It's All About Control!

Presenter: Dennis Burgard

Representing: M.E.T. Automation & Controls

Thank you for allowing me to present today!

M.E.T.
Automation & Controls

1 West Main Street
P.O Box 376
East Helena, MT
59635

Automation
- Integration
- Service - Primary
  - Municipal
  - Irrigation districts

Nick Vasquez – Fabrication, Service, CAD, graphics
Joel Burgard – Project manager, programmer, server, security
Josh Hendricks – Instrumentation tech, field installs
Mandy Burgard – Senior Graphics Programmer / Project coordinator

Pete Parsons – Inside Sales,
Les Austin – Shop manager /
Skye Burgard – Field assistant, service
Sandy Burgard – Office manager / administrative

INITIAL CONSIDERATIONS FOR AUTOMATION:

1. Data Collection Only
    - Flow / Gate / Level Instantaneous Display
    - Trended data for historical review
    - Logged data CSV, MS Excel, Historian
2. Full Control
    - Collect as detailed above
    - Control
        - AUTO: Enter setpoint, and automatically controls to that point
        - HAND: Command to specific point and stays
3. Data collection and storage
    - Microsoft Excel
    - Historian
    - SQL Server
4. Access to system
    - Local computer
    - Remote Computer
    - Phone, Tablet, etc.
5. Network
    - Radio
    - Hardwire
    - Gateway/Internet/Phone Modem
    - Satellite

Monitor location only: Level/Flow/Gate Position

Solar / AC Power / I/O Radio / Local Display / Sensor Mounting

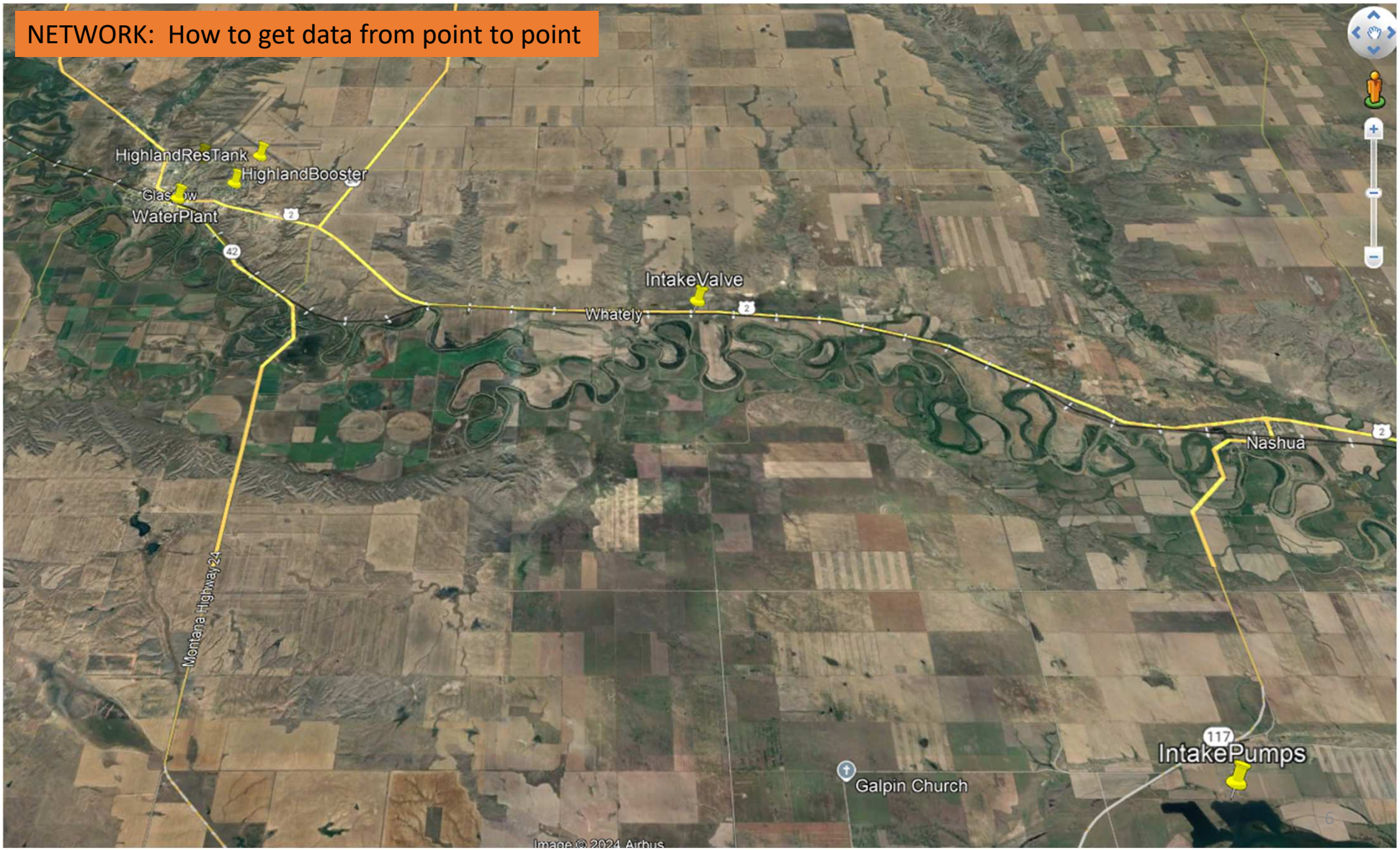
Control location:

Gate Position/Pump Motor

Flow Based:

Gate Control

Pump Control


NETWORK: How to get data from point to point
HighlandResTank
HighlandBooster
WaterPlant
IntakeValve
Whately
Nashua
Montana Highway 24
IntakePumps
Galpin Church
Image © 2024 Airbus

Deep Dive Look into primary components

- Network
- Security
- Server
- HMI
- Actuators
- Level
- Sontek Flow
- Antennas
- Lightning

