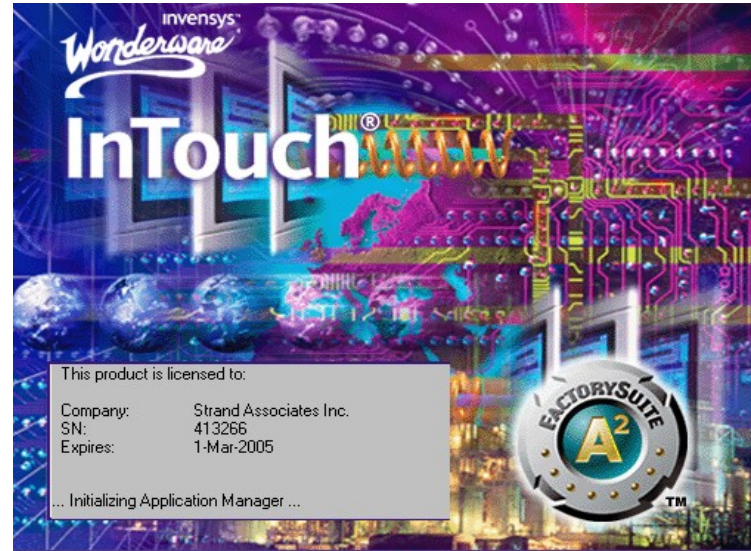


Using SCADA to Reduce Energy Consumption and Optimize Operational Efficiencies



October 2010





Introduction

- Greetings!
- Using SCADA to Reduce Energy Consumption and Optimize Operational Efficiencies
 - Basics/Fundamentals
 - SCADA Applications for Reducing Energy Consumption
 - Utility Charges
 - Indirect Charges
 - SCADA Applications for Optimizing Operational Efficiencies
 - Reduction in labor
 - Identify problems quicker
 - Extend equipment life
- Q&A



Wastewater Treatment Energy Facts

- 650 Public Wastewater Treatment Facilities in Wisconsin
 - ~85% are 1.0 MGD or smaller and consume 24% of total energy
 - Remaining ~15% consume 76% of total energy used
- Wastewater Treatment Facilities spend ~7% of operating budget on energy
- Aeration and pumping are largest energy consumers
 - ~54% for aeration
 - ~14% for pumping



Basics/Fundamentals

- How Can I Save Energy?
 - Operational Savings (Indirect)
 - Labor
 - Hours per task, overtime
 - Materials
 - Vehicles, infrastructure, replacement parts, maintenance
 - Utility Savings (Direct)
 - Electric Bill
 - Gas Bill



Basics/Fundamentals

- Why Should I Save Energy?
 - Reduce expenditures/taxpayer dollars spent
 - Utility bills
 - Labor costs
 - Indirect costs
 - Reduce “Environmental Footprint”
 - Power plants
 - Distribution/transmission
 - Reduce fossil fuel consumption
 - Coal, natural gas, petroleum
 - Lower market energy prices



Basics/Fundamentals

- How Do I Save Energy?
 - Energy Analysis
 - Review Equipment Installation
 - Review Current System Operation and Maintenance
 - Review SCADA System Hardware and Automation
 - Energy Savings Plan
 - Baseline Energy Consumption
 - Set Benchmark for Future Goals
 - Operational Energy Savings
 - Utility Energy Savings

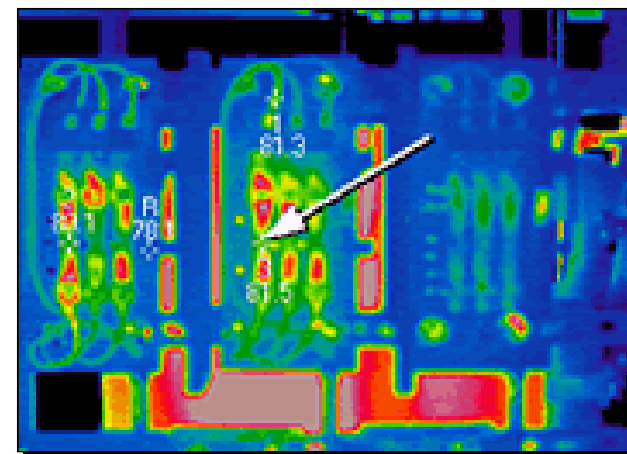
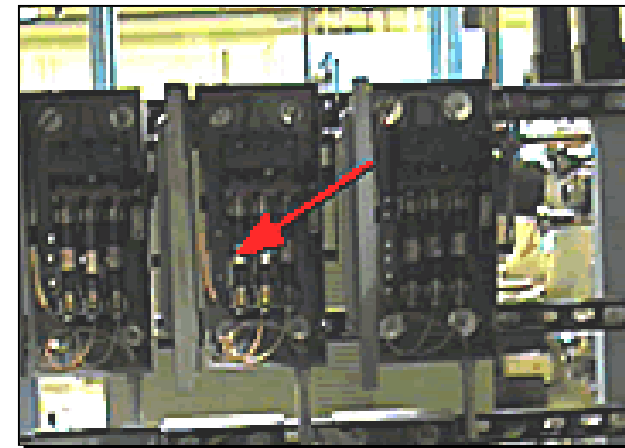
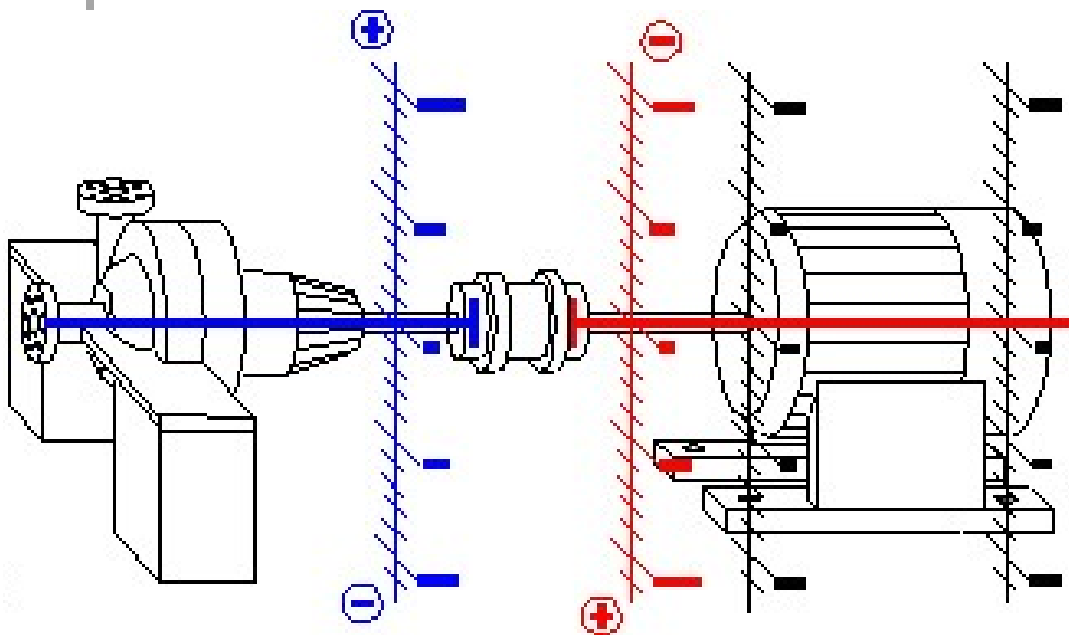


