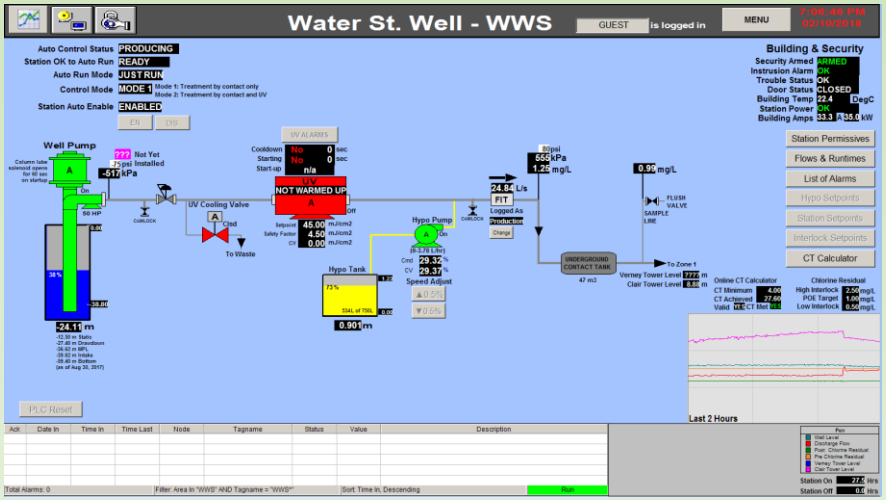
Guelph Water Services
New SCADA Design & Programming Standards

Released July 2018 and now under continuous development



Speaker: Graham Nasby, Water SCADA & Security Specialist

So, what do real engineers do?

Ok…ok..

SCADA is ok too

Goals

- Existing SCADA programming standard had not been updated in 15+ years
- **An update was sorely needed**

- SCADA technology has improved since 2002
- ASM & EPRI Studies on SCADA Screen Effectiveness published 2008/2009
- EEMUA 201 standard on operator displays published in 2002, revised 2010
- High Performance HMI Handbook published in 2008
- ISA101 High Performance HMI standard published in 2015
- Bring in Best Practices from ISA112 SCADA System standards committee

1. Make SCADA Easier to use
2. Reduce Screen Clutter
3. Give operators information to troubleshoot problems (why did it shut down?)
4. Hide unnecessary information, with “Show Details” buttons to show more
5. Standard control interfaces for pumps, valves, instruments, and UVs
6. Make colours, symbols and terminology more consistent
7. Apply High Performance HMI Ideas (but make look/feel changes gradually)

Timeline

Jan-Dec 2016 – Assessment of Current SCADA System

Jan 2017 – Start of SCADA co-op student program

Jan 2017 – July 2018 (18 months)
Set up SCADA development/test environment (3 servers, 2 desktops, 3 laptops)
Prototype, develop and test new SCADA programming standards
Co-op students provided manpower, under direction of SCADA & Security Specialist

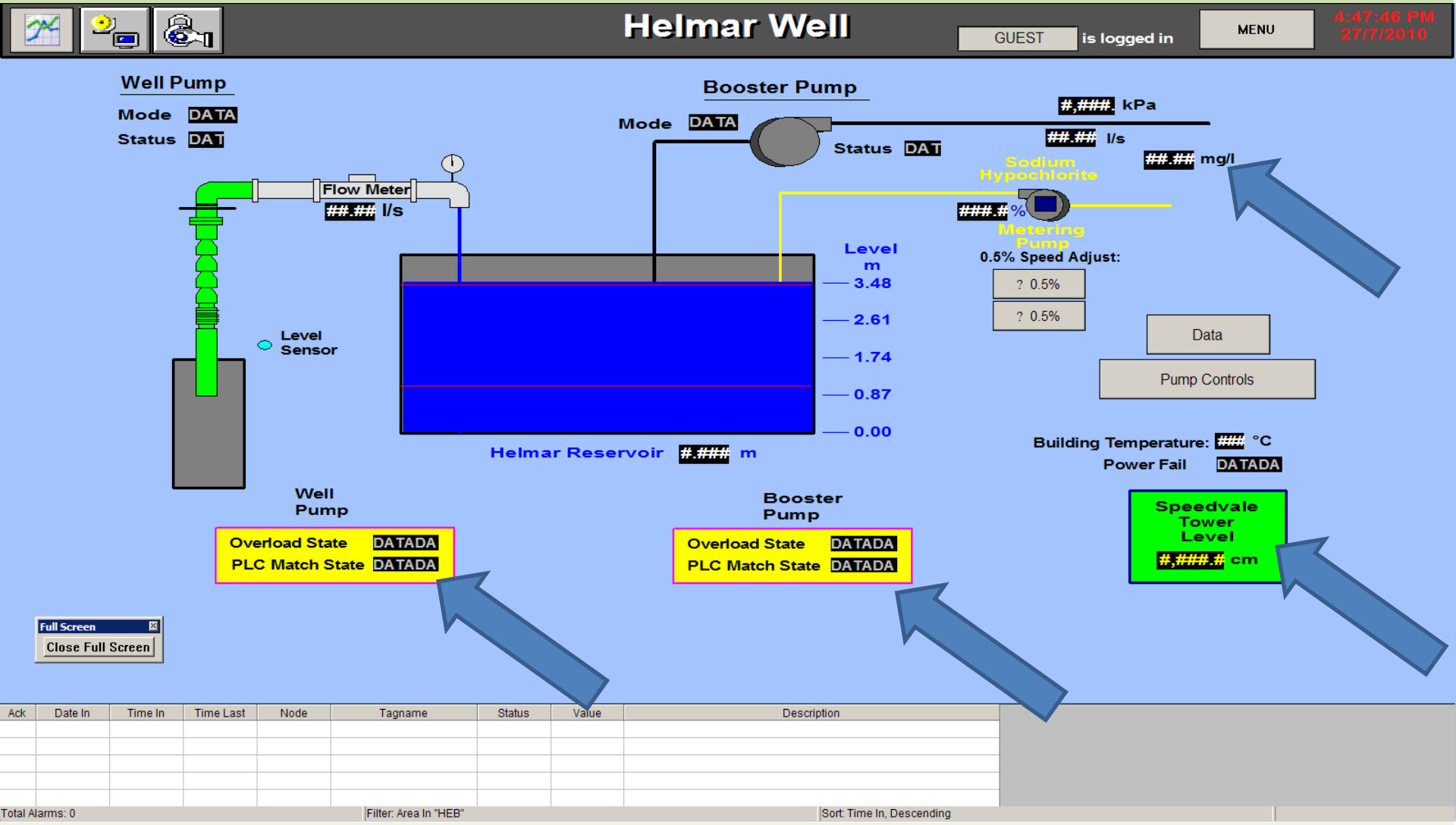
July 3, 2018 – First revision of the New SCADA Programming Standards Released

June 2018 – SCADA standards used for new code at Water Street Well & Emma Well
July 2018 – work starts on new code Helmar, Dean, Queensdale, Calico, Downey, etc.
August 2018 – work begins on new code by a system integrator for Burkes Upgrades

September 2018 – new code Water Street Well commissioned
October 2018 – new code at Emma Well being commissioned
Early 2019 – new code to be commissioned at Burkes Well
Mid-2019– new code for Helmar, Dean, Queensdale, Calico, etc. to be rolled out

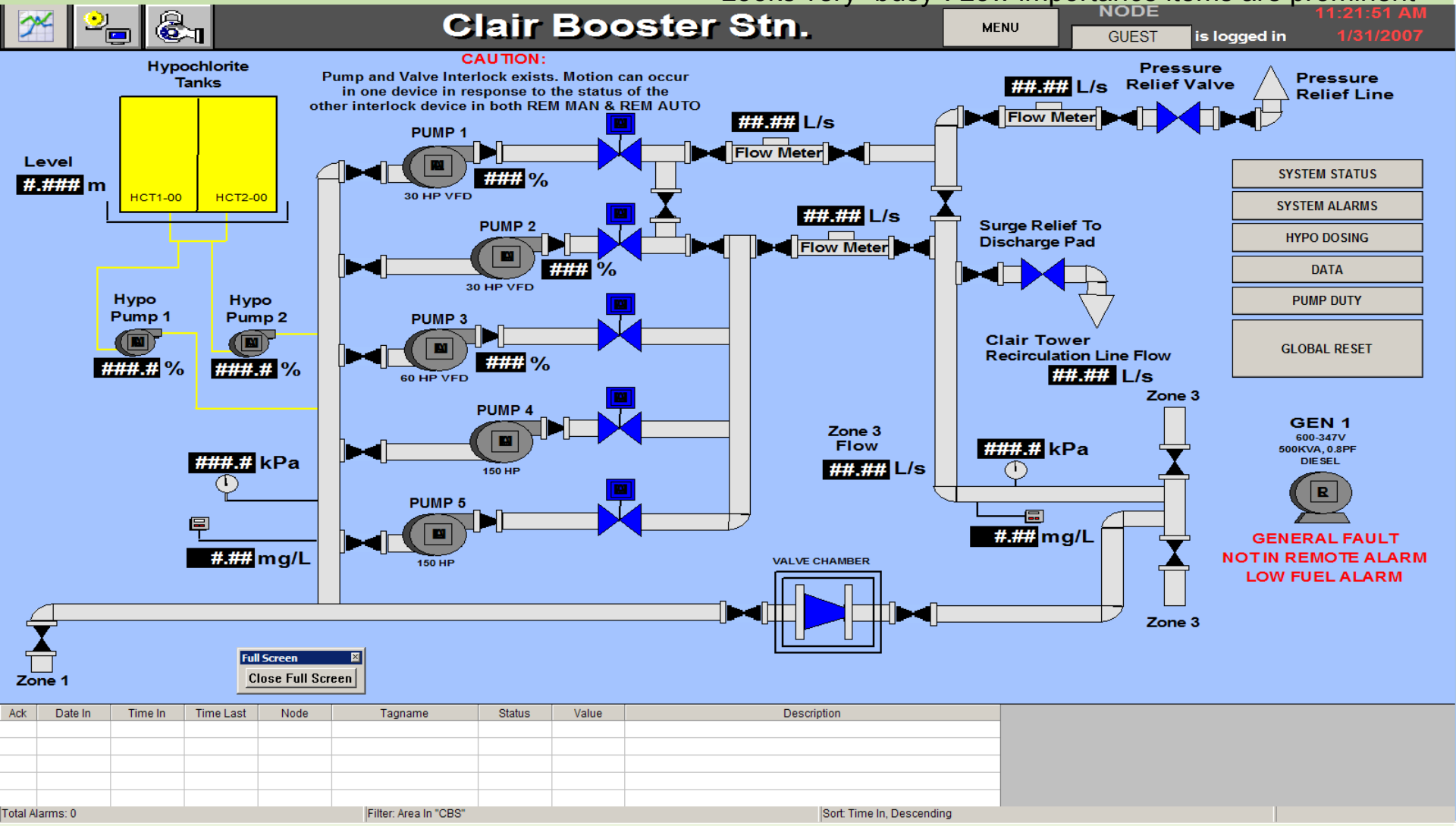
Old Screens

"Missing information" for operators
Bright colours on unimportant items
Inconsistent placement/display of values



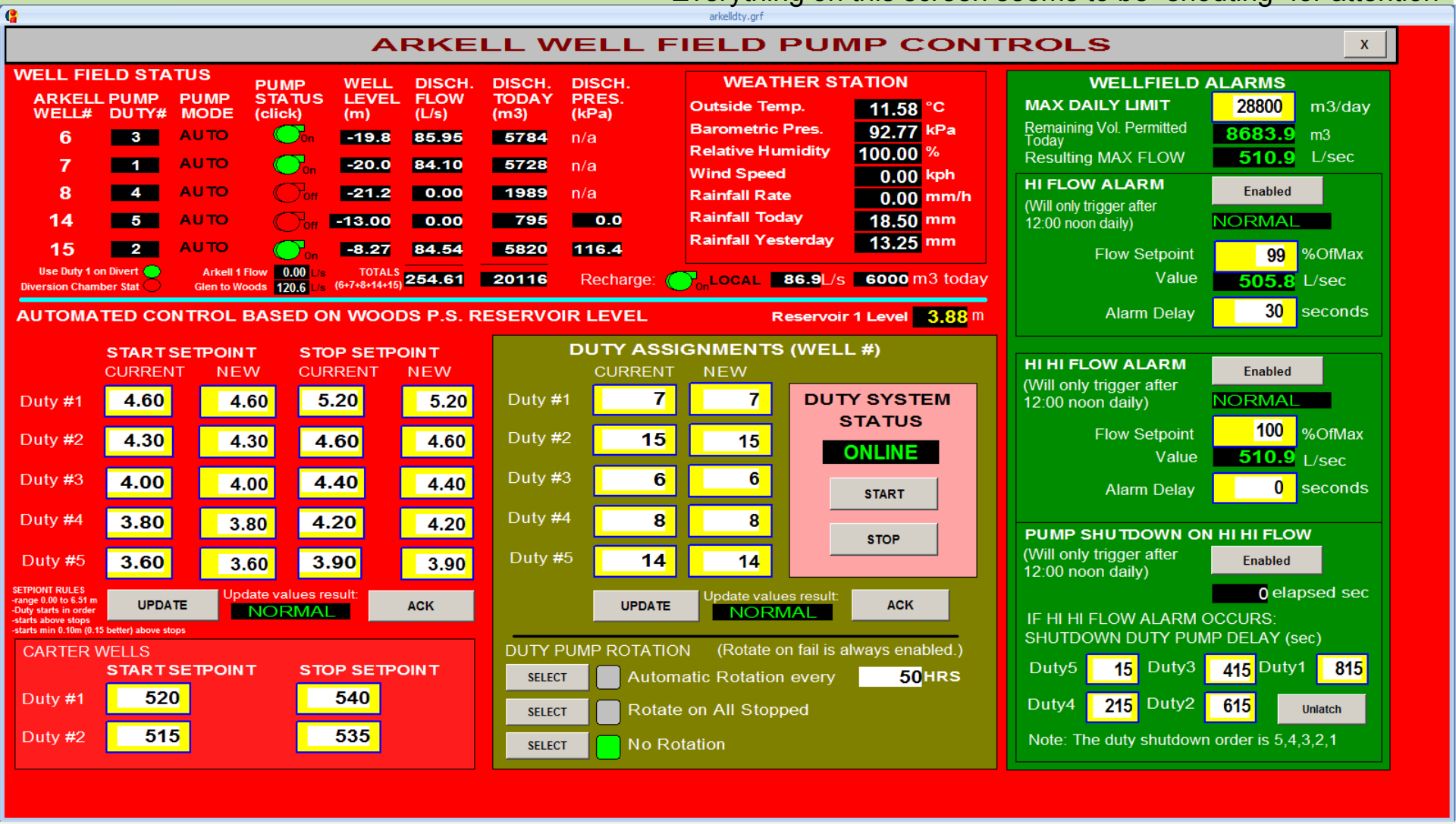
Old Screens

Confusing piping arrangements
Piping shown does not match reality. Key info missing.
Looks very "busy". Low importance items are prominent



