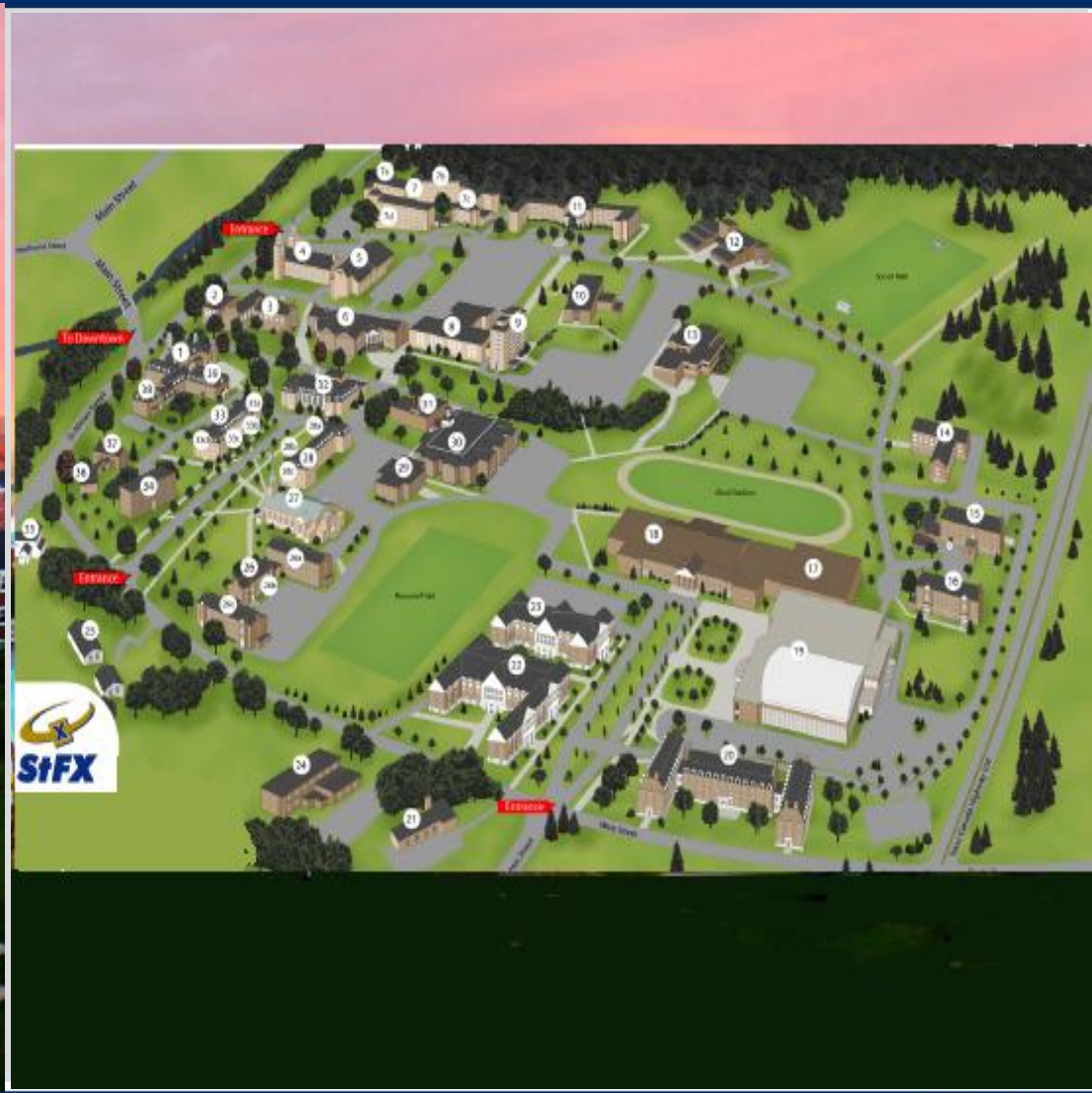


Energy Submetering & Variable Steam Carriage Pressure

St. Francis Xavier University, 2008



St. Francis Xavier University Campus