Basics/Fundamentals

- Review Condition and Operation of Existing Facilities
 - HVAC equipment
 - Type of equipment
 - Equipment operation
 - Structure – windows, doors, insulation
 - Lighting
 - Building Thermal Scanning
- Implement Energy Saving Changes
 - Increase R value walls/ceiling
 - Lower heating temperatures/raise cooling temperatures
 - Review/modify ventilation controls
 - Replace non-insulated doors/louvers with insulated

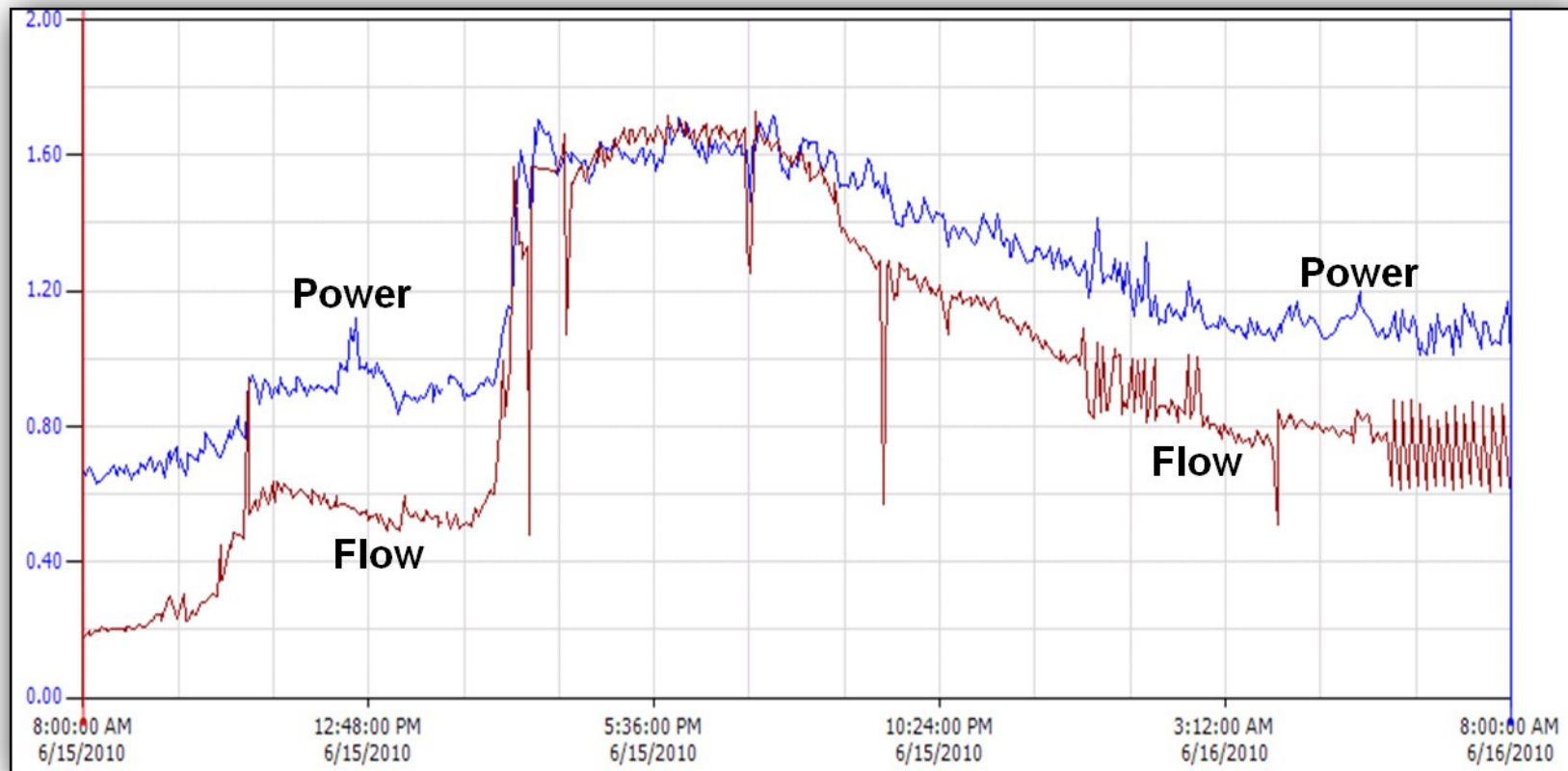
Basics/Fundamentals

- Review Maintenance Program/Procedures
 - Equipment operating at intended efficiency
 - Excessive heat, vibration = wasted energy



