

Treatment Plant SCADA & Instrumentation

Water and Wastewater
Operator's School
August 5, 2010

Marc Pedrotti, P.E.

R. E. Pedrotti Company, Inc.

- Celebrating 34 Years in Water & Wastewater Industry
- Manufacturer's Representative
- System Integrator

Overview

- Basics of SCADA
 - Understanding the Alphabet Soup
 - System Components
 - Communication Methods
- Developing a System
 - Define Level of Control
 - Control Networks
 - Future SCADA

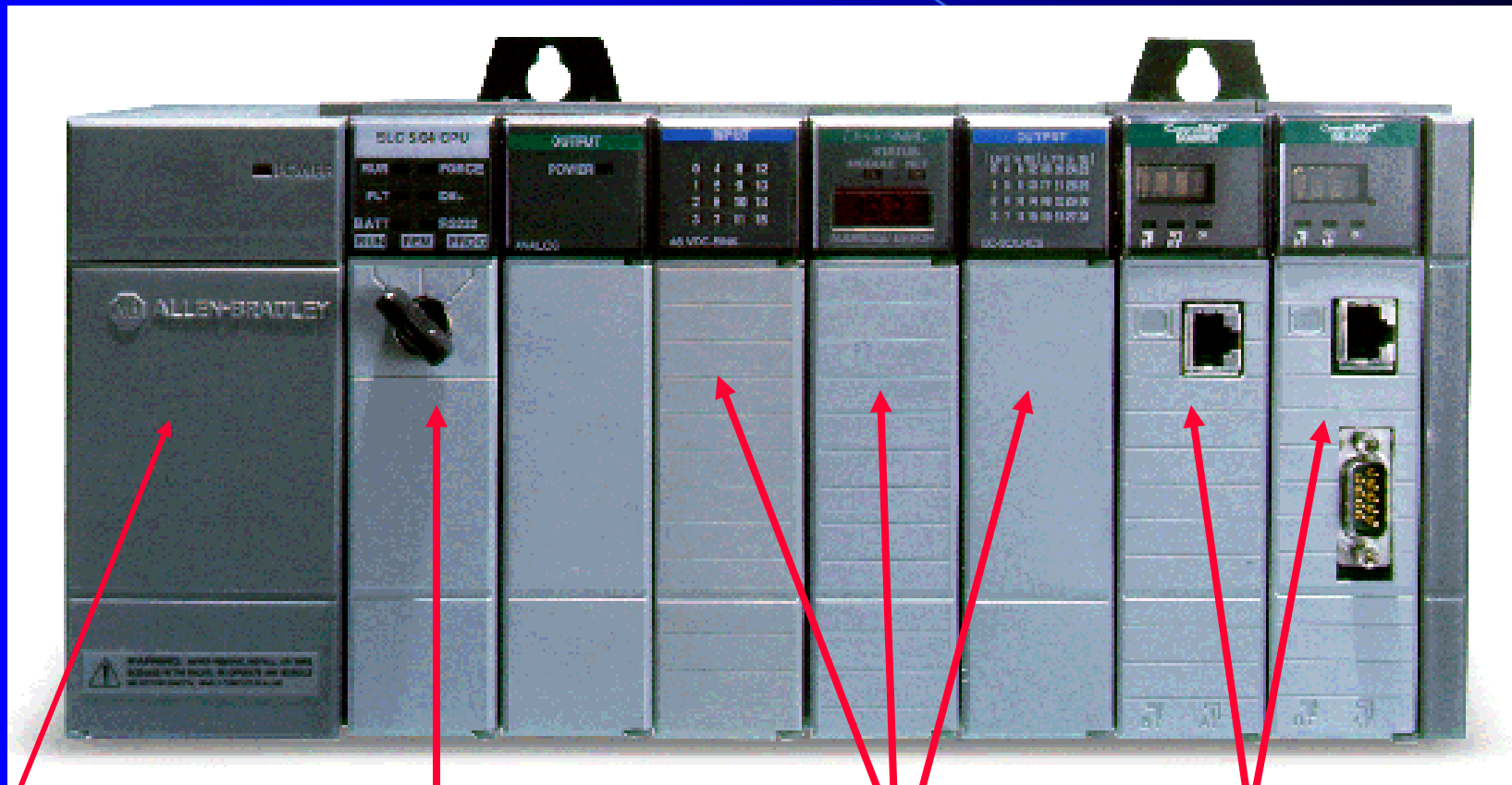
Alphabet Soup

- SCADA
- HMI
- I/O
- PLC
- DCS
- RTU
- GUI
- CMMS
- CPU

SCADA

Supervisory
Control
And
Data
Acquisition

Programmable Logic Controller



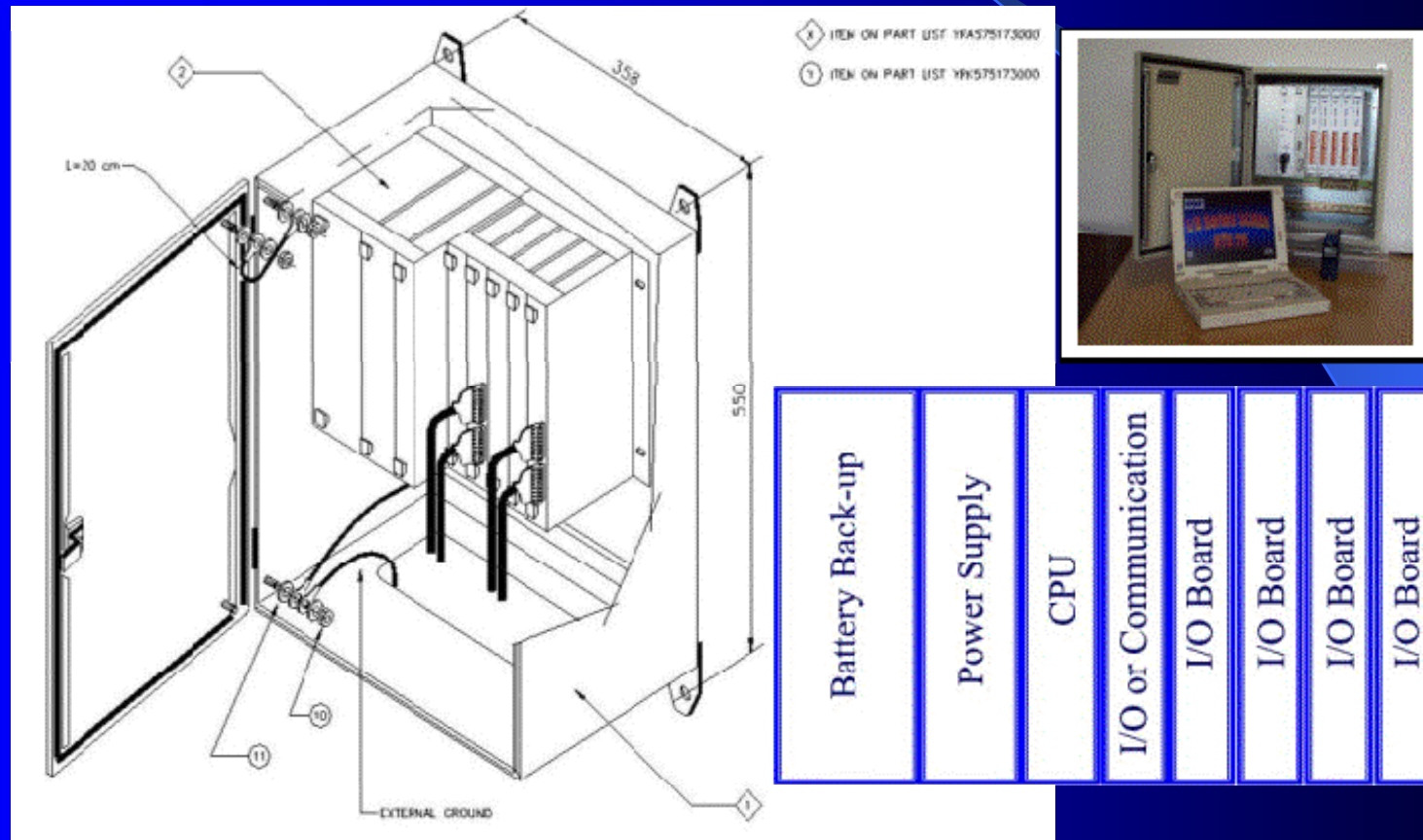
Power
Supply

CPU

I/O

Communication
Cards **REP** R.E. Pedrotti Co.

Remote Terminal Unit



REP R.E. Pedrotti Co.