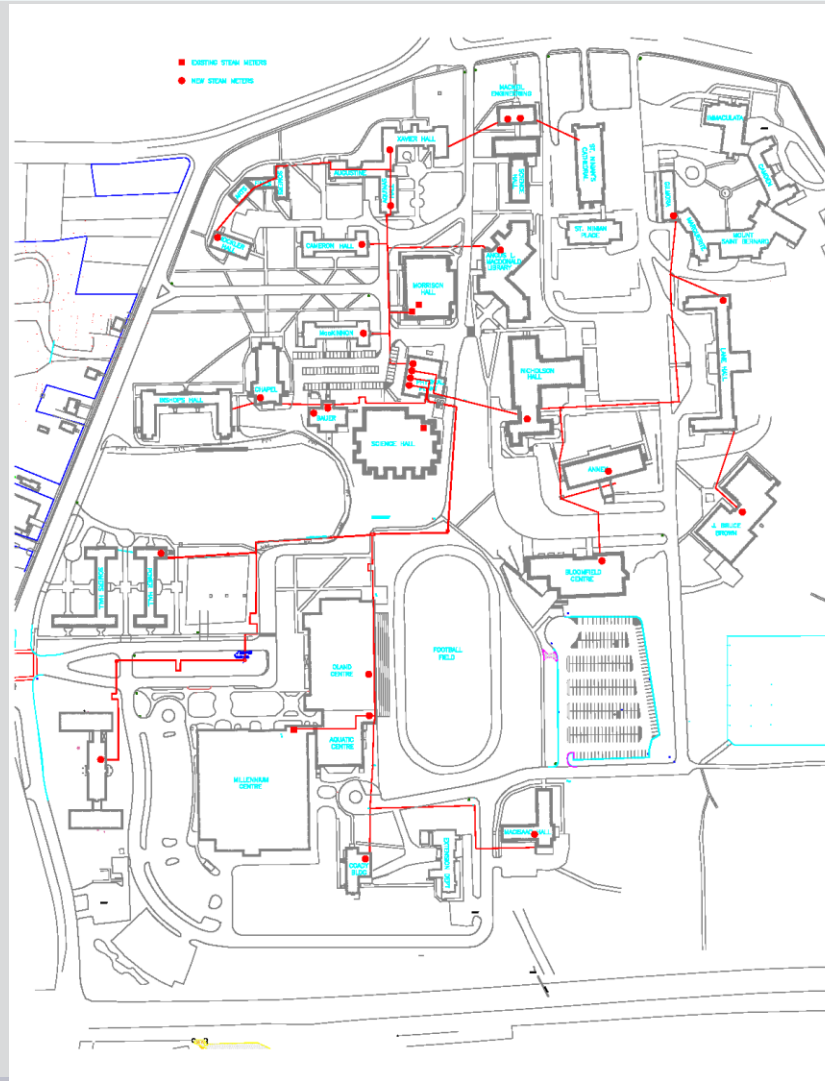


Objectives

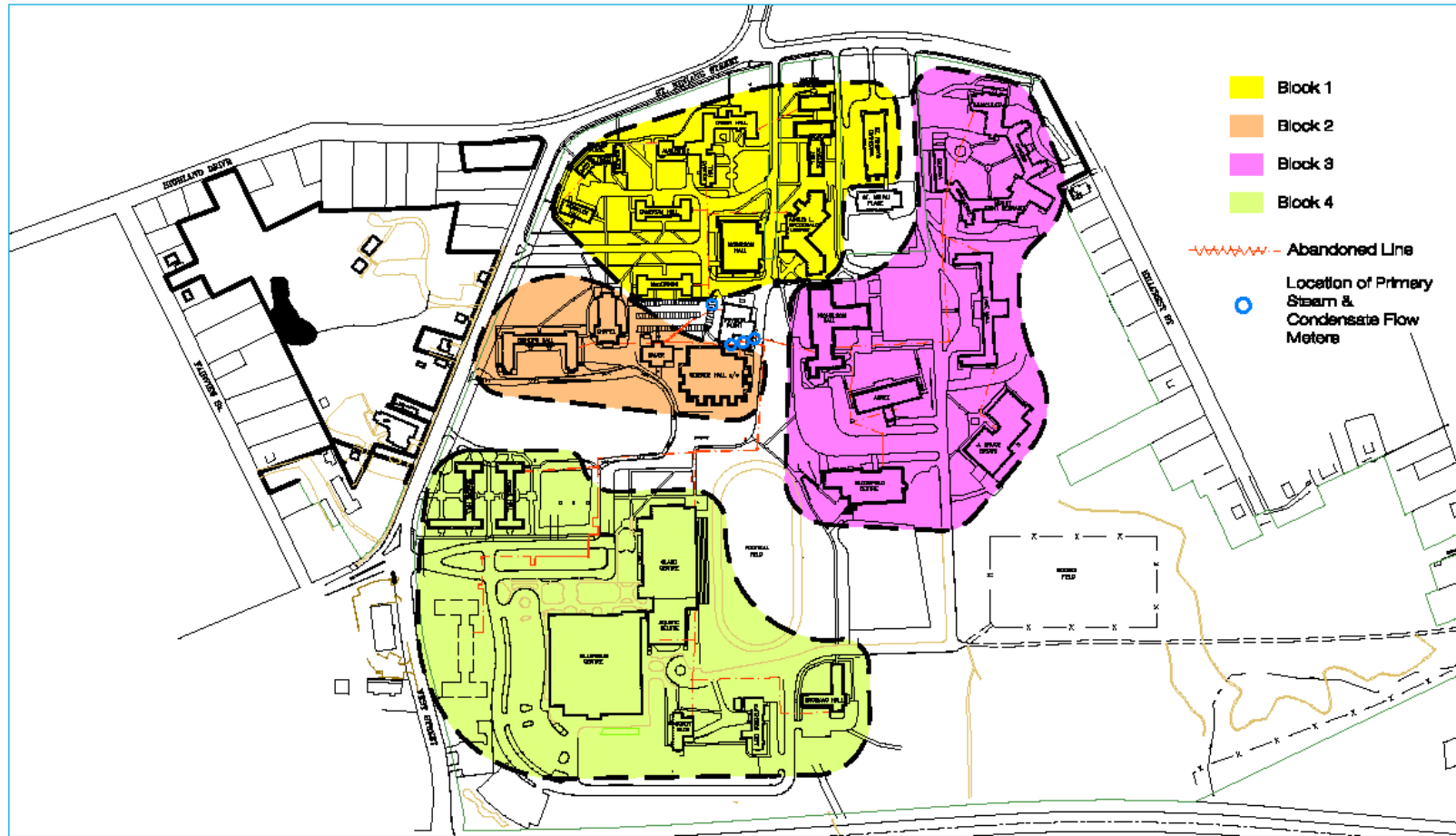


- ✘ **Measurement of Steam & Electrical Consumption**
- ✘ **Dashboard Display for Building Occupants**