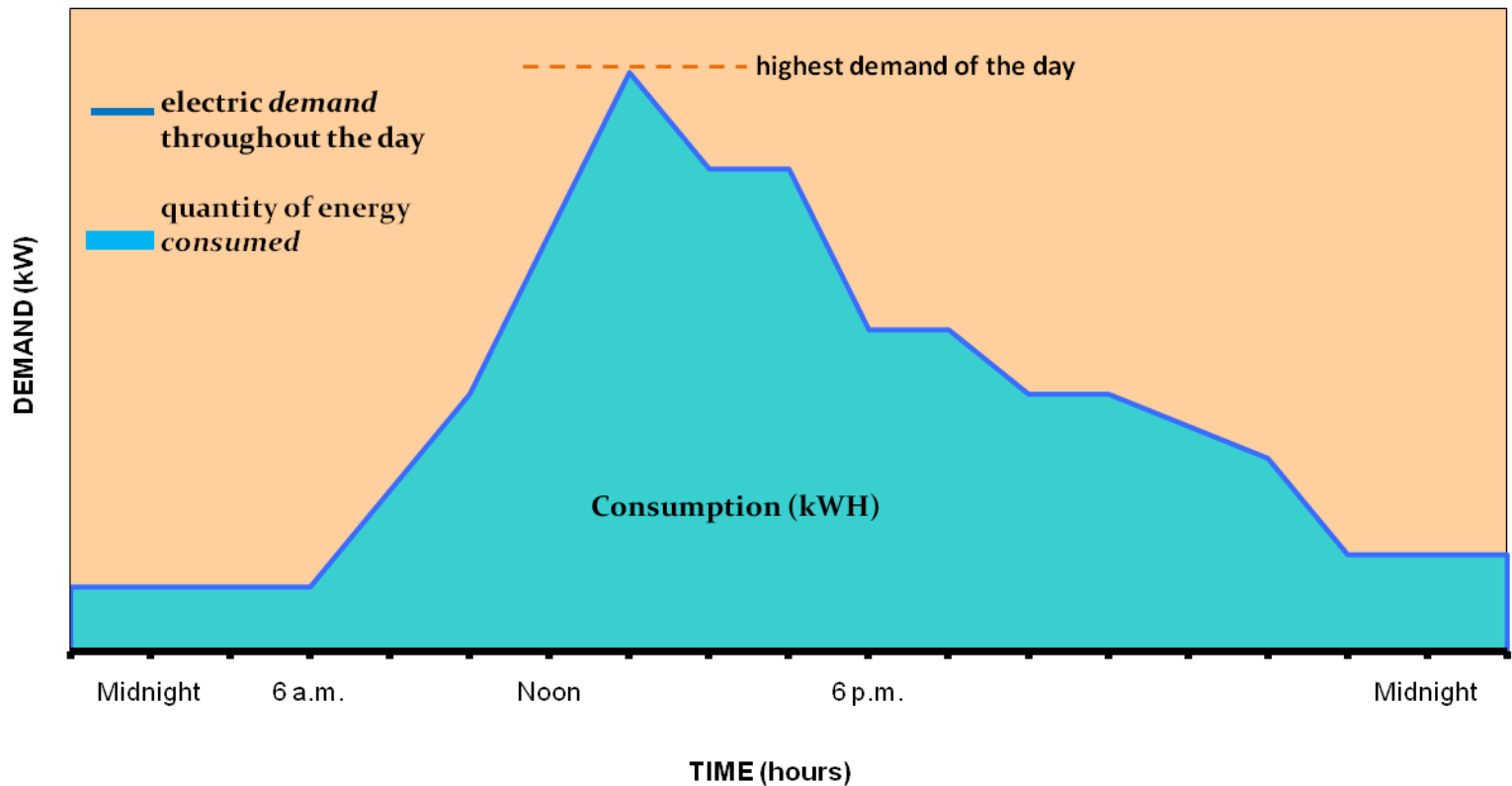
Basics/Fundamentals

- Review External Factors
 - Inflow and Infiltration
 - Community water conservation
 - Appliances, toilets, faucets
 - Industrial/high usage customers



Basics/Fundamentals

- Learn How Energy is Consumed



■ Demand = kW ↔ GPM

■ Consumption = kWh ↔ KGAL

Basics/Fundamentals

- Know your Utility Charges

COMMERCIAL		Electric Meter: 085844156	Billed for 29 Days
Meter Reading	Mar 05	13655	
	Feb 05	<u>13401</u>	
		254 X 300.000 Multiplier =	76200 KWH
Energy Charge.....	76200 KWH X \$.048720	= \$ 3,712.46
Demand Charge.....	135 KW X \$	7.880000	= \$ 1,063.80
Customer Demand Charge.....	213 KW X \$	2.000000	= \$ 426.00
Customer Charge.....	29 Days X \$.9205	= \$ 26.69
State Low-Income Assistance Fee.....			= \$ 23.95
		TOTAL	\$ 5,252.90

Wisconsin sales tax exempt or not applicable.

- Demand charges = \$1489 (29%)
 - kwh charges = \$3712 (71%)
- Potential load reduction using standby power