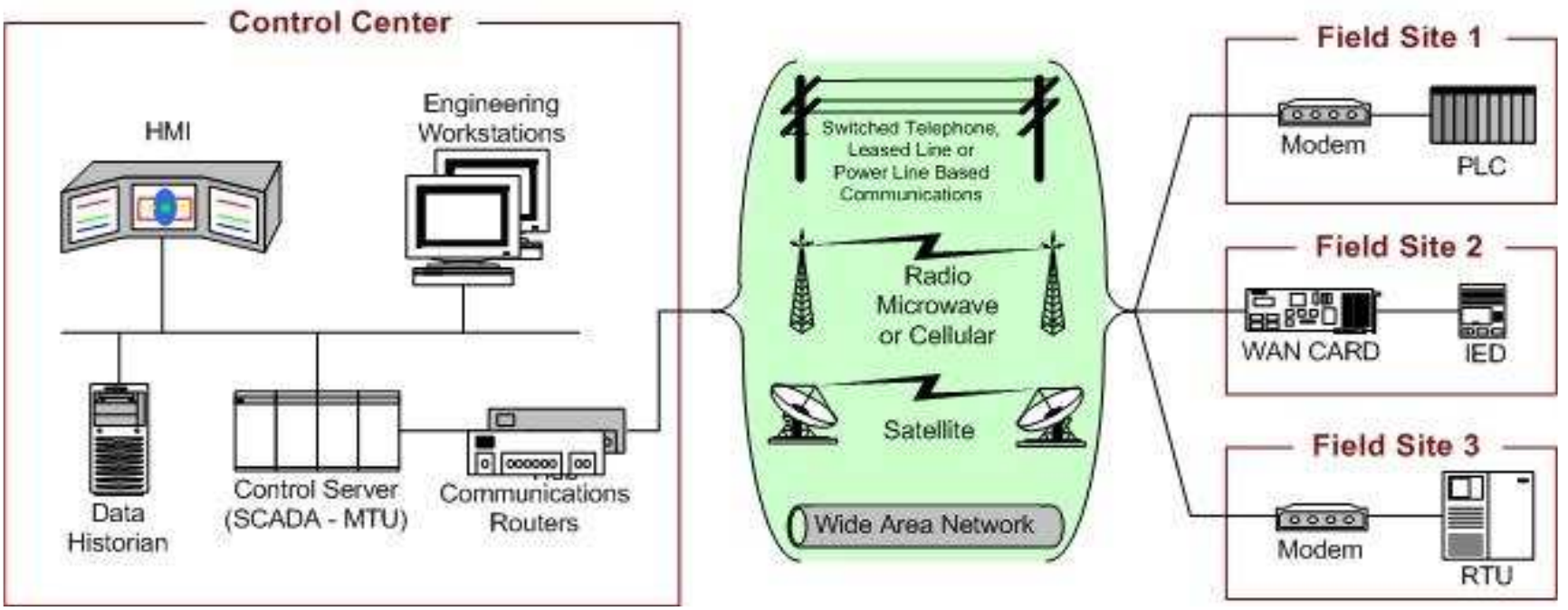
Communication Network

BACKBONE OF IRRIGATION SCADA SYSTEM

Introduction

Joel Burgard

Network Architecture



SCADA System General Layout

What to Consider?

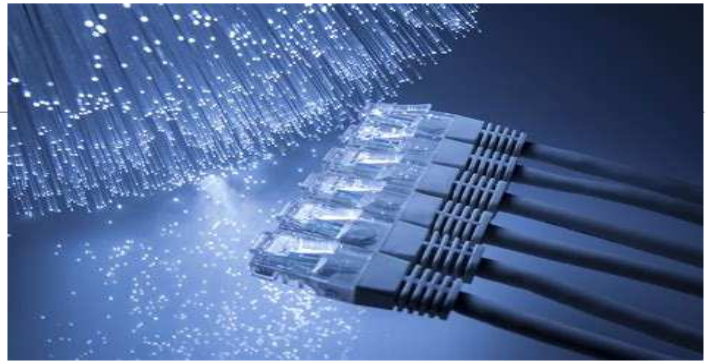
Reliability

Cost

Serviceability

Security

Hardwired

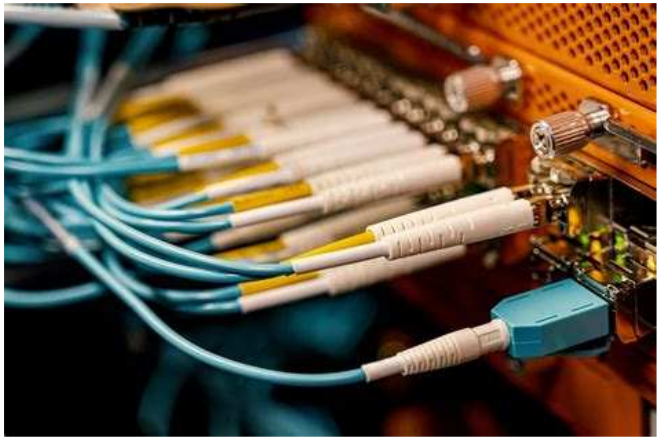


Ethernet

- Short Distance
- Simple

Fiber Optics

- More Nuanced
- Will go as far as you want to pay for it



Wireless

Radio

Gateway (VPN)

Satellite


Graph: Min, Avg, Max Elevation: 3740, 4209, 4796 ft
Range Totals: Distance: 30.2 mi Elev Gain/Loss: 1375 ft, -2325 ft Max Slope: 9.7%, -13.3% Avg Slope: 1.5%, -1.8%
4796 ft
4500 ft
4250 ft
4000 ft
3740 ft
3815 ft
-0.9%
2.5 mi
5 mi
7.5 mi
10 mi
12.5 mi
15 mi
17.5 mi
20 mi
22.5 mi
25 mi
27.5 mi
30.1 mi


Graph: Min, Avg, Max Elevation: 3663, 3818, 4049 ft
Range Totals: Distance: 15.2 mi Elev Gain/Loss: 827 ft, -983 ft Max Slope: 20.3%, -20.0% Avg Slope: 1.9%, -1.6%
4049 ft
4000 ft
3950 ft
3900 ft
3850 ft
3800 ft
3750 ft
3700 ft
3663 ft
3828 ft
0.3%
2.5 mi
5 mi
7.5 mi
10 mi
12.5 mi
14.7 mi

Security

Best Practices

- Passwords:
  - Minimum 15 character long
  - 1 Lowercase, 1 Uppercase, 1 Symbol, and 1 Numeric Character
  - Change Once a week
  - Should be accompanied by a token that cycles every 60 seconds
  - Should be accompanied with multifactor authentication
- All accounts should automatically log out upon closing application
- Everyone should have individual account
- All communications should be a minimum AES 256 Encryption protocol
- Server/Workstation should be in secured reinforced room only accessible with RFID badges

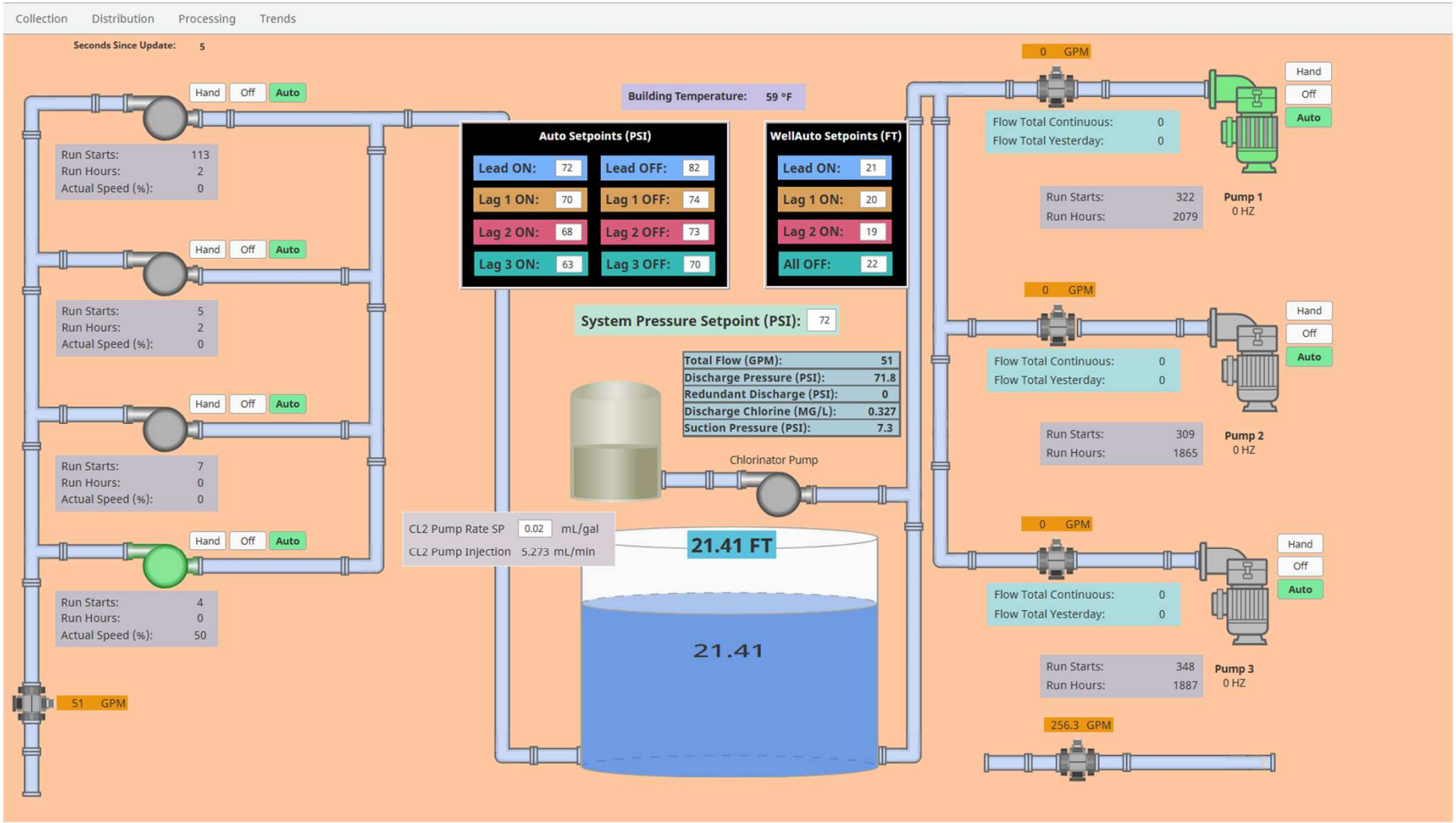
Security (CONT'D)