Simple Discrete Control



Level Switches

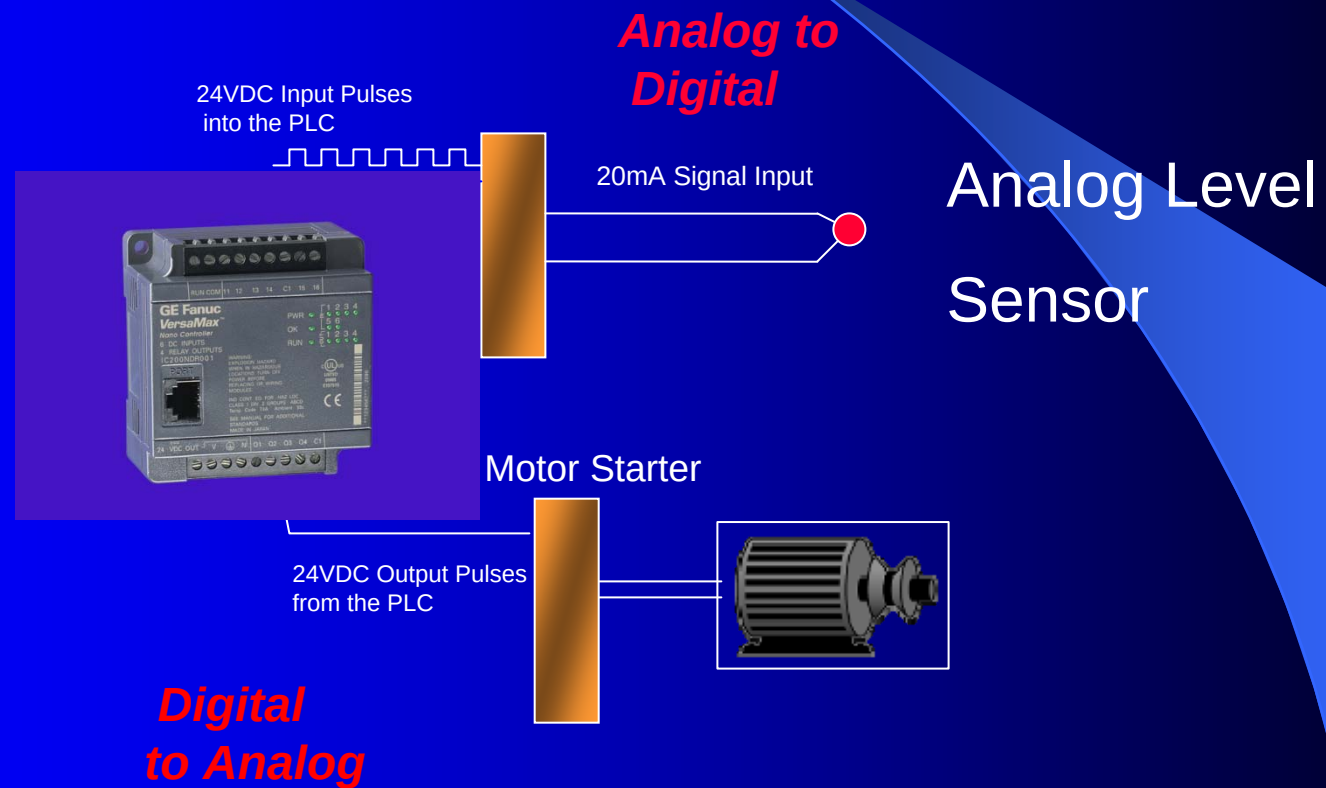


Motor Starter

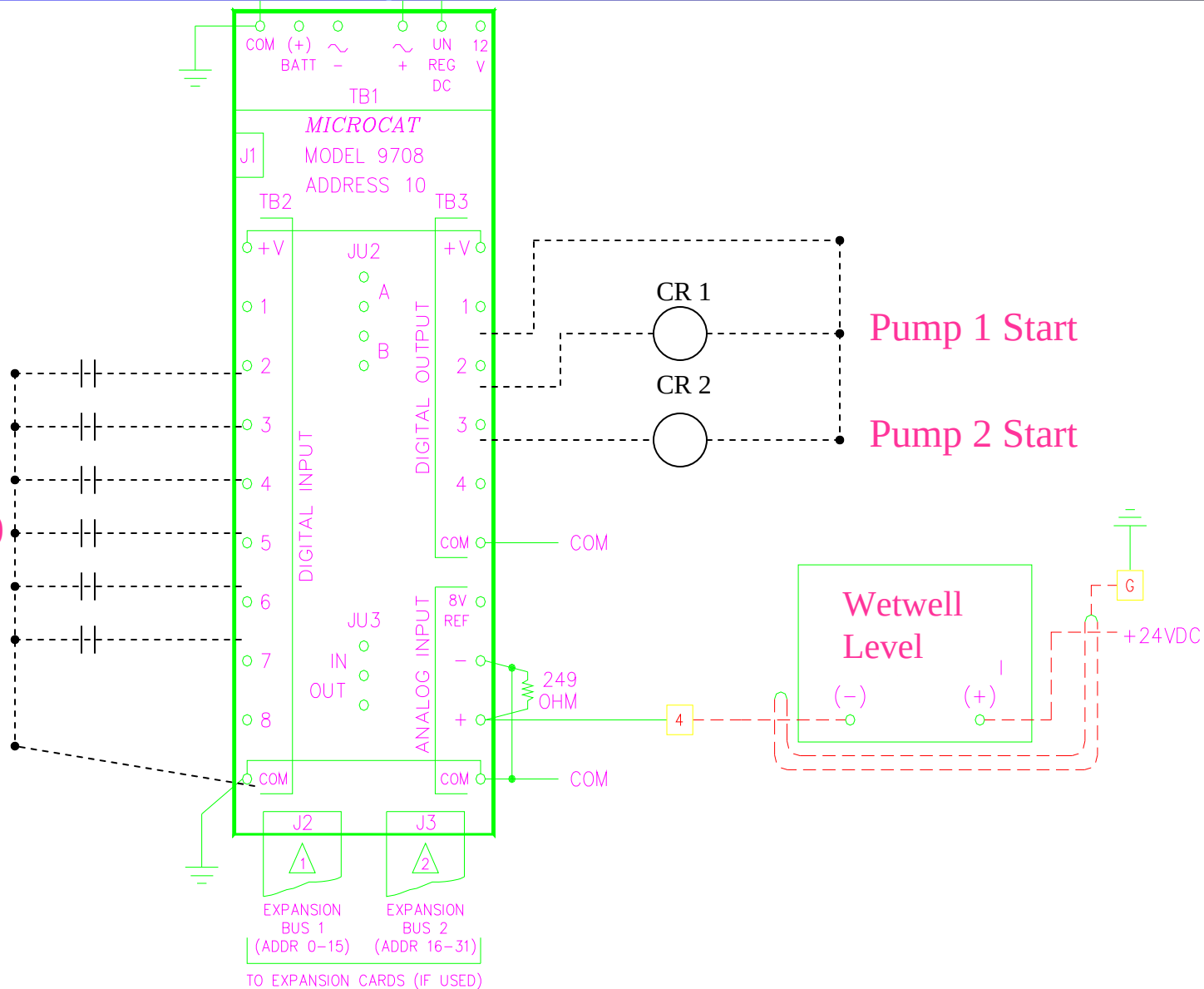
24VDC Output Pulses
from the PLC



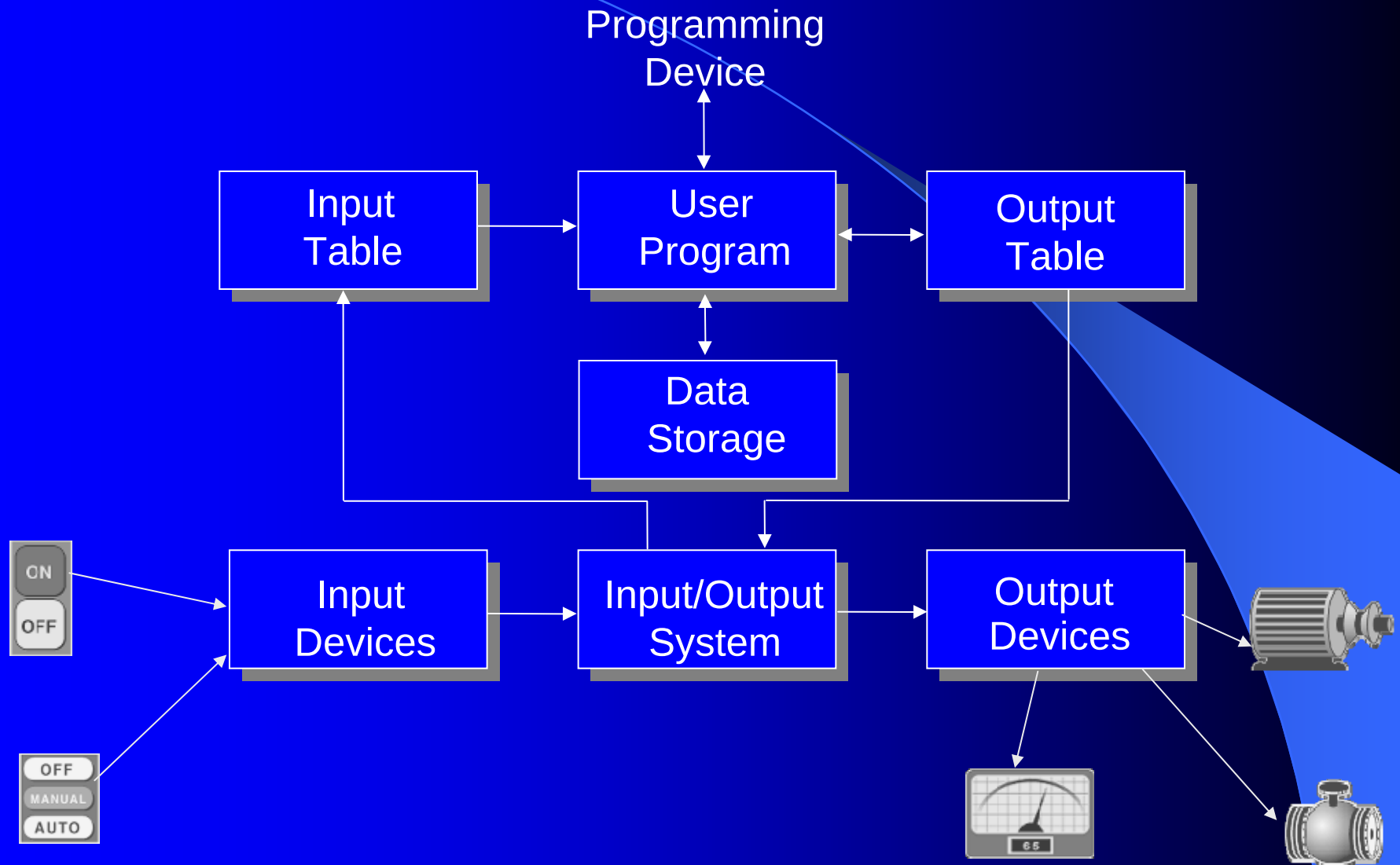
Analog Control



Pump 1 Run
Pump 2 Run
High Level Alarm
Float Switch (Sump)
Intrusion Alarm



Introduction to Control



SCADA Components

- HMI (Human Machine Interface)
- OIT (Operator Interface Terminal)
- PC (Personal Computer)
- CPU (Central Processing Unit)
- Instrumentation

