Chariton Valley Biomass Project

Research / Reports

Crop Studies & Cost

Soil Stability/Erosion/Carbon

Harvest Impacts on Wildlife

Air/Ash/Water Impacts

Equipment Development

Baler Development

Bale Accumulator

Bale Handling

Biomass Processing

Processing Facility

June 2005

August 2005

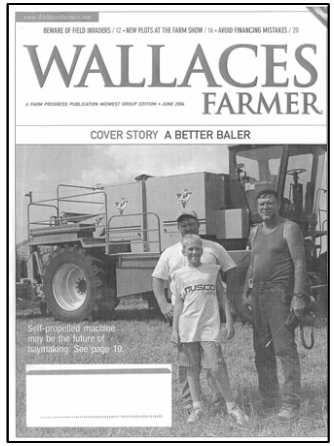
September 2005

November 2005

Outreach

Public Outreach

Web Outreach

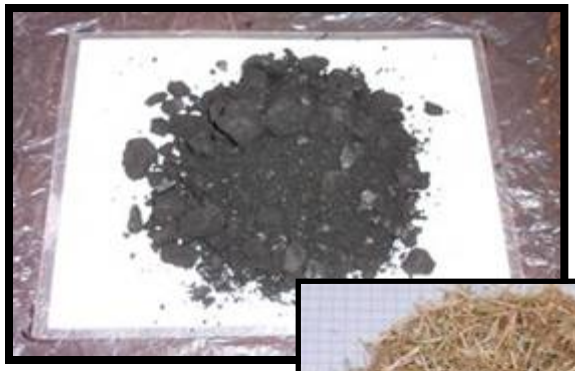


Publications

Switchgrass Cofiring
Ottumwa, Iowa

- Ottumwa Generating Station
  - Alliant Energy / Mid-American
  - 726 MW, PRB Coal, 1982 startup
  - Twin furnace T-fired PC boiler
  - 2.5 to 5% heat input from switchgrass, 12.5 to 25 ton/hr
  - Separate biomass injection, 2 - 4 ports

- Status
  - 2000 hr continuous test burn on-going
  - Newly constructed facility completed
  - Long term test to investigate fouling, slagging, and corrosion impacts



- Fuel
  - 3’ x 4’ x 8’ switchgrass bales
  - 2-step milling process to 1/8” minus

Project Characteristics

- Test Facility (The “Grass Station”)
  - Designed for 12.5 ton/hour
  - 25,000 tons of switchgrass for 2,000 hour continuous test burn accumulated from 4,000 acres over several years
  - Contains several innovative, first-of-a-kind pieces of equipment (which are working great)
  - 17.5 MW of BASELOAD Renewable Energy
  - Automated control & monitoring system
  - 24 hour data logging
  - Would require 100,000 tons/yr, from 25k to 75k acres initially
- Commercial Facility
  - Designed for 25 tons/hr
  - Designed for automated crane operation based on Danish straw-fired plants
  - 35.0 MW of BASELOAD Renewable Energy
  - Air permits already granted for construction on the merit of previous air emissions test results
  - Would require 200,000 tons/yr, from 50k to 150k acres initially

ORNL-DWG 93M-8892

SWITCHGRASS

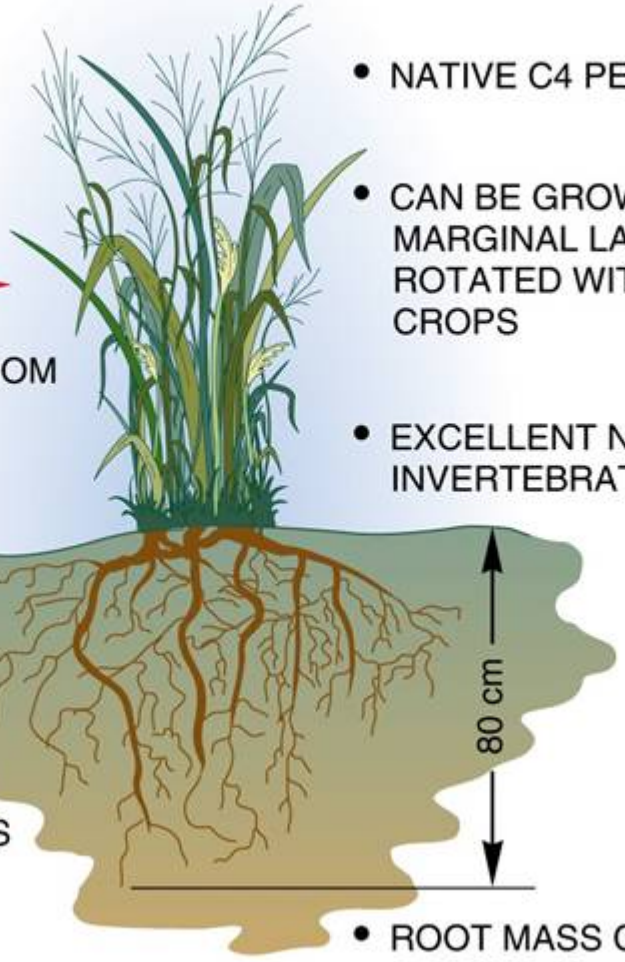
- DECREASED WINDFLOW AND EVAPORATION

WIND

- LESS EROSION FROM SURFACE FLOW

WATER

- DEEP ROOTING SYSTEM BENEFITS



- NATIVE C4 PERENNIAL
- CAN BE GROWN ON MARGINAL LANDS OR ROTATED WITH OTHER CROPS
- EXCELLENT NESTING AND INVERTEBRATE HABITAT
- ROOT MASS CAN REACH 8 DRY Mg/ha; AN EXCELLENT CARBON SINK