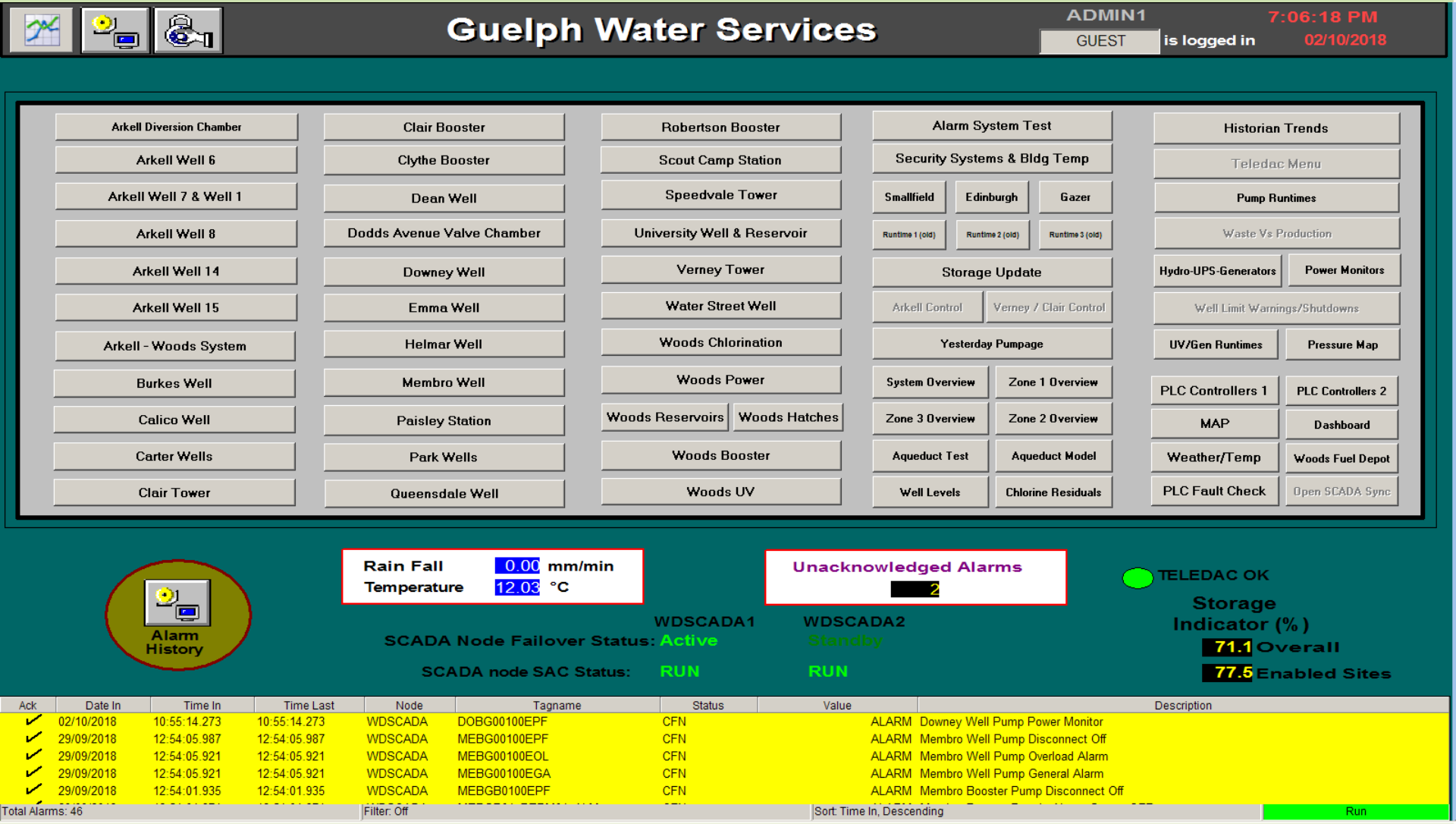
Old Screens

Fire Engine Red!
Hard to see pumps that are off.
Everything on this screen seems to be “shouting” for attention

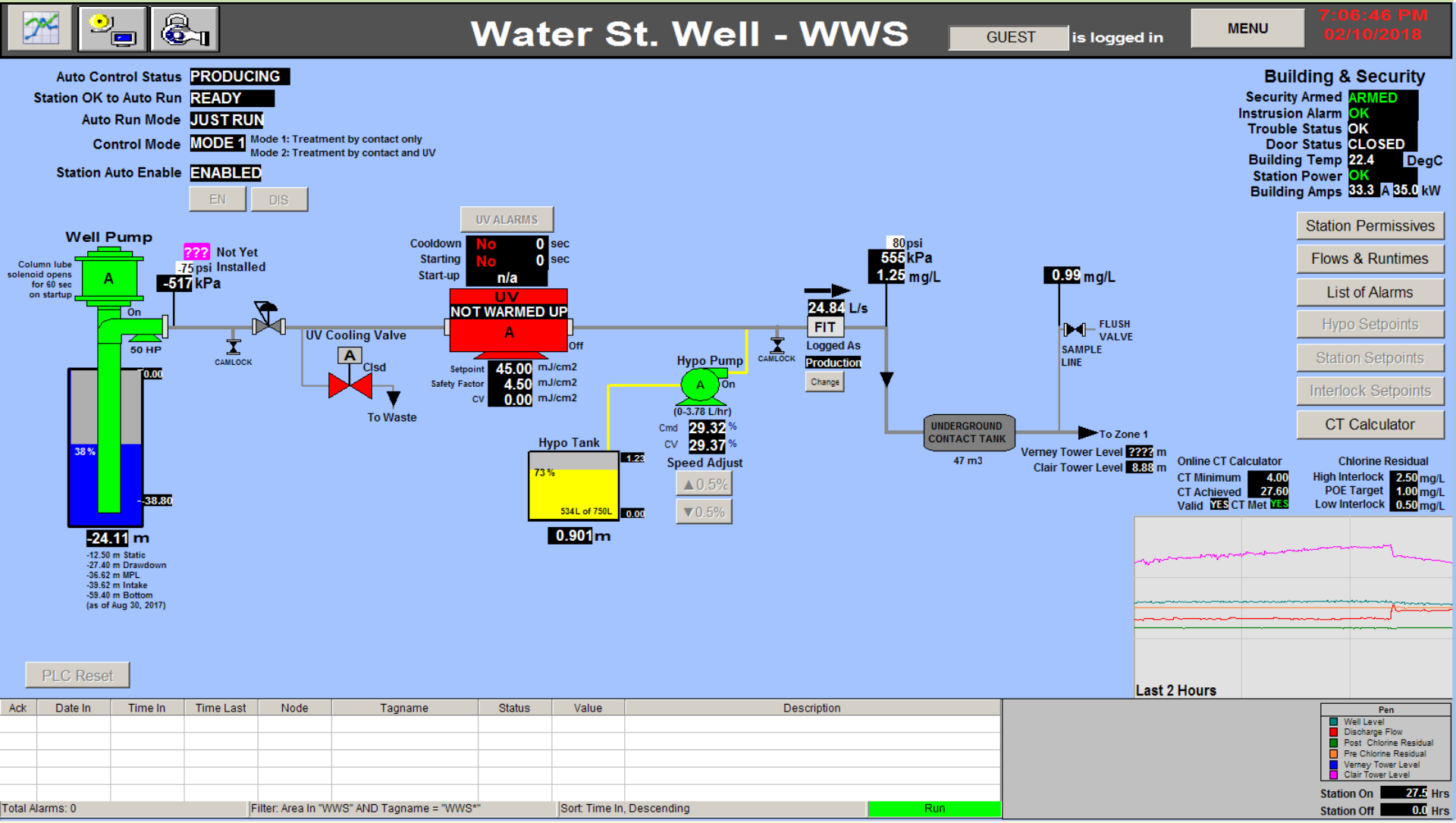


So, what is new with SCADA?

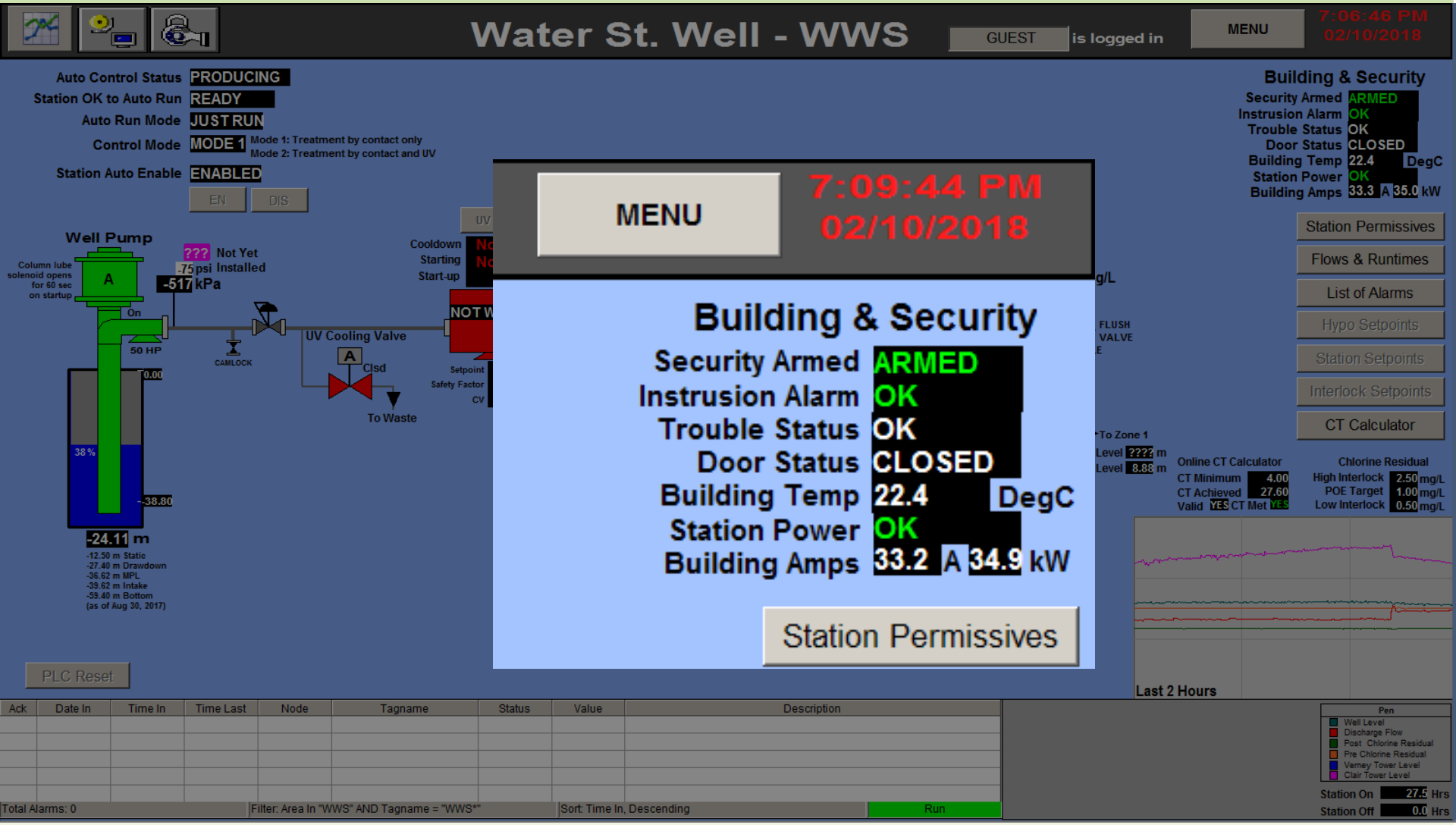
SCADA: What Guelph Water is doing



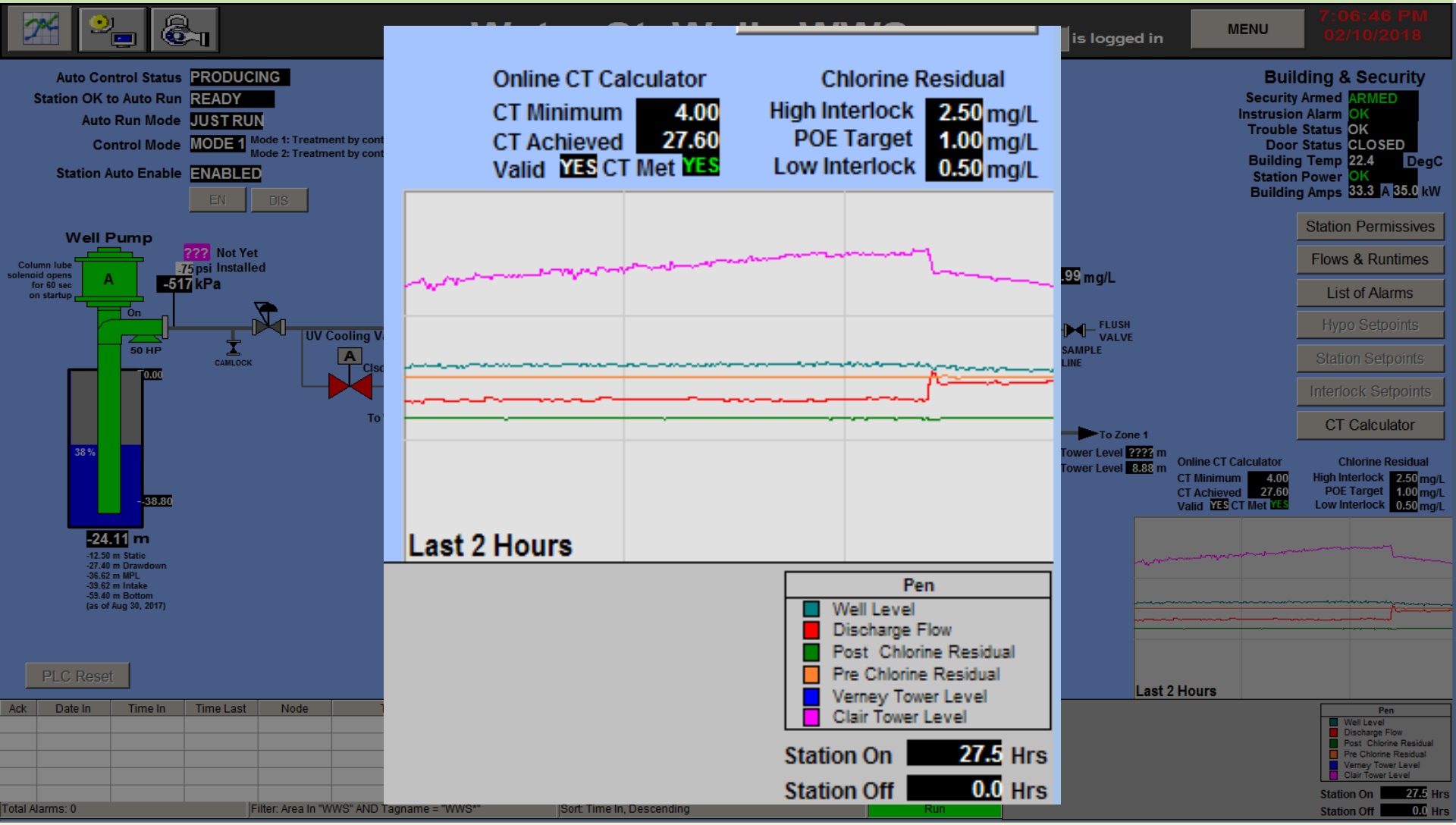
High Density Information – careful use of colour