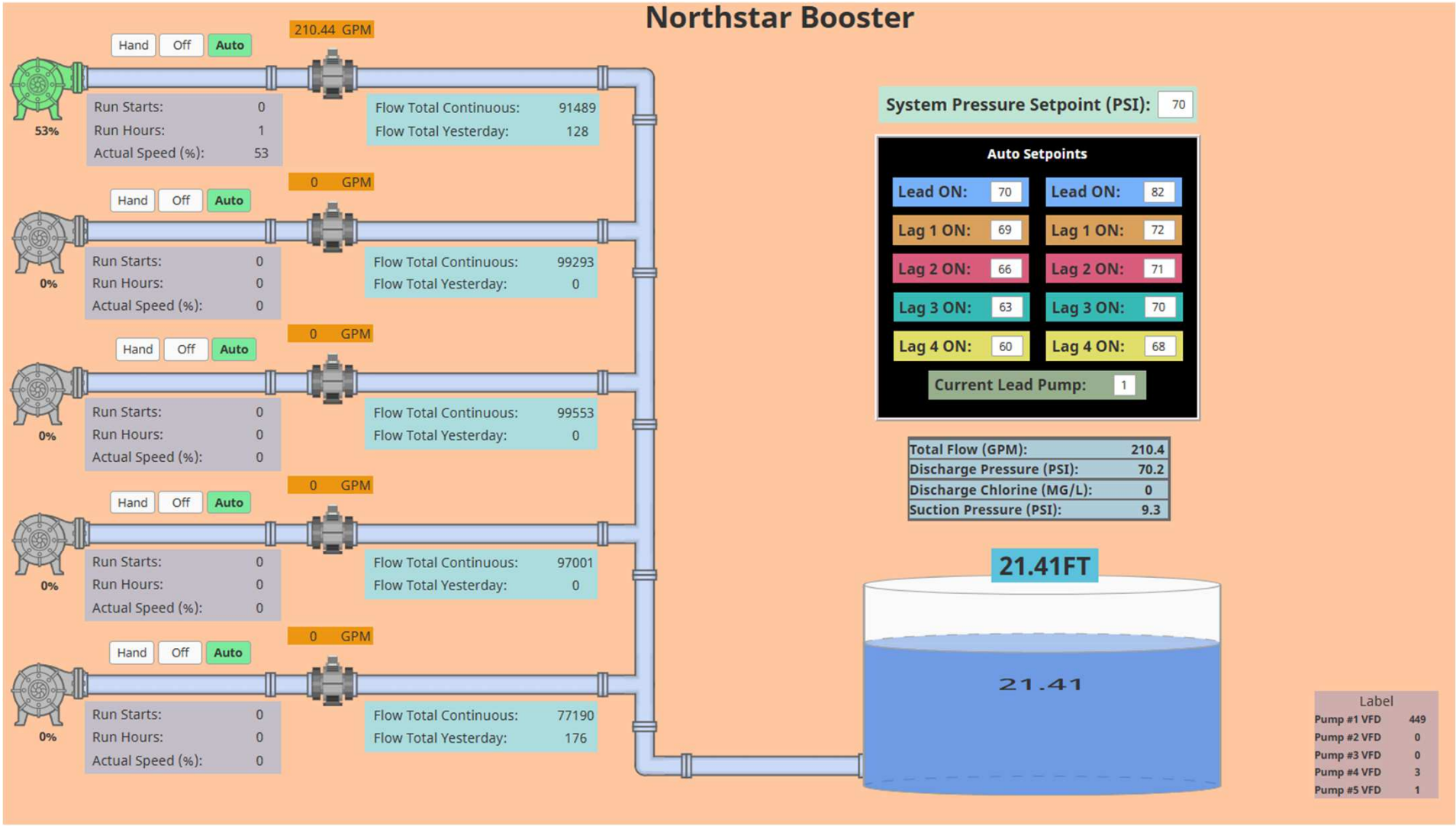
Time and place for high security

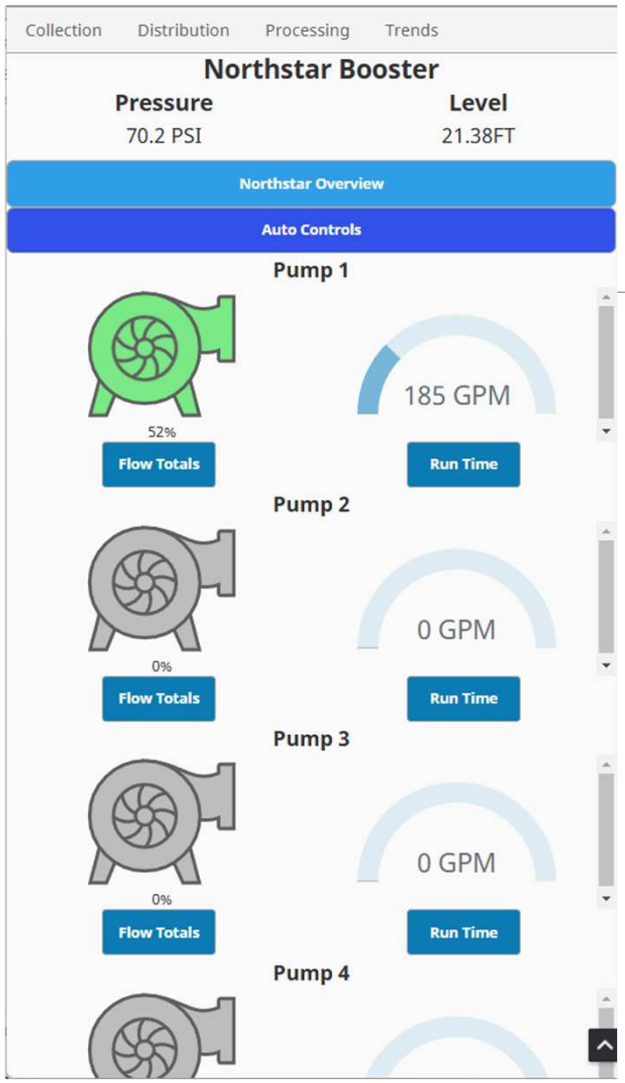
Your security will be determined by your desired level of convenience