Growing Season

After Frost, Before Harvest

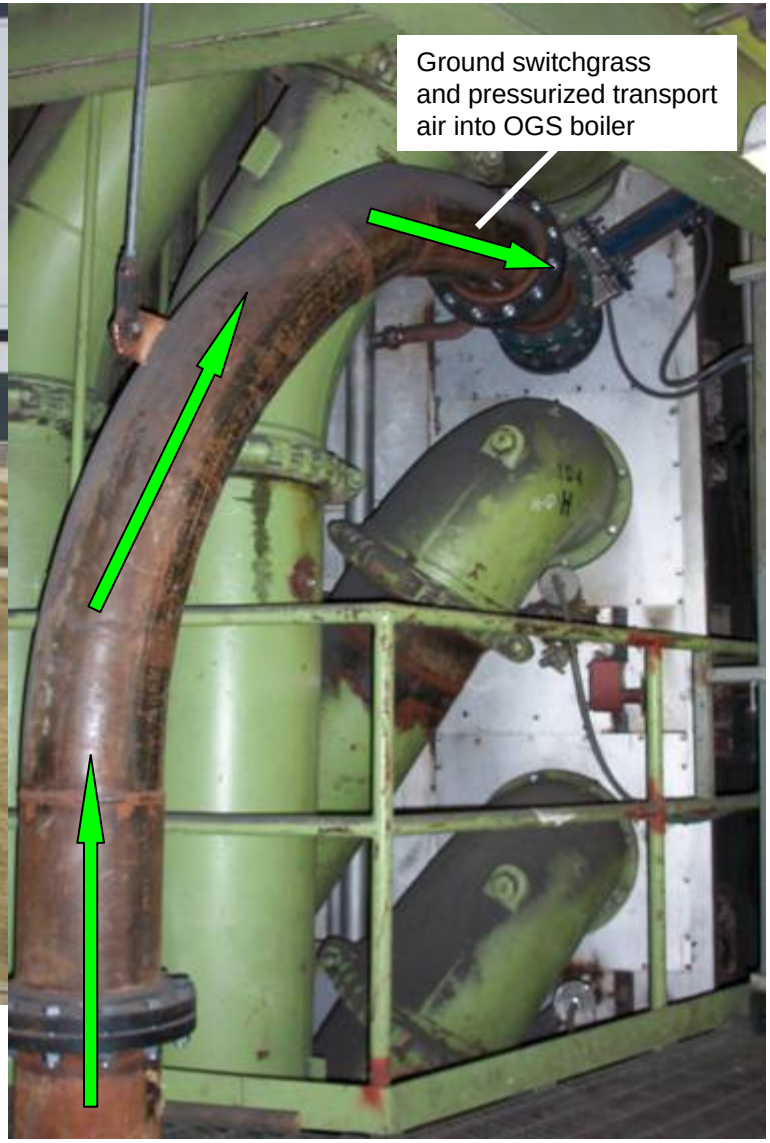
During Harvest

After Harvest