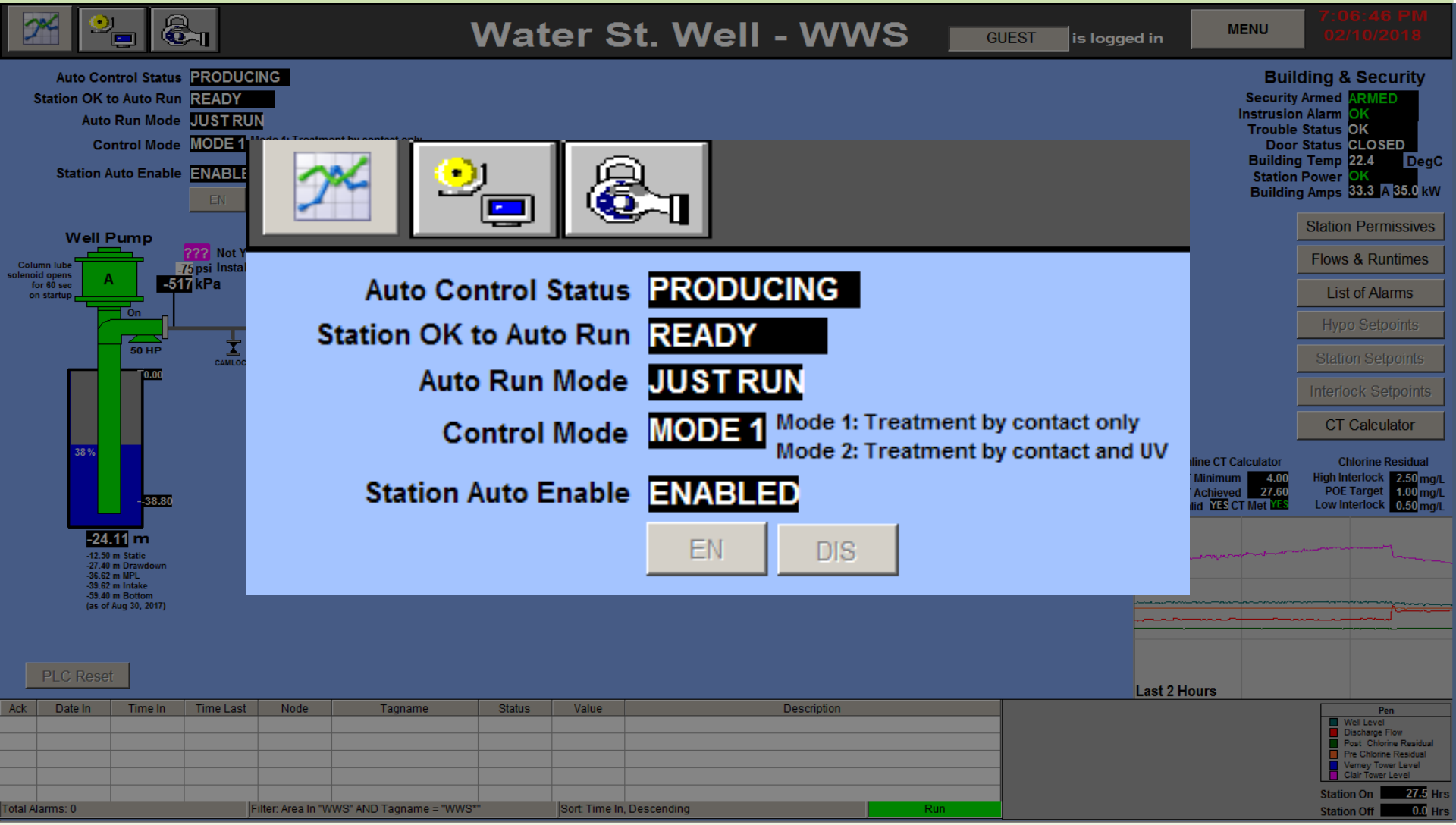
Building & Security Information in top left



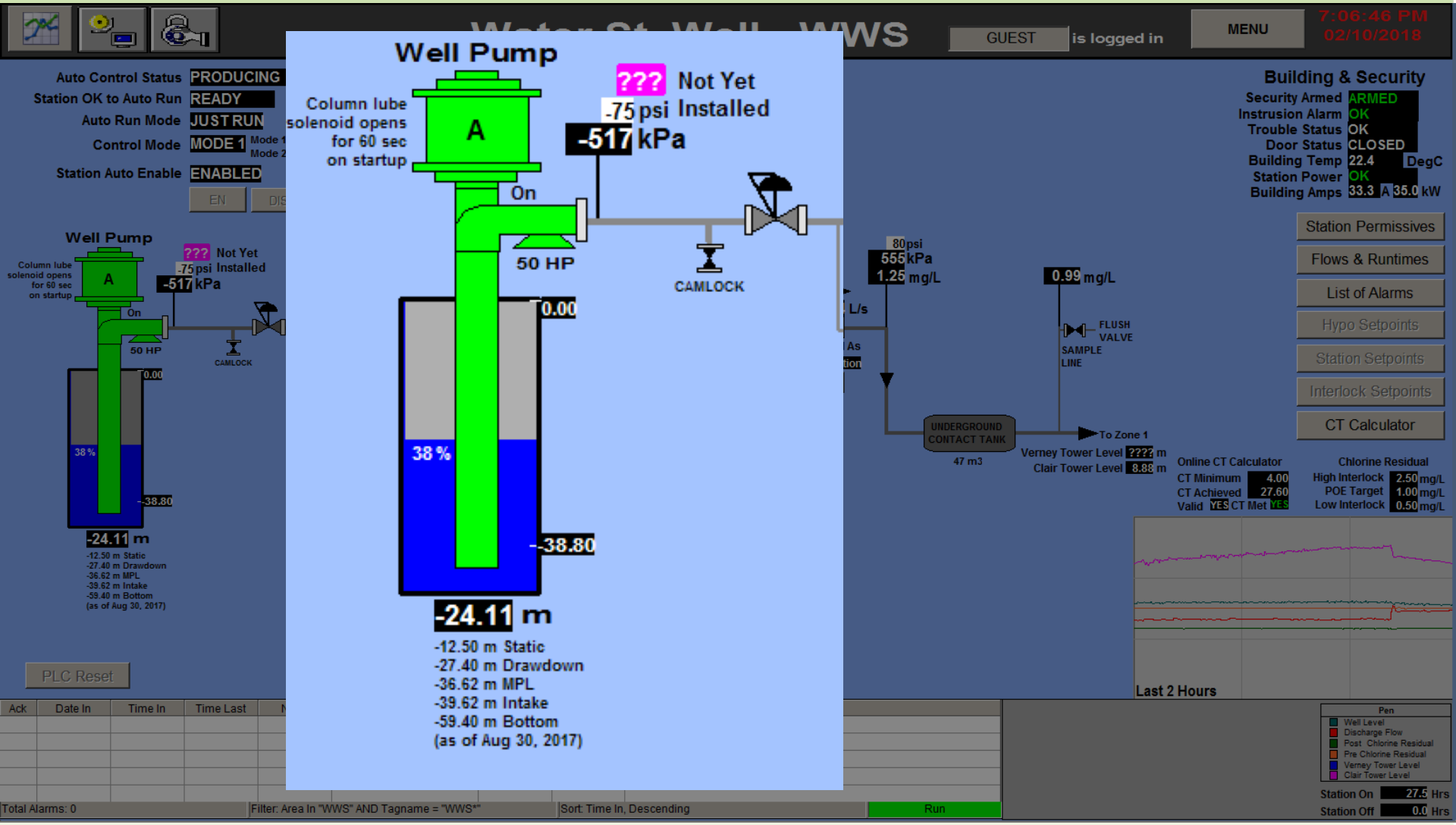
Summary Trends and Key Compliance info at bottom right