Instrumentation

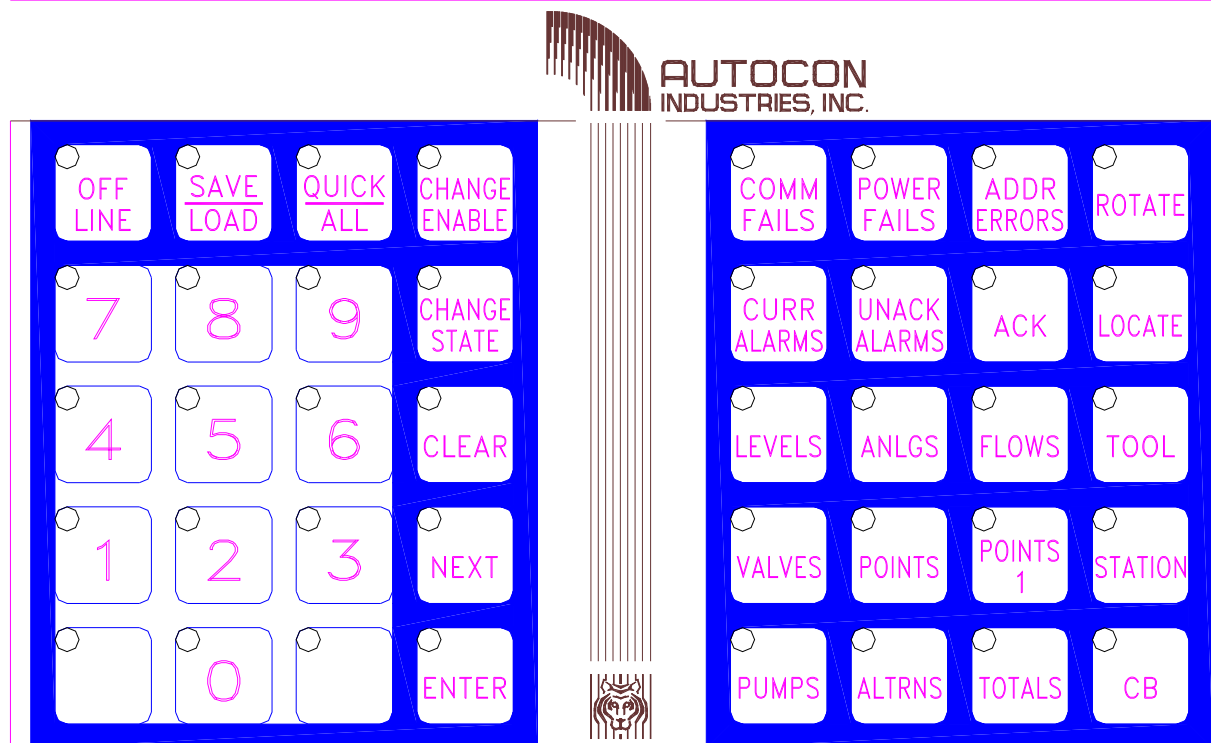
- Pressure
- Flow
- Level
- Dissolved Oxygen
- Gas Detection
- Chlorine Monitors
- Turbidity
- pH
- Temperature
- TSS
- Nitrates
- Phosphate
- BOD
- Ammonia
- TOC
- Chemical Security

Personal Computer and Servers

- Computer
 - Size
 - Back-Up
 - CD Rom (RW)
 - DVD
 - Monitor
 - Redundant
 - Modem (Remote Access)