- ✘ **Variable Steam Carriage Pressure**

Steam & Electrical Submetering Plan

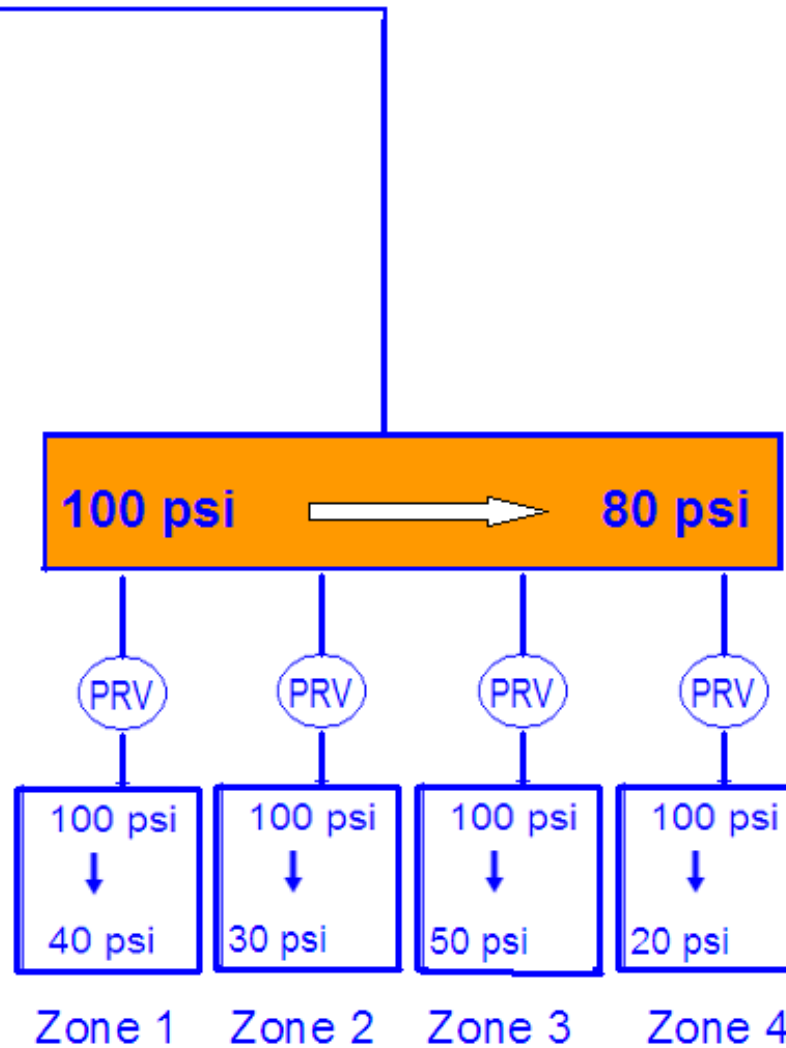
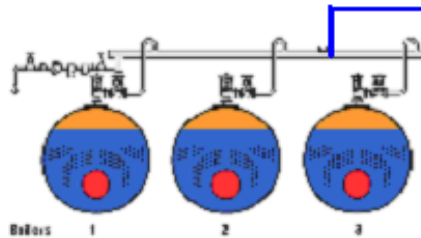


