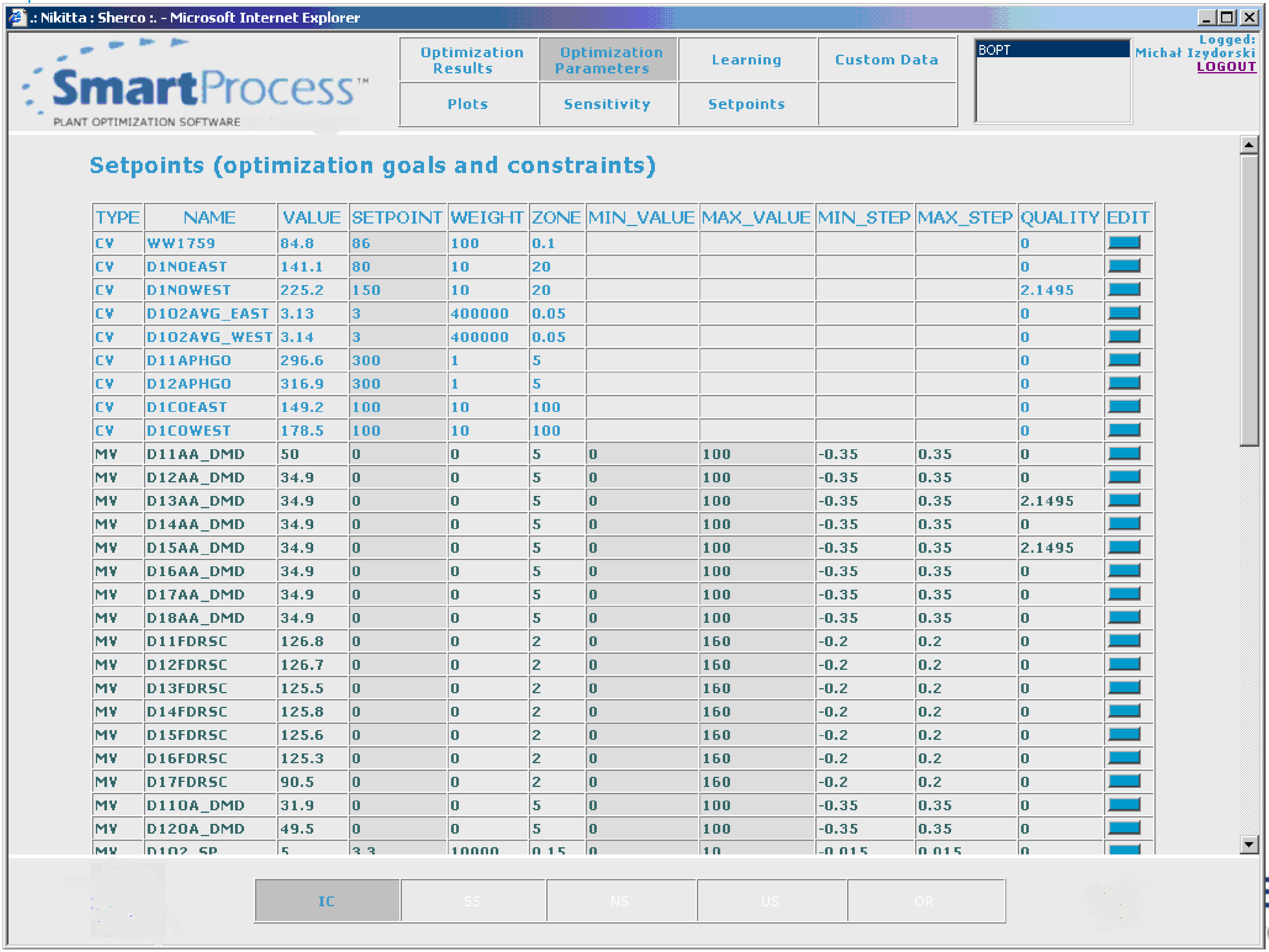


Typical SmartProcess Integration

Combustion Optimizer tools:SmartEngine



Web based interface



Setpoints (optimization goals and constraints)

TYPE	NAME	VALUE	SETPOINT	WEIGHT	ZONE	MIN_VALUE	MAX_VALUE	MIN_STEP	MAX_STEP	QUALITY	EDIT
CV	WW1759	84.8	86	100	0.1					0	
CV	D1NOEAST	141.1	80	10	20					0	
CV	D1NOWEST	225.2	150	10	20					2.1495	
CV	D1O2AVG_EAST	3.13	3	400000	0.05					0	
CV	D1O2AVG_WEST	3.14	3	400000	0.05					0	
CV	D11APHGO	296.6	300	1	5					0	
CV	D12APHGO	316.9	300	1	5					0	
CV	D1COEAST	149.2	100	10	100					0	
CV	D1COWEST	178.5	100	10	100					0	
MV	D11AA_DMD	50	0	0	5	0	100	-0.35	0.35	0	
MV	D12AA_DMD	34.9	0	0	5	0	100	-0.35	0.35	0	
MV	D13AA_DMD	34.9	0	0	5	0	100	-0.35	0.35	2.1495	
MV	D14AA_DMD	34.9	0	0	5	0	100	-0.35	0.35	0	
MV	D15AA_DMD	34.9	0	0	5	0	100	-0.35	0.35	2.1495	
MV	D16AA_DMD	34.9	0	0	5	0	100	-0.35	0.35	0	
MV	D17AA_DMD	34.9	0	0	5	0	100	-0.35	0.35	0	
MV	D18AA_DMD	34.9	0	0	5	0	100	-0.35	0.35	0	
MV	D11FDRSC	126.8	0	0	2	0	160	-0.2	0.2	0	
MV	D12FDRSC	126.7	0	0	2	0	160	-0.2	0.2	0	
MV	D13FDRSC	125.5	0	0	2	0	160	-0.2	0.2	0	
MV	D14FDRSC	125.8	0	0	2	0	160	-0.2	0.2	0	
MV	D15FDRSC	125.6	0	0	2	0	160	-0.2	0.2	0	
MV	D16FDRSC	125.3	0	0	2	0	160	-0.2	0.2	0	
MV	D17FDRSC	90.5	0	0	2	0	160	-0.2	0.2	0	
MV	D11OA_DMD	31.9	0	0	5	0	100	-0.35	0.35	0	
MV	D12OA_DMD	49.5	0	0	5	0	100	-0.35	0.35	0	
MV	D1O2_SP	5	3.3	10000	0.15	0	10	-0.015	0.015	0	

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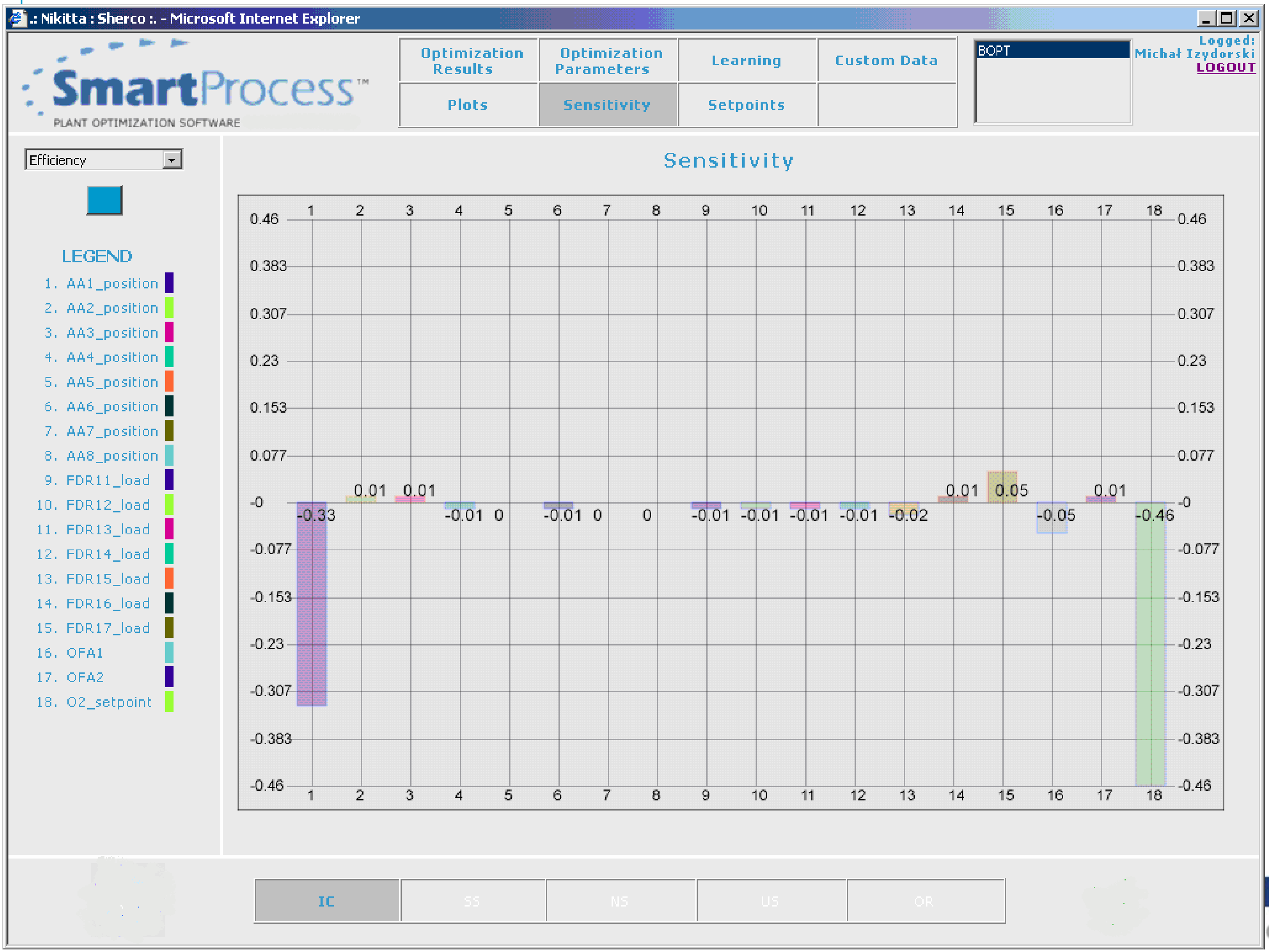
Sensitivity Analysis User interface



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Case Study
Plant Optimization – Ameren Newton Unit #2

Ameren

Company: Ameren Energy Generating

Site: Newton Station

Unit:	Unit #2
Location:	Newton, IL, USA
MW:	615
Boiler:	Alstom (CE)
Turbine:	GE
Primary Fuel:	Coal

Application: NOx Optimization, Steam Temp Optimization

- 20.1% Average NOx Improvements
- 1% HR Improvements at high loads
- Issues driving the need for change
  - 2003 emissions mandate to maintain NOx below **0.13** #/mmBTU
  - Avoid installing SCR
  - Sell/Trade NOx credits
- 4 month project cycle
- No outage required
- Payback of 9 months on NOx improvements 8 months on (>$400K) from Heat rate improvement