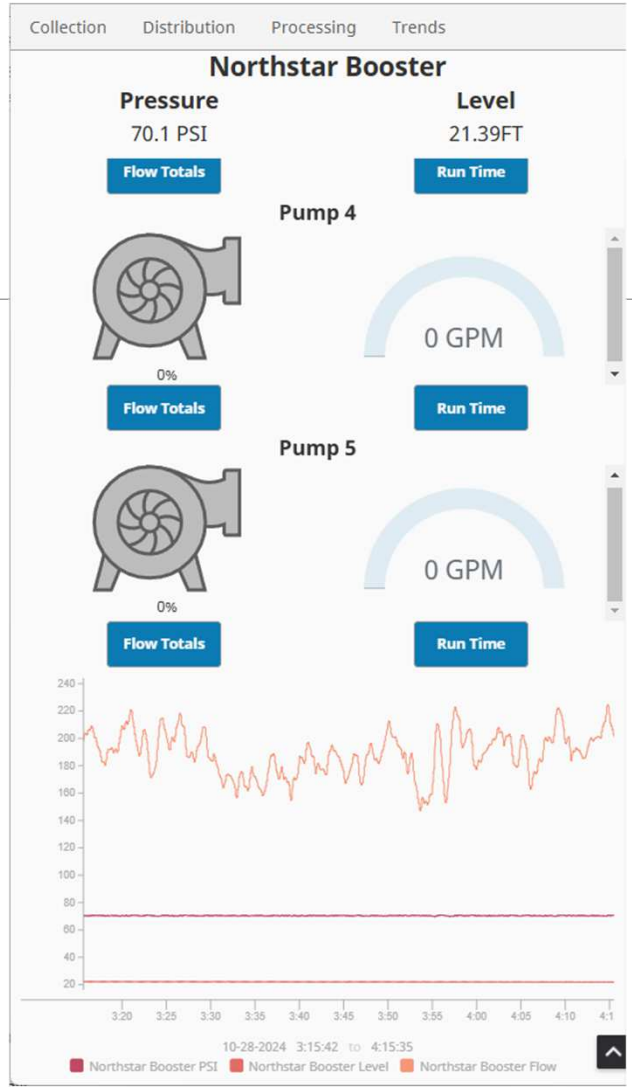
Easy to underthink convenience in an office

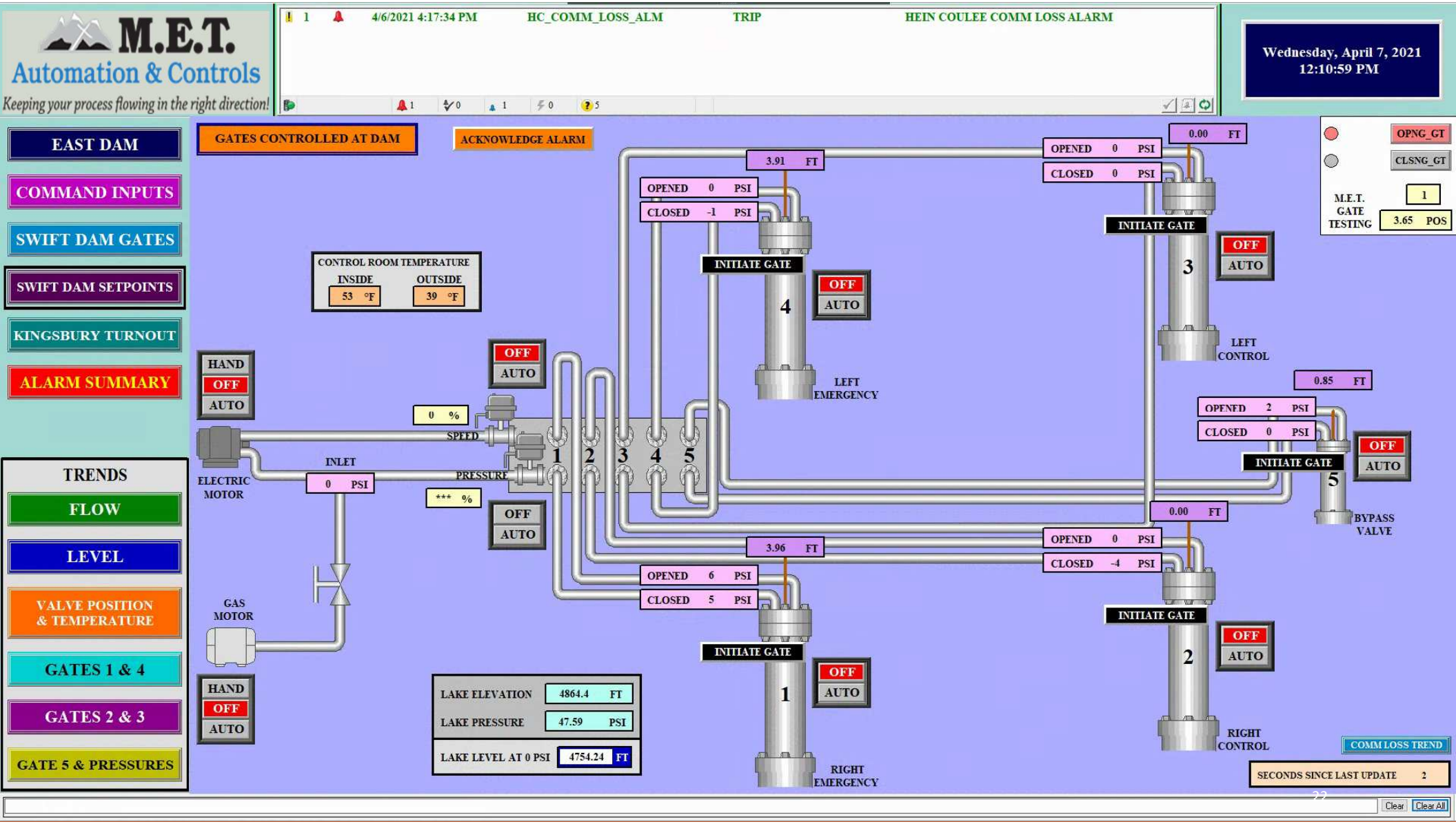
Server/Workstation


Collection
Distribution
Processing
Trends
Seconds Since Update: 5
Building Temperature: 59 °F
Hand
Off
Auto
Run Starts: 113
Run Hours: 2
Actual Speed (%): 0
Run Starts: 5
Run Hours: 2
Actual Speed (%): 0
Run Starts: 7
Run Hours: 0
Actual Speed (%): 0
Run Starts: 4
Run Hours: 0
Actual Speed (%): 50
51 GPM
Auto Setpoints (PSI)
Lead ON: 72
Lead OFF: 82
Lag 1 ON: 70
Lag 1 OFF: 74
Lag 2 ON: 68
Lag 2 OFF: 73
Lag 3 ON: 63
Lag 3 OFF: 70
WellAuto Setpoints (FT)
Lead ON: 21
Lag 1 ON: 20
Lag 2 ON: 19
All OFF: 22
System Pressure Setpoint (PSI): 72
Total Flow (GPM): 51
Discharge Pressure (PSI): 71.8
Redundant Discharge (PSI): 0
Discharge Chlorine (MG/L): 0.327
Suction Pressure (PSI): 7.3
Chlorinator Pump
CL2 Pump Rate SP 0.02 mL/gal
CL2 Pump Injection 5.273 mL/min
21.41 FT
21.41
0 GPM
Flow Total Continuous: 0
Flow Total Yesterday: 0
Run Starts: 322
Run Hours: 2079
Pump 1
0 HZ
Flow Total Continuous: 0
Flow Total Yesterday: 0
Run Starts: 309
Run Hours: 1865
Pump 2
0 HZ
Flow Total Continuous: 0
Flow Total Yesterday: 0
Run Starts: 348
Run Hours: 1887
Pump 3
0 HZ
256.3 GPM


Northstar Booster
210.44 GPM
Hand
Off
Auto
Run Starts: 0
Run Hours: 1
Actual Speed (%): 53
Flow Total Continuous: 91489
Flow Total Yesterday: 128
53%
0 GPM
Run Starts: 0
Run Hours: 0
Actual Speed (%): 0
Flow Total Continuous: 99293
Flow Total Yesterday: 0
0%
0 GPM
Run Starts: 0
Run Hours: 0
Actual Speed (%): 0
Flow Total Continuous: 99553
Flow Total Yesterday: 0
0%
0 GPM
Run Starts: 0
Run Hours: 0
Actual Speed (%): 0
Flow Total Continuous: 97001
Flow Total Yesterday: 0
0%
0 GPM
Run Starts: 0
Run Hours: 0
Actual Speed (%): 0
Flow Total Continuous: 77190
Flow Total Yesterday: 176
0%
System Pressure Setpoint (PSI): 70
Auto Setpoints
Lead ON: 70
Lead ON: 82
Lag 1 ON: 69
Lag 1 ON: 72
Lag 2 ON: 66
Lag 2 ON: 71
Lag 3 ON: 63
Lag 3 ON: 70
Lag 4 ON: 60
Lag 4 ON: 68
Current Lead Pump: 1
Total Flow (GPM): 210.4
Discharge Pressure (PSI): 70.2
Discharge Chlorine (MG/L): 0
Suction Pressure (PSI): 9.3
21.41FT
21.41
Label
Pump #1 VFD 449
Pump #2 VFD 0
Pump #3 VFD 0
Pump #4 VFD 3
Pump #5 VFD 1