Variable Steam Carriage Pressure



ST.F.X.U. Steam & Condensate Line Distribution

Pressure Modulation Schematics



Shutdown Schedule



D	Task Name	Duration	Start	Finish	May 19, '08	May 26, '08	Jun 1, '08	Jun 8, '08	Jun 15, '08
					S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S
1	Shutdown: Governors Hall	2 days?	Mon 6/2/08	Tue 6/3/08					
2	Mobilization by AB	1 day?	Mon 6/2/08	Mon 6/2/08					
3	Jim to shutdown Governors Hall 11:00 pm	1 day?	Mon 6/2/08	Mon 6/2/08					
4	Work: Install Meters 7:30-4:00 pm	1 day?	Tue 6/3/08	Tue 6/3/08					
5	AB finish work 4:30 pm	1 day?	Tue 6/3/08	Tue 6/3/08					
6	Start Up 3 pm(4 hours)	1 day?	Tue 6/3/08	Tue 6/3/08					
7									
8	Shutdown: Bauer, Bishops and Chapel	3 days?	Sun 6/8/08	Tue 6/10/08					
9	Jim to shutdown steam	1 day?	Sun 6/8/08	Sun 6/8/08					
10	AB to start work 7:30am	1 day?	Mon 6/8/08	Mon 6/8/08					
11	AB Finish Work 4:30	1 day?	Tue 6/10/08	Tue 6/10/08					
12	Start Up 3 pm(4 hours)	1 day?	Tue 6/10/08	Tue 6/10/08					
13									
14	Main Campus Steam Shut Down	28 days?	Thu 5/22/08	Thu 6/26/08					
15	Install Staging	1 day?	Thu 5/22/08	Thu 5/22/08					
16	Remove Insulation	1 day?	Thu 6/12/08	Thu 6/12/08					
17	X-ray piping and header	1 day?	Wed 6/18/08	Wed 6/18/08					
18	Shutdown: Boiler House Martin 3pm	3 days?	Sun 6/22/08	Tue 6/24/08					
19	Martin to shut down 3 pm	1 day?	Sun 6/22/08	Sun 6/22/08					
20	AB to start 7:00 am	1 day?	Mon 6/23/08	Mon 6/23/08					
21	AB to finish 5:00 pm	1 day?	Tue 6/24/08	Tue 6/24/08					
22	Install valve at Camden Hall	2 days?	Mon 6/23/08	Tue 6/24/08					
23	Re-pressurizing	1 day?	Tue 6/24/08	Tue 6/24/08					
24	Block 4 Morrison	1 day?	Tue 6/24/08	Tue 6/24/08					
25	Block 4 KMC Governors	1 day?	Tue 6/24/08	Tue 6/24/08					
26	Block 2 Bishops	1 day?	Tue 6/24/08	Tue 6/24/08					
27	Lane 6 Bloomfield	15 days?	Thu 5/22/08	Tue 6/10/08					
28	Mobilization by AB	1 day?	Thu 5/22/08	Thu 5/22/08					
29	AB to start work 7:00 am	1 day?	Mon 6/8/08	Mon 6/8/08					
30	AB Finish Work 5:00 pm	1 day?	Tue 6/10/08	Tue 6/10/08					
31	STFX Start up Block 3	1 day?	Thu 6/26/08	Thu 6/26/08					
32									
33	Shutdown: Science Hall, Library, Chapel	53 days?	Sun 6/22/08	Mon 8/11/08					
34	Shutdown all summer	53 days?	Sun 6/22/08	Mon 8/11/08					
35									
36	Shutdown: MacNeil, Somers, MacLassac	3 days?	Thu 6/26/08	Mon 6/30/08					