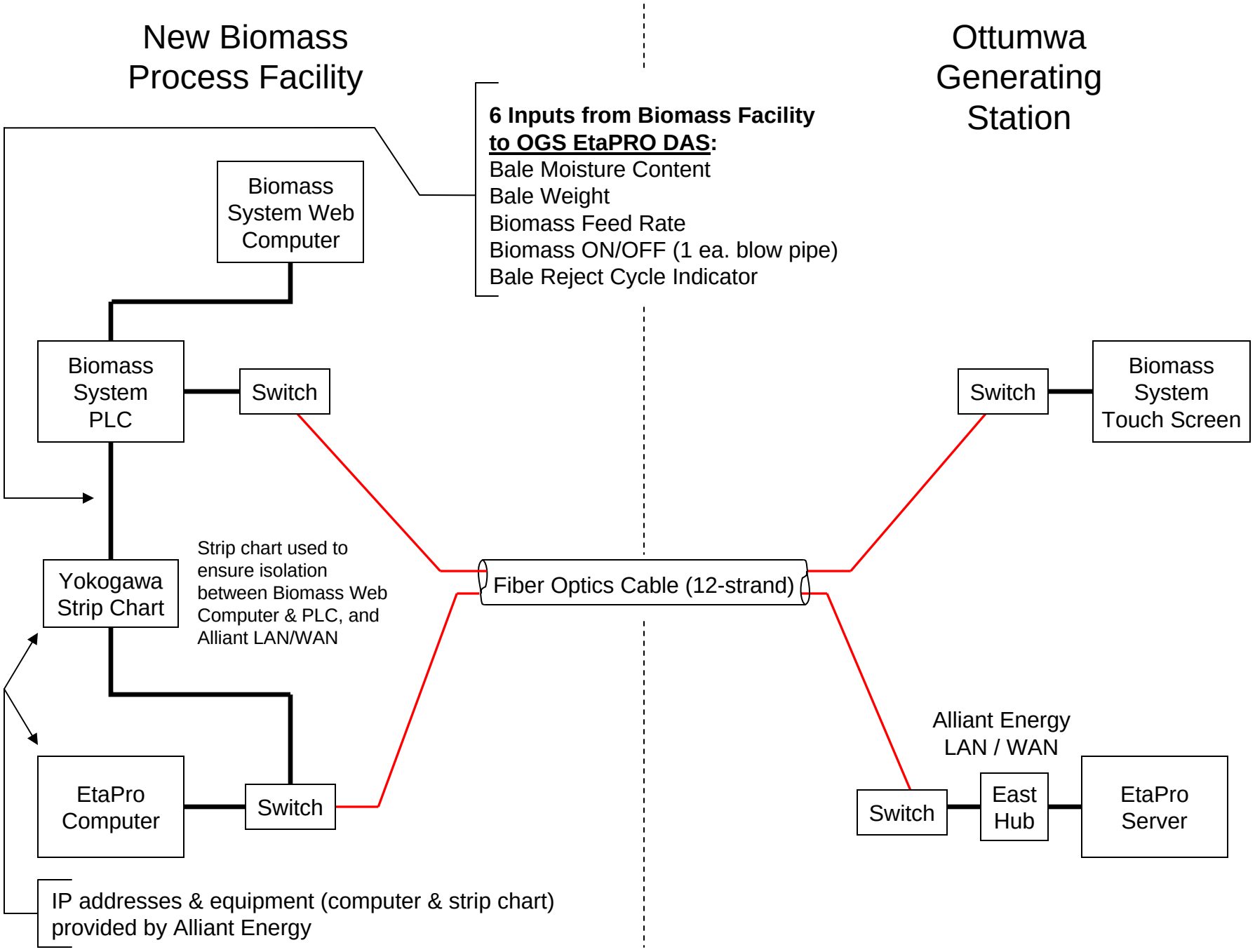

NEW HOLLAND
BB960

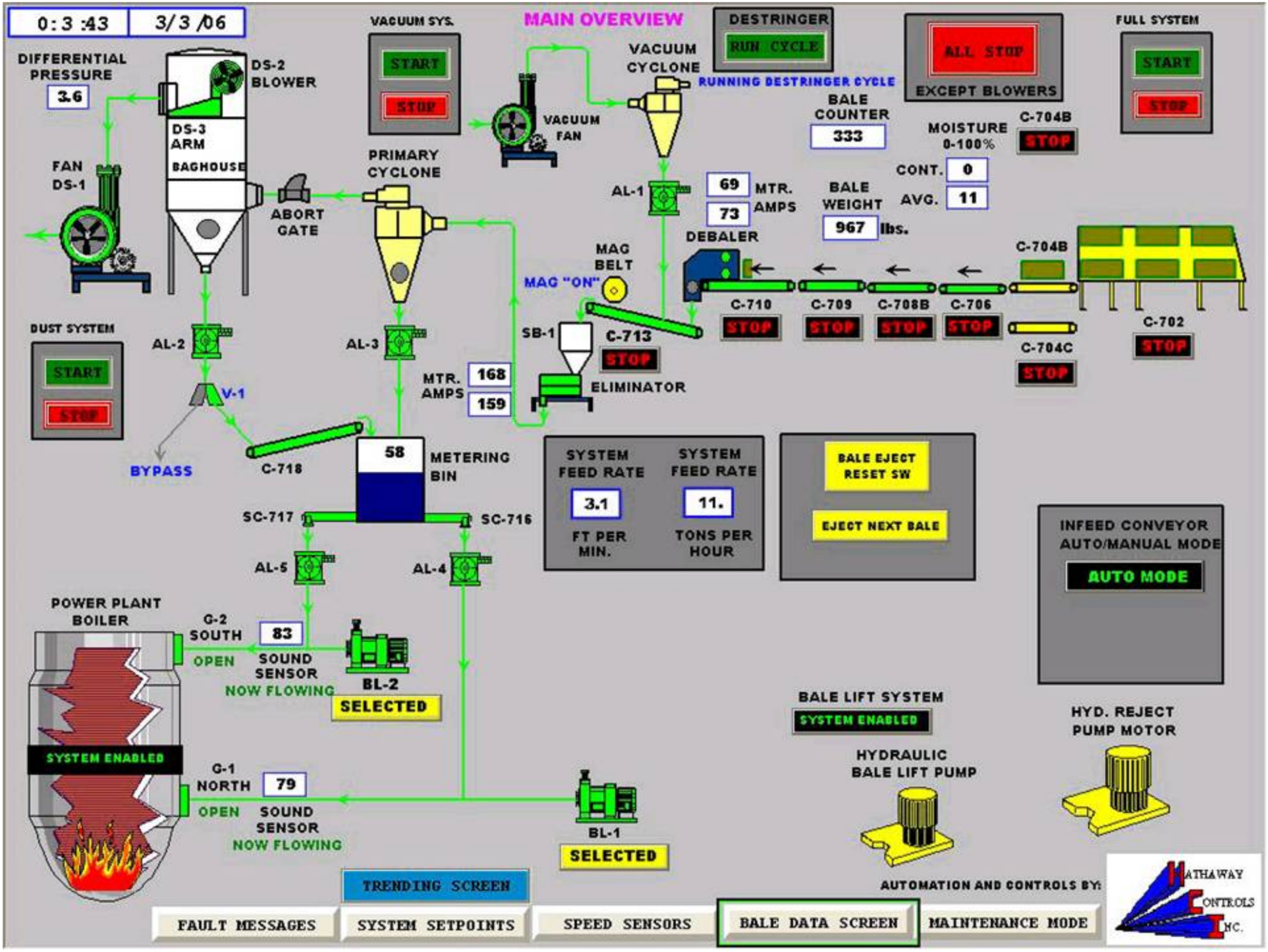
Replacing up to 5% of this . . . .