Collection
Distribution
Processing
Trends
Northstar Booster
Pressure
70.2 PSI
Level
21.38FT
Northstar Overview
Auto Controls
Pump 1
52%
185 GPM
Flow Totals
Run Time
Pump 2
0%
0 GPM
Flow Totals
Run Time
Pump 3
0%
0 GPM
Flow Totals
Run Time
Pump 4


Collection
Distribution
Processing
Trends
Northstar Booster
Pressure
70.1 PSI
Level
21.39FT
Flow Totals
Run Time
Pump 4
0%
0 GPM
Flow Totals
Run Time
Pump 5
0%
0 GPM
Flow Totals
Run Time
240
220
200
180
160
140
120
100
80
60
40
20
3:20
3:25
3:30
3:35
3:40
3:45
3:50
3:55
4:00
4:05
4:10
10-28-2024 3:15:42 to 4:15:35
Northstar Booster PSI
Northstar Booster Level
Northstar Booster Flow


M.E.T.
Automation & Controls
Keeping your process flowing in the right direction!
1 4/6/2021 4:17:34 PM HC_COMM_LOSS_ALM TRIP HEIN COULEE COMM LOSS ALARM
Wednesday, April 7, 2021
12:10:59 PM
EAST DAM
COMMAND INPUTS
SWIFT DAM GATES
SWIFT DAM SETPOINTS
KINGSBURY TURNOUT
ALARM SUMMARY
TRENDS
FLOW
LEVEL
VALVE POSITION & TEMPERATURE
GATES 1 & 4
GATES 2 & 3
GATE 5 & PRESSURES
GATES CONTROLLED AT DAM
ACKNOWLEDGE ALARM
OPNG_GT
CLSNG_GT
M.E.T. GATE TESTING
1
3.65 POS
CONTROL ROOM TEMPERATURE
INSIDE 53 °F
OUTSIDE 39 °F
HAND OFF AUTO
OFF AUTO
0 %
SPEED
INLET
0 PSI
PRESSURE
*** %
ELECTRIC MOTOR
GAS MOTOR
1 2 3 4 5
3.91 FT
OPENED 0 PSI
CLOSED -1 PSI
INITIATE GATE
4
LEFT EMERGENCY
0.00 FT
OPENED 0 PSI
CLOSED 0 PSI
INITIATE GATE
3
LEFT CONTROL
0.85 FT
OPENED 2 PSI
CLOSED 0 PSI
INITIATE GATE
5
BYPASS VALVE
3.96 FT
OPENED 6 PSI
CLOSED 5 PSI
INITIATE GATE
1
RIGHT EMERGENCY
0.00 FT
OPENED 0 PSI
CLOSED -4 PSI
INITIATE GATE
2
RIGHT CONTROL
LAKE ELEVATION 4864.4 FT
LAKE PRESSURE 47.59 PSI
LAKE LEVEL AT 0 PSI 4754.24 FT
COMM LOSS TREND
SECONDS SINCE LAST UPDATE 2
Clear
Clear All

Step-By-Step Gate Operation Procedure for operating at the DAM

1.) Confirm control – GATES CONTROLLED AT DAM

2.) Set all controls to AUTO
- Motor – GAS or ELECTRIC
- Speed Valve
- Pressure Valve
- Desired Gate – 1, 2, 3, 4, or 5

3.) Verify Gate PSI for desired gate – SWIFT DAM SETPOINTS

4.) Set desired position - OPEN SP (#.## FT)

5.) Select INITIATE GATE

6.) Recommend – When completed turn all controls back to OFF

HMI (Human to Machine Interface)
OIT (Operator Interface Terminal)

-Intuitive Graphics: Should be able to know process and understand graphics

-Appropriate Data: Shows necessary items without cluttering with unnecessary values

-History Access: See Trend of process, perhaps min/max, or totals, etc.

-Clean, easy to follow.

-Value added items:

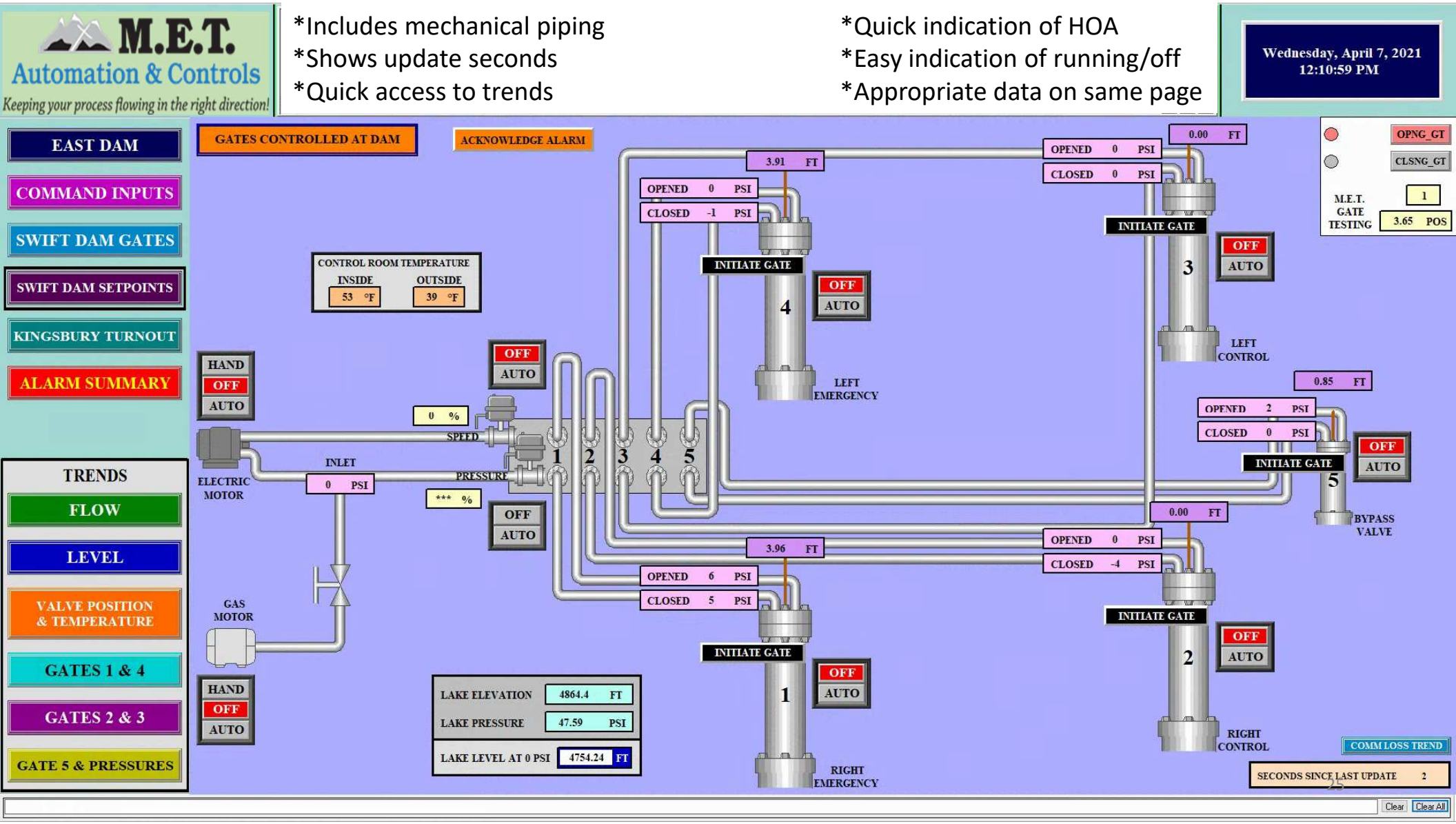
Update times

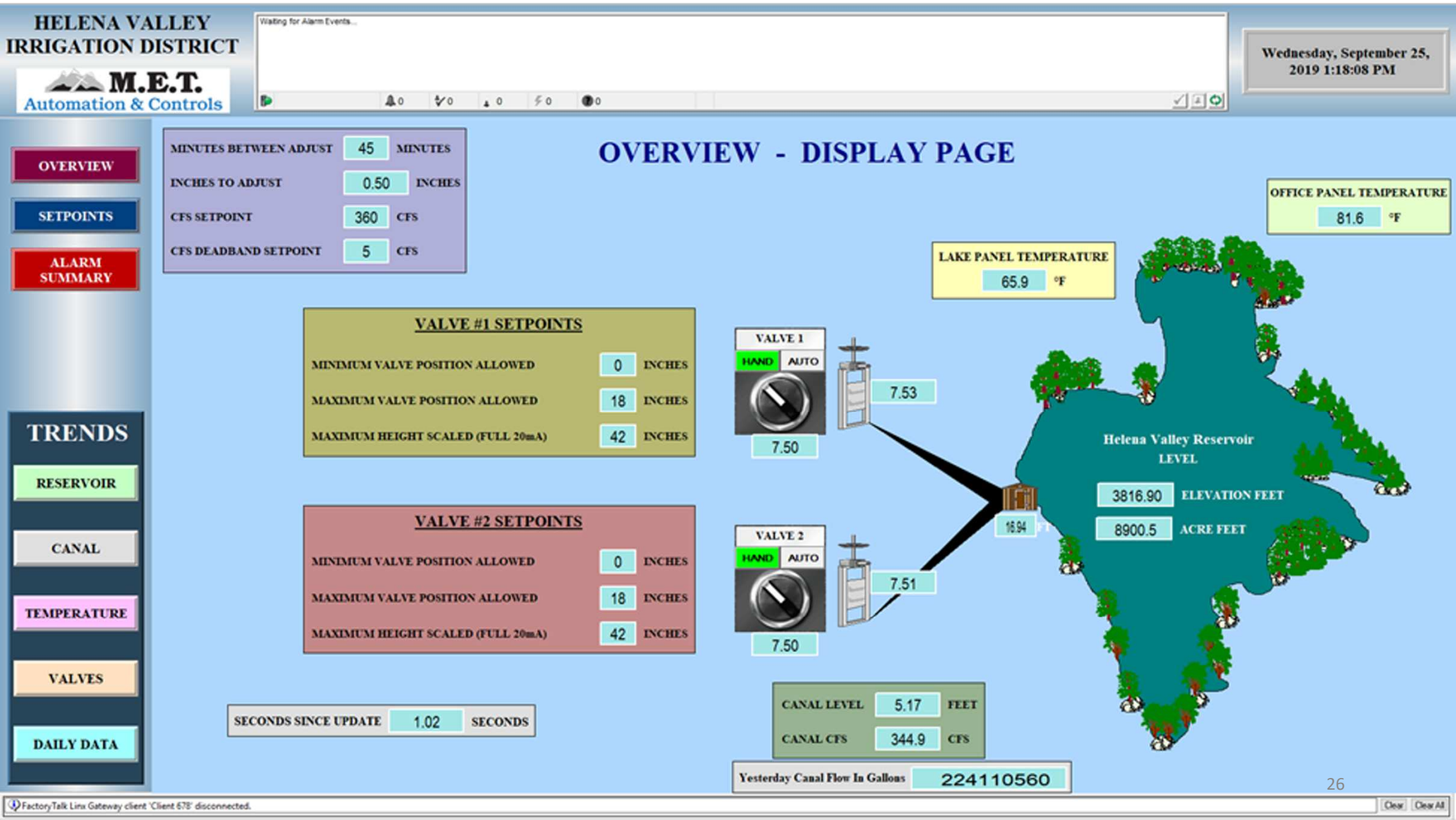
Daily Values

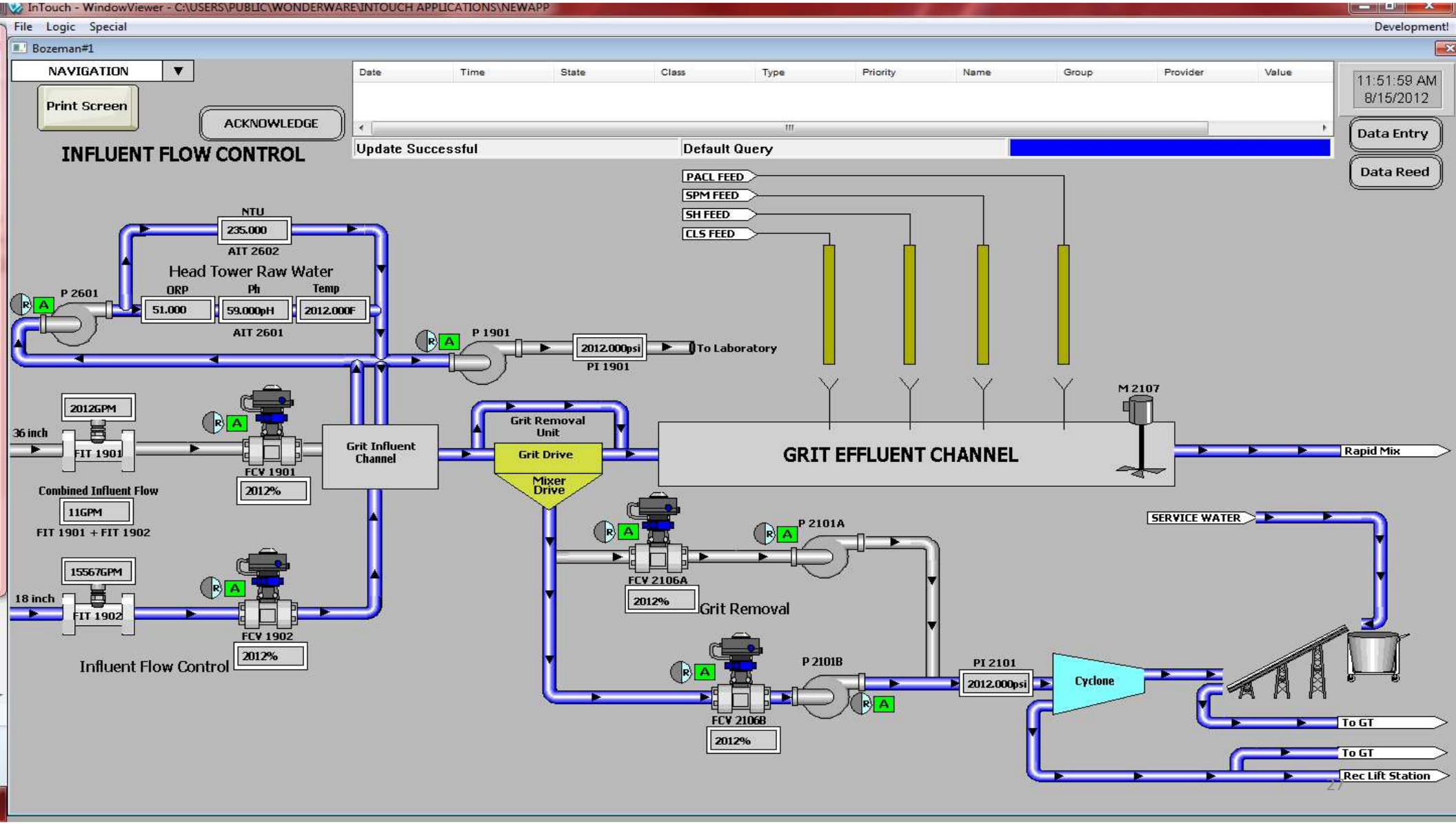
Alarm Conditions

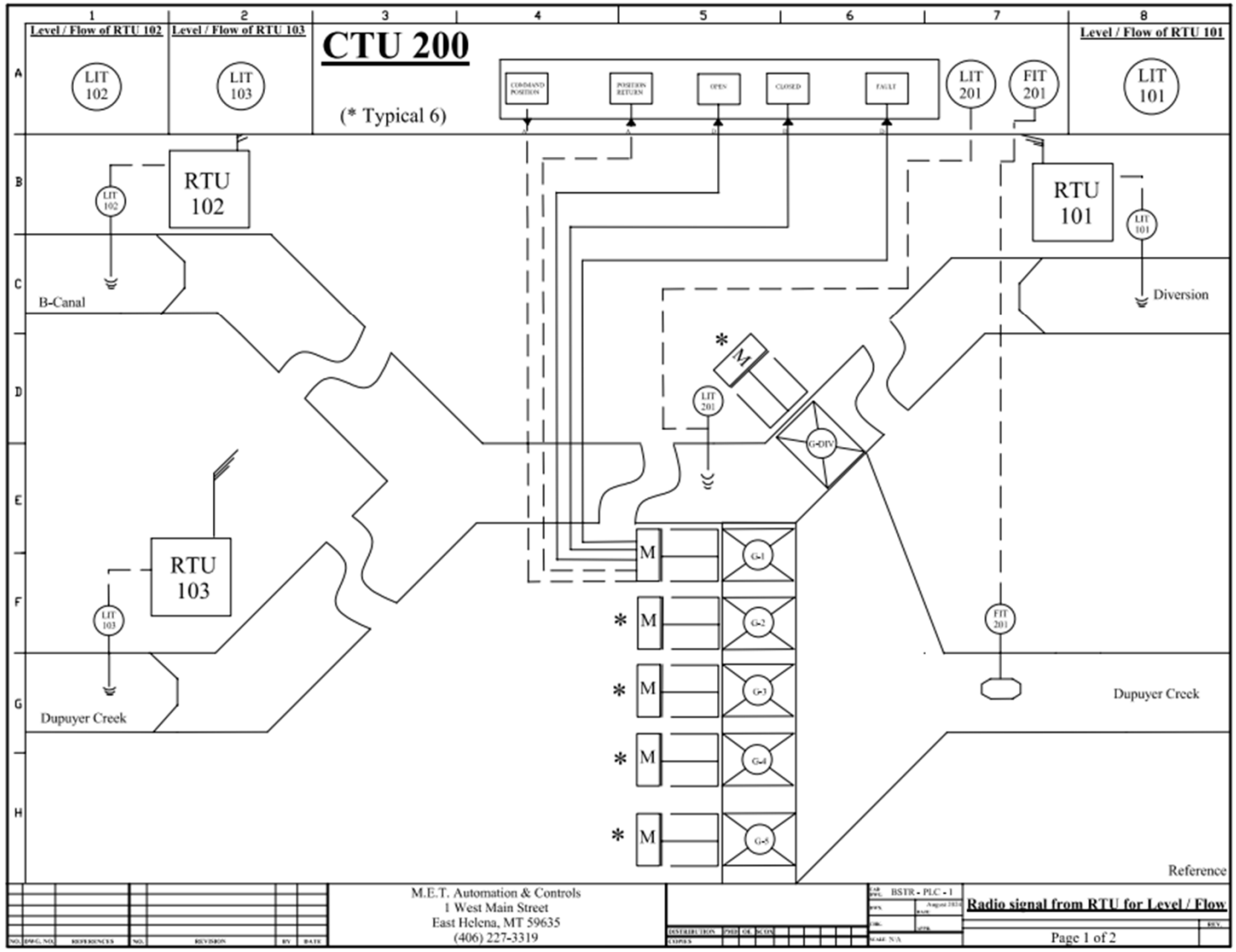
*Includes mechanical piping
*Shows update seconds
*Quick access to trends

*Quick indication of HOA
*Easy indication of running/off
*Appropriate data on same page




HELENA VALLEY IRRIGATION DISTRICT
M.E.T. Automation & Controls
Waiting for Alarm Events...
Wednesday, September 25, 2019 1:18:08 PM
OVERVIEW
SETPOINTS
ALARM SUMMARY
TRENDS
RESERVOIR
CANAL
TEMPERATURE
VALVES
DAILY DATA
MINUTES BETWEEN ADJUST 45 MINUTES
INCHES TO ADJUST 0.50 INCHES
CFS SETPOINT 360 CFS
CFS DEADBAND SETPOINT 5 CFS
OVERVIEW - DISPLAY PAGE
OFFICE PANEL TEMPERATURE 81.6 °F
LAKE PANEL TEMPERATURE 65.9 °F
VALVE #1 SETPOINTS
MINIMUM VALVE POSITION ALLOWED 0 INCHES
MAXIMUM VALVE POSITION ALLOWED 18 INCHES
MAXIMUM HEIGHT SCALED (FULL 20mA) 42 INCHES
VALVE #2 SETPOINTS
MINIMUM VALVE POSITION ALLOWED 0 INCHES
MAXIMUM VALVE POSITION ALLOWED 18 INCHES
MAXIMUM HEIGHT SCALED (FULL 20mA) 42 INCHES
VALVE 1
HAND AUTO
7.50
7.53
VALVE 2
HAND AUTO
7.50
7.51
16.94 FT