(OIT) Operator Interface Terminal

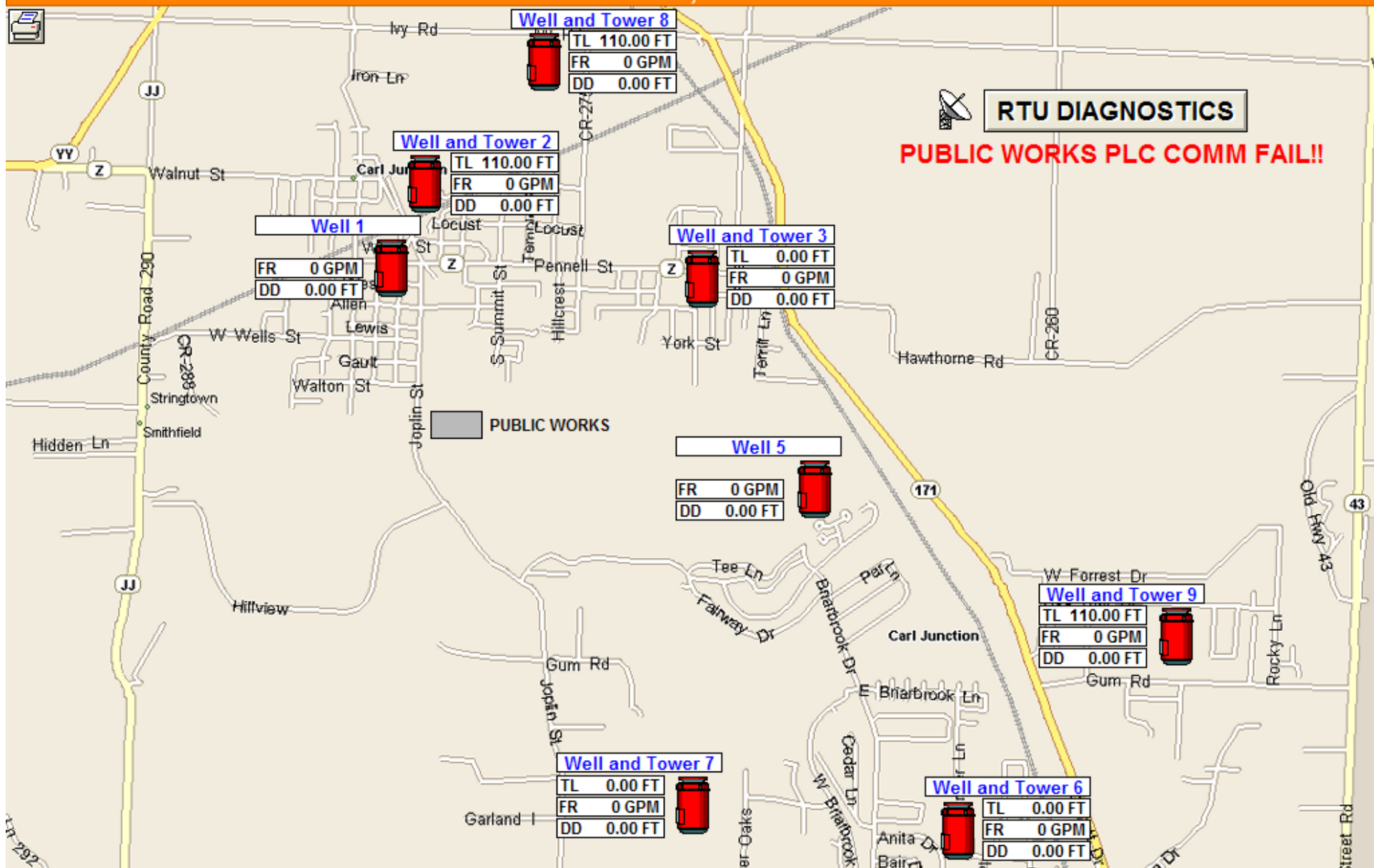
20 CHARACTER DISPLAY



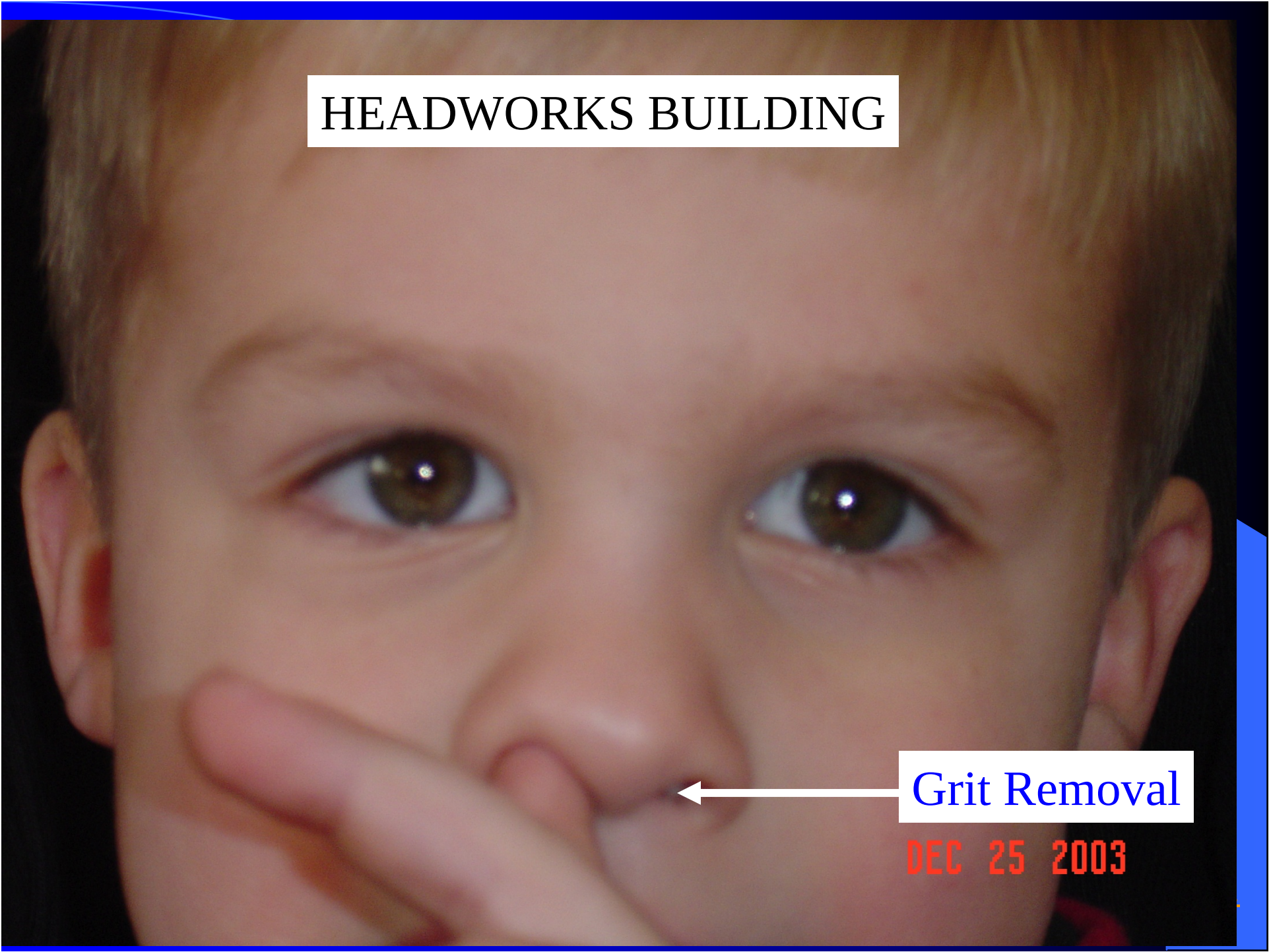
HMI Software

- Wonderware
- Intellution
- RS View
- Foxboro I/A
- Factory Link

Carl Junction, MO Overview