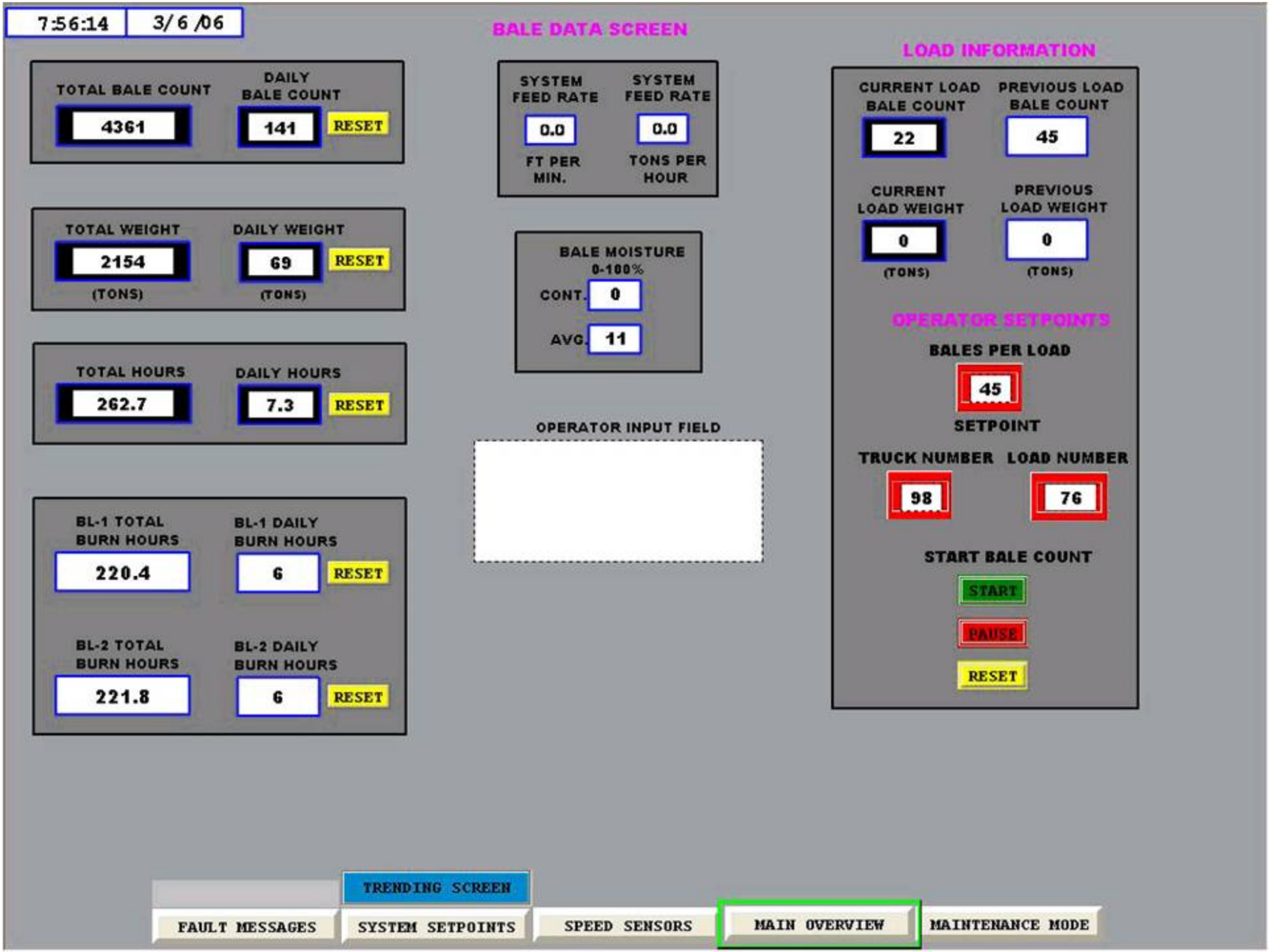
with this . . . .



Switchgrass Blow Lines Transporting Ground Switchgrass into Boiler House (left) and Boiler (right).


New Biomass Process Facility
Ottumwa Generating Station
6 Inputs from Biomass Facility to OGS EtaPRO DAS:
Bale Moisture Content
Bale Weight
Biomass Feed Rate
Biomass ON/OFF (1 ea. blow pipe)
Bale Reject Cycle Indicator
Biomass System Web Computer
Biomass System PLC
Switch
Switch
Biomass System Touch Screen
Yokogawa Strip Chart
Strip chart used to ensure isolation between Biomass Web Computer & PLC, and Alliant LAN/WAN
Fiber Optics Cable (12-strand)
Alliant Energy LAN / WAN
EtaPro Computer
Switch
Switch
East Hub
EtaPro Server
IP addresses & equipment (computer & strip chart) provided by Alliant Energy


0:3 :43
3/3 /06
MAIN OVERVIEW
VACUUM SYS.
START
STOP
DESTRINGER
RUN CYCLE
RUNNING DESTRINGER CYCLE
ALL STOP
EXCEPT BLOWERS
FULL SYSTEM
START
STOP
DIFFERENTIAL PRESSURE
3.6
DS-2 BLOWER
DS-3 ARM
BAGHOUSE
VACUUM FAN
VACUUM CYCLONE
BALE COUNTER
333
MOISTURE 0-100%
C-704B
STOP
CONT.
0
AVG.
11
FAN DS-1
ABORT GATE
PRIMARY CYCLONE
AL-1
69
73
MTR. AMPS
BALE WEIGHT
967
lbs.
DEBALER
C-704B
MAG BELT
MAG "ON"
C-710
C-709
C-708B
C-706
STOP
C-702
DUST SYSTEM
START
STOP
AL-2
AL-3
SB-1
C-713
STOP
ELIMINATOR
C-704C
MTR. AMPS
168
159
V-1
BYPASS
C-718
58
METERING BIN
SYSTEM FEED RATE
3.1
FT PER MIN.
SYSTEM FEED RATE
11.
TONS PER HOUR
BALE EJECT RESET SW
EJECT NEXT BALE
INFEED CONVEYOR AUTO/MANUAL MODE
AUTO MODE
SC-717
SC-716
AL-5
AL-4
POWER PLANT BOILER
G-2 SOUTH
83
OPEN
SOUND SENSOR
NOW FLOWING
BL-2
SELECTED
BALE LIFT SYSTEM
SYSTEM ENABLED
HYD. REJECT PUMP MOTOR
HYDRAULIC BALE LIFT PUMP
SYSTEM ENABLED
G-1 NORTH
79
OPEN
SOUND SENSOR
NOW FLOWING
BL-1
SELECTED
TRENDING SCREEN
AUTOMATION AND CONTROLS BY:
HATHAWAY CONTROLS INC.
FAULT MESSAGES
SYSTEM SETPOINTS
SPEED SENSORS
BALE DATA SCREEN
MAINTENANCE MODE


7:56:14
3/6/06
BALE DATA SCREEN
TOTAL BALE COUNT
4361
DAILY BALE COUNT
141
RESET
TOTAL WEIGHT
2154
(TONS)
DAILY WEIGHT
69
(TONS)
RESET
TOTAL HOURS
262.7
DAILY HOURS
7.3
RESET
BL-1 TOTAL BURN HOURS
220.4
BL-1 DAILY BURN HOURS
6
RESET
BL-2 TOTAL BURN HOURS
221.8
BL-2 DAILY BURN HOURS
6
RESET
SYSTEM FEED RATE
0.0
FT PER MIN.
SYSTEM FEED RATE
0.0
TONS PER HOUR
BALE MOISTURE
0-100%
CONT.
0
AVG.
11
OPERATOR INPUT FIELD
LOAD INFORMATION
CURRENT LOAD BALE COUNT
22
PREVIOUS LOAD BALE COUNT
45
CURRENT LOAD WEIGHT
0
(TONS)
PREVIOUS LOAD WEIGHT
0
(TONS)
OPERATOR SETPOINTS
BALES PER LOAD
45
SETPOINT
TRUCK NUMBER
98
LOAD NUMBER
76
START BALE COUNT
START
PAUSE
RESET
TRENDING SCREEN
FAULT MESSAGES
SYSTEM SETPOINTS
SPEED SENSORS
MAIN OVERVIEW
MAINTENANCE MODE