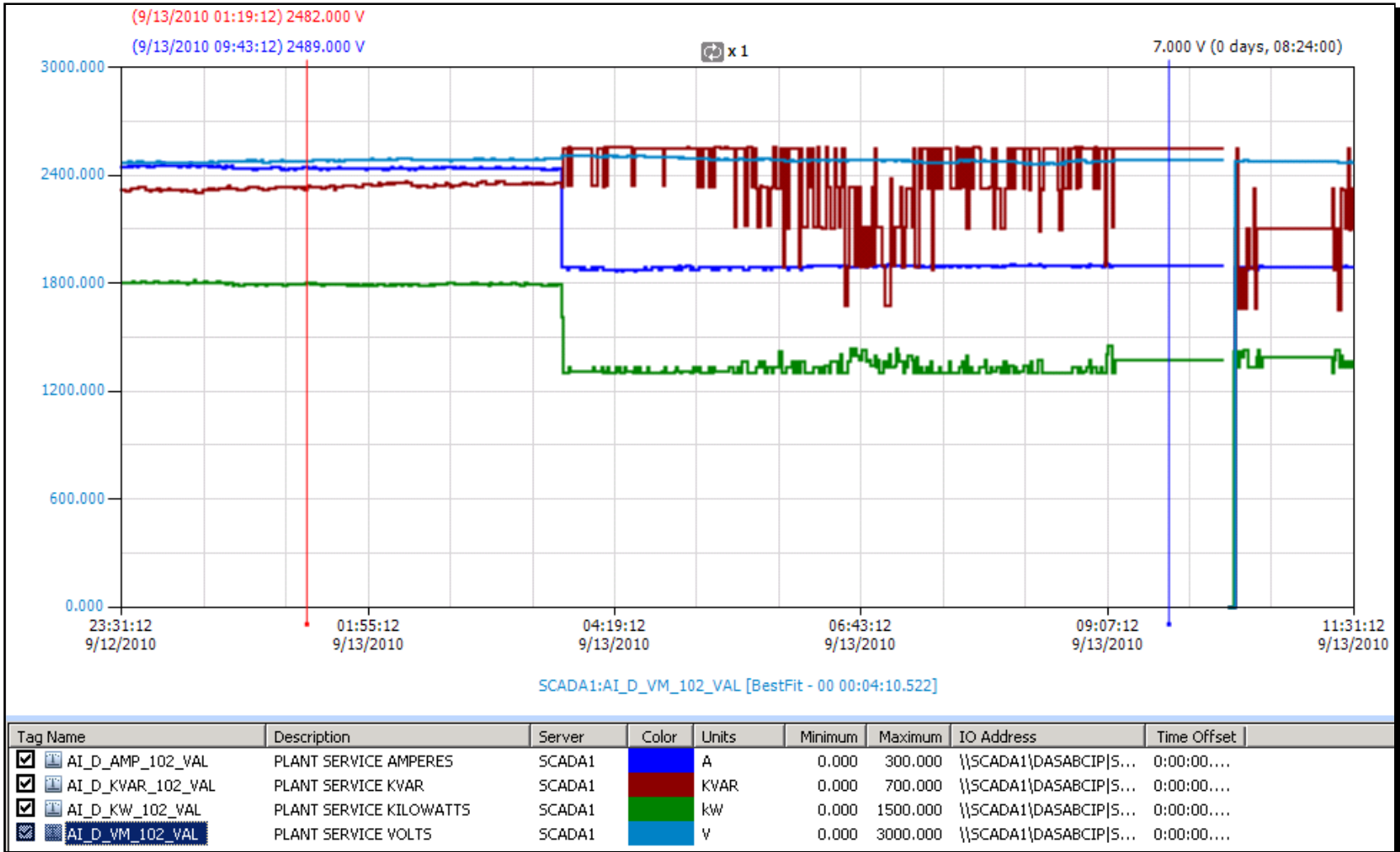
Basics/Fundamentals

- Implement Power Metering/Monitoring



Basics/Fundamentals

Implement Power Metering/Monitoring



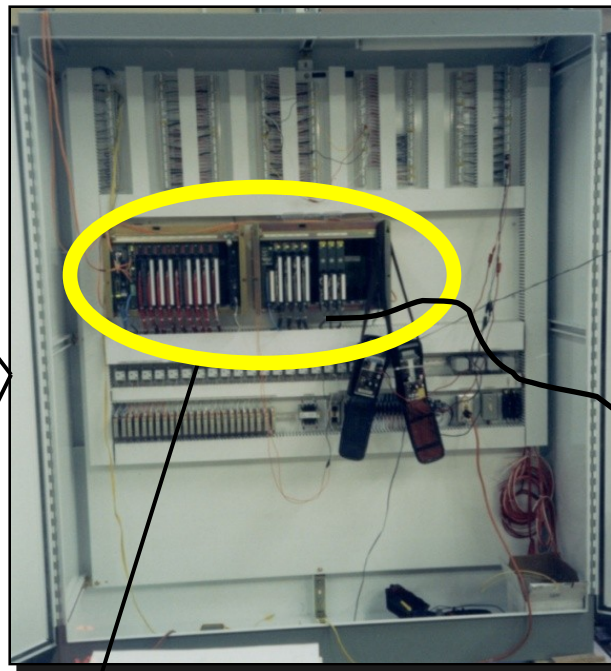
Basics/Fundamentals

SCADA SYSTEM

- Utilize Available Technology/Automation



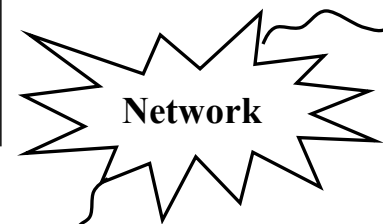
Field Devices



PLC



Operator Interface



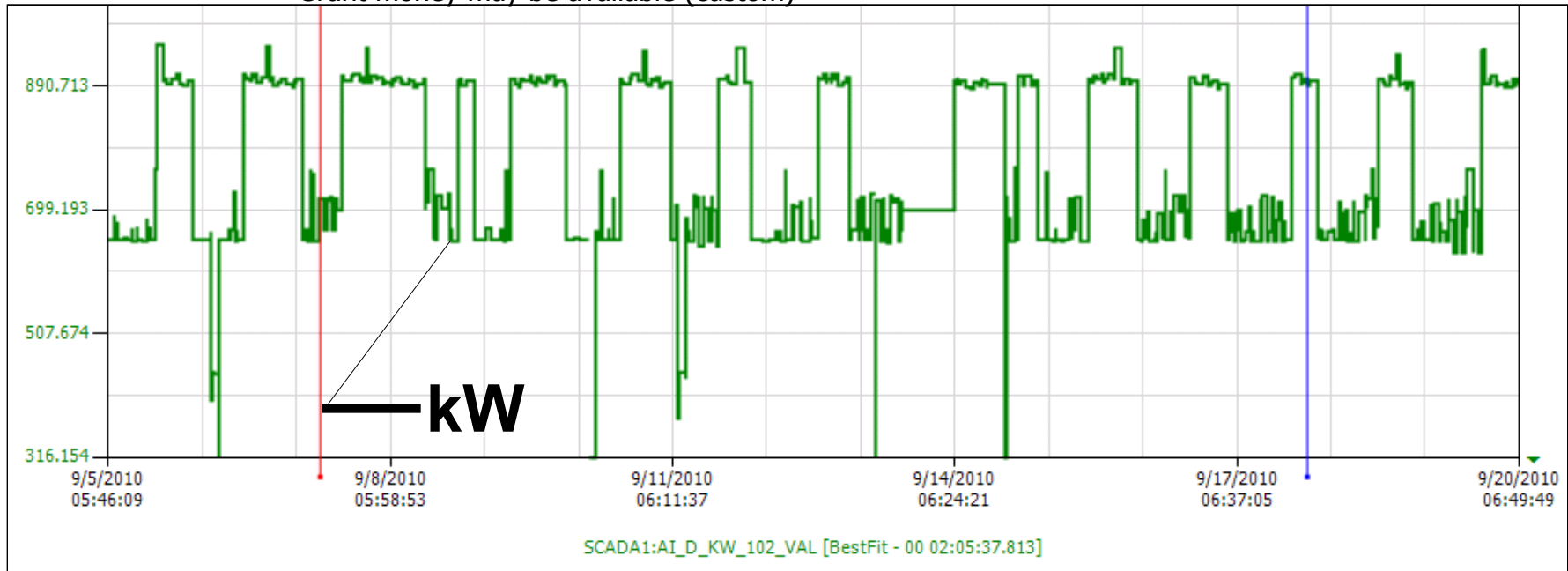
Network



Reduce Energy Consumption

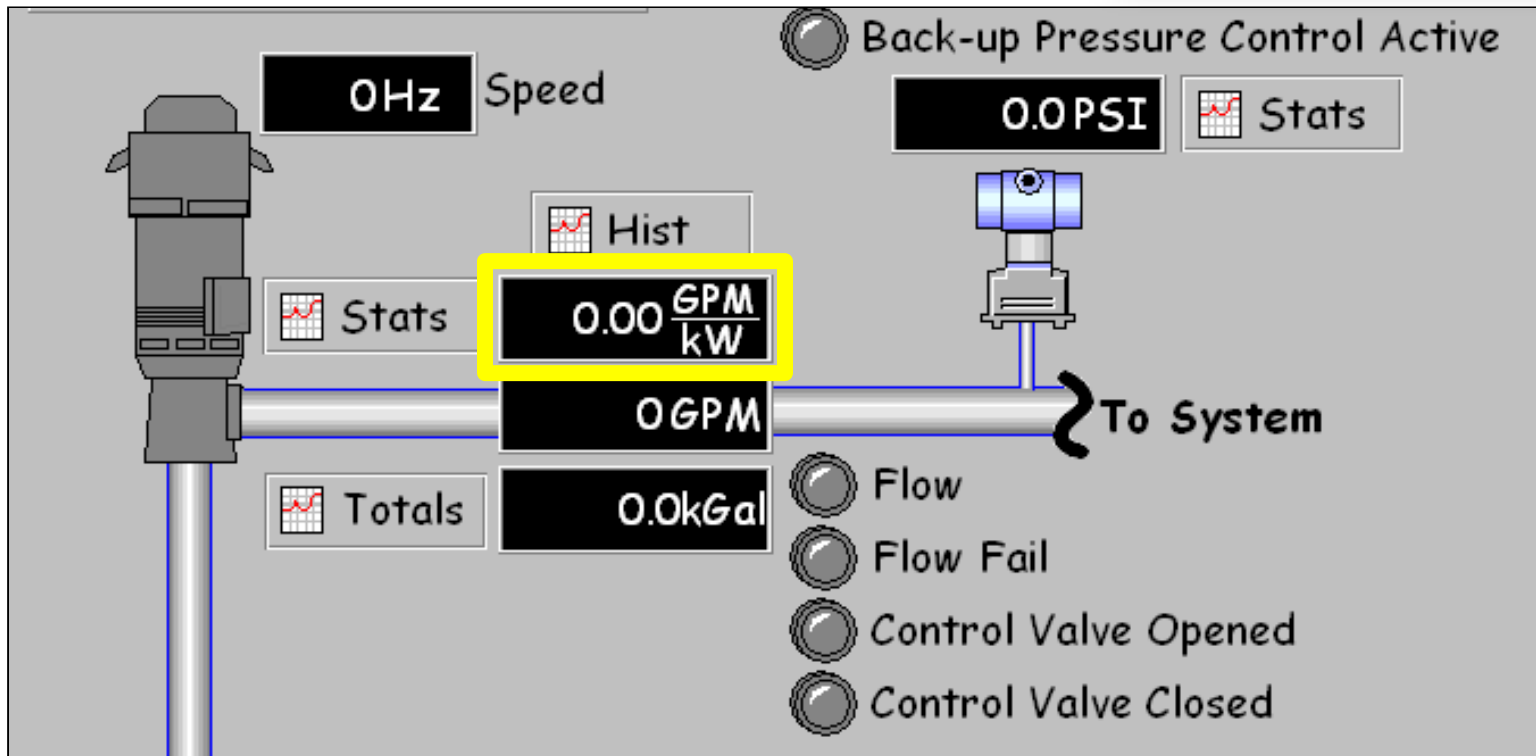
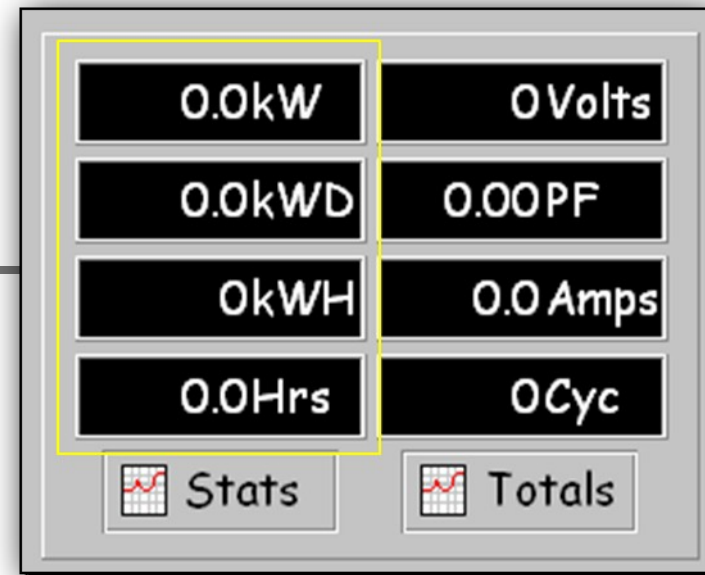
■ Monitor power usage