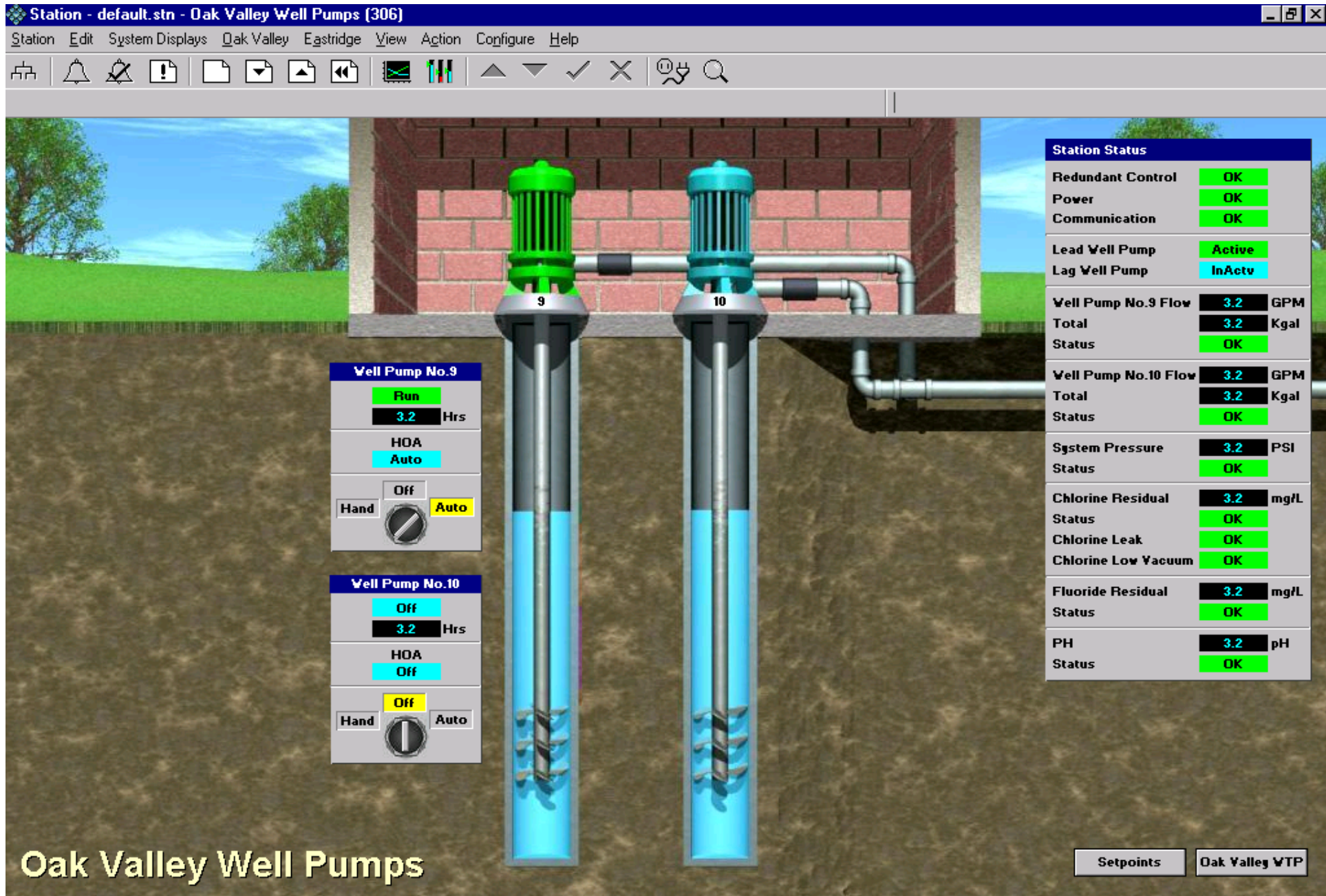
LOW
CUTOFF

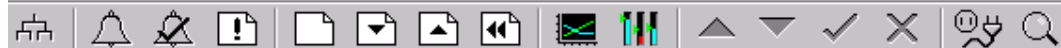
A close-up photograph of a young child's face. The child has light skin and brown eyes. A finger is visible near the child's nose. The image is framed by a blue border.