Summary Statistics to Date

Summary Statistics:

Date :	Wednesday, March 22, 2006	
Bale Count :	529	bales
Run Time :	24.0	hrs
Total Bale Weight :	247.9	tons
Max. Bale Weight :	1,353	lbs.
Min. Bale Weight :	743	lbs.
Average Bale Weight:	937	lbs.
Average Moisture Content:	13%	

Overall Statistics (through midnight):		
Total Bales Processed (accepted) :	11,264	bales
Total Tons Processed (accepted) :	5,567	
Average Bale Weight:	988	lbs./bale
Total System Processing Hours:	627.6	hours
Percent of Run-hour Goal:	31%	of 2000 hour goal
Percent of Tonnage Goal:	22%	of 25,000 ton goal
Estimated Power Generated :	6,975	MWh
Time Remaining until May 12th Outage:	50	days
	1,200	hours

Average Iowa Homes Powered for Full Year :	667	average annual homes

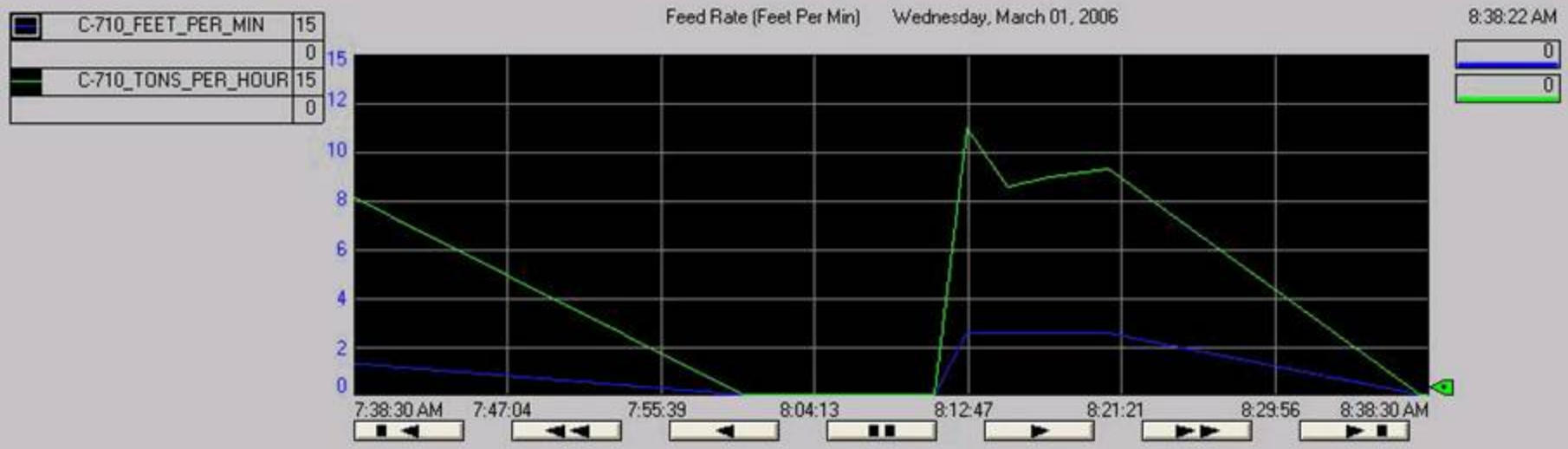
TRENDING SCREEN #1

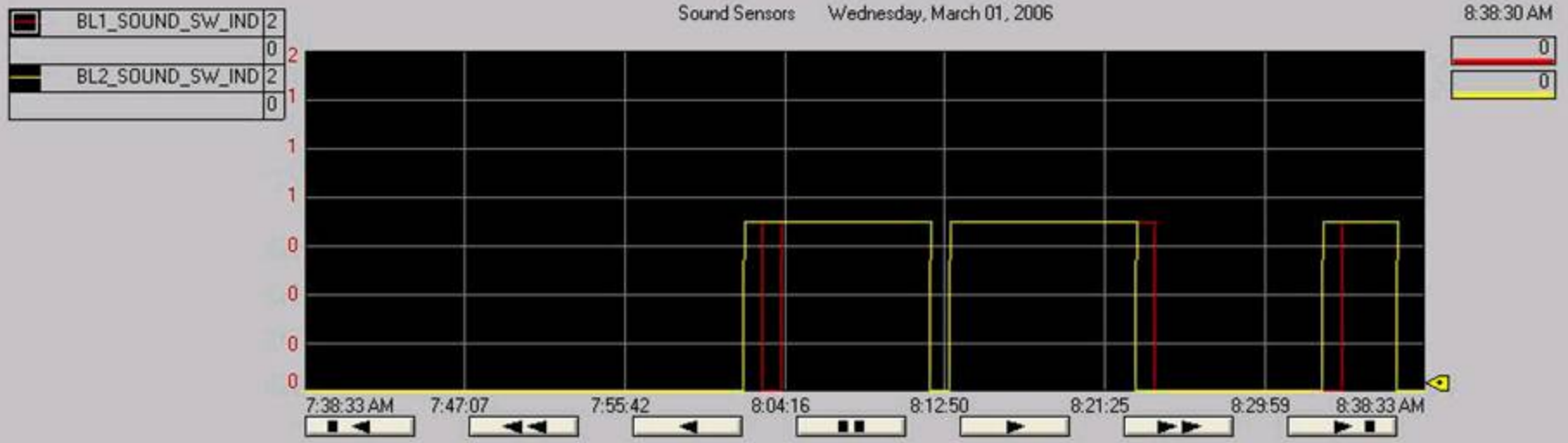
TRENDING SCREEN 2 | TRENDING SCREEN 3

FAULT MESSAGES | SYSTEM SETPOINTS | SPEED SENSORS | MAIN OVERVIEW | MAINTENANCE MODE

8:38:14 | 3/1/06

TRENDING SCREEN #2





TRENDING SCREEN 1 | TRENDING SCREEN 3

FAULT MESSAGES | SYSTEM SETPOINTS | SPEED SENSORS | MAIN OVERVIEW | MAINTENANCE MODE

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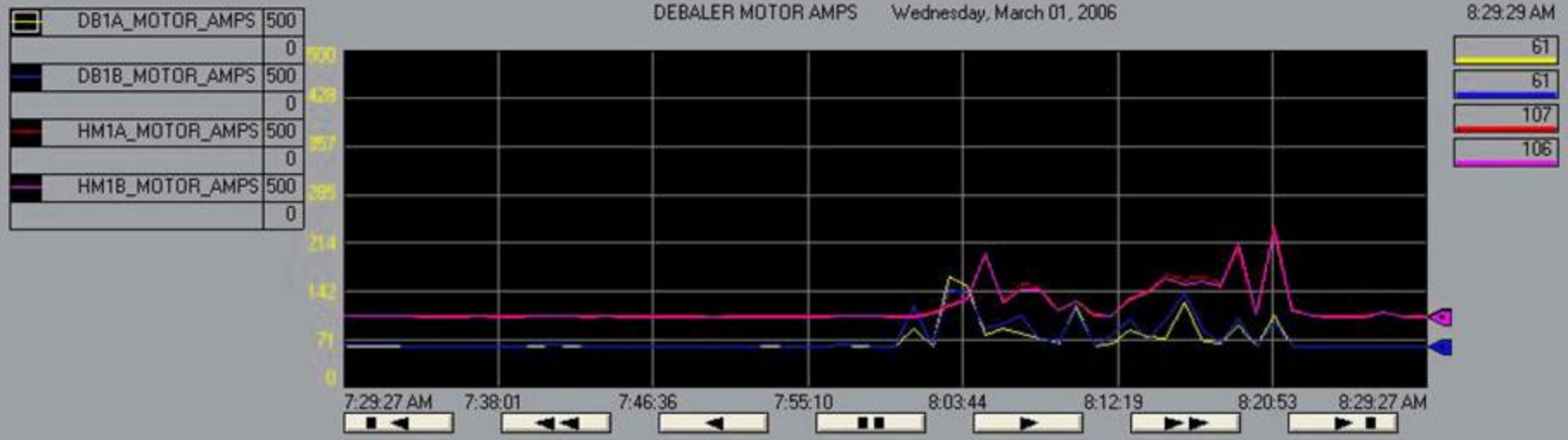
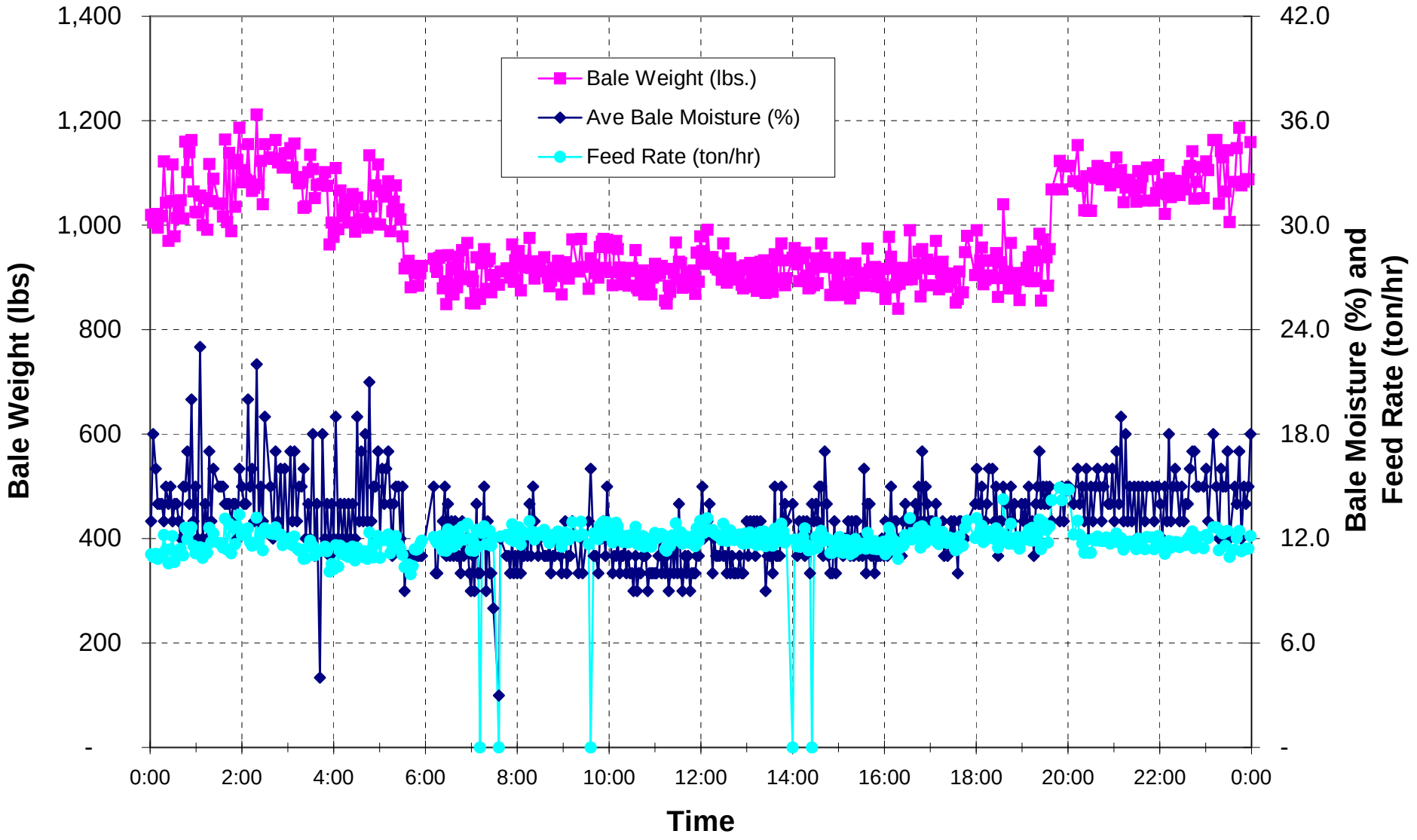
TRENDING SCREEN #3