- kWh & kW Demand
- High kW and kW Demand Warning and Alarms
- Compare Pumping versus "Other" Energy costs
- Generate Daily and Monthly Reports
- Minimal Investment
 - Grant money may be available (custom)



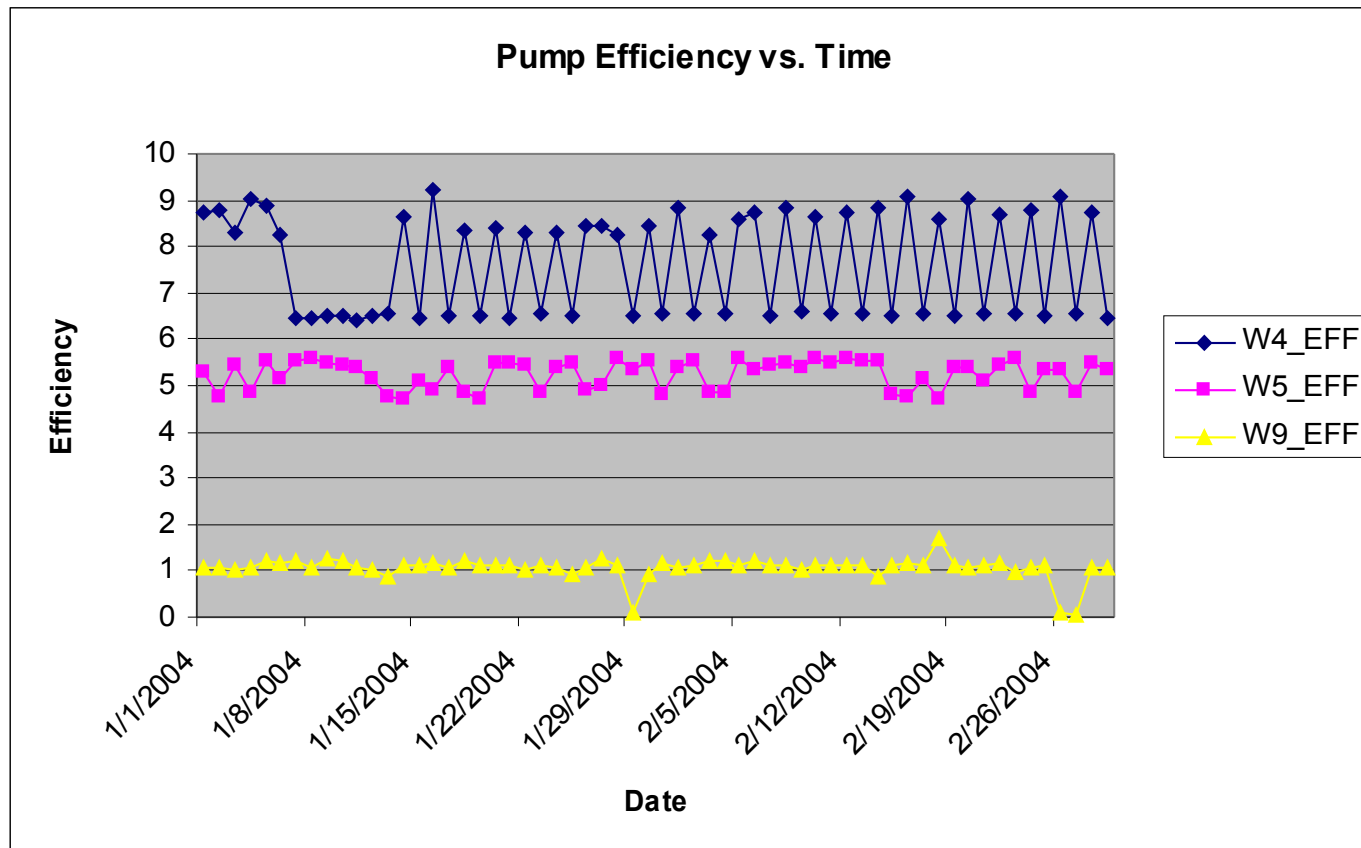
Reduce Energy Consumption

- Monitor pump data
 - kWh & kW Demand
 - Instantaneous Efficiency (GPM/kW)
 - Daily/Monthly Efficiency (GAL/KWH)