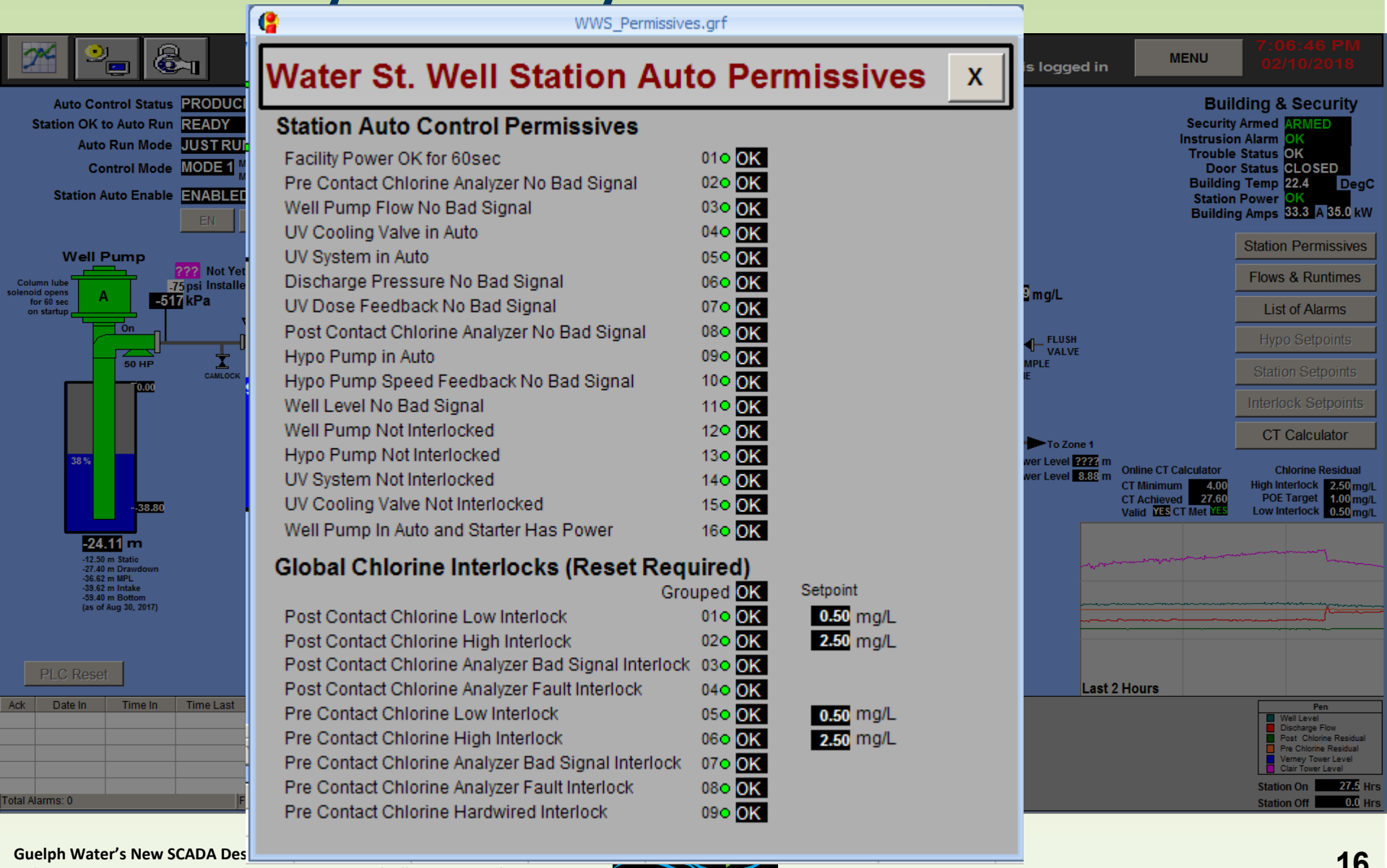
Station Control Mode on Top Left



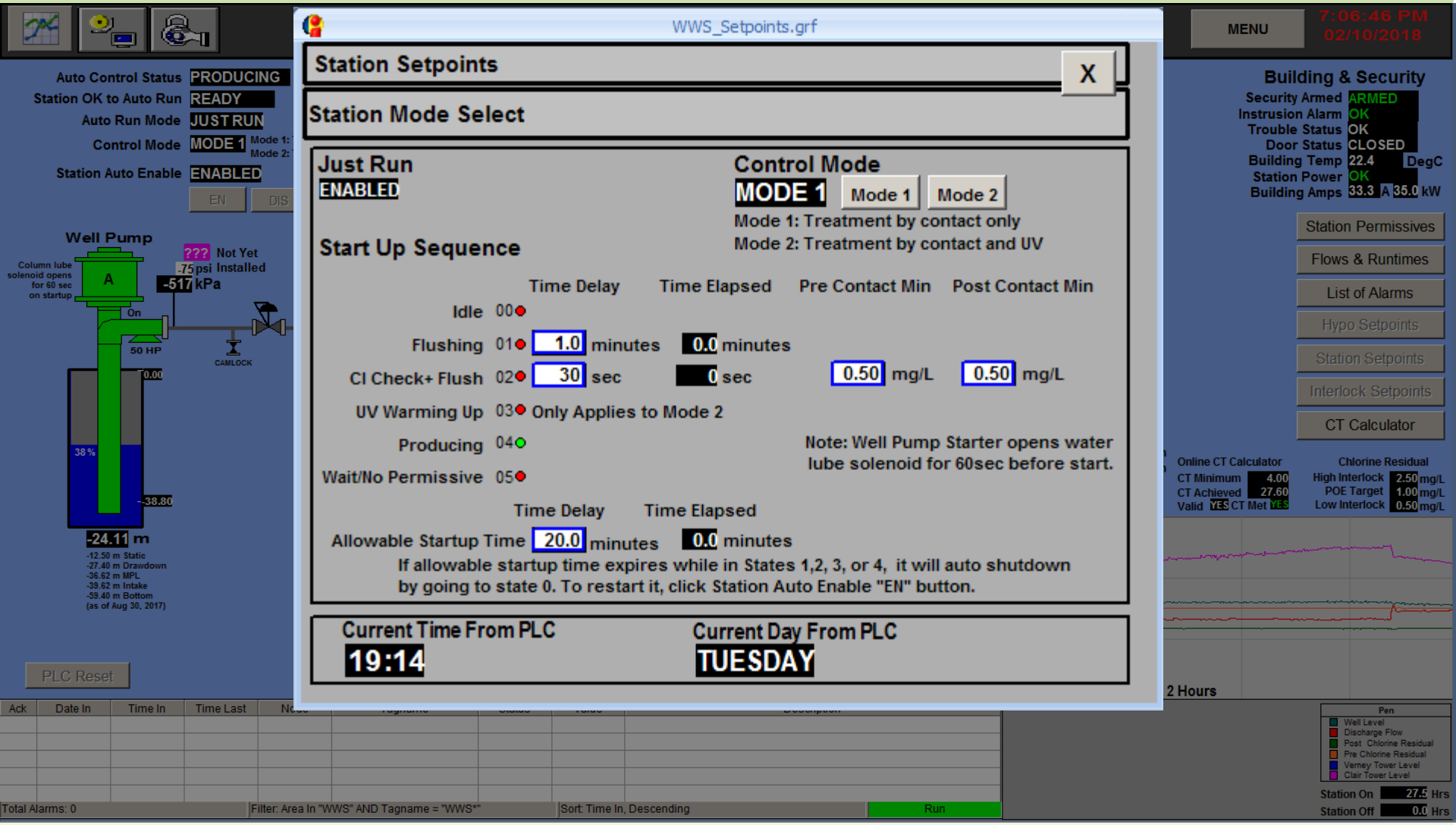
Better Well pump Information



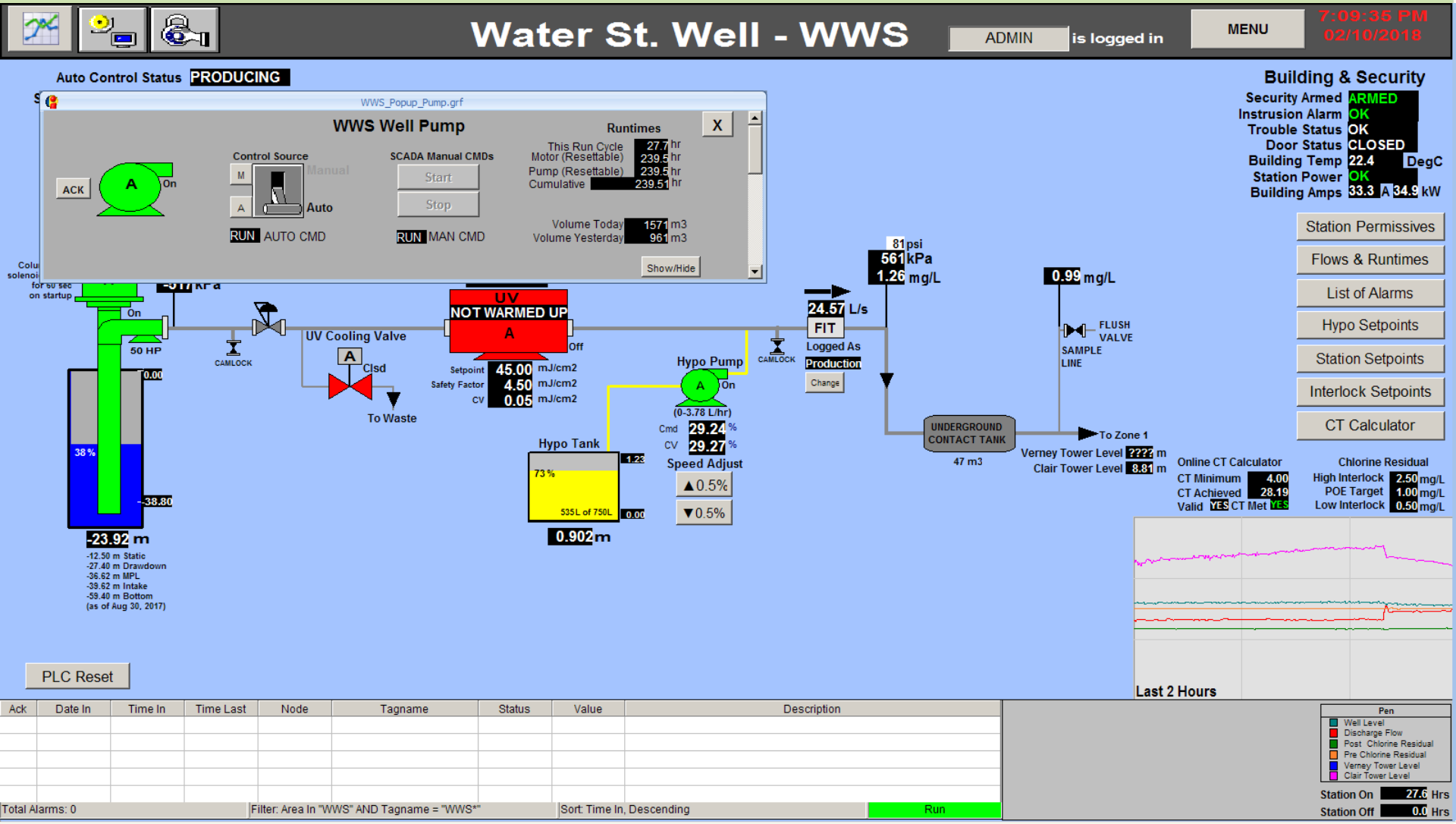
No more mysteries why station won't start



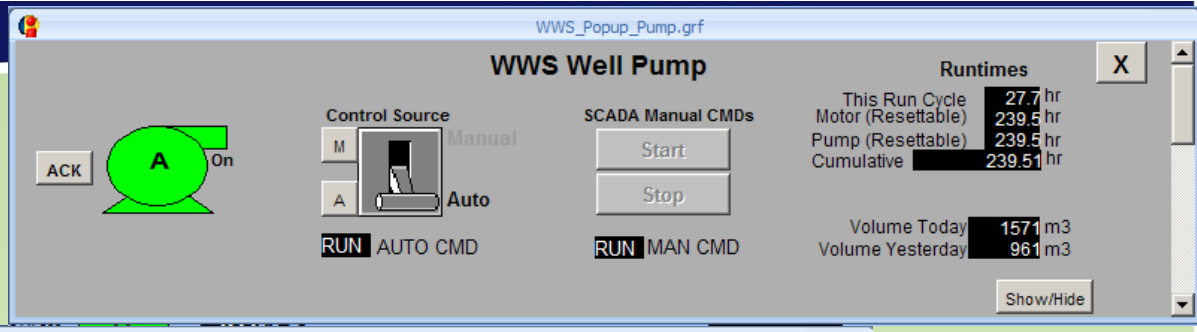
Status Information on Well Start-up Sequence



Better Pop-Up Windows – pump starters



Better Pop-Up Windows - pumps



WWS_Popup_Pump.grf

WWS Well Pump

X

ACK

A On

Control Source

M

A

Manual

Auto

SCADA Manual CMDs

Start

Stop

Runtimes

This Run Cycle 27.7 hr
Motor (Resettable) 239.5 hr
Pump (Resettable) 239.5 hr
Cumulative 239.51 hr

RUN AUTO CMD

RUN MAN CMD

Volume Today 1571 m3
Volume Yesterday 961 m3

Show/Hide

Permissives

Facility Power OK

Well Pump Starter Power OK

	Interlocks (Reset Required)	Man.	Auto
01 OK	Well Level Below MPL	01 OK	OK
02 OK	Well Pump Flow Rate Above Permit	02 OK	OK
	Well Pump Daily Flow Above Permit	03 OK	OK
	Well Pump Starter Fault	04 OK	OK
	Well Pump Low Flow (< 5L/s, 30s)	05	OK
	Global Chlorine Interlock	06 OK	OK
	Hypo Pump Interlocked	07	OK
	Hypo Pump Did Not Start In 5 Sec	08	OK
	Well Level Bad Signal	09	OK
	UV Lost Warmed Up Status (Mode 2)	10 OK	OK
	UV Interlocked (Mode 2)	11 OK	OK
	Well Pump E-Stop Pressed	12 OK	OK
	Hardwired Low Chlorine Interlock	13 OK	OK

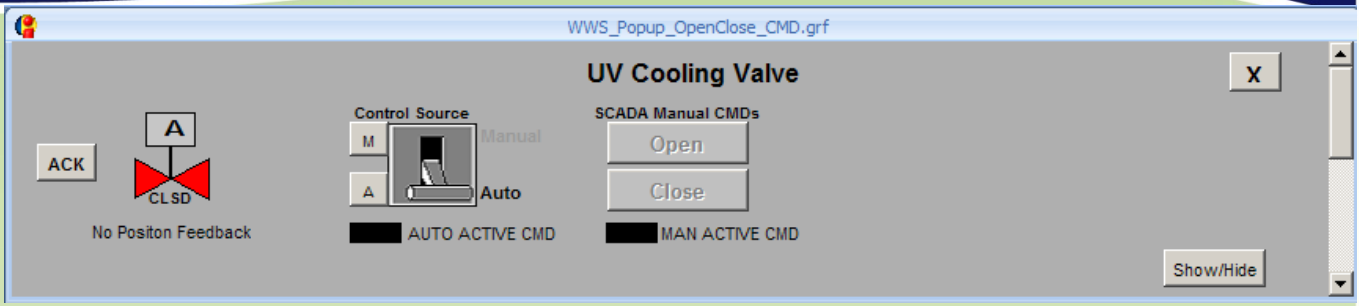
Alarms	
(S) Well Pump Fail to Start Alarm	01 OK
(S) Well Pump Fail to Stop Alarm	02 OK
(S) Well Pump Uncommanded Start Alarm	03 OK
(S) Well Pump Uncommanded Stop Alarm	04 OK
Well Pump Starter No Power	05 OK
Well Pump Left In Local For 30 min	06 OK
Well Pump Starter Fault Alarm	07 OK
Well Level Near MPL Alarm	08 OK
Well Pump Daily Flow Near Permit Alarm	09 OK
Well Pump Flow Near Permit Alarm	10 OK
Well Pump Shutdown on Interlock Alarm	11 OK
Well Pump E-Stop Pressed Alarm	12 OK

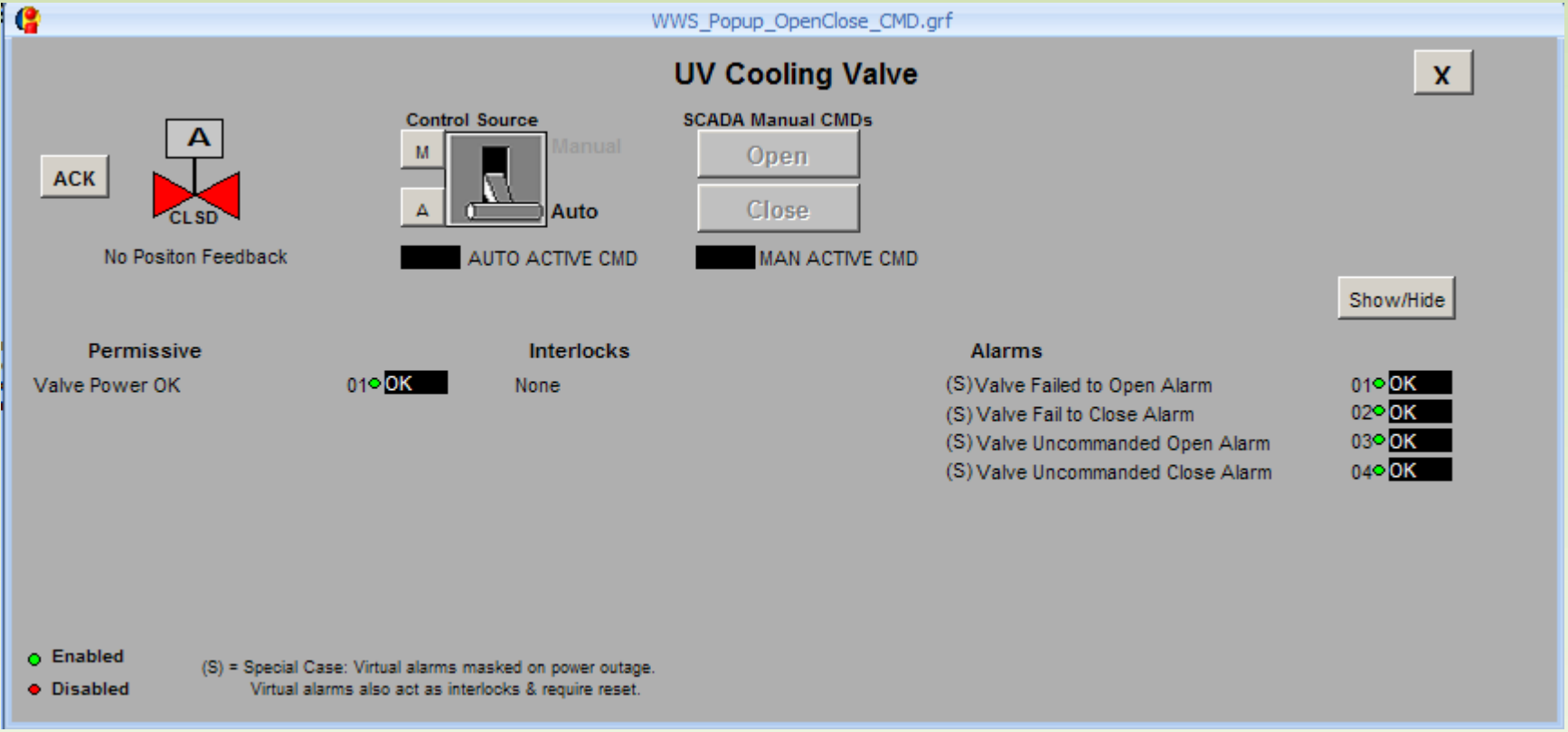
○ Enabled

● Disabled

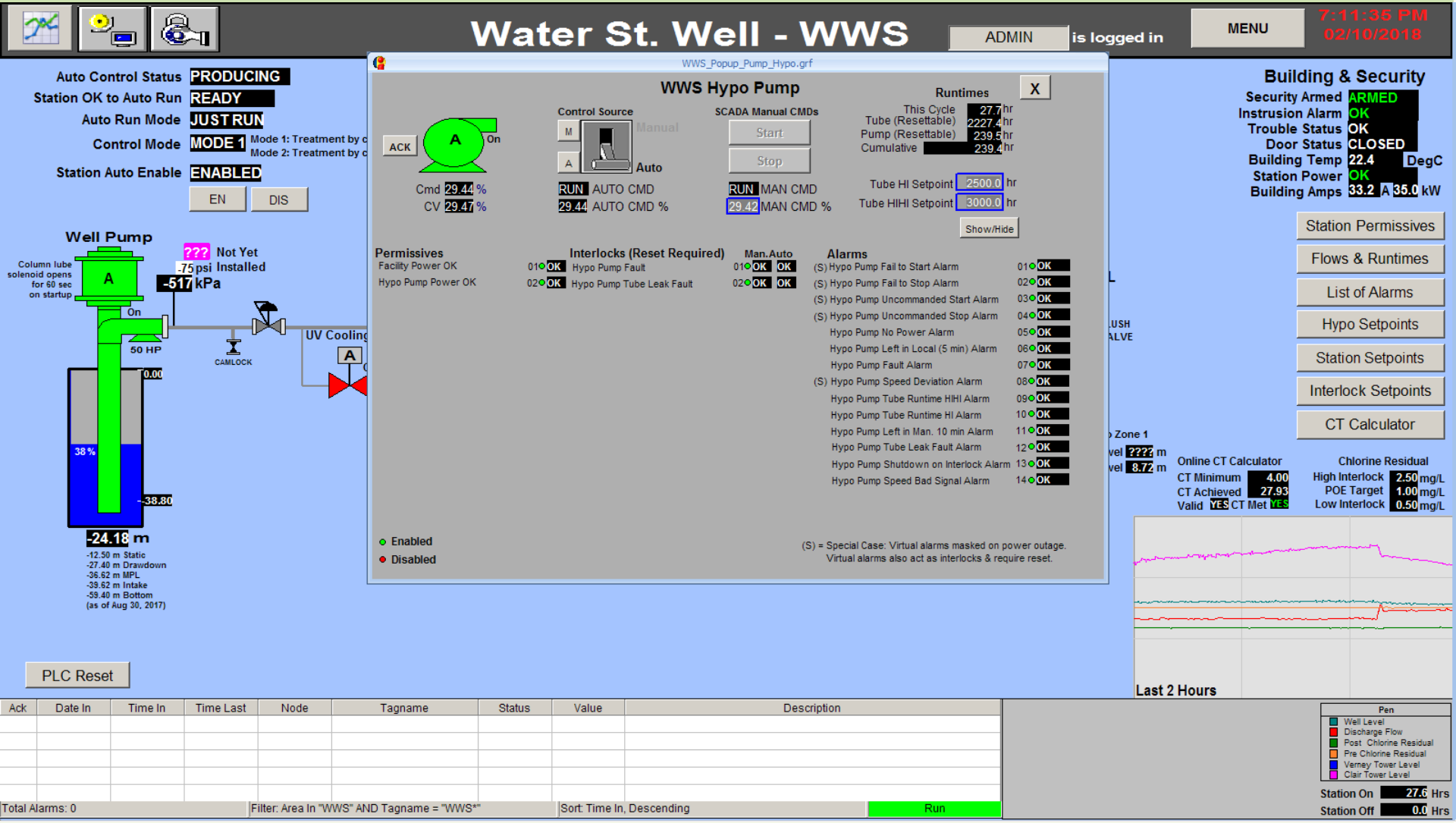
(S) = Special Case: Virtual alarms masked on power outage.
Virtual alarms also act as interlocks & require reset.