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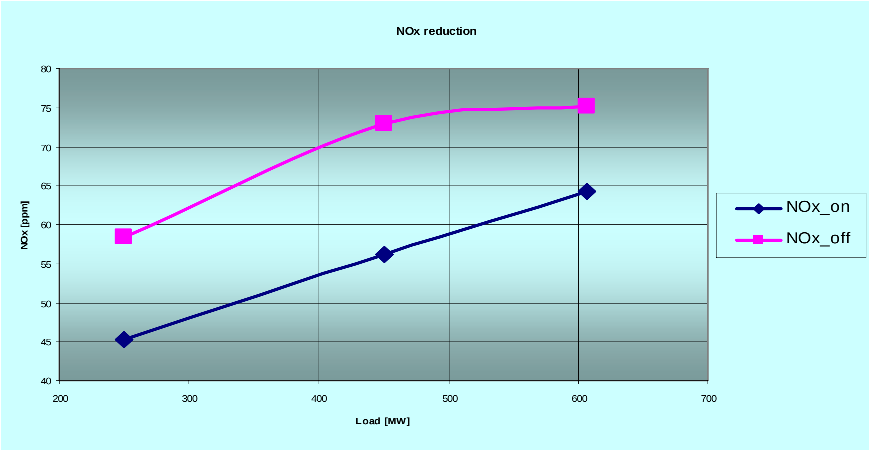
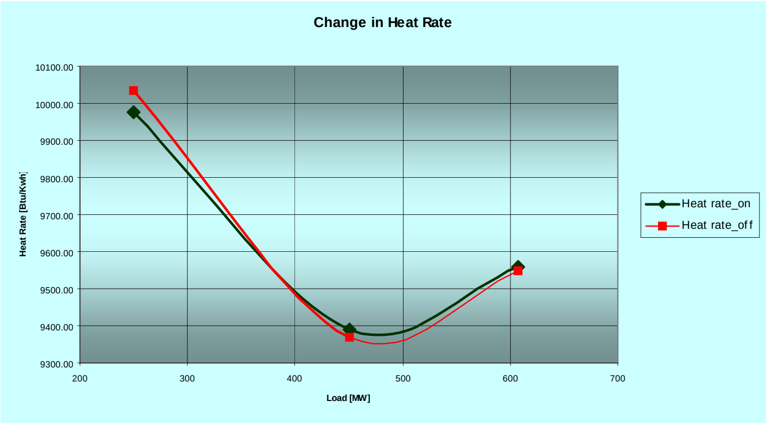
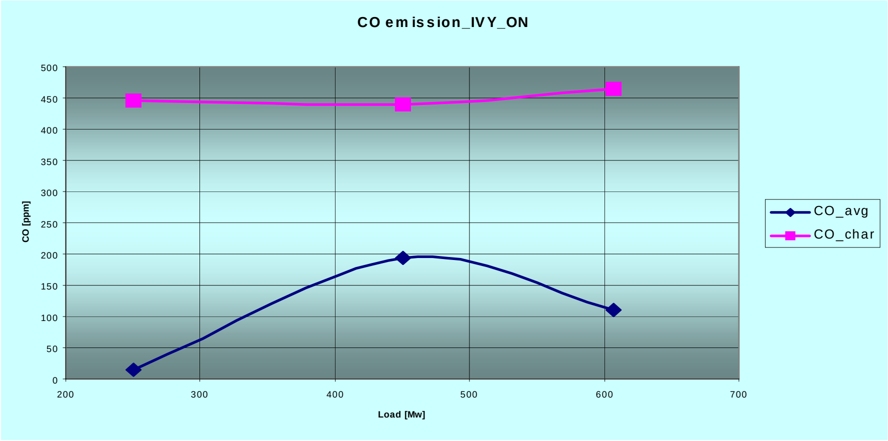
Ameren Newton Unit #2 NOx Optimization Results Overview – NOx Mode (100%)



NOx Reduction



Maintain Heat rate



Below Average CO Levels

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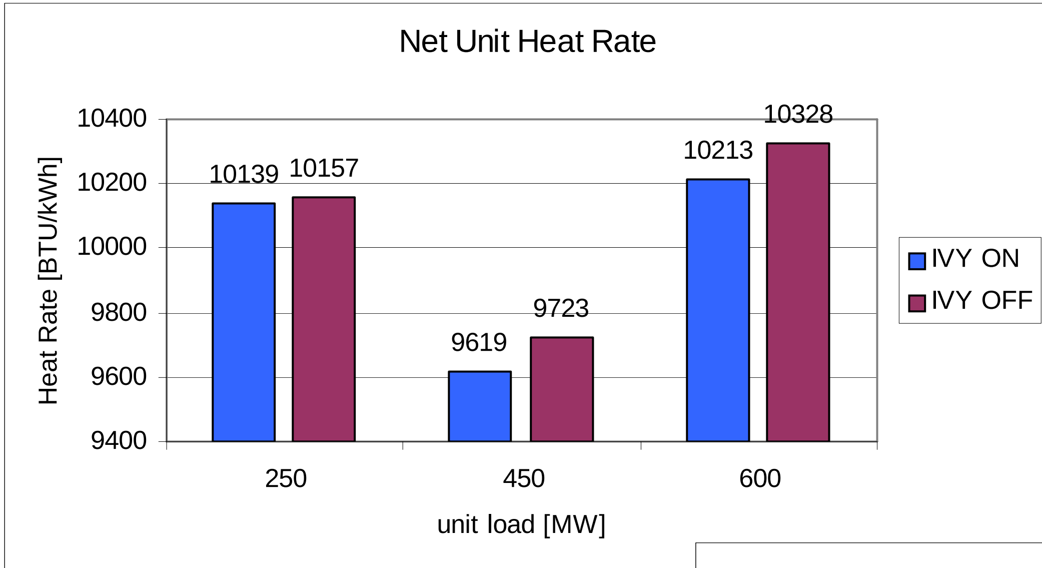
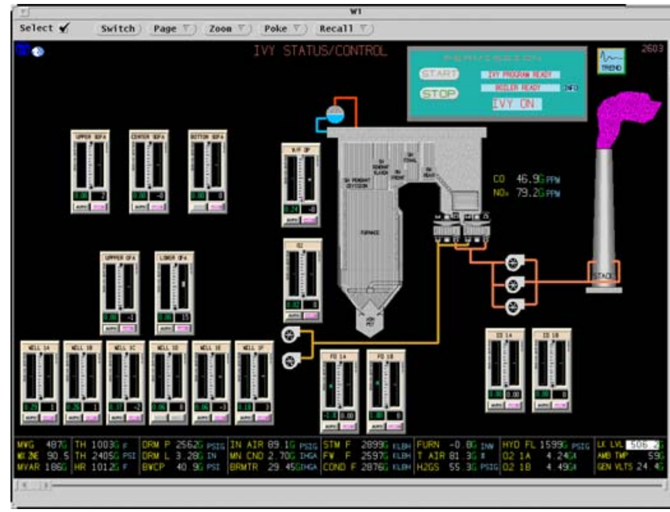
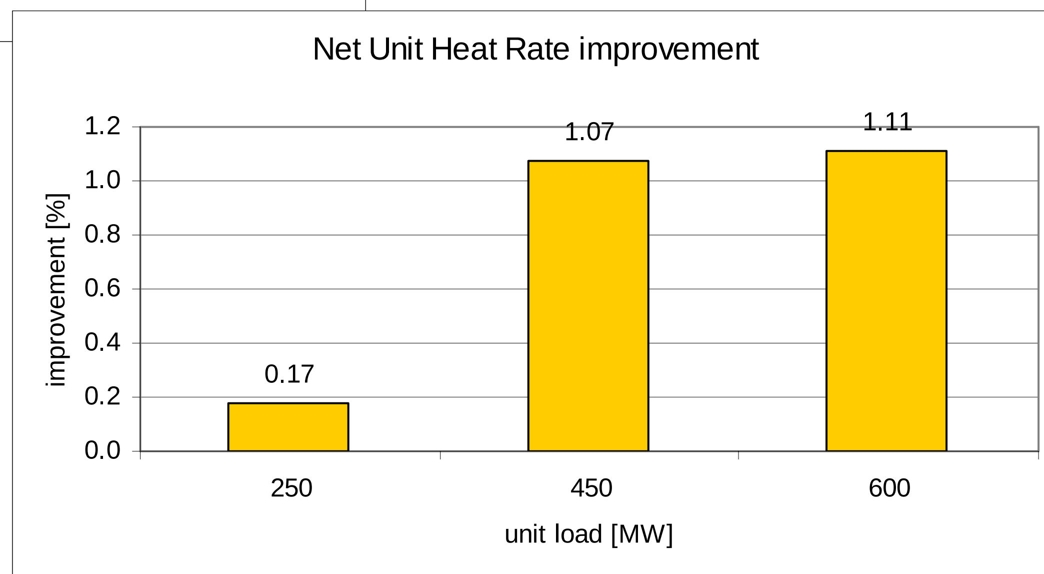
Ameren Newton Unit #2 NOx Optimization Results Overview – HR Mode (100%)





Ave. of 1% improvement in Heat Rate over the typical Load range of 450 to 600 MW equals

$407,000



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Case Study #44
Plant Optimization – Dynegy Hennepin #2

Company: Dynegy

Site: Hennepin

Unit: Unit #2
Location: Hennepin, IL
MW: 250
Boiler: Alstom (CE)
Turbine: GE
Primary Fuel: Coal

Application: NOx Optimization

- 13% Average NOx Improvements
- Issues driving the need for change
  - Drive plant average below .13 #/mmBTU
  - Prior solution ineffective
- Real-time optimization of NOx emissions and heat rate optimization
- 4 month project cycle
- No outage required
- Head to head comparison against “other “ competitive solution

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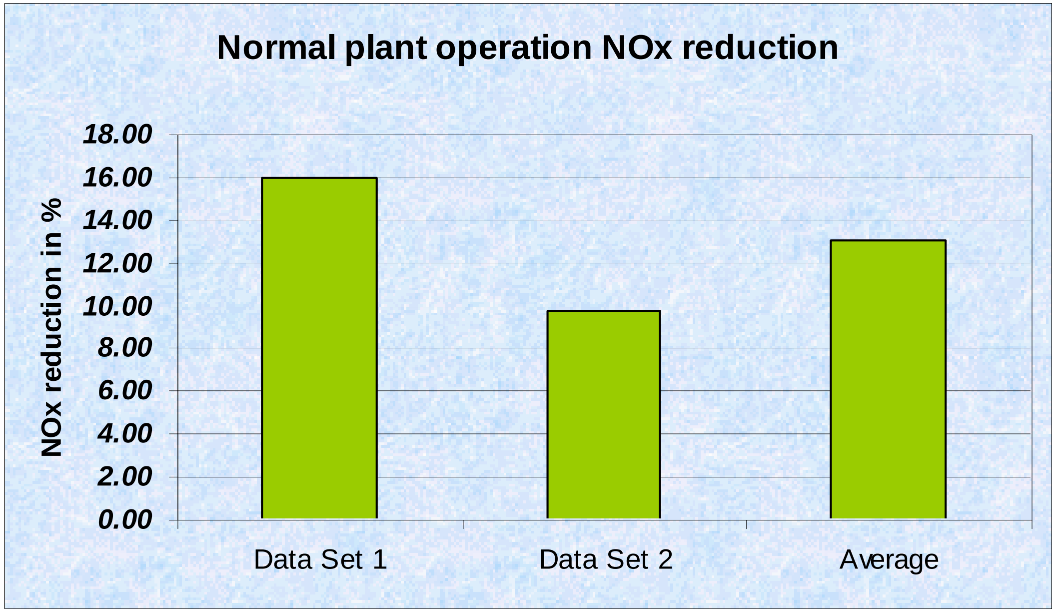
Summary