Reduce Energy Consumption

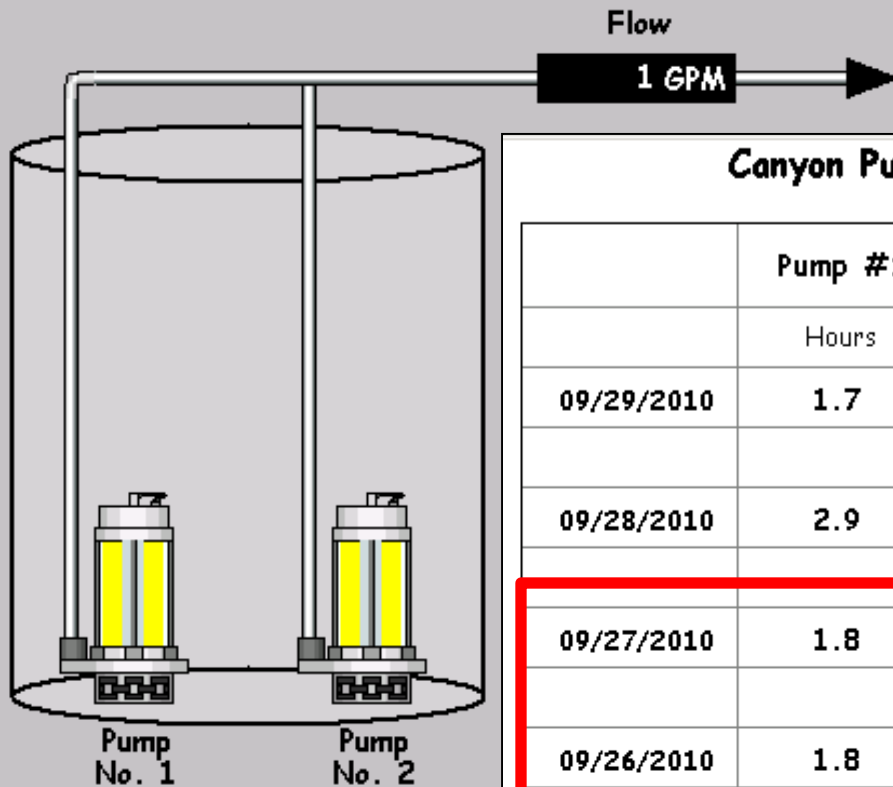
- Maximize pump efficiencies
 - Operate most efficient pumps during peak hours or most often
 - Use for Predictive Maintenance



Reduce Energy Consumption

- Analyze pump station data

SCC-59 - Canyon Pump Station



Site Data for 9/29/2010

Flow 99.2 kGAL

Pump 1

Runtime 1.7 Hrs.

Starts 17 Evts.

Pump 2

Runtime 2.1 Hrs.

Starts 18 Evts.

Canyon Pump Station - 10 Day Historical Data

22:46:30

09/29/2010

	Pump #1	Pump #1	Pump #2	Pump #2	Station Total
	Hours	kGAL	Hours	kGAL	kGAL
09/29/2010	1.7	46.9	2.1	52.2	99.2
09/28/2010	2.9	66.6	4.3	90.1	156.6
09/27/2010	1.8	49.9	2.2	53.3	103.1
09/26/2010	1.8	50.1	2.2	57.1	107.1
09/25/2010	1.6	47.2	2.7	57.5	104.6

Reduce Energy Consumption

- Maximize Off-peak Operation
 - Intermittent processes
 - Wasting
 - Sludge transfer
 - Thickening
 - SCADA Time Clock Control

		Start Time		Stop Time	
Cycle 1	<input checked="" type="checkbox"/> On	4HR	0MN	5HR	0MN
	<input type="checkbox"/> Off				
Cycle 2	<input checked="" type="checkbox"/> On	6HR	0MN	7HR	0MN
	<input type="checkbox"/> Off				
Cycle 3	<input checked="" type="checkbox"/> On	8HR	0MN	9HR	0MN
	<input type="checkbox"/> Off				
Cycle 4	<input checked="" type="checkbox"/> On	22HR	0MN	23HR	0MN
	<input type="checkbox"/> Off				
Cycle 5	<input checked="" type="checkbox"/> On	0HR	0MN	1HR	0MN
	<input type="checkbox"/> Off				
Cycle 6	<input checked="" type="checkbox"/> On	2HR	0MN	3HR	0MN
	<input type="checkbox"/> Off				
Cycle 7	<input type="checkbox"/> On	0HR	0MN	0HR	0MN
	<input checked="" type="checkbox"/> Off				
Cycle 8	<input type="checkbox"/> On	0HR	0MN	0HR	0MN
	<input checked="" type="checkbox"/> Off				

Reduce Energy Consumption

- Use VFDs to Reduce Demand Charges



- 400 Mile Trip @ 60MPH and 32 MPG
 - Trip time = 6.7 HRS, 12.5 GAL, \$37.50 (@ \$3/GAL)
- 400 Mile trip @ 72 MPH and 26 MPG
 - Trip time = 5.6 HRS, 15.4 GAL, \$46.20 (@ \$3/GAL)

Reduce Energy Consumption

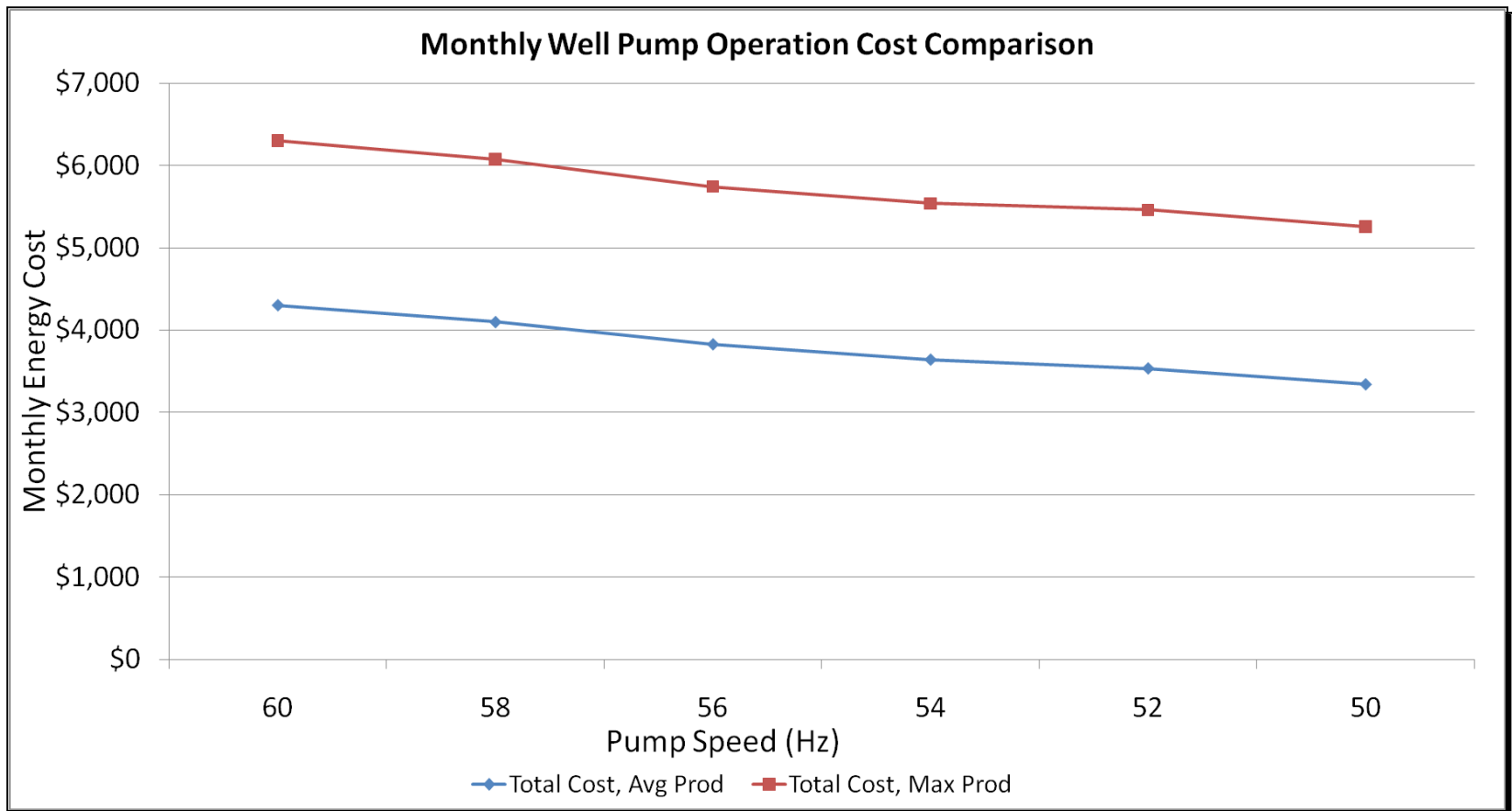
- Use VFDs to Reduce Demand Charges
 - Determine Best Operating Point