Better Pop-Up Windows - Motorized Valves

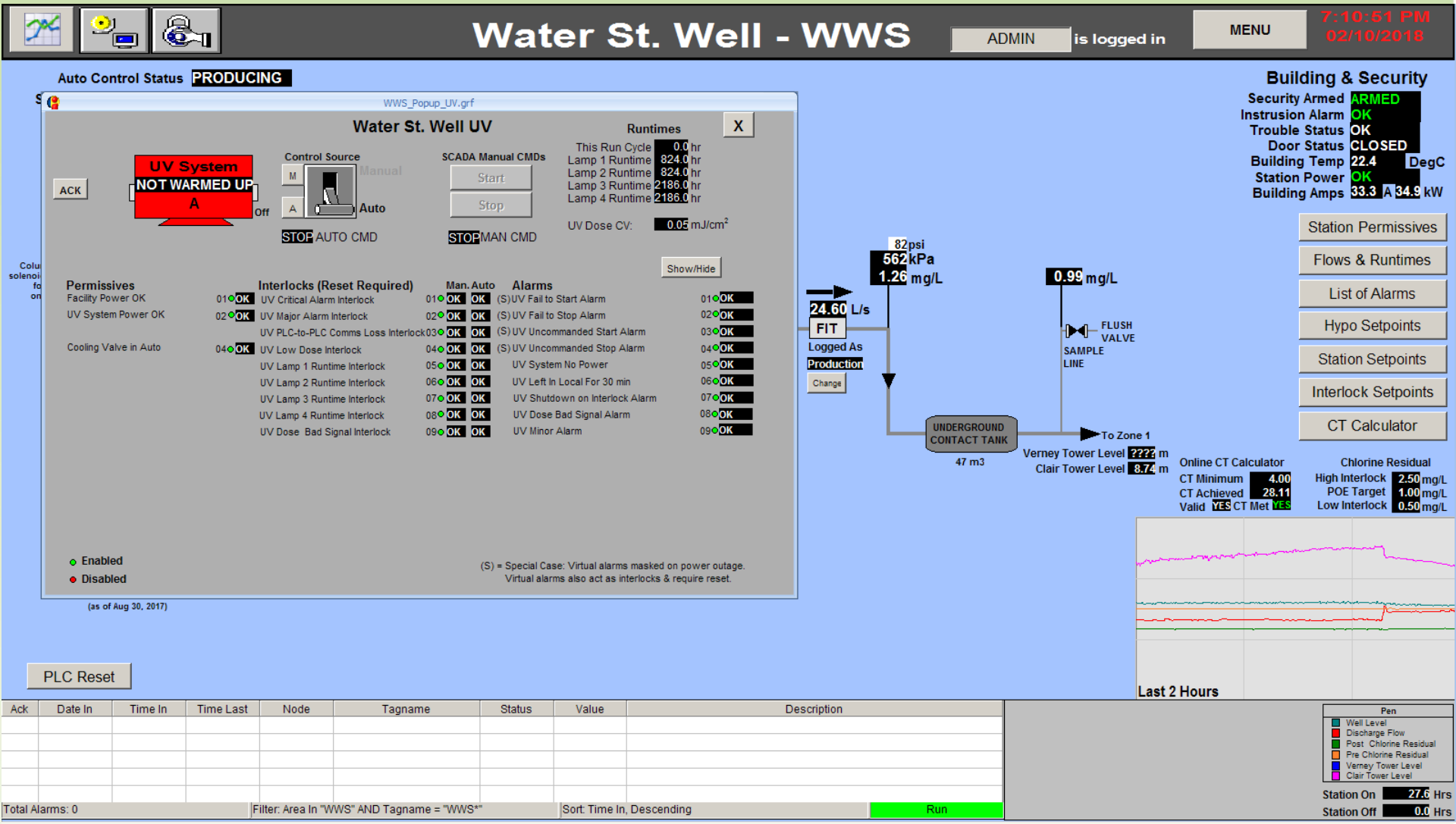




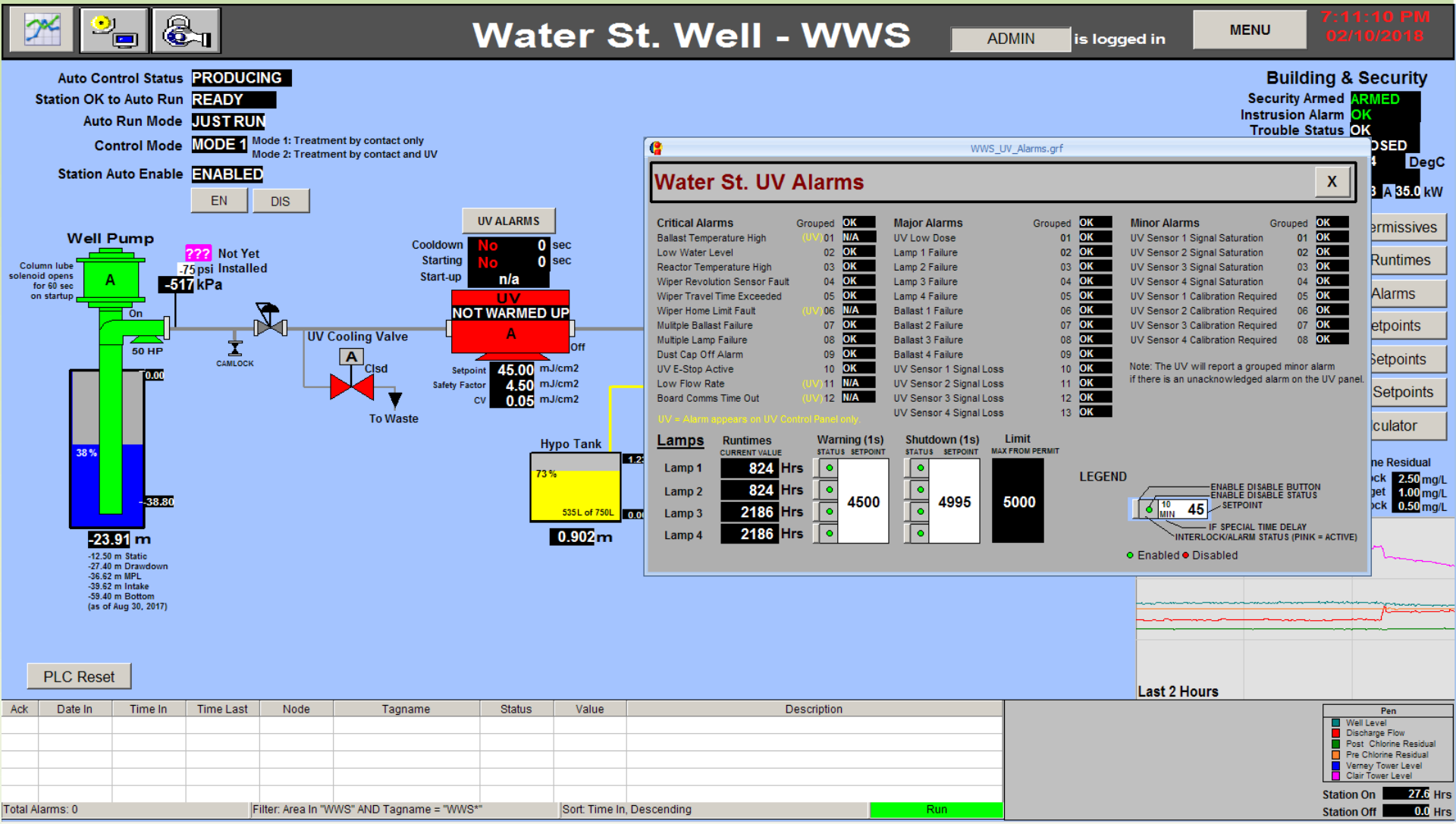
Better Pop-Up Windows – chemical dosing pumps



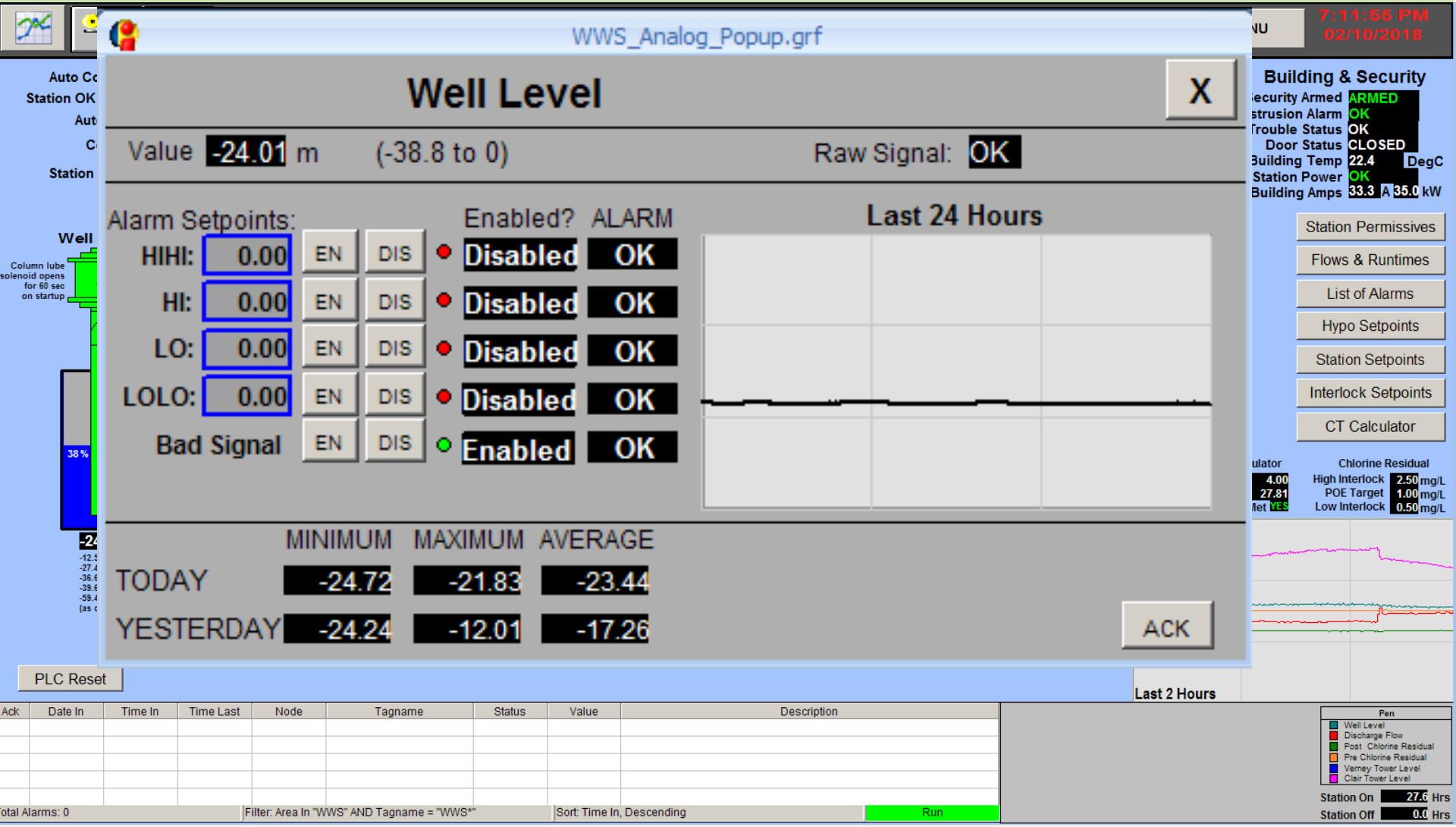
Better Pop-Up Windows – Packaged UV Systems



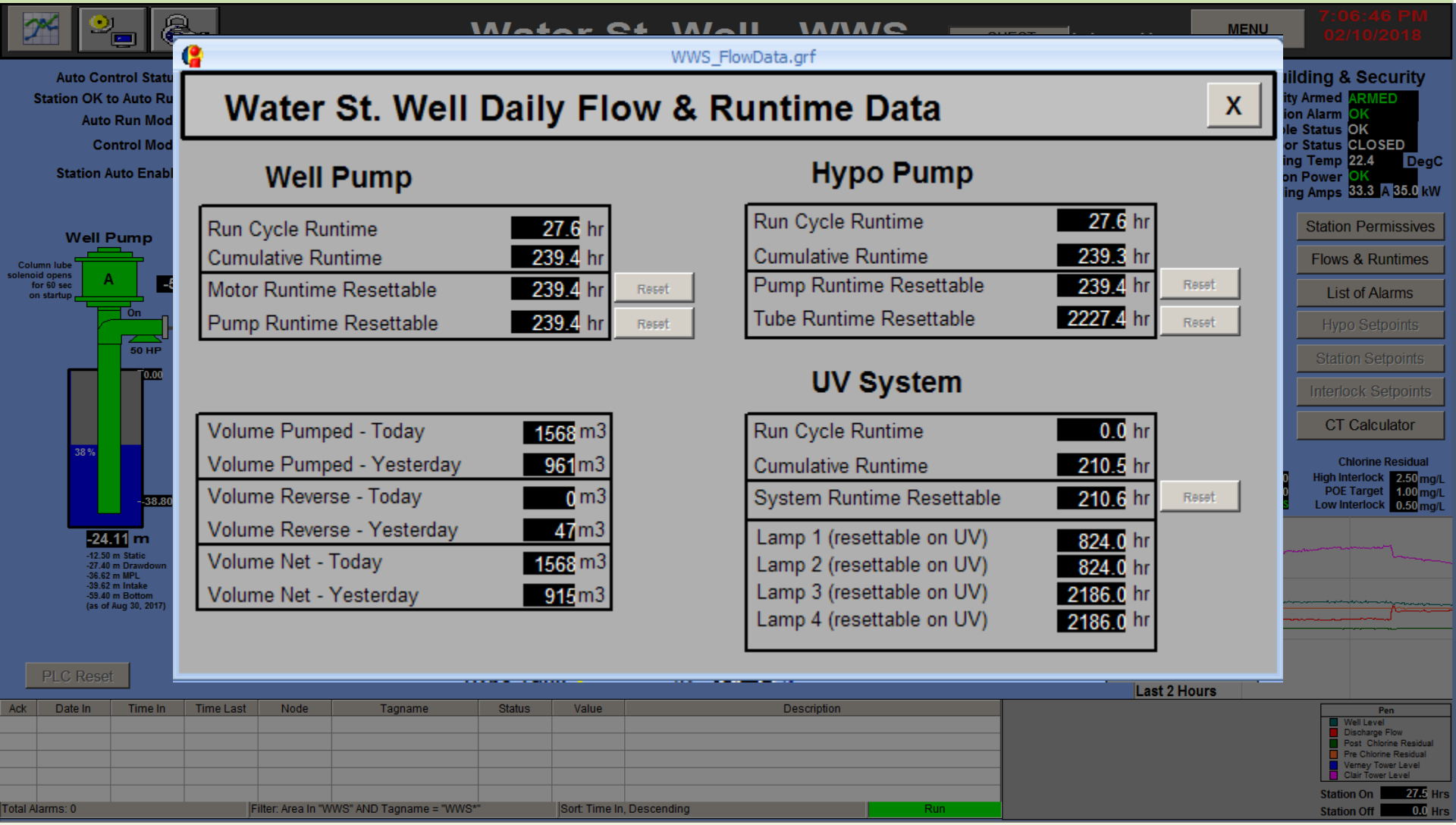
Better Pop-Up Windows – UV System specific alarms