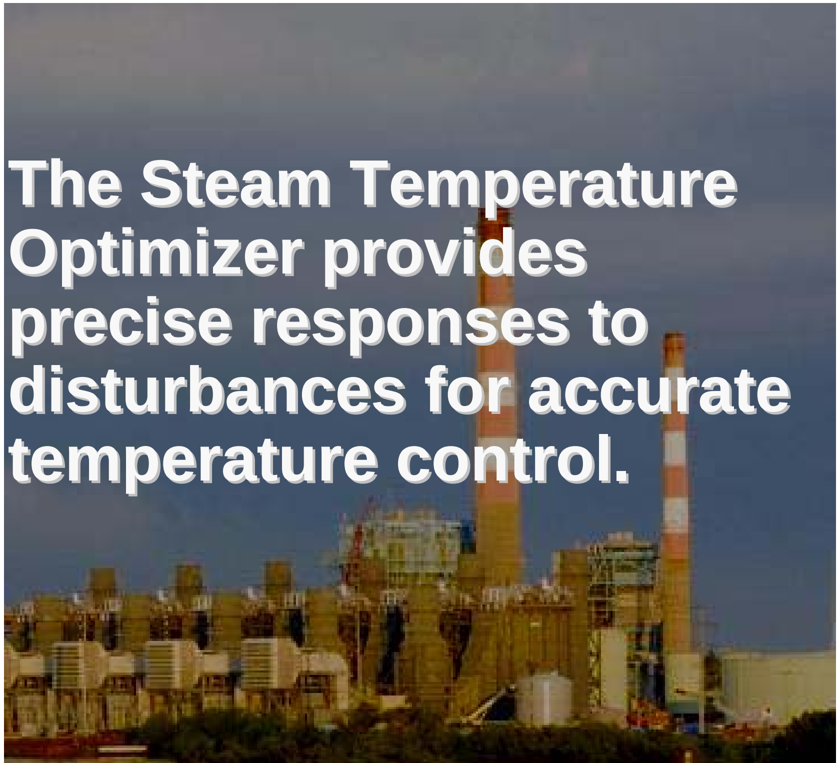


SmartEngine ON Load > 190MW January 25th, 2004 to March 3rd, 2004	Baseline - SmartEngine OFF Load > 190MW June 1st, 2003 to August 16th, 2003
NOX	**NOX**
0.112	0.141

Change in %

NOX
-21.17%

Steam Temperature Optimizer



Improve steam temperature for faster ramp rates.

- Results
  - Improves ramp rates up to 1% of MCR per minute
  - Minimizes temperature variations by up to 75%
  - Controls spray valves, tilts, pass dampers, for accurate temperature
  - Multivariable control strategy to maintain optimum steam temperature

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Case Study: Neal North Steam Temperature Optimization

Application

- 515 MW, coal-fired, drum boiler, GE turbines, WDPF control system

Challenge

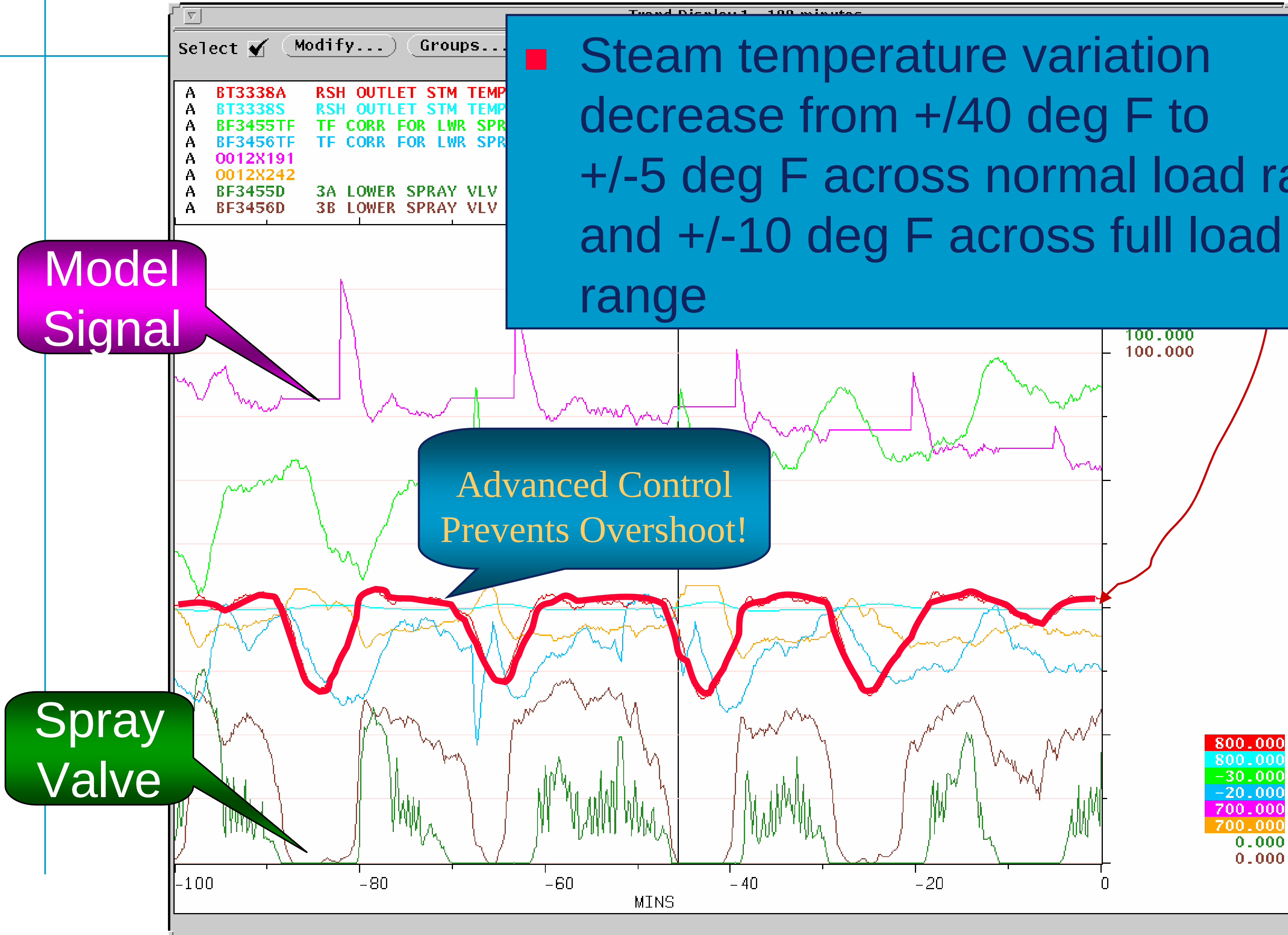
- Excessive steam temperature oscillations limited unit response to about 1% per minute at low loads and 0.3% per minute at high loads.
- Stress on boiler pressure parts caused operational falters
- Temperature variations and high steam pressure frequently proved harmful to boiler and turbine components.

Results

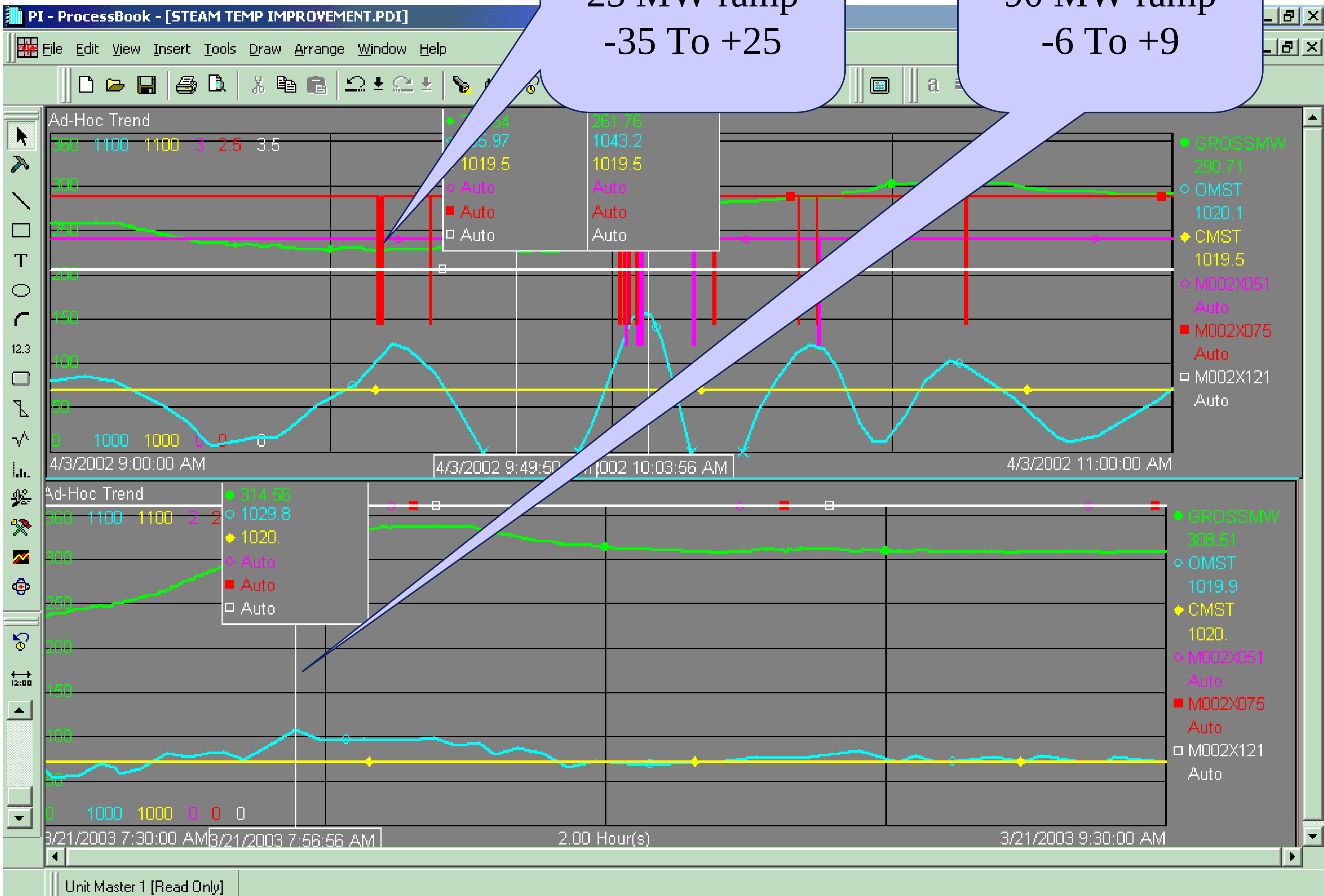
- Maintained steam temperature oscillations to within 5ºF while lowering overall main steam temperature deviations by almost 40% (compared to the data from testing with the new tuning parameters).

Radiant SH Outlet Response to Sootblowing

- Steam temperature variation decrease from +/40 deg F to +/-5 deg F across normal load range and +/-10 deg F across full load range



Results!!