Well 10		Motor Data: 250HP, 1780 RPM, 0.839 PF, 95.4% EFF, NEMA Des B		
Speed (Hz)	kW Reading	Flow	GPM/kW	
(from Mitsubishi VFD)	(from Mitsubishi VFD)	(from Sta flowmeter)	(calculated)	
60	167.8	1275	7.60	
58	151.1	1161	7.68	
56	132.5	1049	7.92	
54	117	935	7.99	
52	103.5	815	7.87	
50	86.5	685	7.92	
48	lost flow at this speed			
		kW Savings 50.8		
System pressure before testing, 55.1 PSI				
System pressure after testing, 58 PSI (well in operation)				

Reduce Energy Consumption

Use VFDs to Reduce Demand Charges

- Lower kw/demand saves ~\$600/month





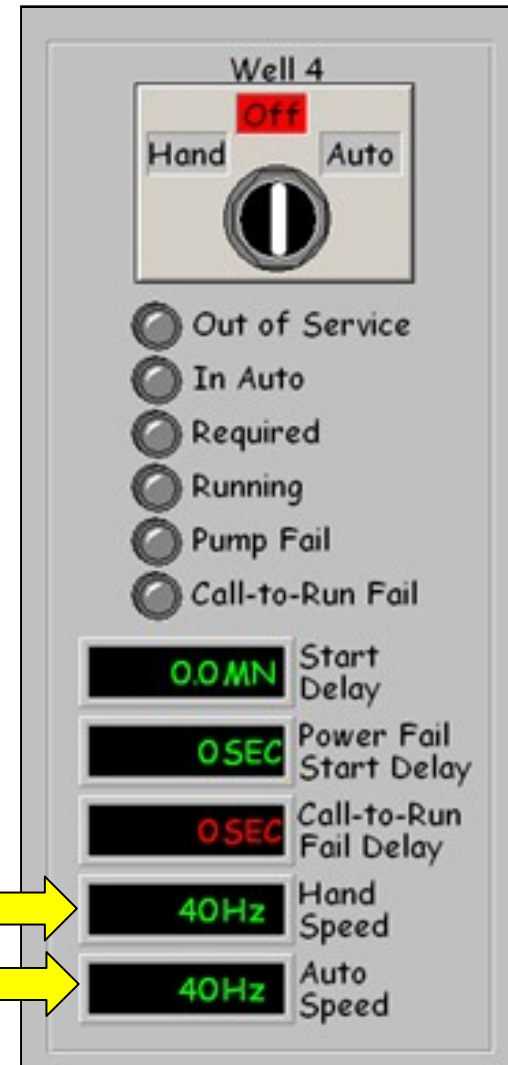
Reduce Energy Consumption

- Use VFDs to Reduce Demand Charges
 - Confirm best operating point works with process and equipment
 - Peak flows
 - Minimum flow/mixing requirements
 - Hydraulics
 - Chemical Feed Systems
 - More runtime = more maintenance?

Reduce Energy Consumption

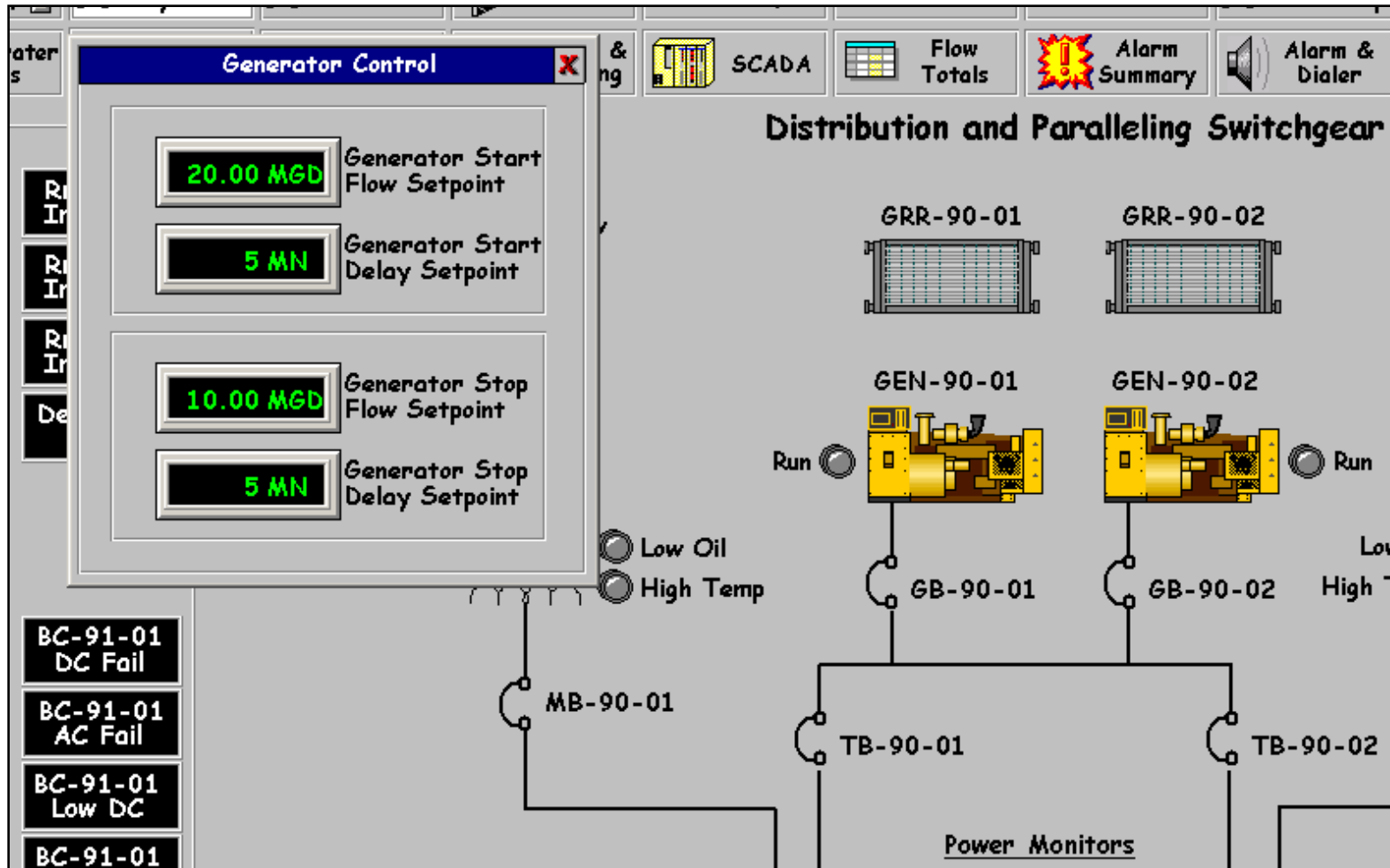
Use VFDs to Reduce Demand Charges

- Consider sources of Funding in Payback
 - Focus on Energy incentive pays ~40% of up-front VFD cost
- Additional operational flexibility
 - Ramp-up and Ramp-down
 - Back-up Control
 - May require flow pacing of other equipment
- Longer life/lower maintenance
 - Lower bearing load
 - Reduced shaft deflection