- x **De-Energizing Plant**
 - x Complete plant shutdown of all campus buildings
 - x Historically, never shutdown 100%
- x **De-Energizing Zones**
 - x Shutting down multiple buildings in each zone
- x **De-Energizing Individual Buildings**

Cost

	STFX for all	Cost / unit
Pressure Modulation 4 Zones	\$190,000	\$46,000/unit
Steam Meters Branches (20)	\$340,000	\$17,000/meter
Electrical (31)	\$70,000	\$4,000/meter
Total	\$600,000	\$67,000

Benefits & Risks



Benefits

- ✘ Benchmarks - Consumption and Operating Pressures
- ✘ Buy-in by Chief & Power Engineers
 - ✘ Dashboard will help
 - ✘ Fish oil was a success

Risks

- ✘ De-Energizing the Plant and Zones
- ✘ Water Hammer – Sound Metering - Ultrasonic

Preston Phipps – Andrew Napier



- ✘ Measuring Steam Mass Flow Rate in a Variable Carriage Pressure System
 - ✘ -Why Variable Carriage Pressure?
 - ✘ -Issues in the Steam Plant
 - ✘ -How VCP Affects Steam Mass Flow Measurement
 - ✘ -Field System Resolving Problems
 - ✘ -Presenting the Information
 - ✘ -Accessing the Information via Internet

Why Variable Carriage Pressure?



- x Analyze the Energy Saving for 1 Km of 8" NPS, at 85% Insulation Efficiency @ 100 vs 30 PSIG
- x -Radiant Loss is 300 MBH less (1012 vs 715)
\$52,035 annually @ \$20/mmbtu
- x -Leakage Loss is 176 lb/hr* less (288 vs 112)
\$30,885 annually @ \$20/Klb>(*4) 1/8" leaks)
- x -HP Trap Flash Loss is 104 lb/hr less
\$18,220 annually @ \$20/Klb
- x -Total Annual Energy Saving **\$101,140.00**

Issues in the Steam Plant



- x -Why Dropping Boiler Pressure Isn't Feasible
 - x -Percolation and/or Stack Acidulation
- x -External Pilot PRV with Air Loaded Pilot from DCS
 - x -I/P Signal is Multiplied to Pilot Diaphragm
- x -Density(pressure) Is Dropped in Direct Proportion
 - x to Mass Flow Rate to Keep Line Velocity Constant
- x -Steam Plant Meters for Control and High Quality
 - x Datum. Compare to Building Meters for Line Loss
- x -PRV Bypass Valves are Mandatory

VCP Affects Mass Flow Measurement



- ✘ -80 Psig Steam Occupies 4.65 cu ft/lb
- ✘ -30 Psig Steam Occupies 9.40 cu ft/lb
- ✘ -Although Specific Volume Changes Greatly with Pressure, Total Energy is Constant
- ✘ -Any Energy Load Can Occur at Any Pressure for Any Specific Building's Meter
- ✘ -Highest Velocity Occurs at High Energy Load/ Low Pressure; Lowest Velocity is the Reverse
- ✘ -**10:1** on **Mass Flow** = **20:1** on **Volume Flow**