Auto
25 MW ramp
-35 To +25
STO Auto
90 MW ramp
-6 To +9
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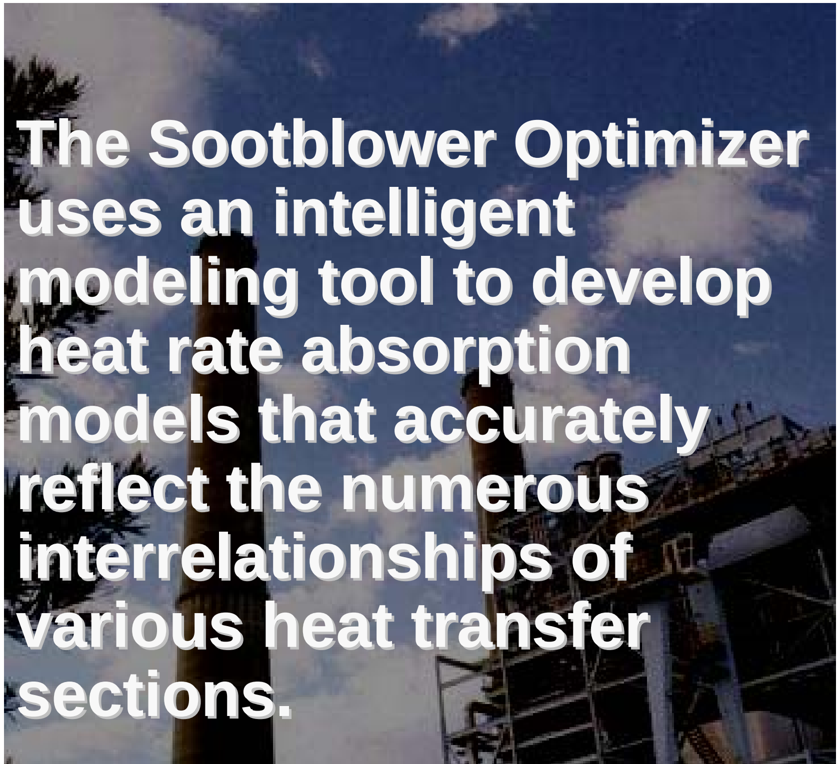
Ad-Hoc Trend
GROSSMW
OMST
CMST
M002X051
M002X075
M002X121
Auto
4/3/2002 9:00:00 AM
4/3/2002 11:00:00 AM
3/21/2003 7:30:00 AM
3/21/2003 7:56:56 AM
2.00 Hour(s)
3/21/2003 9:30:00 AM
Unit Master 1 [Read Only]

Sootblower Optimizer



The Sootblower Optimizer uses an intelligent modeling tool to develop heat rate absorption models that accurately reflect the numerous interrelationships of various heat transfer sections.

Ensure efficient sootblowing.

- Results
  - Delivers optimal cleanliness, resulting in a 0.5% heat rate improvement
  - Decreases soot accumulation
  - Improves overall boiler efficiency
  - Balances blowing sequences
  - Minimizes unnecessary steam usage
  - Reduces opacity spikes
  - Reduces NOx formations
  - Enhances steam temperature variability

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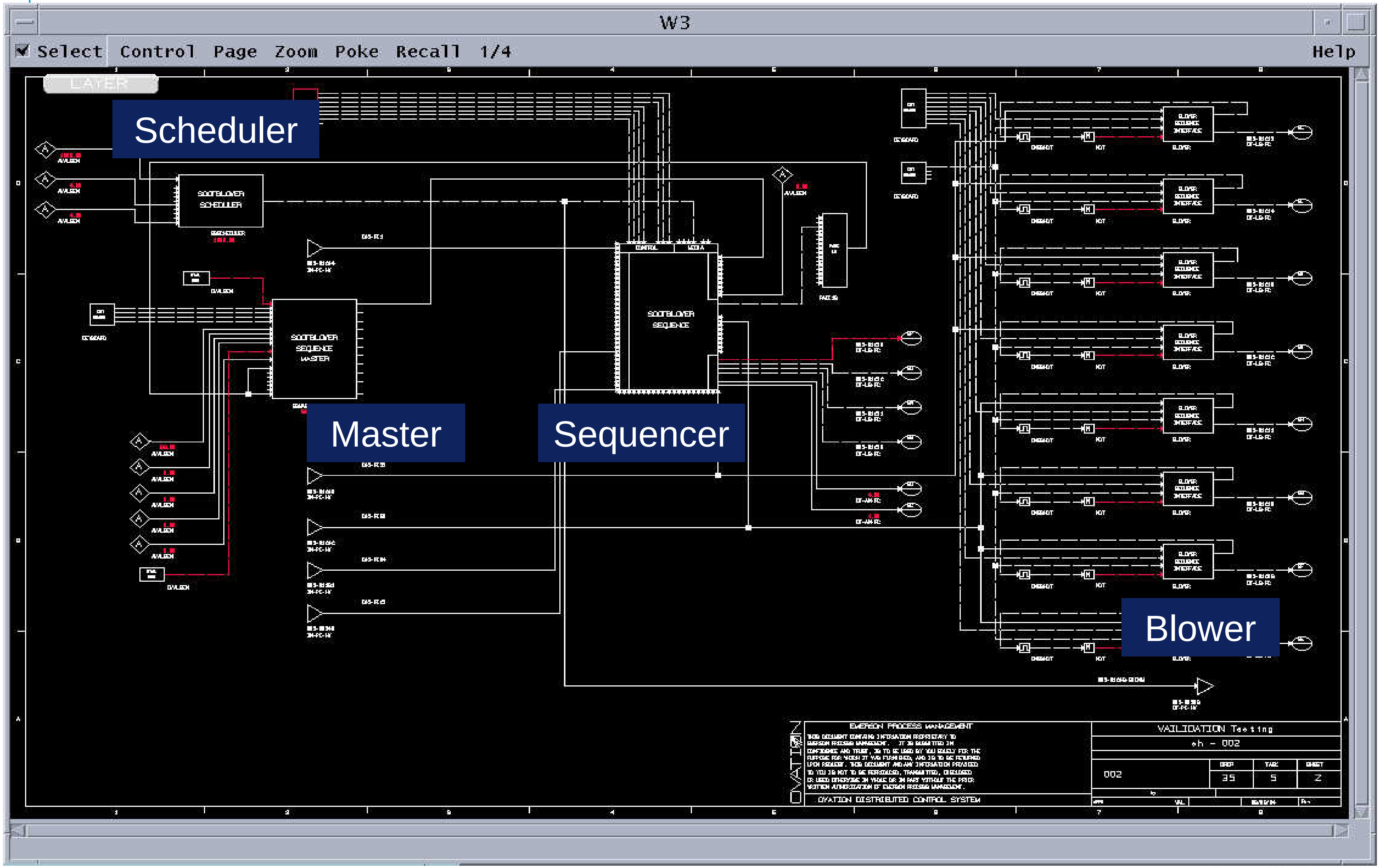
Sootblower Control Illustration



SmartEngine Sootblower

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SmartProcess™ PLANT OPTIMIZATION SOFTWARE

Key Process Parameters	Sequence Off-time	Input Data Conditioning	Model Adaptation
Sootblower Operation Advisor	Section Cleanliness Model Selection	Configuration	Plots

Logged: demo
Log Out

BOILER SECTION	DESIRED CLEANLINESS	ACTUAL CLEANLINESS	DIFFERENCE	PRIORITIES	EDIT
Water Wall	0.97	1.008	0.038		
Secondary Superheater	0.99	-0	-0.99		
Intermediate Superheater	1.02	1.08	0.06		
Finished Superheater	1	0.872	-0.128		
Reheater	1.02	0.875	-0.145		
Primary Superheater	1	1.113	0.113		
Economizer	0.95	0.81	-0.14		
Air Heater	0.95	0.964	0.014		

Treshold	0.1	
Selection	manual	

RECOMMENDED SEQUENCES:

ACTUAL SEQUENCES:

Jul 9 2003 04:11:47 PM : Cleanliness Algorithm: Secondary Superheater is fouled. However no appropriate sequence can be choosen. Reheater is fouled. However no appropriate sequence can be choosen. Economizer is fouled. However no appropriate sequence can be choosen. Finished Superheater is fouled. However no appropriate sequence can be choosen.
Jul 9 2003 04:11:47 PM : Steam Temp. Algorithm: Load is high, reheater steam temp. is high. No action is recommended.
Jul 9 2003 04:11:47 PM : Time Algorithm: No sequence has exceeded its maximum off-time. No action is recommended.
Jul 9 2003 04:11:47 PM : Running sequences: Seq01, Seq02, Seq03, Seq04, Seq06, Seq08, Seq10, Seq11, Seq12, Seq14, Seq16, Seq17, Seq18.
Jul 9 2003 04:11:47 PM : Recommended sequences: no sequence is recommended.
Jul 9 2003 04:11:24 PM : Cleanliness Algorithm: Secondary Superheater is fouled. However no appropriate sequence can be choosen. Reheater is fouled. However no appropriate sequence can be choosen. Economizer is fouled. However no appropriate sequence can be choosen. Finished Superheater is fouled. However no appropriate sequence can be choosen.
Jul 9 2003 04:11:24 PM : Steam Temp. Algorithm: Load is high, reheater steam temp. is high. No action is recommended.
Jul 9 2003 04:11:24 PM : Time Algorithm: No sequence has exceeded its maximum off-time. No action is recommended.
Jul 9 2003 04:11:24 PM : Running sequences: Seq01, Seq02, Seq03, Seq04, Seq06, Seq08, Seq10, Seq11, Seq12, Seq14, Seq16, Seq18.
Jul 9 2003 04:11:24 PM : Recommended sequences: no sequence is recommended.
Jul 9 2003 04:10:49 PM : Cleanliness Algorithm: Secondary Superheater is fouled. However no appropriate sequence can be choosen. Reheater is

Archive

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Case Study: Sootblower Optimization
Southern California Edison - Mohave Unit #1

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL® Company

Company: Southern California Edison

Site: Mohave Station

Unit: Unit #1
Location: Laughlin, NV
MW: 800
Boiler: Alstom (CE)
Turbine: GE
Primary Fuel: Coal

Application: Steam Temperature Optimization

- Heat transfer rate increases
  - 8-10 % water wall and div superheaters
  - 6-7% final superheater and front reheat
  - 2-4% rear reheat and economizer
- Opacity reduction
- Issues driving the need for change:
  - Reduced opacity spikes during sootblowing and load ramps
- Real-time sootblower optimization
- 5 month project cycle
- No outage required
- Estimated payback of 8 months

EMERSON. Process Management

Global Performance Advisor

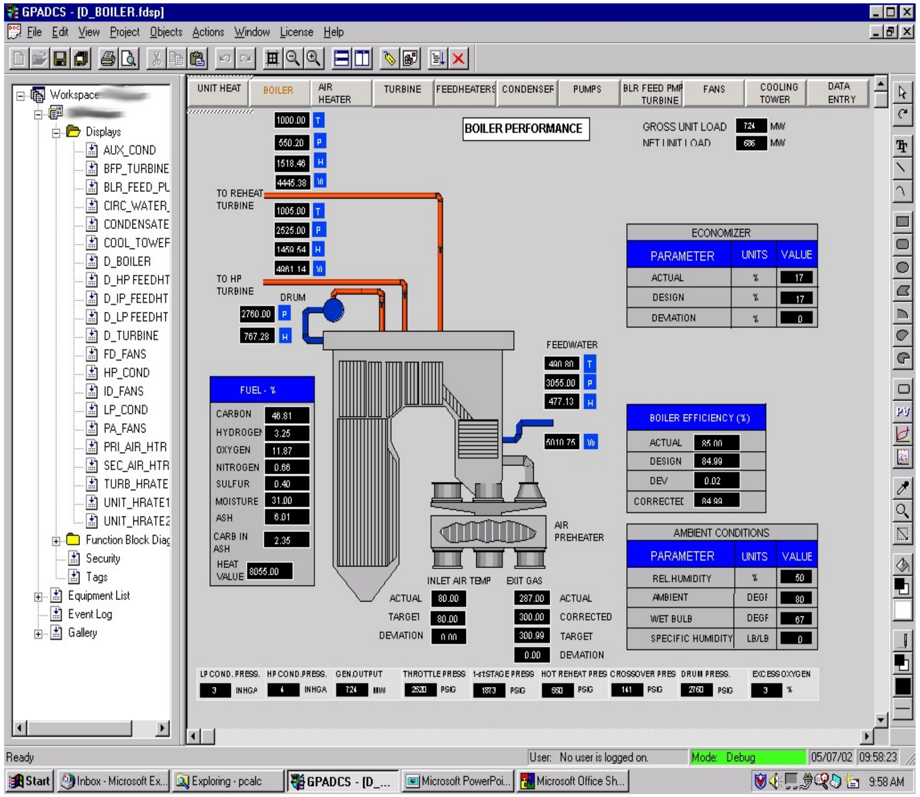
Monitor and benchmark plant performance.