TRENDING SCREEN 1 | TRENDING SCREEN 2

FAULT MESSAGES | SYSTEM SETPOINTS | SPEED SENSORS | MAIN OVERVIEW | MAINTENANCE MODE

CHARITON VALLEY BIOMASS PROJECT
Daily Switchgrass Processing Chart (Friday March 10, 2006)



Biopower Calculation

- Measure tons per hour and Btu biomass input in real-time using:
  - Digital scale on conveyor system
  - Microwave moisture content meter
  - Lab analysis of switchgrass samples (Btu/lb)
- Calculation
  - $MW = \frac{(12.5\ \text{ton/hr})(2000\ \text{lb/ton})(6980\ \text{Btu/lb})}{(11{,}000\ \text{Btu/kw-hr})(1000\ \text{kW/MW})}$

    13% m.c., ave

    FERC Form 1 OGS Heat Rate
  - MW = 15.86 MW
- We also measure reduction in coal flow as biomass flow increases

Emissions Monitoring (GE)

Emissions Probe In Outlet Duct

GE's Mobile Emissions Lab

GE's Emissions Vans at Stack

CO, NOx, O2, PM, PM10, Hg, Cl

Emissions Equipment at OGS

CEMS Probes In Outlet Duct

SO2, NOx, Opacity

Portable Emissions Monitor

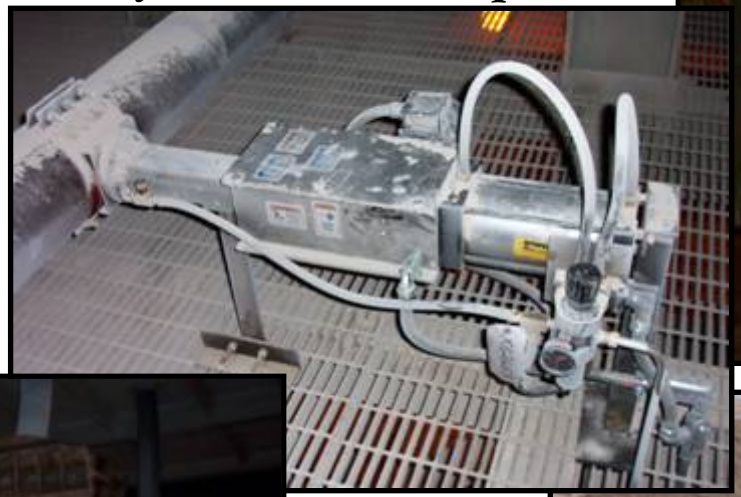
CO, SO2, NOx, O2

Other Sampling

Bottom Ash Liquids

Economizer Ash