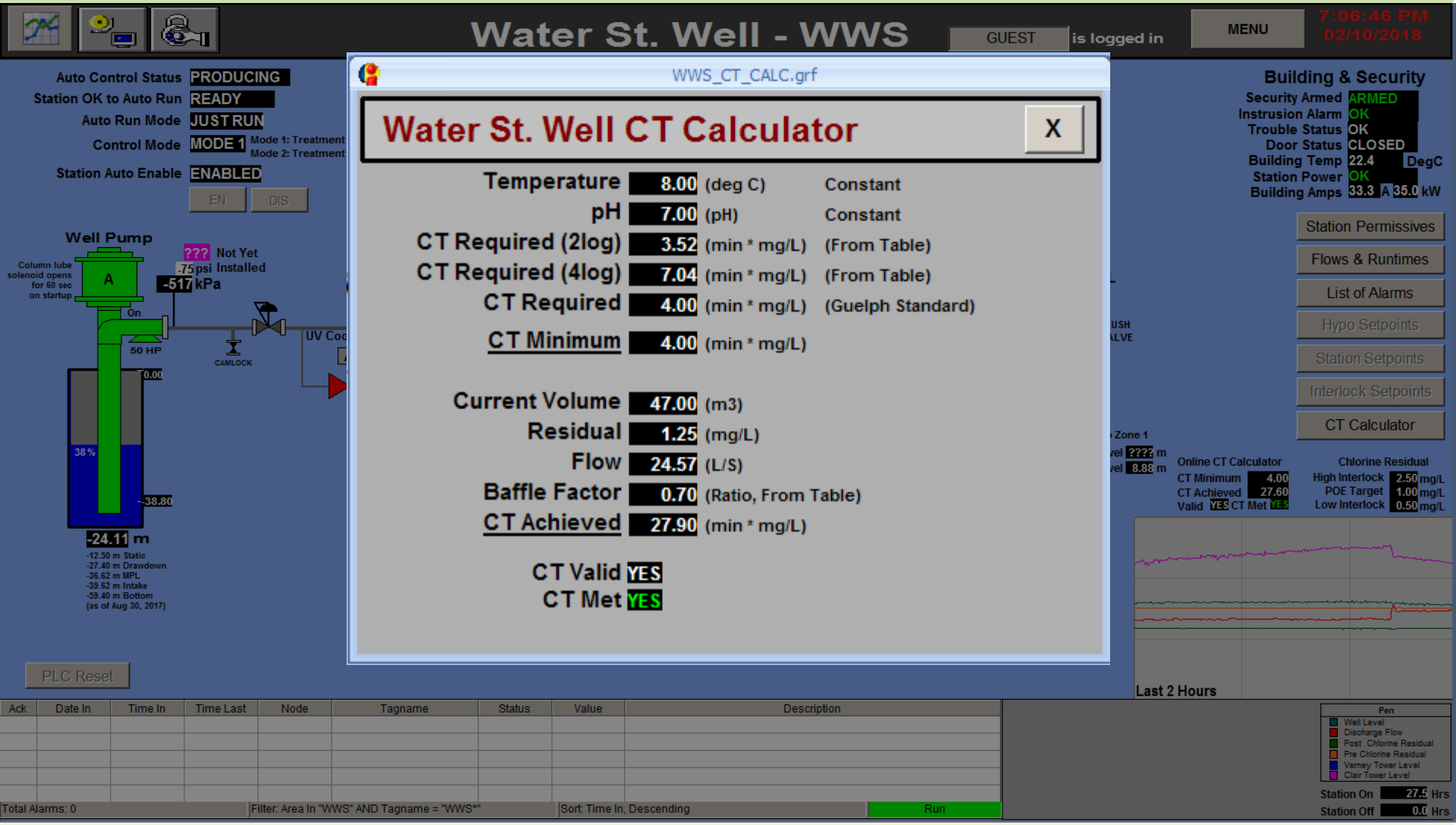
Better Pop-Up Windows – analog measurements



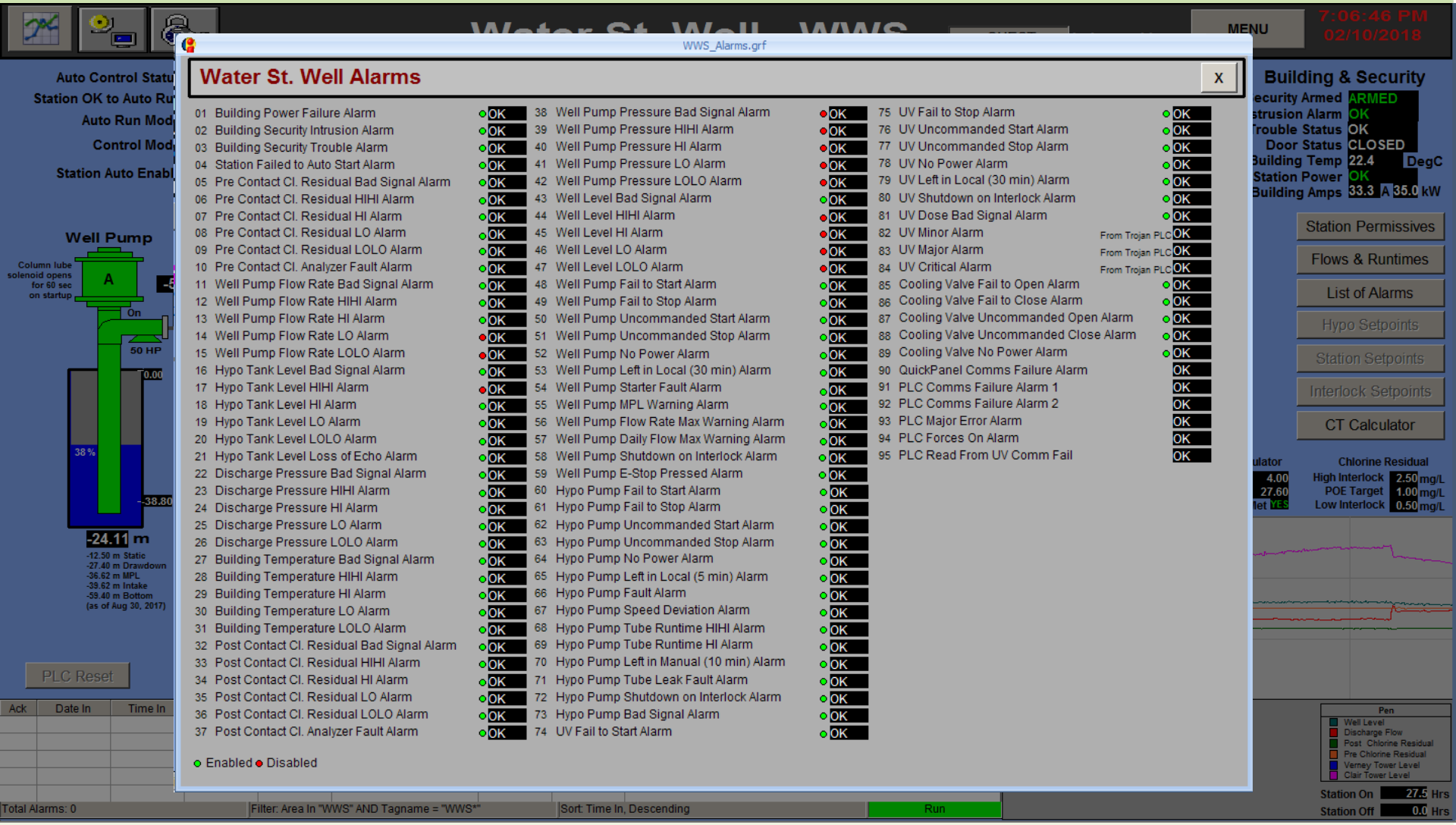
Pump Runtimes



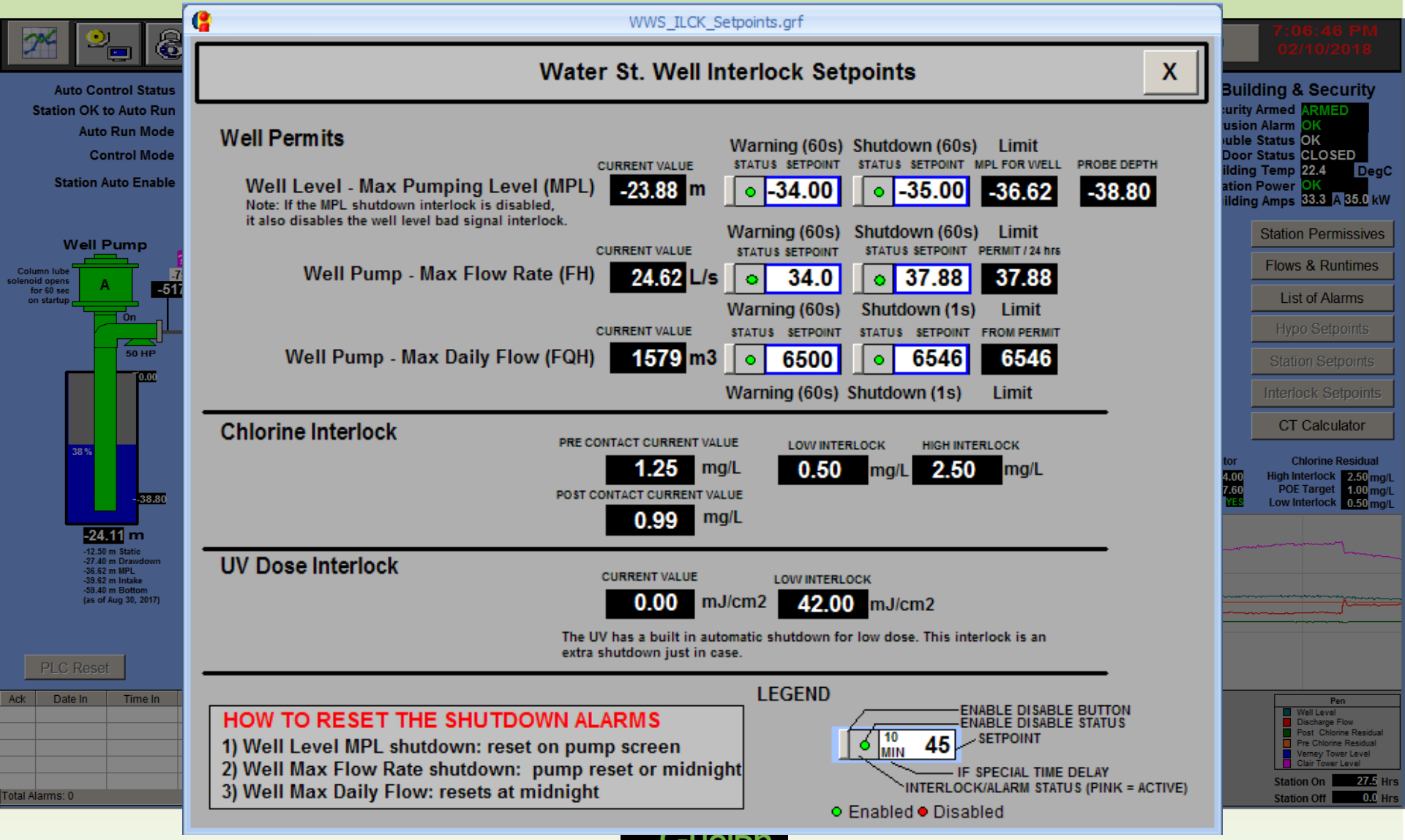
Online CT Calculator – primary disinfection numbers



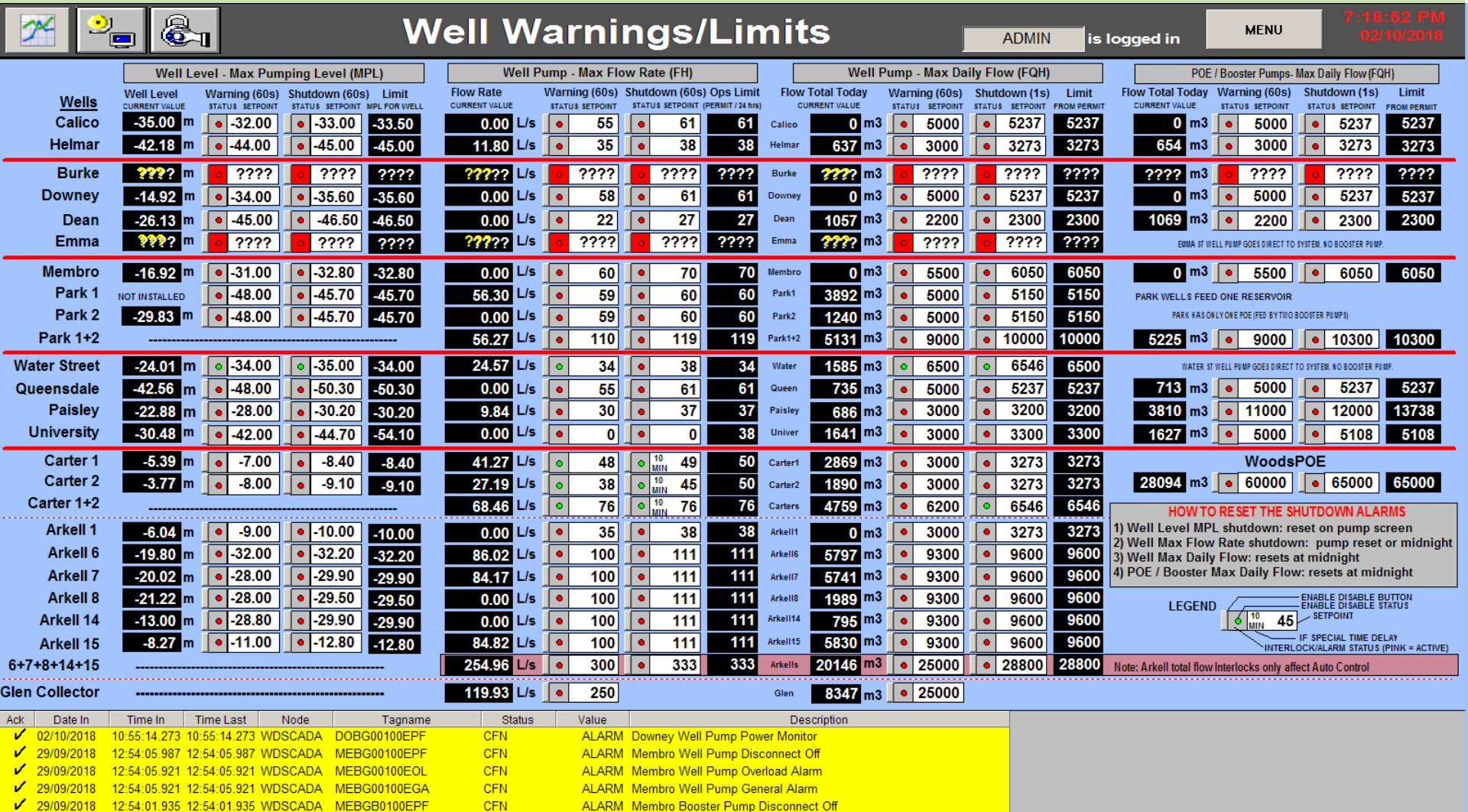
List of All Configured Alarms for a Site