- Results
  - Reduces operating costs by tracking unit heat rate penalty costs over time and indicating dollars lost due to equipment performance deviations
  - Calculates net unit heat rate and tracks heat rate deviations
  - Displays deviations and cost of deviations to help operators determine corrective action or flag equipment repair and maintenance needs.

EMERSON. Process Management

SmartProcess™ Global Performance Advisor

- Unit Heat Rate Module
- Turbine Heat Rate Module
- Turbogenerator Heat Balance
- Condenser Performance Module
- Boiler Performance Module
- Economizer Performance Module
- Boiler Feedwater Feedheater Train
- Boiler Feedpump Turbine Module
- Fan Efficiency Module
- Large Pump Performance Module
- Cooling Tower Module



EMERSON
Process Management

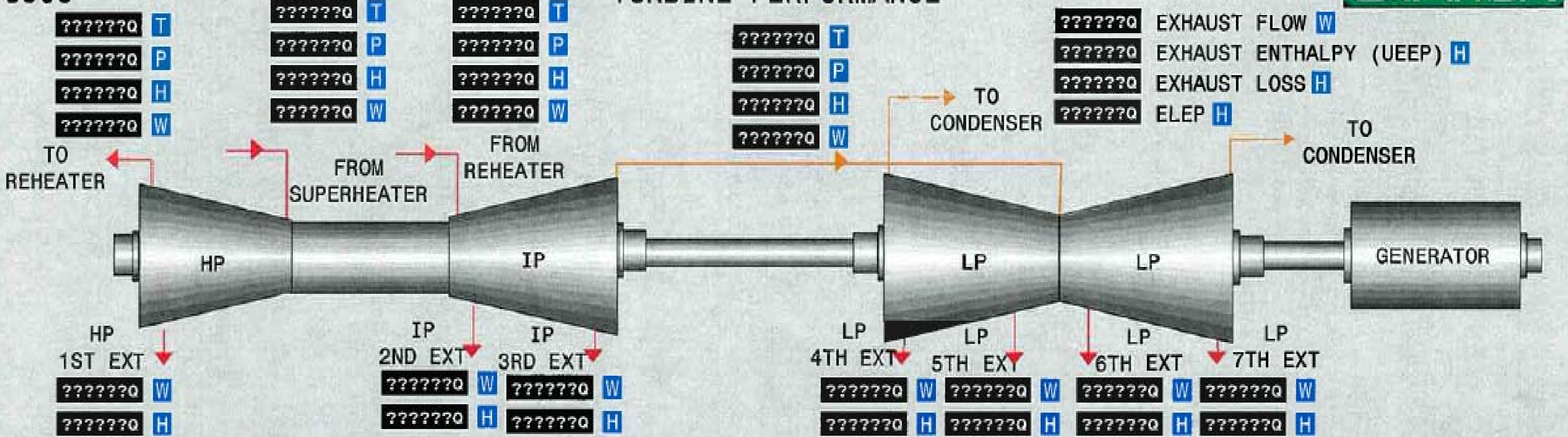
MAIN MENU | LDC | TURBINE MASTER | BOILER OVERVIEW | AIR/DRAFT CONTROL | FEEDWATER CONTROL | TURB PP CONTROL | TURB VLV CONTROL | GLAND STEAM 1 | GLAND STEAM 2 | LUBE OIL SYSTEM | EMERGENCY TRIP | REACTIVE CAPABILITY | ROTOR STRESS | STEAM CHEST

GPA MENU | TURBINE PERFORM | TURBINE HEAT | GENERATOR PRESYNC | ATC PRESTART | TURBINE ROLL | TURBINE WTR DTCT | ATC HOLD/ TRIPS | TURBINE SUPERVISOR | TURBINE TEMPS | GENERATOR SYSTEMS

#3906

TURBINE PERFORMANCE

OVATION



TURBINE SECTION PERFORMANCE

PARAMETER	ENG UNIT	HP	IP	LP	REHEAT
ACTUAL EFFICIENCY	%	??????Q	??????Q	??????Q	??????Q
DESIGN EFFICIENCY	%	??????Q	??????Q	??????Q	??????Q
DEVIATION	%	??????Q	??????Q	??????Q	??????Q
PCT LOAD GENERATION	%	??????Q	??????Q	??????Q	??????Q
EXHAUST MOISTURE	%			??????Q	

KEY PRESSURES

PARAMETER	ENG UNIT	ACTUAL	CORRECTED
FIRST STAGE	PSIG	??????Q	??????Q
REHEAT	PSIG	??????Q	??????Q
CROSSOVER	PSIG	??????Q	??????Q

PARAMETER ENTRY

GENERATOR PERFORMANCE

PARAMETER	UNITS	VALUE
GROSS OUTPUT	MW	??????Q
NET OUTPUT	MW	??????Q
AUXILIARY POWER	MW	??????Q
TOTAL GENERATOR LOSSES	MW	??????Q
GENERATOR EFFICIENCY	%	??????Q
APPARENT POWER	MVA	??????Q
POWER FACTOR	REAL	??????Q

LDC MODE	MEGAWATTS	THROT PRESS	THROTTLE TEMP	SH TEMP	RH TEMP	COND PRESS	INST OPACITY	EXCESS O2	DRUM LEVEL
	?????Q ?????	?????Q ?????	?????Q ?????	?????Q ?????	?????Q ?????	?????Q ?????	?????Q ?????	?????Q ?????	?????Q ?????

MAIN MENU | LDC | TURBINE MASTER | BOILER OVERVIEW | AIR/DRAFT CONTROL | FEEDWATER CONTROL | TURB PP CONTROL | TURB VLV CONTROL | GLAND STEAM 1 | GLAND STEAM 2 | LUBE OIL SYSTEM | EMERGENCY TRIP | REACTIVE CAPABILITY | ROTOR STRESS | STEAM CHEST

GPA MENU | TURBINE PERFORM | TURBINE HEAT | GENERATOR PRESYNC | ATC PRESTART | TURBINE ROLL | TURBINE WTR DTCT | ATC HOLD/ TRIPS | TURBINE SUPERVISOR | TURBINE TEMPS | GENERATOR SYSTEMS

#3905

TURBINE HEAT RATE/GENERATOR OUTPUT

OVATION

GROSS TURBINE CYCLE HEAT RATE

PARAMETERS	ENG UNIT	VALUE
ACTUAL	BTU/KWH	??????Q
DESIGN	BTU/KWH	??????Q
DEVIATION	BTU/KWH	??????Q
CORRECTED	BTU/KWH	??????Q

GENERATOR OUTPUT

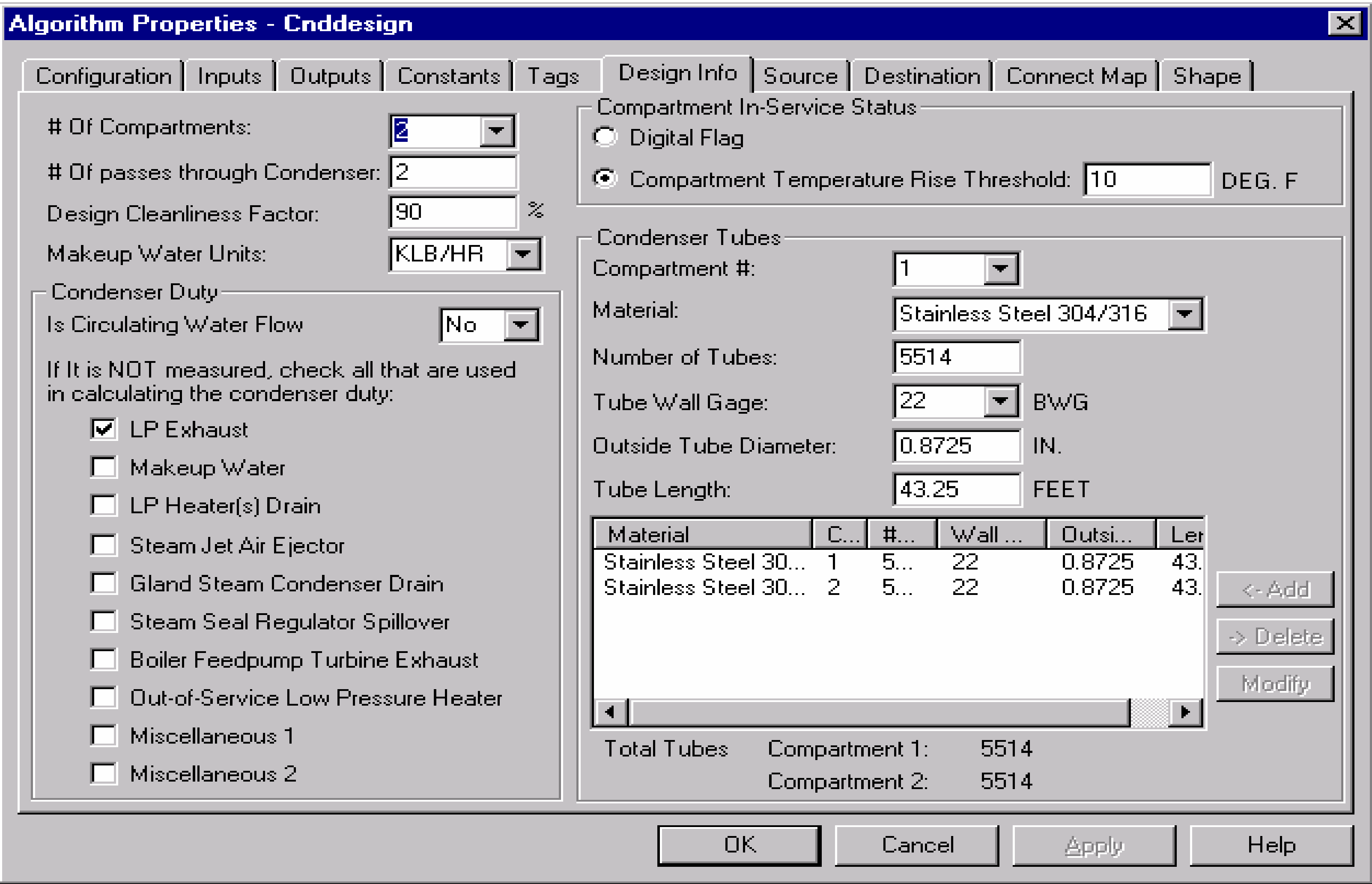
PARAMETERS	ENG UNIT	VALUE
GROSS OUTPUT	MW	??????Q
TOTAL CORRECTION	MW	??????Q
CORRECTED OUTPUT	MW	??????Q

DETAILED HEAT RATE / OUTPUT CORRECTION DATA

PARAMETERS	ENG UNIT	DESIGN VALUE	ACTUAL VALUE	OUTPUT DEVIATION (MW) -2 -1 0 1 2		HEAT RATE DEV (BTU/KWH) 50 25 0 -25 -50	
THROTTLE STEAM TEMP	DEGF	??????Q	??????Q	??????Q		??????Q	
REHEAT STEAM TEMP	DEGF	??????Q	??????Q	??????Q		??????Q	
THROTTLE STEAM PRESS	PSIG	??????Q	??????Q	??????Q		??????Q	
REHEAT PRESS DROP	%	??????Q	??????Q	??????Q		??????Q	
EXHAUST PRESS	IN HGA	??????Q	??????Q	??????Q		??????Q	
REHEAT SPRAY FLOW	KLB/HR	??????Q	??????Q	??????Q		??????Q	
SUPERHEAT SPRAY FLOW	KLB/HR	??????Q	??????Q	??????Q		??????Q	
BFP TURB EXT STEAM	KLB/HR	??????Q	??????Q	??????Q		??????Q	
MAKE UP WATER	KLB/HR	??????Q	??????Q	??????Q		??????Q	
CONDSR SUBCOOL	DEGF	??????Q	??????Q	??????Q		??????Q	
TOP HEATER TTD	DEGF	??????Q	??????Q	??????Q		??????Q	
OTHER HTRS COMBINED TTD	DEGF					??????Q	
TOTALS				??????Q		??????Q	

LDC MODE	MEGAWATTS	THROT PRESS	THROTTLE TEMP	SH TEMP	RH TEMP	COND PRESS	INST OPACITY	EXCESS O2	DRUM LEVEL
	?????Q?????	?????Q?????	?????Q?????	?????Q?????	?????Q?????	?????Q?????	?????Q?????	?????Q?????	?????Q?????