Reduce Energy Consumption

- Use SCADA and Standby Generators to Reduce Demand



Reduce Energy Consumption

- Use SCADA and Standby Generators to Reduce Demand



Reduce Energy Consumption

Use SCADA to control facility site lighting

Group A Control		Group B Control		Group C Control		Group D Control	
<input type="checkbox"/>	Timeclock	<input type="checkbox"/>	Timeclock	<input type="checkbox"/>	Timeclock	<input type="checkbox"/>	Timeclock
<input type="checkbox"/>	Photocell	<input type="checkbox"/>	Photocell	<input checked="" type="checkbox"/>	Photocell	<input checked="" type="checkbox"/>	Photocell
<input checked="" type="checkbox"/>	Timeclock & Photocell	<input checked="" type="checkbox"/>	Timeclock & Photocell	<input type="checkbox"/>	Timeclock & Photocell	<input type="checkbox"/>	Timeclock & Photocell
<input type="checkbox"/>	Manual	<input type="checkbox"/>	Manual	<input type="checkbox"/>	Manual	<input type="checkbox"/>	Manual
HR	MN	HR	MN	Photocell Control Only		Photocell Control Only	
<input type="text" value="23"/>	<input type="text" value="55"/>	<input type="text" value="23"/>	<input type="text" value="55"/>				
Off Time		Off Time					

- Group A = Minimal Roadway Lighting
- Group B = Remaining Roadway Lighting
- Group C = Building-mounted Lighting (Structure 100)
- Group D = Building-mounted Lighting (Structure 200)

Reduce Energy Consumption

- Use SCADA as an energy management program with LED lighting (Indoor and Outdoor)
 - Dual level switching
 - Dimming
 - Occupancy Sensors



Optimize Operational Efficiencies

- Monitor Motors to Predict Maintenance and Reduce Down-time
 - On-line motor insulation monitoring
 - Identify problem before failure/emergency situation
 - Recondition versus rewind
- NFPA 70E (Arc Flash)



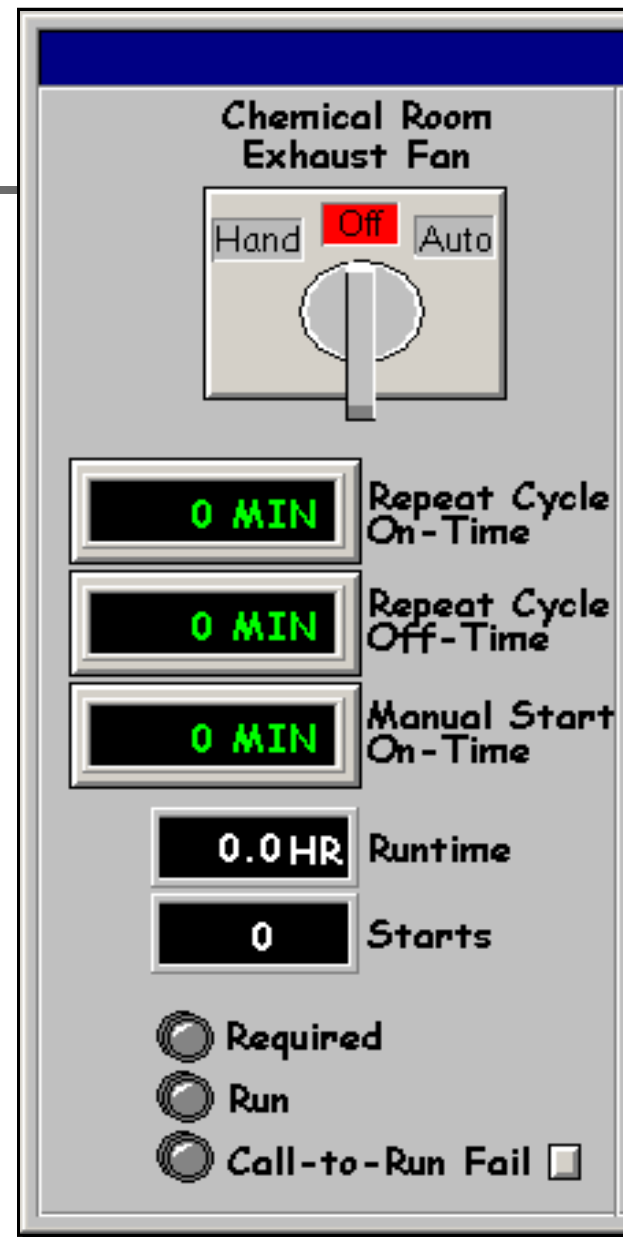


Optimize Operational Efficiencies

- Control HVAC equipment from SCADA
 - Greater flexibility and customization available
 - More user friendly, easier to operate than HVAC controls
 - Continuous temperature monitoring (and trending)



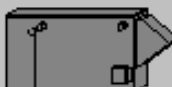

Optimize Operational Efficiencies

- Chemical room ventilation
 - Intermittent ventilation to help reduce corrosion
 - Operator adjustable to account for outdoor temperatures



Optimize Operational Efficiencies

- Large/Multi-building facility heating and ventilation
 - Temperature controlled Make-up Air Units
 - Applications requiring continuous or intermittent ventilation

BFP Room Temperature	GBT Room Temperature
 Temp Stats	 Temp Stats
0 °F	0 °F
BFP Room Heat Output	GBT Room Heat Output
0 %	0 %
MAU-50-01	MAU-50-02
	
BFP Room Make-Up Air Unit	GBT Room Make-Up Air Unit
Room Temp	Room Temp
55 °F	55 °F
Time Interval	Time Interval
10 MIN	10 MIN
Time Duration	Time Duration
5 MIN	5 MIN
15 MIN	MAU-50-01/02 Shutdown Delay
<input type="radio"/> HVAC Alarm*	
*Fan or MAU Not Running	



Optimize Operational Efficiencies

- Reduce After Hours (Overtime) Costs with Software Dialer
 - Alarm Message Provides Specific Information
 - May eliminate after hours visit
 - Obtain real-time SCADA Information from Software Dialer
 - Maintain hardware dialer!





Summary

- SCADA systems can be used as a tool to reduce energy consumption and optimize operational efficiencies!!!
- Perform an Energy Analysis and Develop an Energy Savings Plan
- Review equipment installation and application, and weigh cost versus benefit
- Minimal capitol expense could yield significant savings



Questions

- Any questions?