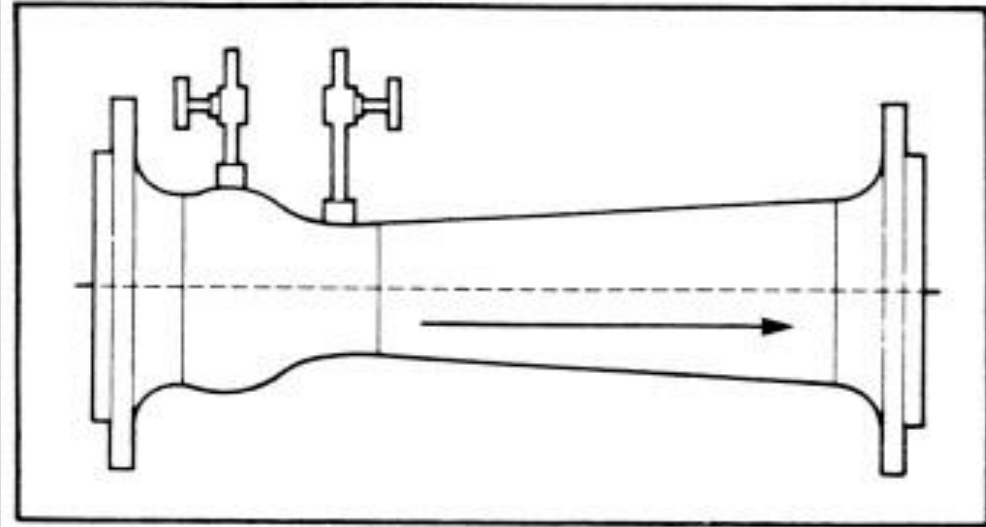
VCP Affects Mass Flow Measurement



- x -Pipeline Velocities Must Be Reasonable
- x -Density of Steam Must Be a Measured Variable via
- x RTD or Pressure Transmitter
- x -Primary Flow Element Has Wide Rangability but
- x with Low Permanent Pressure Loss (400" signal)
- x -Separation Reliant Elements Are Unpredictable
- x -Blockage Reliant Elements Have Too Much PPL
- x -DP Cells Must be "Stacked" into Flow Computer
- x -Computer Integrates Variables & Multiplies

Venturi, Nozzle and Venturi Nozzle

- Shape of nozzle or venturi is intended to create a predictable flow pattern for high rangeability
- Predictable variation of constant at extremes unless choked
- Very low permanent pressure loss relative to blockage elements



Secondary Instrumentation



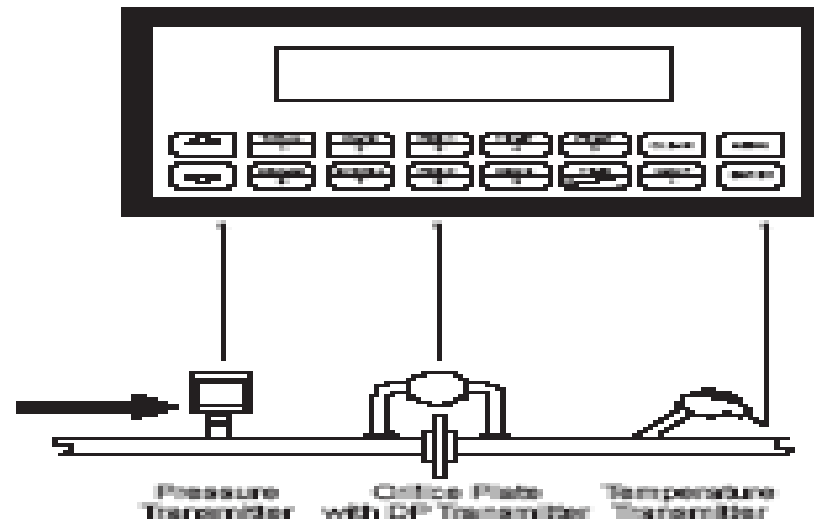
- x -Supertrol 2 with RS-485 & Modbus RTU Protocol
- x Supertrol is the Slave (Query-Response Cycle)
- x -Modbus is Converted to Ethernet then Output via
- x Wi-Fi for Wireless Connectivity
- x -All Components in a Common Enclosure(120VAC)
- x -Dual DP Cells on a Common 3-Valve Manifold are
- x Zeroed Together Simultaneously
- x -RTD Is Other Loop Powered Input to Supertrol 2

Secondary Instrumentation



Field System Resolving Problems

Steam Mass & Steam Heat Illustration



Calculations

Mass Flow

Mass Flow = volume flow • density (T, p)

Heat Flow

Heat Flow = Volume flow • density (T, p) • Sp. Enthalpy of steam (T, p)

Presenting the Information

INFILINK HMI Run Mode - INFILINK Demo - [Main]

Project Tag Groups Logger User Window Help

Main Menu

INFILINK

Kessler-Ellis Products

Draw Objects


Animations


Alarms


Trends


Graphics


Virtual Panels


Libraries


Recipes


DDE Links


Modem


New Features


Drivers


10 Industrial Way East Eatontown, NJ 07724 TEL: (732) 935-1320
<http://www.kep.com> FAX: (732) 935-9344

Press [F2] on any window to return to this menu.
Press [F5] on any window to activate the alarm feature.

Start | I... | I... | I... | I...

Internet Access to Information



- x Internet - real time metering every minute
 - x Local provider option -DSL, T1, Cable, Wireless
 - x Modbus TCP information exchange
- x Campus fiber-optic network buried along with piping
- x Auxiliary Measurements from customer site using the existing communication channel
- x Examples of polling for information:
 - x Monitoring of proper Steam Trap Operation
 - x Remote customer control of automated valve
 - x User defined alarm notification