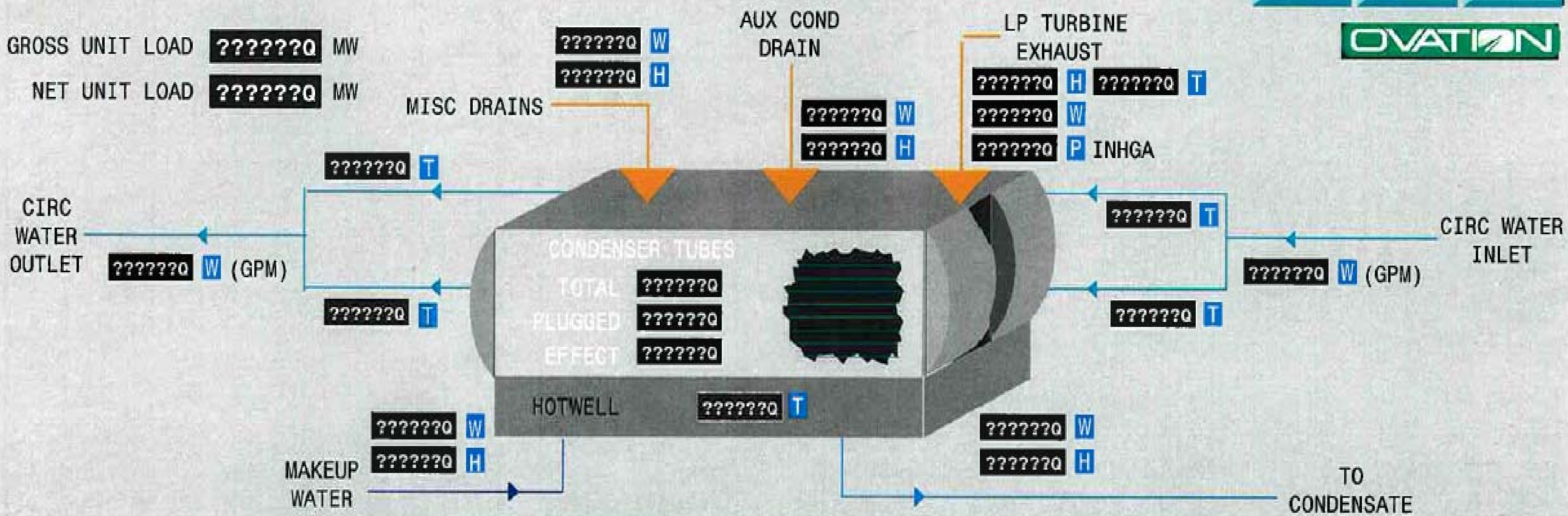
Condenser Design Data Screen



#3907

CONDENSER PERFORMANCE

OVATION

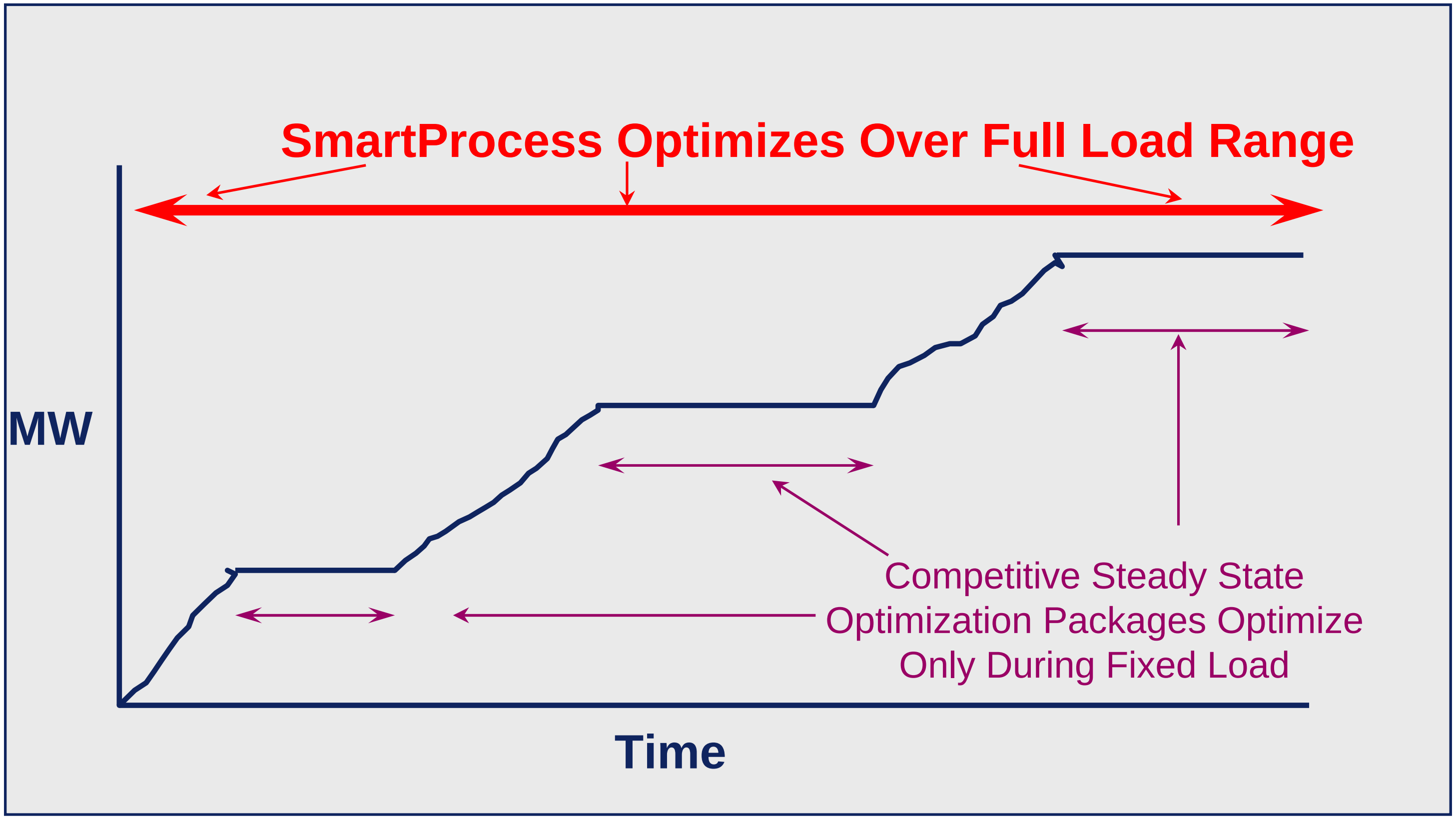


PARAMETER	UNITS	ACTUAL	EXPECTED (CLEAN CONDITION)
BACK PRESSURE	INHGA	??????Q	??????Q
HEAT TRANSFER COEFFICIENT	BTU/(HR*FT^2*^{o}F)	??????Q	??????Q
CLEANLINESS	%	??????Q	??????Q
TERMINAL TEMP DIFFERENCE	DEGF	??????Q	
INITIAL TEMP DIFFERENCE	DEGF	??????Q	
SUBCOOLING	DEGF	??????Q	
LOG MEAN TEMP DIFFERENCE	DEGF	??????Q	
CIRC WATER VELOCITY	FT/SEC	??????Q	
CONDENSER DUTY	MBTU/HR	??????Q	

PARAMETER ENTRY

SmartProcess Design Advantages

- SmartProcess modules dynamically optimize the process throughout the full plant operating range

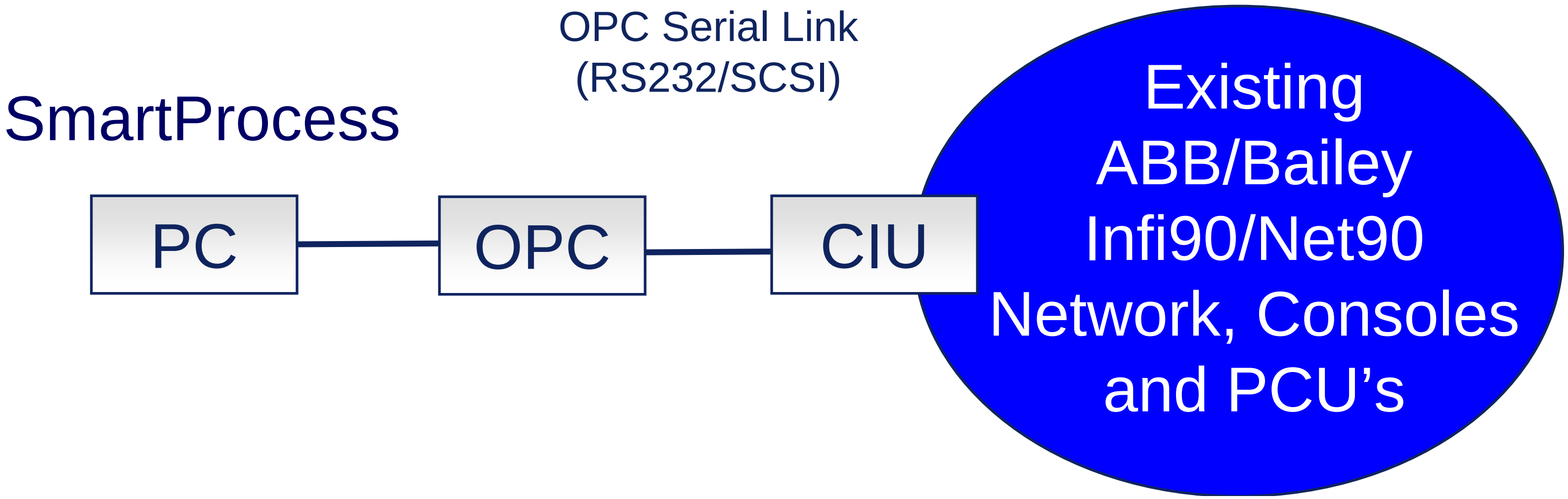


Typical SmartProcess Project Steps

- Site Assessment
- Project Start
- Development of Plant Test Plan and Design of control modifications
- Execution of Plant Test Plan
- Data Collection & Conditioning
- Model Design & Validation
- Installation of Model
- Advisory Mode Operation & Operator Training
- Closed-Loop Mode Operation
- Final Training & Performance Assessment