Well Permit Values, Warnings, and Interlocks



Well Permits – for all sites



Well Warnings/Limits

ADMIN is logged in | MENU | 7:18:52 PM 02/10/2018

Wells	Well Level - Max Pumping Level (MPL)				Well Pump - Max Flow Rate (FH)				Well Pump - Max Daily Flow (FQH)				POE / Booster Pumps- Max Daily Flow (FQH)			
	Well Level CURRENT VALUE	Warning (60s) STATUS SETPOINT	Shutdown (60s) STATUS SETPOINT	Limit MPL FOR WELL	Flow Rate CURRENT VALUE	Warning (60s) STATUS SETPOINT	Shutdown (60s) STATUS SETPOINT	Ops Limit (PERMIT / 24 hrs)	Flow Total Today CURRENT VALUE	Warning (60s) STATUS SETPOINT	Shutdown (1s) STATUS SETPOINT	Limit FROM PERMIT	Flow Total Today CURRENT VALUE	Warning (60s) STATUS SETPOINT	Shutdown (1s) STATUS SETPOINT	Limit FROM PERMIT
Calico	-35.00 m	-32.00	-33.00	-33.50	0.00 L/s	55	61	61	Calico 0 m3	5000	5237	5237	0 m3	5000	5237	5237
Helmar	-42.18 m	-44.00	-45.00	-45.00	11.80 L/s	35	38	38	Helmar 637 m3	3000	3273	3273	654 m3	3000	3273	3273
Burke	???? m	????	????	????	????? L/s	????	????	????	Burke ???? m3	????	????	????	???? m3	????	????	????
Downey	-14.92 m	-34.00	-35.60	-35.60	0.00 L/s	58	61	61	Downey 0 m3	5000	5237	5237	0 m3	5000	5237	5237
Dean	-26.13 m	-45.00	-46.50	-46.50	0.00 L/s	22	27	27	Dean 1057 m3	2200	2300	2300	1069 m3	2200	2300	2300
Emma	???? m	????	????	????	????? L/s	????	????	????	Emma ???? m3	????	????	????	EMMA ST WELL PUMP GOES DIRECT TO SYSTEM. NO BOOSTER PUMP.			
Membro	-16.92 m	-31.00	-32.80	-32.80	0.00 L/s	60	70	70	Membro 0 m3	5500	6050	6050	0 m3	5500	6050	6050
Park 1	NOT INSTALLED	-48.00	-45.70	-45.70	56.30 L/s	59	60	60	Park1 3892 m3	5000	5150	5150	PARK WELLS FEED ONE RESERVOIR			
Park 2	-29.83 m	-48.00	-45.70	-45.70	0.00 L/s	59	60	60	Park2 1240 m3	5000	5150	5150	PARK HAS ONLY ONE POE (FED BY TWO BOOSTER PUMPS)			
Park 1+2	----------				56.27 L/s	110	119	119	Park1+2 5131 m3	9000	10000	10000	5225 m3	9000	10300	10300
Water Street	-24.01 m	-34.00	-35.00	-34.00	24.57 L/s	34	38	34	Water 1585 m3	6500	6546	6500	WATER ST WELL PUMP GOES DIRECT TO SYSTEM. NO BOOSTER PUMP.			
Queensdale	-42.56 m	-48.00	-50.30	-50.30	0.00 L/s	55	61	61	Queen 735 m3	5000	5237	5237	713 m3	5000	5237	5237
Paisley	-22.88 m	-28.00	-30.20	-30.20	9.84 L/s	30	37	37	Paisley 686 m3	3000	3200	3200	3810 m3	11000	12000	13738
University	-30.48 m	-42.00	-44.70	-54.10	0.00 L/s	0	0	38	Univer 1641 m3	3000	3300	3300	1627 m3	5000	5108	5108
Carter 1	-5.39 m	-7.00	-8.40	-8.40	41.27 L/s	48	10 MIN 49	50	Carter1 2869 m3	3000	3273	3273	WoodsPOE			
Carter 2	-3.77 m	-8.00	-9.10	-9.10	27.19 L/s	38	10 MIN 45	50	Carter2 1890 m3	3000	3273	3273	28094 m3	60000	65000	65000
Carter 1+2	----------				68.46 L/s	76	10 MIN 76	76	Carters 4759 m3	6200	6546	6546				
Arkell 1	-6.04 m	-9.00	-10.00	-10.00	0.00 L/s	35	38	38	Arkell1 0 m3	3000	3273	3273				
Arkell 6	-19.80 m	-32.00	-32.20	-32.20	86.02 L/s	100	111	111	Arkell6 5797 m3	9300	9600	9600				
Arkell 7	-20.02 m	-28.00	-29.90	-29.90	84.17 L/s	100	111	111	Arkell7 5741 m3	9300	9600	9600				
Arkell 8	-21.22 m	-28.00	-29.50	-29.50	0.00 L/s	100	111	111	Arkell8 1989 m3	9300	9600	9600				
Arkell 14	-13.00 m	-28.80	-29.90	-29.90	0.00 L/s	100	111	111	Arkell14 795 m3	9300	9600	9600				
Arkell 15	-8.27 m	-11.00	-12.80	-12.80	84.82 L/s	100	111	111	Arkell15 5830 m3	9300	9600	9600				
6+7+8+14+15	----------				254.96 L/s	300	333	333	Arkells 20146 m3	25000	28800	28800	Note: Arkell total flow Interlocks only affect Auto Control			
Glen Collector	----------				119.93 L/s	250			Glen 8347 m3	25000						

HOW TO RESET THE SHUTDOWN ALARMS

1) Well Level MPL shutdown: reset on pump screen
2) Well Max Flow Rate shutdown: pump reset or midnight
3) Well Max Daily Flow: resets at midnight
4) POE / Booster Max Daily Flow: resets at midnight

LEGEND: ENABLE DISABLE BUTTON; ENABLE DISABLE STATUS; 10 MIN 45 SETPOINT; IF SPECIAL TIME DELAY INTERLOCK/ALARM STATUS (PINK = ACTIVE)

Ack	Date In	Time In	Time Last	Node	Tagname	Status	Value	Description
✓	02/10/2018	10:55:14.273	10:55:14.273	WDSCADA	DOBG00100EPF	CFN	ALARM	Downey Well Pump Power Monitor
✓	29/09/2018	12:54:05.987	12:54:05.987	WDSCADA	MEBG00100EPF	CFN	ALARM	Membro Well Pump Disconnect Off
✓	29/09/2018	12:54:05.921	12:54:05.921	WDSCADA	MEBG00100EOL	CFN	ALARM	Membro Well Pump Overload Alarm
✓	29/09/2018	12:54:05.921	12:54:05.921	WDSCADA	MEBG00100EGA	CFN	ALARM	Membro Well Pump General Alarm
✓	29/09/2018	12:54:01.935	12:54:01.935	WDSCADA	MEBGB0100EPF	CFN	ALARM	Membro Booster Pump Disconnect Off

Total Alarms: 46 | Filter: Off | Sort: Time In, Descending | Run

Logging flow to System vs. Waste – for water balance calcs.

System VS Waste Flow

ADMIN1 — ADMIN is logged in — MENU — 7:20:50 PM 02/10/2018

Station	Current (L/s)	TODAY All Flow (m3)	TODAY Going To	TODAY System (m3)	TODAY Waste (m3)	YESTERDAY All Flow (m3)	YESTERDAY System (m3)	YESTERDAY Waste (m3)
Arkell 1	0.00	0	SYSTEM W S	0	0	338	338	0
Arkell 6	86.01	5807	SYSTEM W S	5808	0	6486	6486	0
Arkell 7	84.18	5751	SYSTEM W S	5751	0	7344	7344	0
Arkell 8	0.00	1989	SYSTEM W S	1989	0	1575	1575	0
Arkell 14	0.00	795	SYSTEM W S	795	0	1328	1328	0
Arkell 15	84.74	5840	SYSTEM W S	5840	0	7323	7323	0
Burke Well	????	????	W S	????	????	????	????	????
Carter Wells	41.26	4766	WASTE W S	0	4763	5910	0	5908
Calico Well	0.00	0	SYSTEM W S	0	0	0	0	0
Dean Well	0.00	1057	SYSTEM W S	1057	0	1336	1336	0
Downey Well	0.00	0	SYSTEM W S	0	0	0	0	0
Emma Well	????	????	W S	????	????	????	????	????
Helmar Well	11.70	638	SYSTEM W S	638	0	799	0	0
Membro Well	0.00	0	SYSTEM W S	0	0	0	0	0
Paisley Well	9.87	687	SYSTEM W S	687	0	851	851	0
Park Well #1	56.40	3897	SYSTEM W S	1240	0	4862	1541	0
Park Well #2	0.00	1240	SYSTEM W S	3898	0	1541	4862	0
Queensdale Well	0.00	735	SYSTEM W S	735	0	873	873	0
University Well	0.00	1641	SYSTEM W S	1641	0	1836	1836	0
Water St. Well	24.62	1587	WASTE W S	1588	0	961	961	0
Glen Collector	119.81	8358	SYSTEM	8358	0	10309	10309	0

Station	Current (L/s)	TODAY All Flow (m3)	TODAY Going To	TODAY System (m3)	TODAY Waste (m3)	TODAY Recirc (m3)	YESTERDAY All Flow (m3)	YESTERDAY System (m3)	YESTERDAY Waste (m3)	YESTERDAY Recirc (m3)
Burke Booster	????	????	W S R	????	????	????	????	????	????	????
Calico Booster	0.00	0	SYSTEM W S R	0	0	0	0	0	0	0
Dean Booster	16.15	1071	SYSTEM W S R	1071	0	0	1340	1340	0	0
Downey Booster	0.00	0	SYSTEM W S R	0	0	0	0	0	0	0
Helmar Booster	9.90	655	SYSTEM W S R	655	0	0	814	0	0	0
Membro Booster	0.00	0	SYSTEM W S R	0	0	0	0	0	0	0
Park Booster	62.20	5232	SYSTEM W S R	5232	0	0	6558	6558	0	0
Queensdale Booster	12.58	714	SYSTEM W S R	714	0	0	889	889	0	0
University Booster	25.05	1630	SYSTEM W S R	1630	0	0	1992	1993	0	0
Woods Booster	373.32	28139	SYSTEM W S	28139	0	N/A	35677	35677	0	N/A

System	Current (L/s)	All Flow (m3)	Going To	System (m3)	Waste (m3)	Recirc (m3)	All Flow (m3)	System (m3)	Waste (m3)	Recirc (m3)
System Well*	401.11	43184	N/A	38420	4760	N/A	54360	47653	5908	N/A
System Booster*	694.09	37413	N/A	37413	0	0	47270	46456	0	0

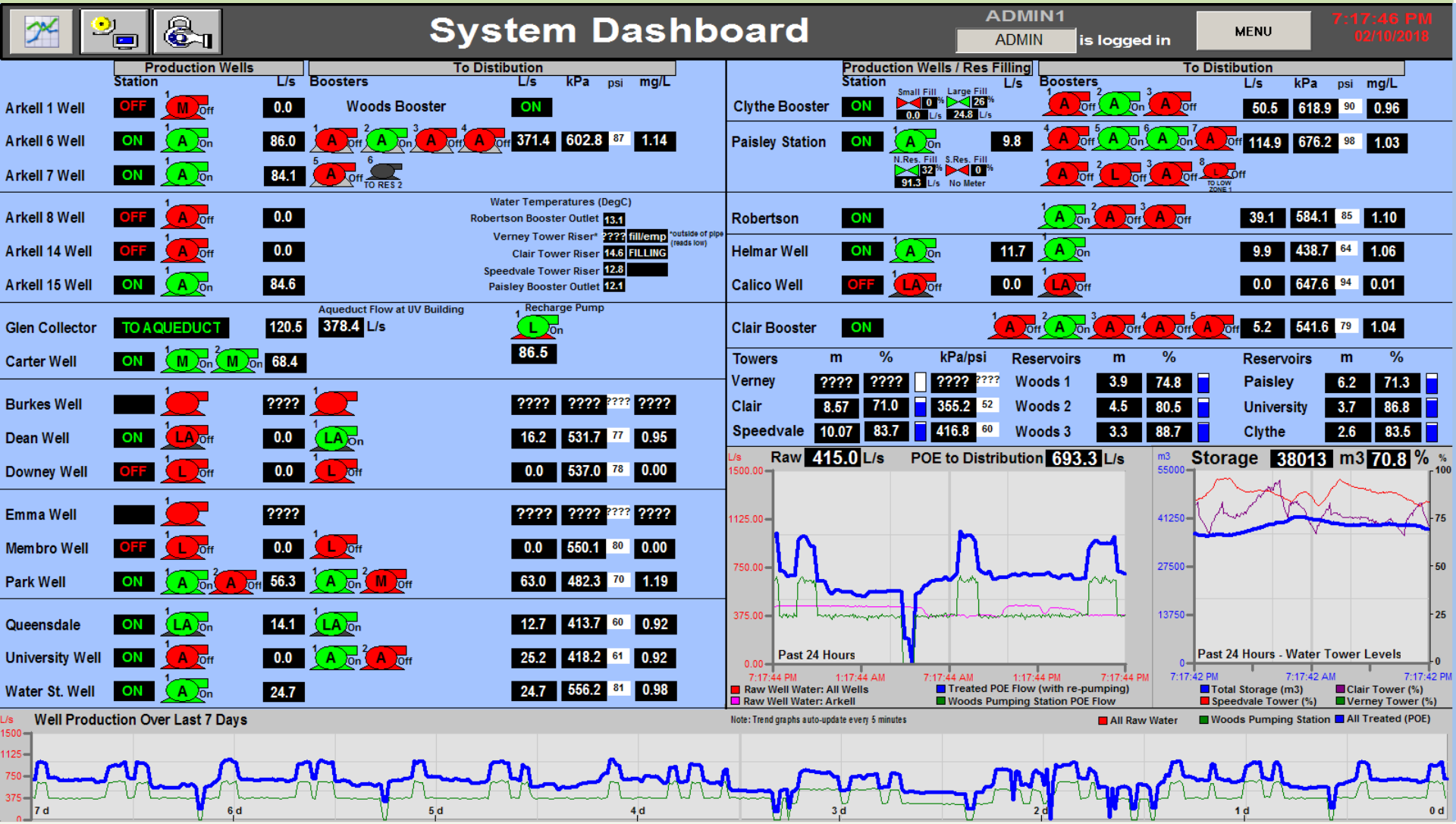
*Note: Burkes is currently not included in the System Totals