Helena Valley Reservoir LEVEL
3816.90 ELEVATION FEET
8900.5 ACRE FEET
SECONDS SINCE UPDATE 1.02 SECONDS
CANAL LEVEL 5.17 FEET
CANAL CFS 344.9 CFS
Yesterday Canal Flow In Gallons 224110560
FactoryTalk Linx Gateway client 'Client 678' disconnected.
Clear
Clear All


InTouch - WindowViewer - C:\USERS\PUBLIC\WONDERWARE\INTOUCH APPLICATIONS\NEWAPP
File Logic Special
Development!
Bozeman#1
NAVIGATION
Print Screen
ACKNOWLEDGE
INFLUENT FLOW CONTROL
Date Time State Class Type Priority Name Group Provider Value
11:51:59 AM
8/15/2012
Data Entry
Data Reed
Update Successful
Default Query
PACL FEED
SPM FEED
SH FEED
CLS FEED
NTU
235.000
AIT 2602
Head Tower Raw Water
ORP Ph Temp
51.000 59.000pH 2012.000F
AIT 2601
P 2601
P 1901
2012.000psi
PI 1901
To Laboratory
M 2107
2012GPM
36 inch
FIT 1901
FCV 1901
2012%
Combined Influent Flow
11GPM
FIT 1901 + FIT 1902
Grit Influent Channel
Grit Removal Unit
Grit Drive
Mixer Drive
GRIT EFFLUENT CHANNEL
Rapid Mix
15567GPM
18 inch
FIT 1902
FCV 1902
2012%
Influent Flow Control
FCV 2106A
2012%
Grit Removal
P 2101A
P 2101B
FCV 2106B
2012%
PI 2101
2012.000psi
Cyclone
SERVICE WATER
To GT
To GT
Rec Lift Station