EMERSON Process Management

Systems Interconnect Capabilities



- <u>RS232 Throughput @ 9600b, @19.2kb</u>

  Scheme 1 CIU* 1 Port - ~250pps, 500pps

  Scheme 2 CIU 2 Ports - ~500pps, 750pps

  Scheme 3 shown above similar to Scheme 1 or 2 capabilities

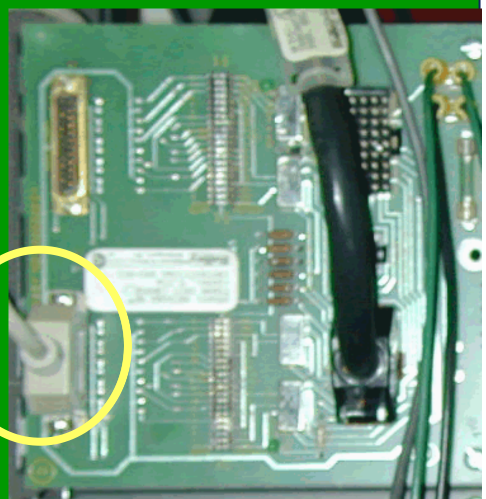
  Note * Support only a single connection

CIU Device	Points	Exception Reports	Control	System
NSPM01	500	No	No	
IMSPM01	500	No	No	
IMCPM02	500	No	No	
IMCPM03	500	Yes	Yes	
NCIC01	500	Yes	Yes	
NCIU01	500	Yes	Yes	
NCIU02	2,500	Yes	Yes	N90
NCIU03	10,000	Yes	Yes	N90
NCIU04	10,000	Yes	Yes	I90
INPCI01	500	Yes	Yes	
INPCI02	10,000	Yes	Yes	I90/S
INICI01	10,000	Yes	Yes	I90/S
INICI12*	10,000	Yes	Yes	I90/S
INICI03*	30,000	Yes	Yes	I90/S

Bailey CIU Components

Bailey CIU Termination Unit

Printer port



Serial port to OPC Server

Computer Transfer Module (ICT)

Network Interface Slave (NIS)

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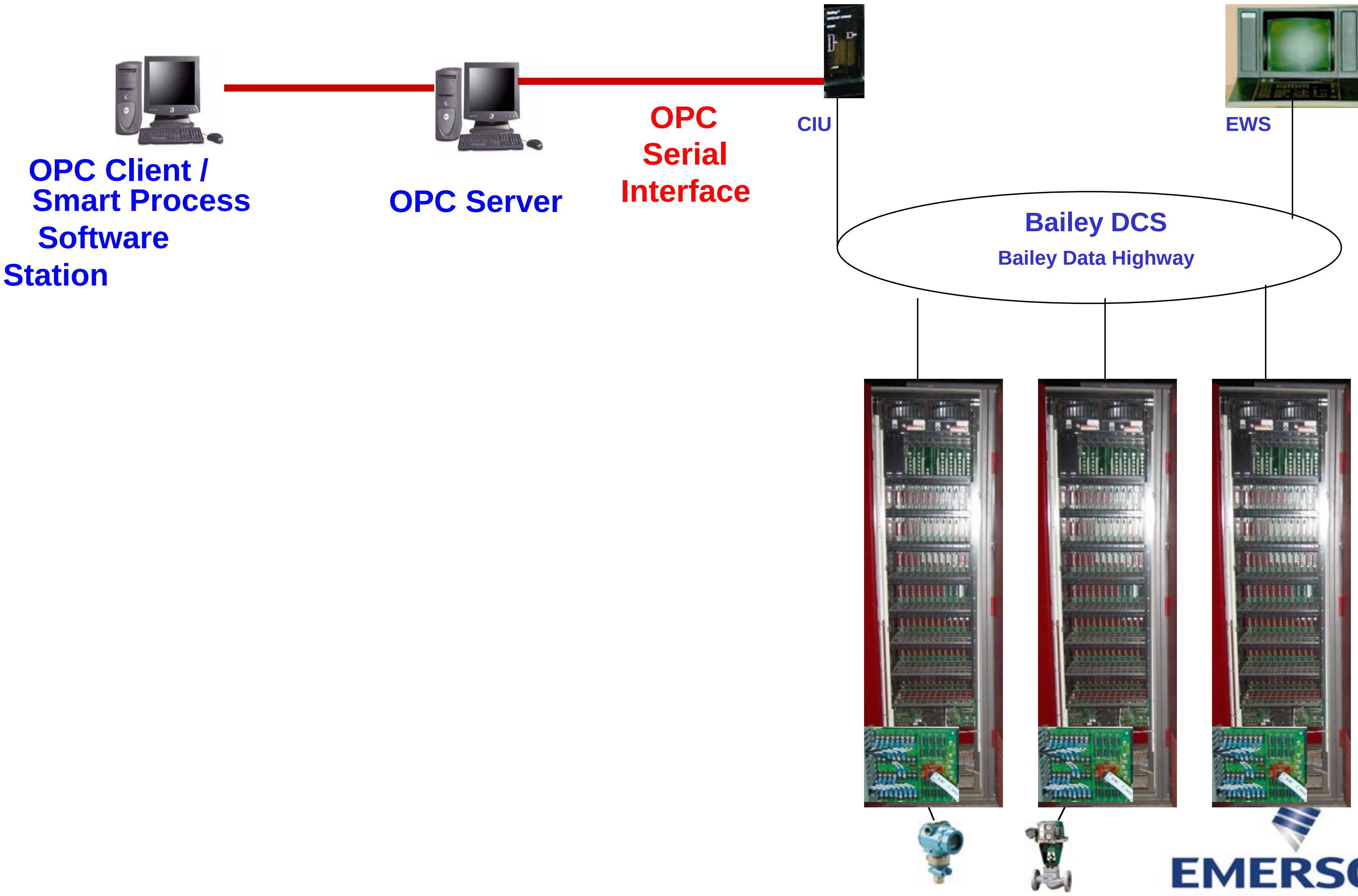
Power Plant Smart Process Solution



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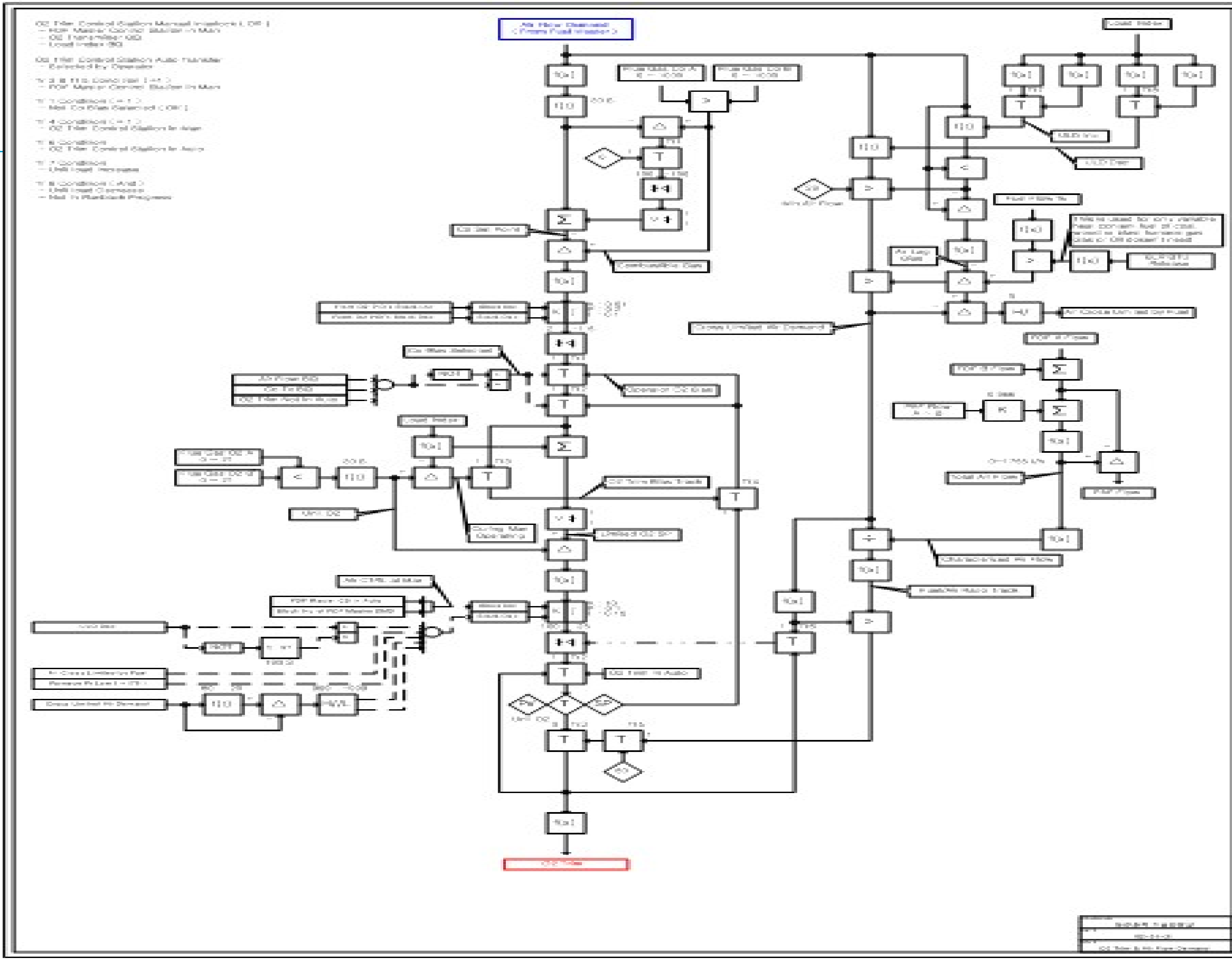
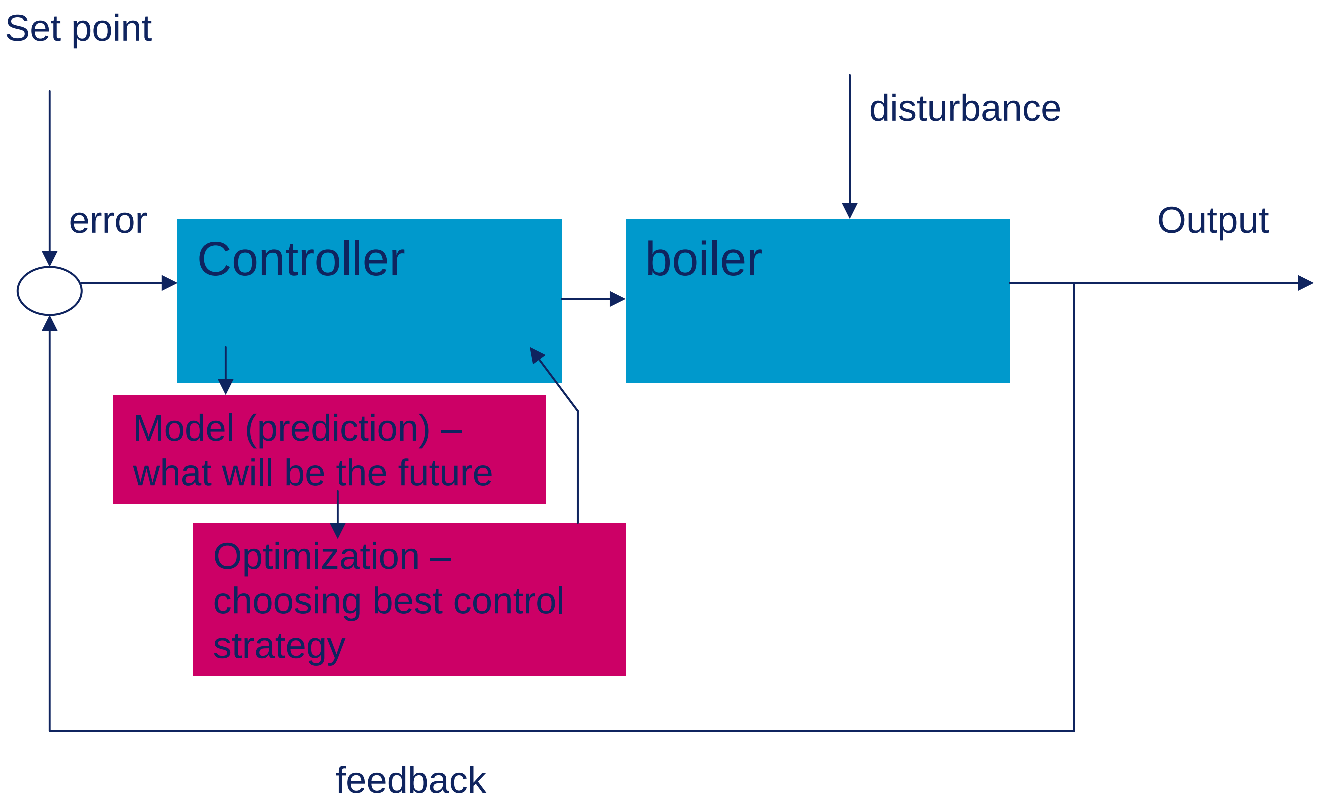
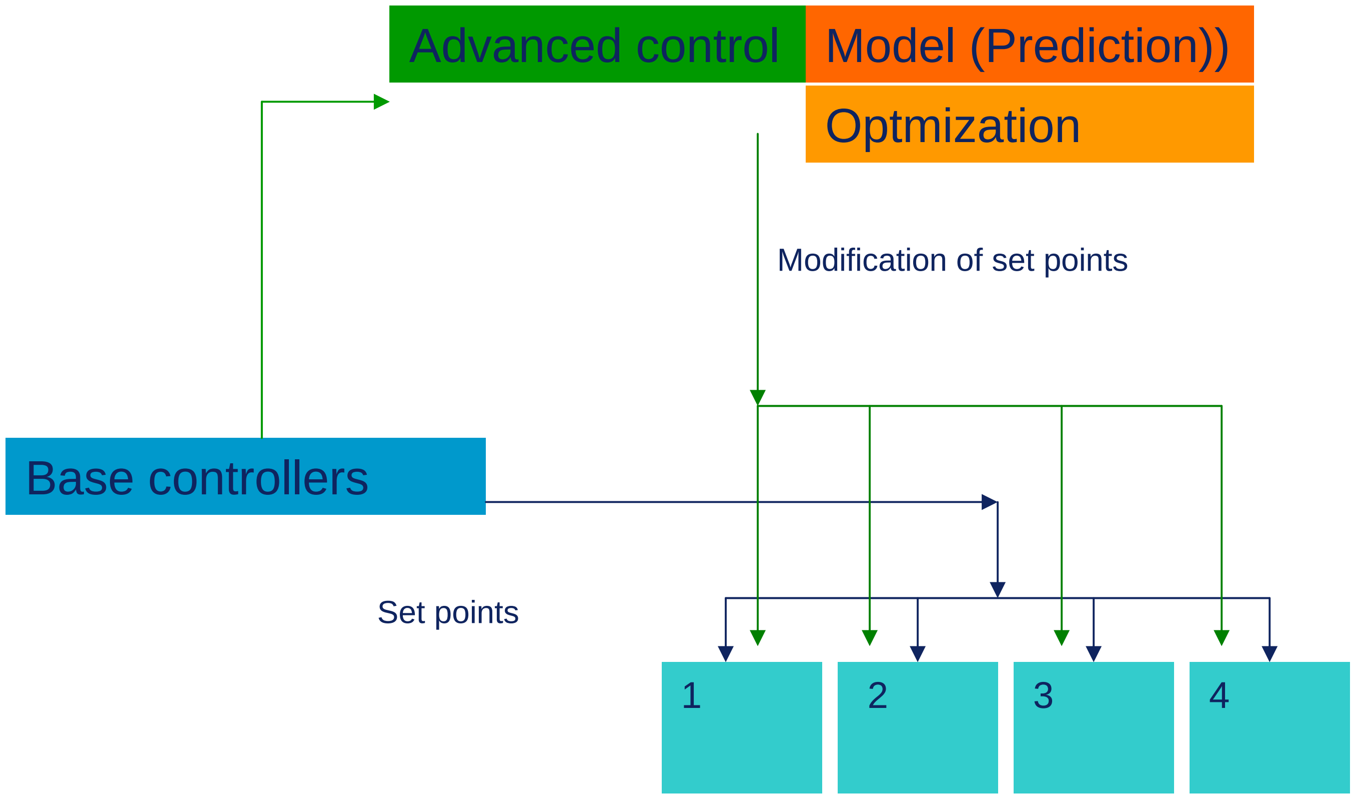