Fly Ash Auto Sampler

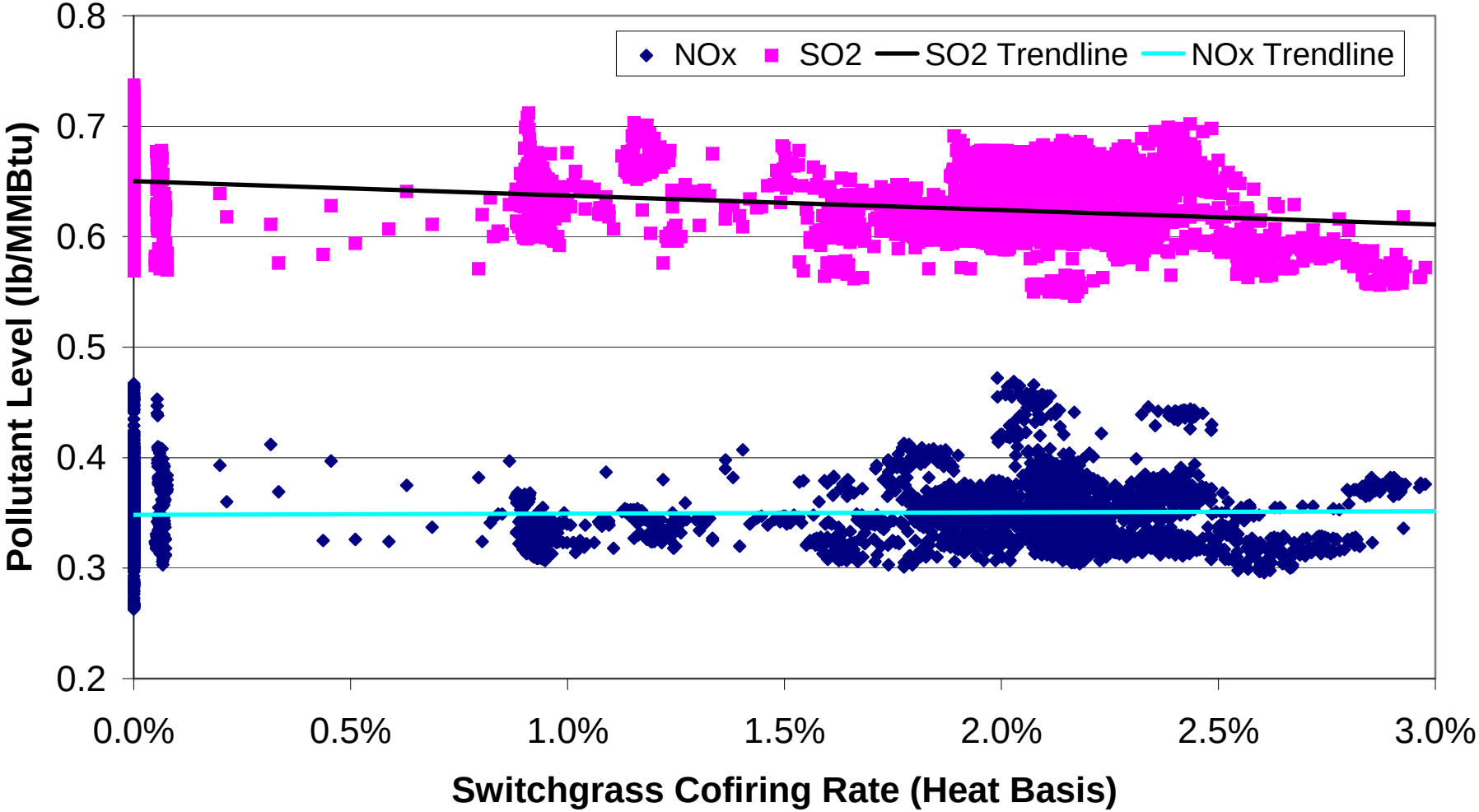


Bottom Ash

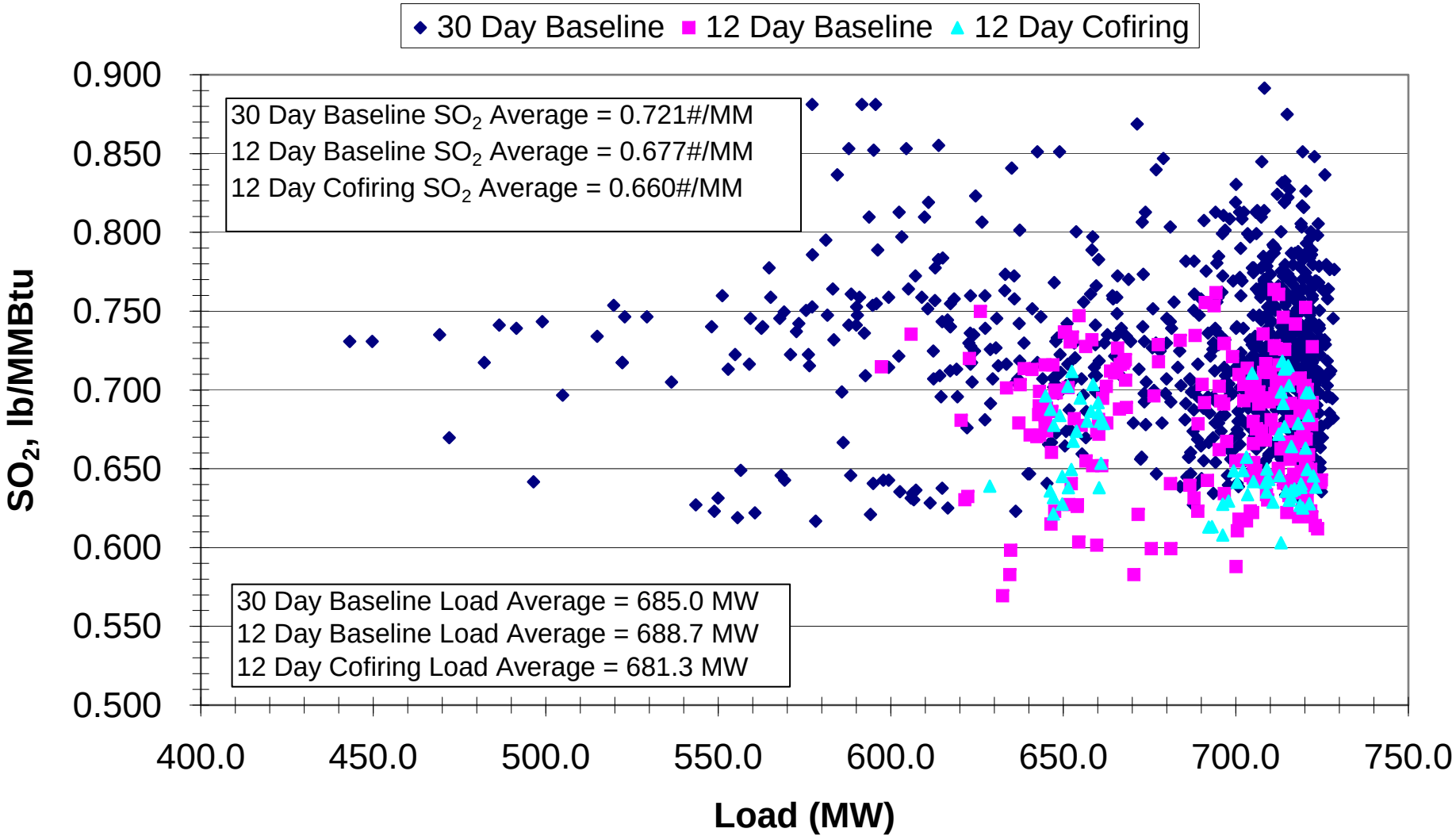
Bulk Fly Ash

Chariton Valley Biomass Project--Interim Test Burn
NOx & SO2 vs. Cofire Rate, Ottumwa Generating Station

Continuous Emissions Monitoring System Data for: December 1 to 5, December 8 to 12, 8 am to 6 pm



Hourly Average SO_2 Readings



Summary: Emissions Results (Interim Test Burn)

- From Continuous Emissions Monitoring System:
  - 6000 minutes of emissions data collected and analyzed
  - 8 am – 6 pm on all test days
  - 53 hours cofiring, 47 hours coal-only
  - Average heat input from switchgrass was 1.9% of boiler total
  - **Results when cofiring:**
    - Average Sulfur Dioxide (SO2) emissions decreased by over 4%
    - Average Nitrogen Oxides (NOx) emissions did not change

- From Stack Emissions Testing:
  - Particulates decreased by 4% (PM), and 14% (PM10)
  - Carbon Monoxide (CO) emissions did not change

Conceptual drawing of a 25 ton/hr automated system based on operating Danish straw plants . . . . . .