W - To Waste, S - To System, R - To Recirculation

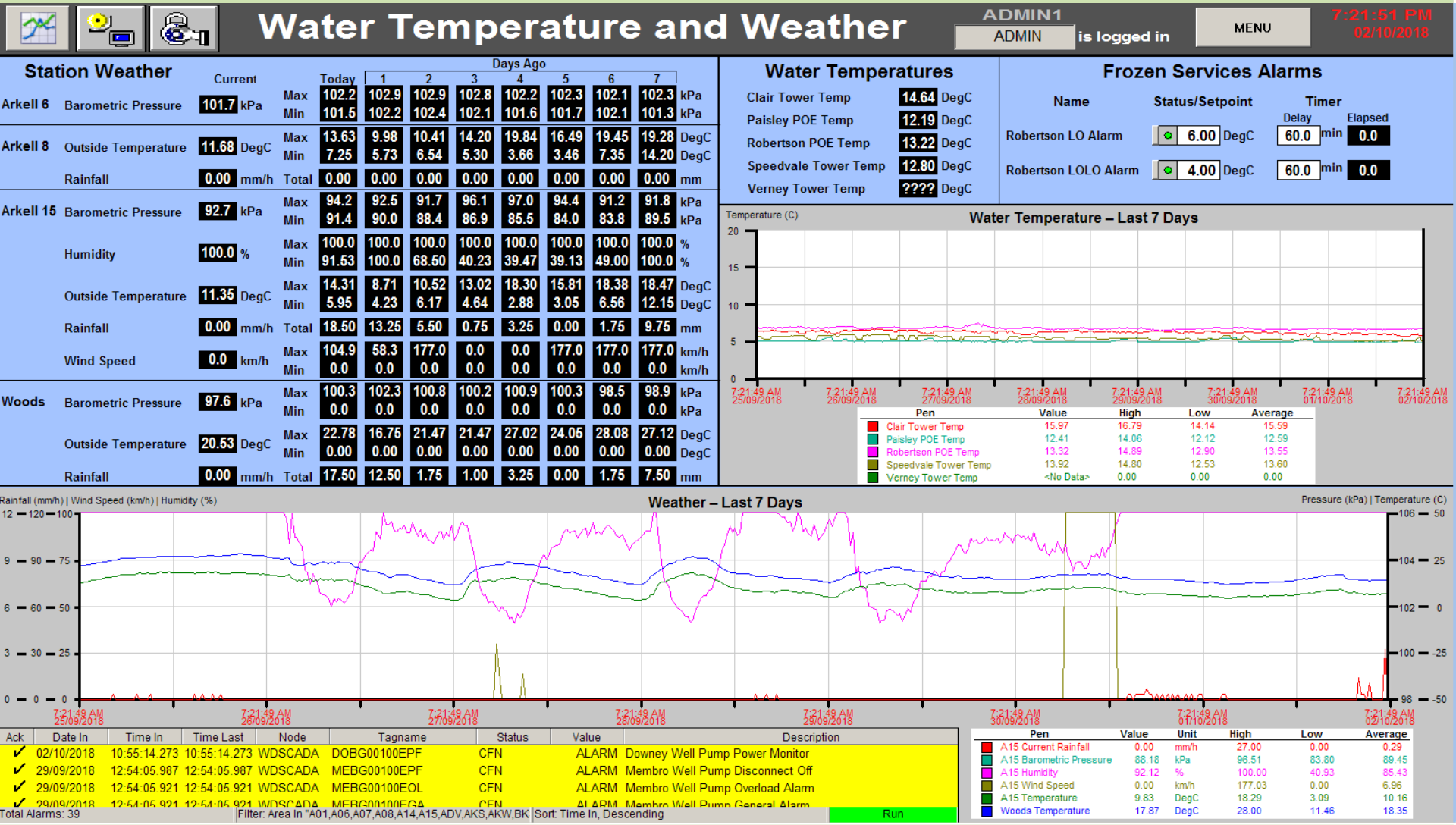
Ack	Date In	Time In	Time Last	Node	Tagname	Status	Value	Description
✓	02/10/2018	10:55:14.273	10:55:14.273	WDSCADA	DOBG00100EPF	CFN	ALARM	Downey Well Pump Power Monitor
✓	29/09/2018	12:54:05.987	12:54:05.987	WDSCADA	MEBG00100EPF	CFN	ALARM	Membro Well Pump Disconnect Off
✓	29/09/2018	12:54:05.921	12:54:05.921	WDSCADA	MEBG00100EOL	CFN	ALARM	Membro Well Pump Overload Alarm

Total Alarms: 46 | Filter: Off | Sort: Time In, Descending | Run

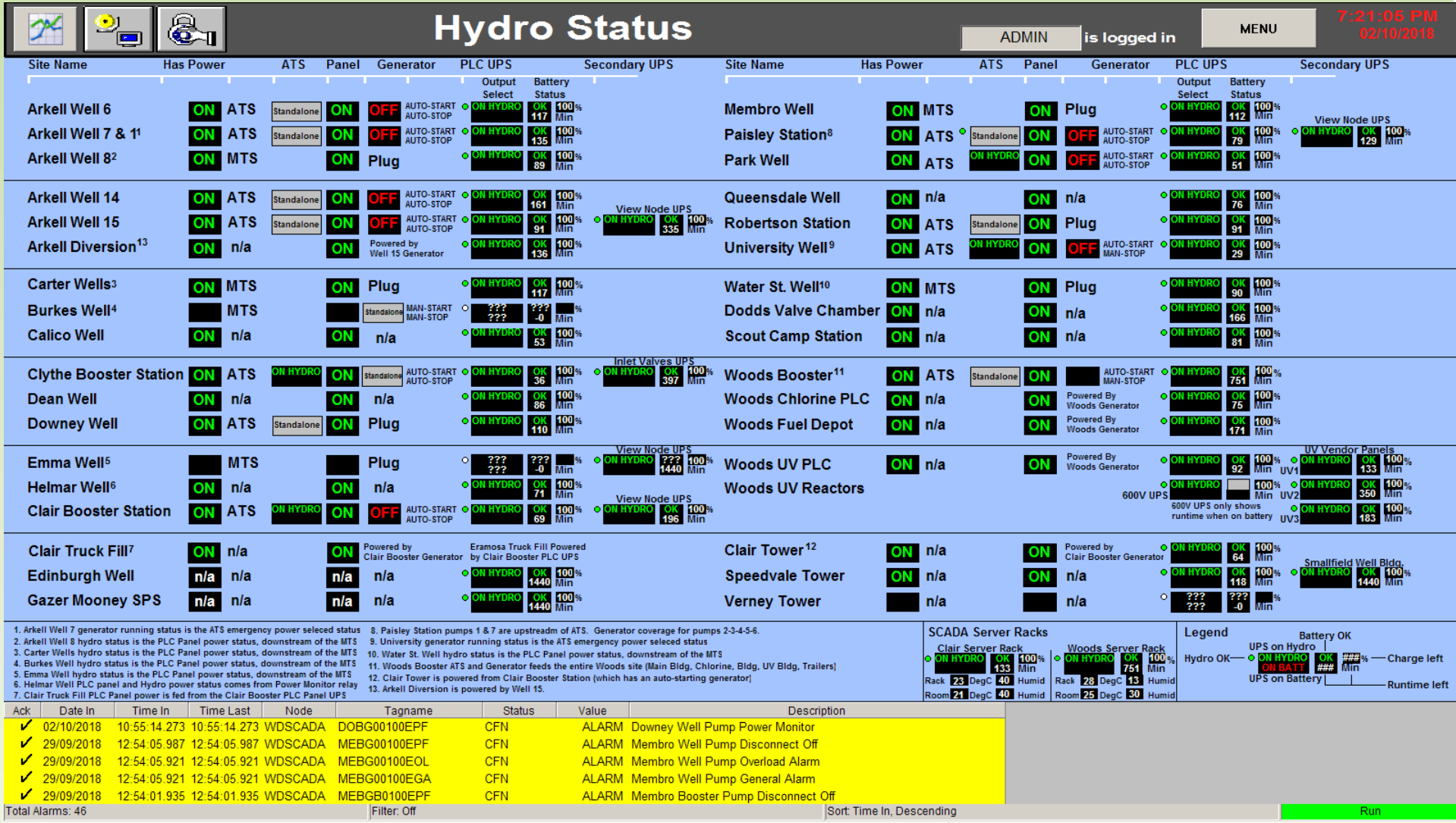
Dash Board Displays – entire system status at a glance



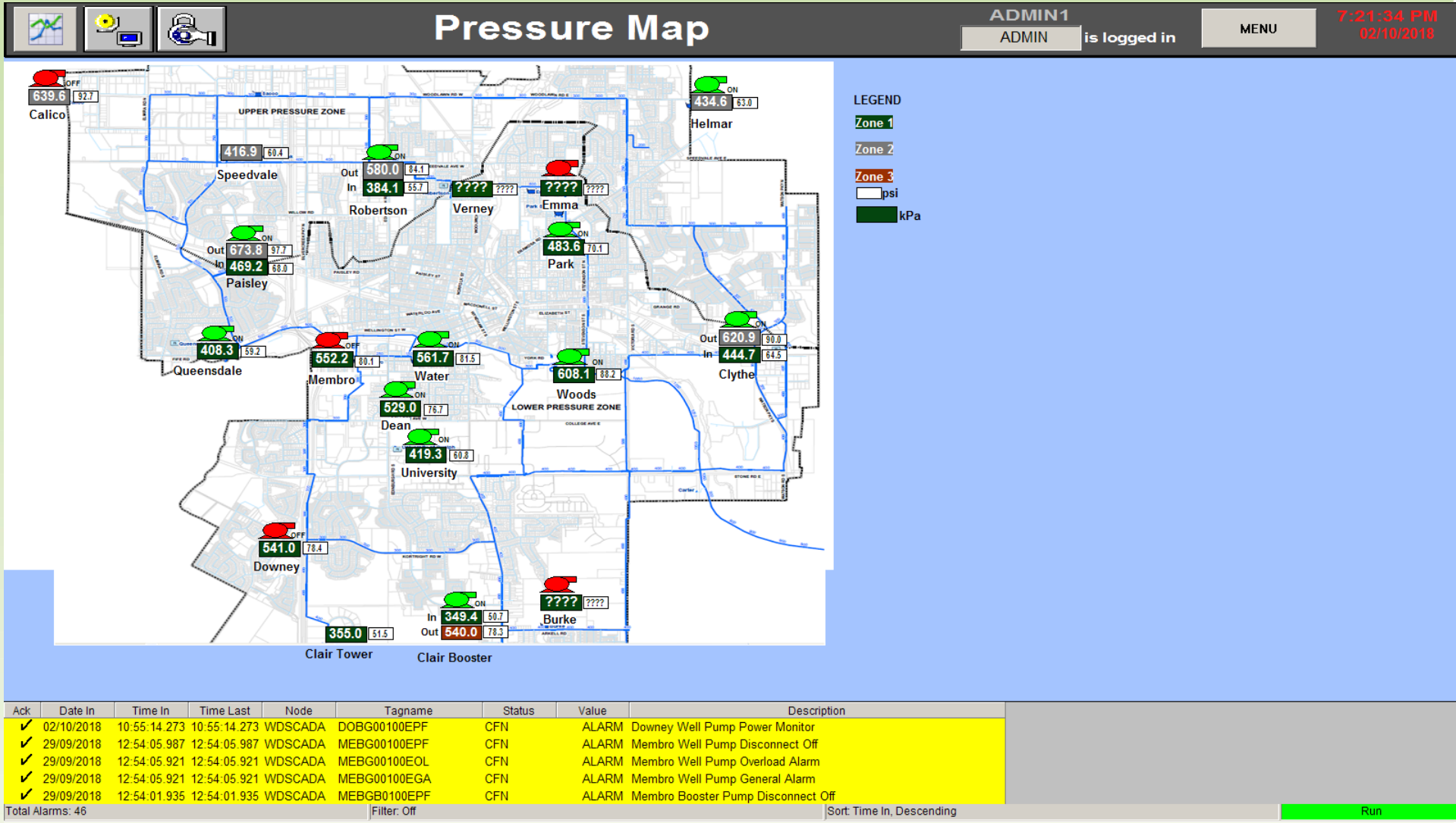
Dash Board Displays - Weather



Dash Board Displays – Which Sites have Power?



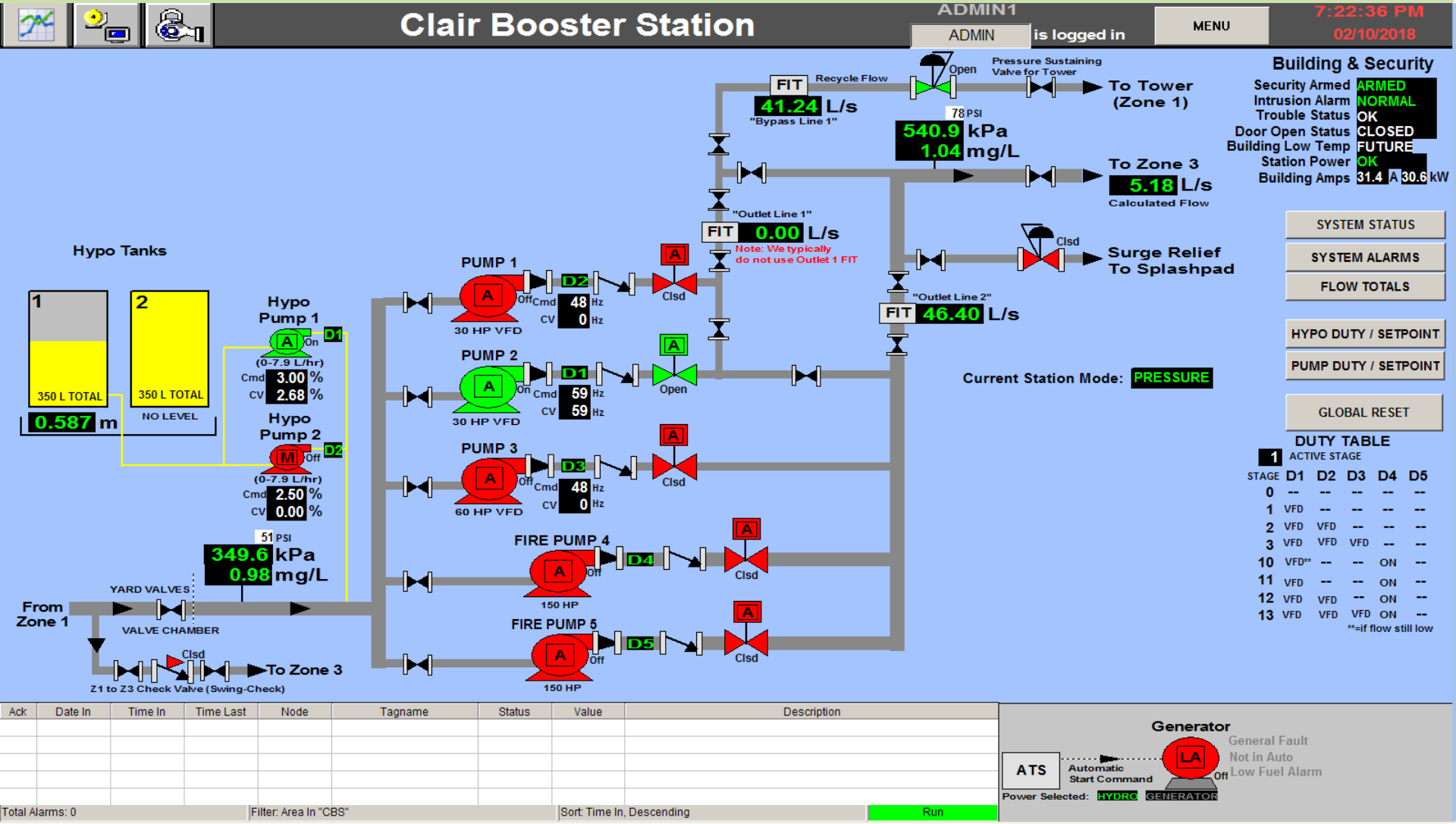
Dash Board Displays – Pressures Across City



Ack	Date In	Time In	Time Last	Node	Tagname	Status	Value	Description
✓	02/10/2018	10:55:14.273	10:55:14.273	WDSCADA	DOBG00100EPF	CFN	ALARM	Downey Well Pump Power Monitor
✓	29/09/2018	12:54:05.987	12:54:05.987	WDSCADA	MEBG00100EPF	CFN	ALARM	Membro Well Pump Disconnect Off
✓	29/09/2018	12:54:05.921	12:54:05.921	WDSCADA	MEBG00100EOL	CFN	ALARM	Membro Well Pump Overload Alarm
✓	29/09/2018	12:54:05.921	12:54:05.921	WDSCADA	MEBG00100EGA	CFN	ALARM	Membro Well Pump General Alarm
✓	29/09/2018	12:54:01.935	12:54:01.935	WDSCADA	MEBGB0100EPF	CFN	ALARM	Membro Booster Pump Disconnect Off

Total Alarms: 46 | Filter: Off | Sort: Time In, Descending | Run

A More Complex Site: VFDs, Duty Numbers, etc.



Next Stop – Emma Well