Advanced Control





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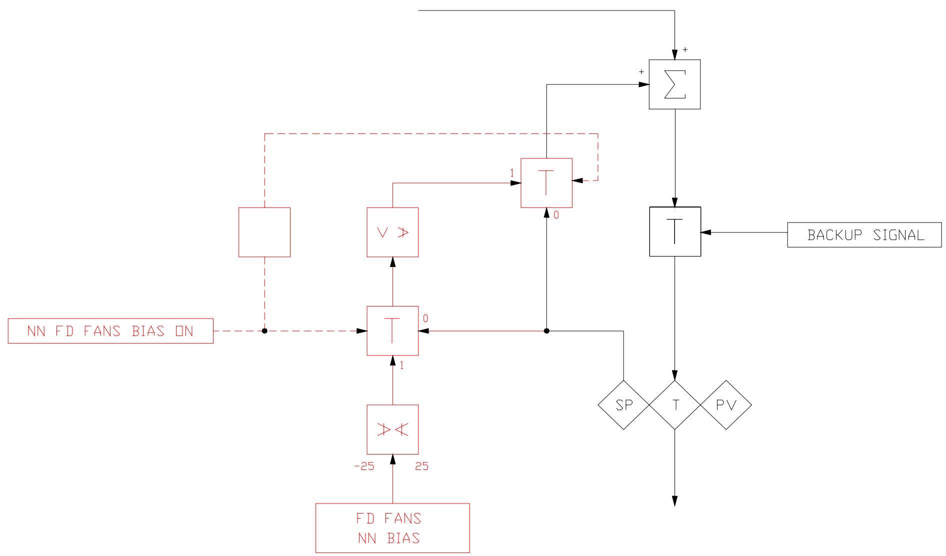

CHANGES	EMERSON PROCESS MANAGEMENT POWER AND WATER SOLUTIONS			SMARTENGINE HOOKS DANJIN POWER PLANT #1
	05/2004	NAME	SIGNATURE	FD FANS BIAS
	DESIGN	R. JANKOWSKI		
	ELABORATE	R. JANKOWSKI		
	VERIFY	W. BRATEK		
	CONFIRM	W. BRATEK		NO OF PICTURE P.13

TT

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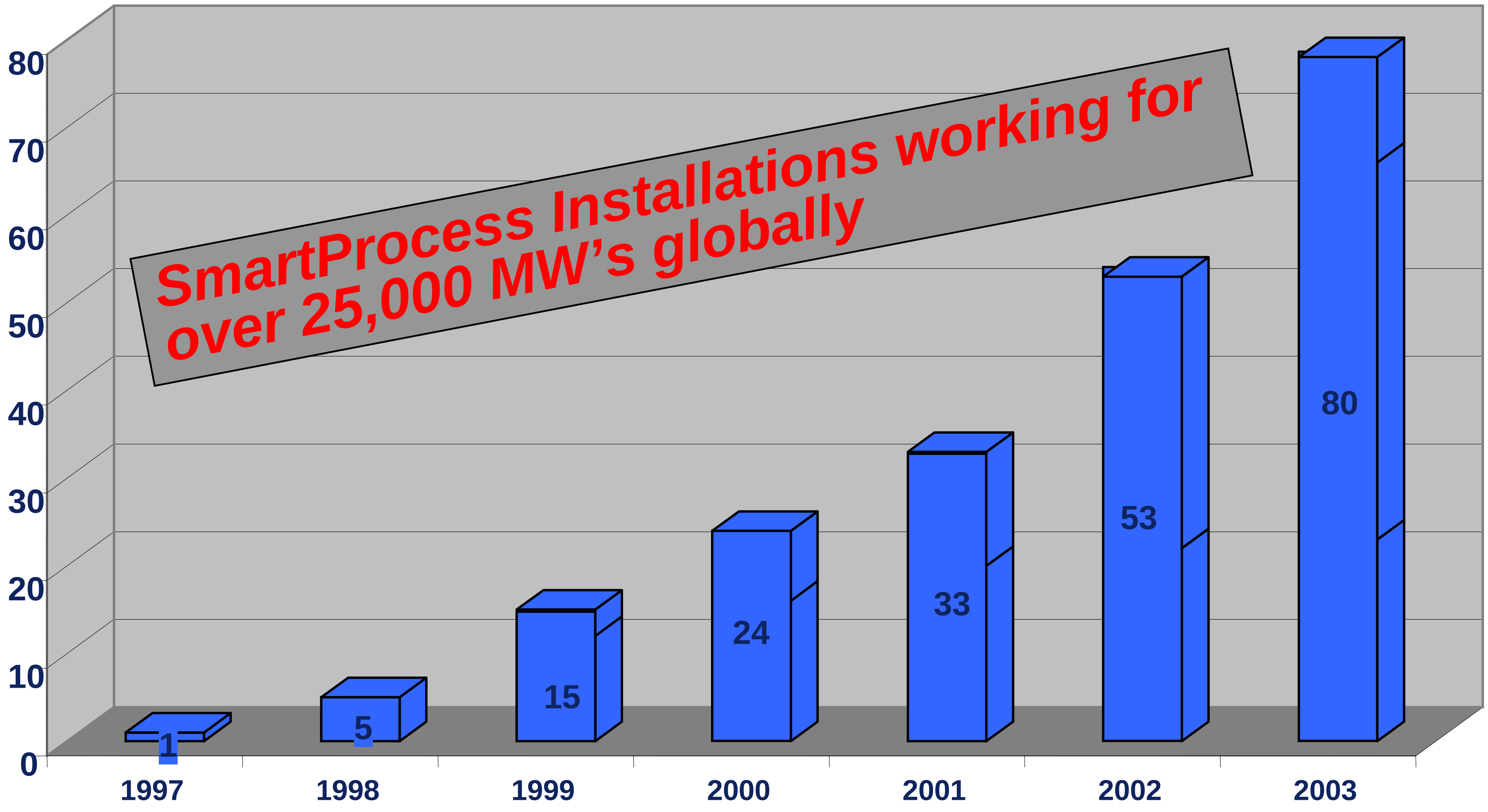
Process Management

SmartProcess Installations - Number



EMERSON Process Management

Major Utilities Choose Emerson SmartProcess

- Considered a competitive advantage
- SmartProcess is latest technology
- Won competitive bids
- Proven sustainable benefits

FPL
Florida Power & Light

Southern California Edison

NSP
Northern States Power

Wisconsin Electric

AN ISO 9001 COMPANY
KEPCO
THE POWER SUPPLIER SINCE 1946

HOME

Xcel Energy

PacifiCorp

MidAmerican
ENERGY HOLDINGS COMPANY
OBSESSIVELY, RELENTLESSLY AT YOUR SERVICE

EMERSON
Process Management

Summary

- Comprehensive package for complete and precise optmization of Power Plant Process.
- Total solution from initial site assessment to final commissioning
- Each SmartProcess module is fully engineered, validated and configured to meet specific generating unit requirements
- Platform independence allows SmartProcess products to be implemented on WDPF, Ovation or any other distributed control system
- Plant model incorporates automatic, adaptive error detection and correction
- Proven Technology with large global installations

SmartProcess™

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