CTU 200
(* Typical 6)
Level / Flow of RTU 102
Level / Flow of RTU 103
Level / Flow of RTU 101
LIT 102
LIT 103
LIT 201
FIT 201
LIT 101
COMMAND POSITION
POSITION RETURN
OPEN
CLOSED
FAULT
RTU 102
RTU 101
RTU 103
B-Canal
Diversion
Dupuyer Creek
Dupuyer Creek
G-DIV
G-1
G-2
G-3
G-4
G-5
M
Reference
M.E.T. Automation & Controls
1 West Main Street
East Helena, MT 59635
(406) 227-3319
BSTR - PLC - 1
Radio signal from RTU for Level / Flow
Page 1 of 2

Discuss Instrument Selection

- Level Transmitters
  - Calculate Flow based on head (primary measuring device)
- Flowmeters Open Channel (Sontek etc.)
- Actuators
- Antenna

Level only transmitters must have a “primary measuring device”: parshall flume, something to create head vs flow table

ULTRASONIC
Can take care of pump application

<u>Duplex Control with lead/lag and alternate:</u>

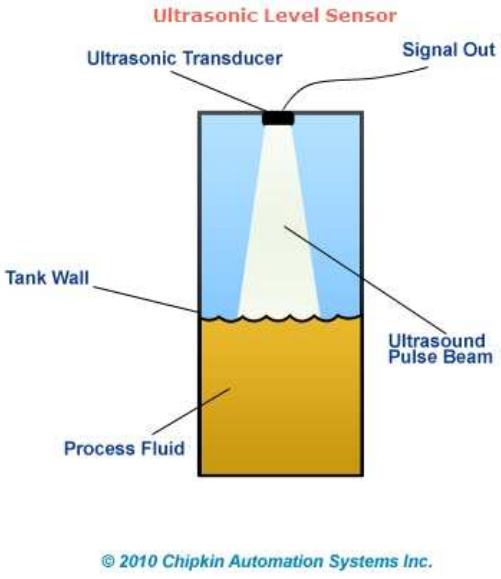
Call duplex pumps (5 relays)
  Alternate, and call both at Lag setpoint
Low and High level alarms
Pump run meter and start counts

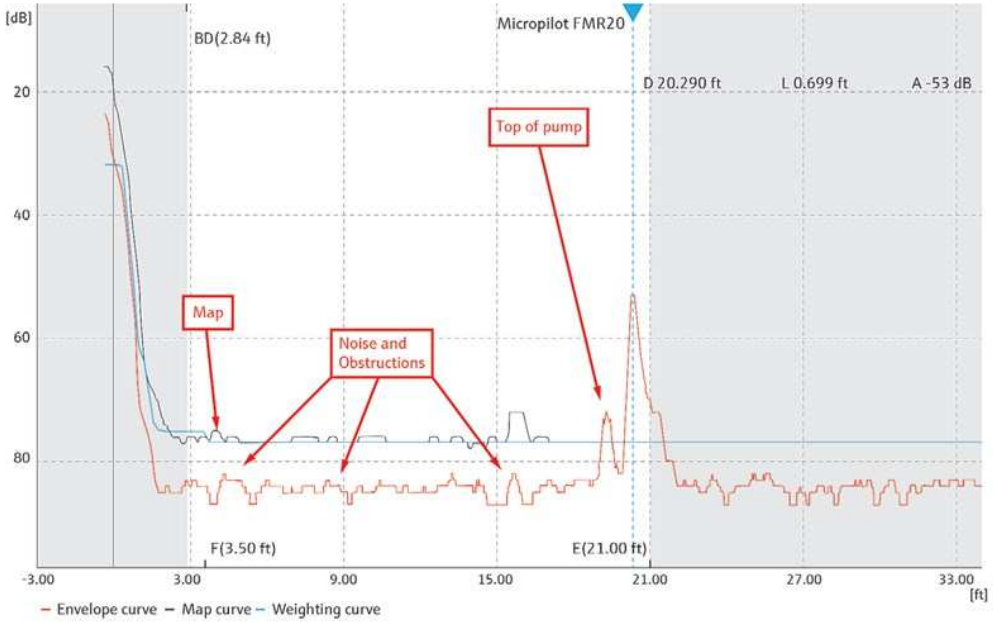
RADAR
SIMPLIFIED TRANSMITTER

<u>Loop Powered Level Transmitter</u>

Simple Level Only

ULTRASONIC





PROS:

Continuous Level
NON-Intrusive
Rugged
Typically includes duplex
Pump Control

CONS:

Expensive
Subject to echo related interference
Pipe or wire in sonic path
Can be affected by grease or foam

Transducer mounting should never sag!!!
****1/4” can represent significant flow.

Solid support across cement channel

Rotates for access
Triangle support

Solid support upstream
With sensor in center

SONTEK – Open Channel Flowmeter with Integral level and velocity detection.

As installed at Big Spring Fish Hatchery

ANTENNA INSTALLATION

Gate Electric Actuators: One of the most important components of an irrigation automation project

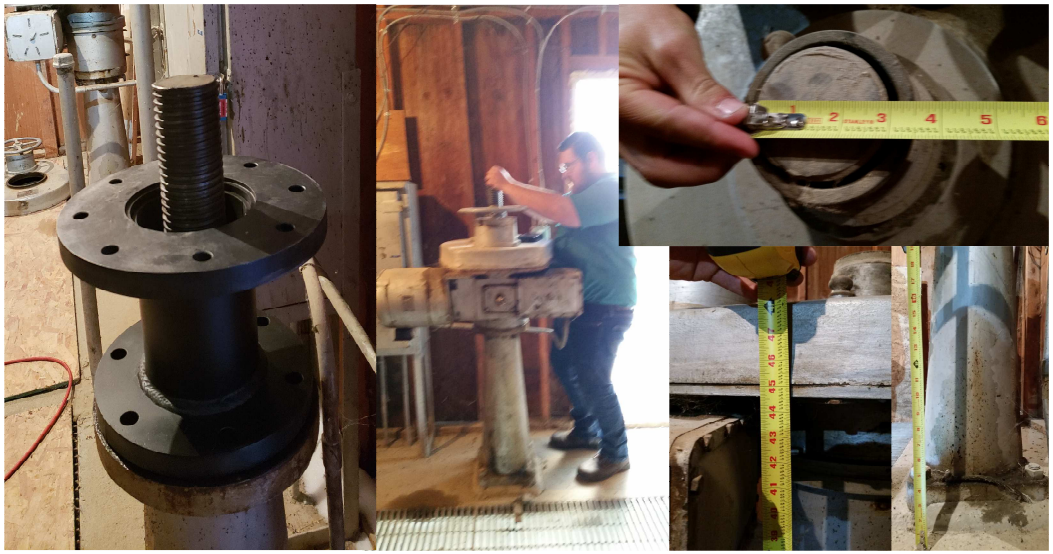
- Vital Application
- Precise installation
  - Close machining
  - Flange plumb and square
- High Fail Item:
  - Mechanical
  - High Use item
  - Extreme weather

Electric Actuators are a precise engineered item:

Integrated torque sensors to protect gate
End Stops for precise open/close position
Torque stop setpoint for tight seal
Exact position calculation with output value
Geared for power in gearing not motor

Prep for installation:

- Stem Details
- Torque requirements
- Mounting Flange
- Pedestal details
- Modulating duty Input/Output requirements
- Physical size/weight



Machining:

- Coupling Nut
- Mounting adapter flange
- Gate mounting plate hole pattern adapter

WHAT TO LOOK FOR IN AN SYSTEM INTEGRATOR

***** Most important thing to make sure the name is three letters and looks like “met”!**

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WHAT TO LOOK FOR IN AN SYSTEM INTEGRATOR

1 Local
2 Responsive
3 Skillset to do more than just write a program
- Machining
- Run conduit and control wiring
- Understand field instruments
- Electric Actuator Trained
- Able to integrate existing (old) motors, VFD's Etc.

3 Manpower to respond
4. Experience in networking, radios, actuators, irrigation districts.

To integrate a new SCADA system into existing components requires being onsite.
And the ability to understand a wide variety of systems!