HEADWORKS BUILDING

Grit Removal

DEC 25 2003





Batesville Lift Station #2

Station Status

Alarms

Lift Station High Level

Alarm

Lift Pump No.1

Failed

Total Run Time

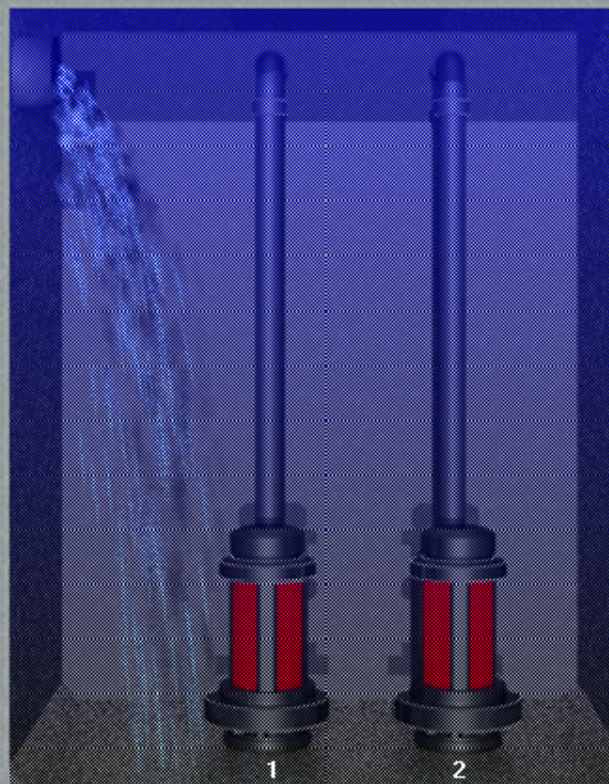
###.### hrs

Lift Pump No.2

Failed

Total Run Time

###.### hrs



23-Mar-01 11:25:54

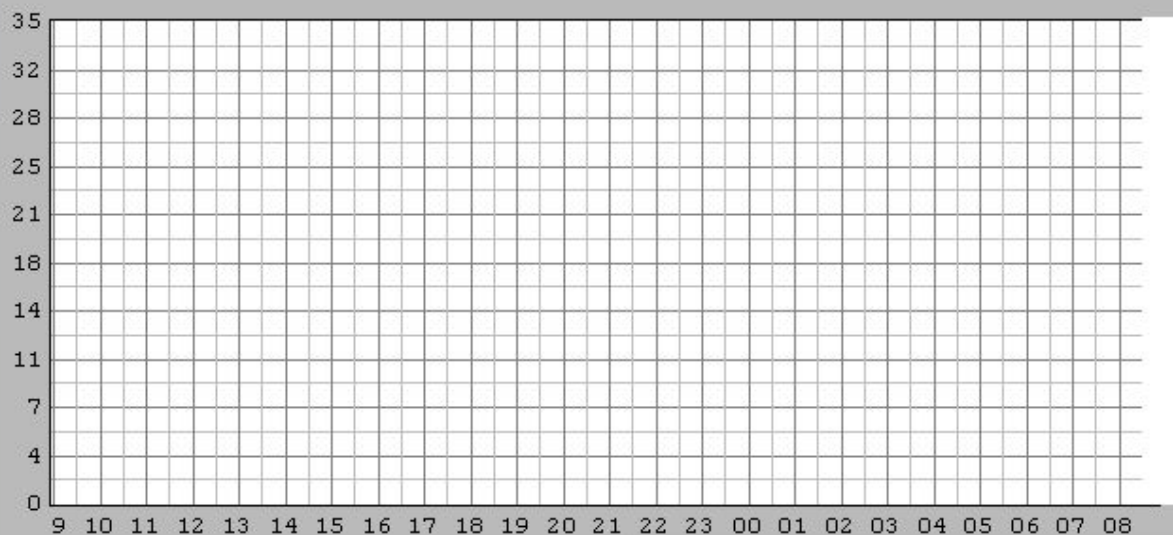
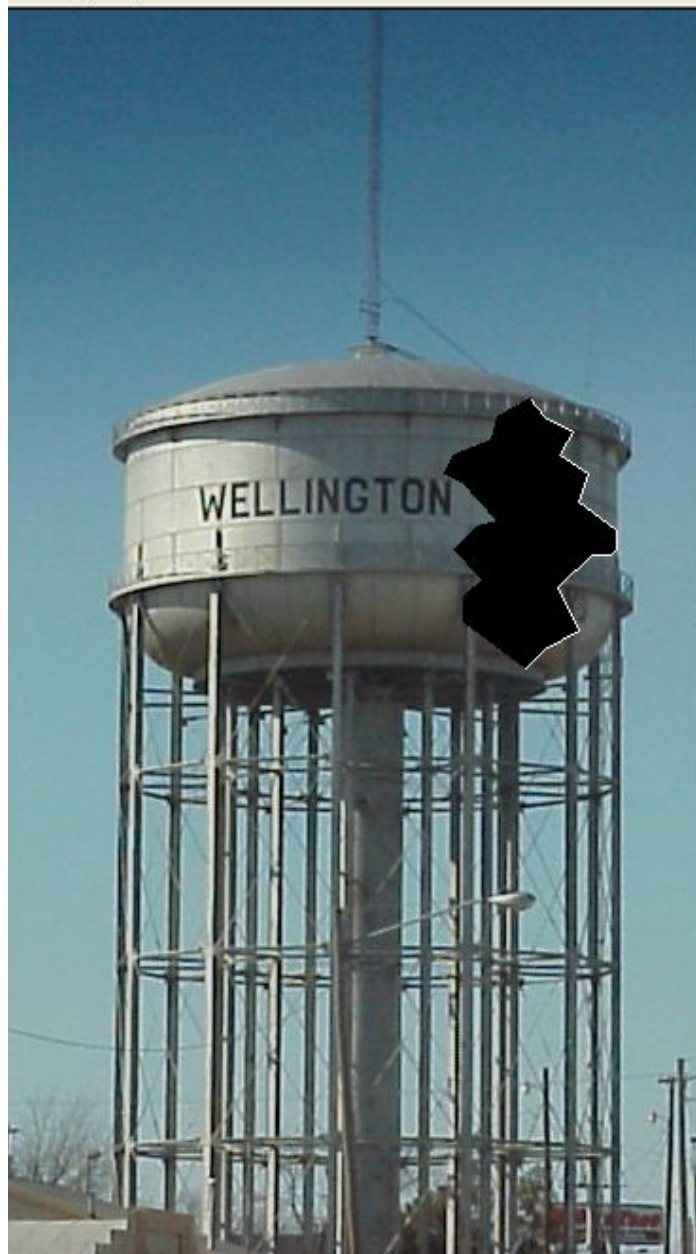
localhost

Stn01

Oper

WATER TOWER

TOWER LEVEL: 0.0 FT
HIGH LEVEL SETPOINT: 0.0 FT
LOW LEVEL SETPOINT: 0.0 FT



LOCATION	COMM	POWER
RTU 3 at the City Water Tower:	OK	OK

REP

R. E. Pedrotti Co., Inc.

Instrumentation, Controls & Computer Systems

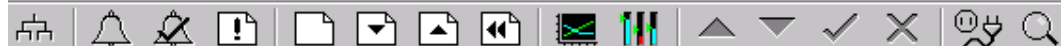
R. E. Pedrotti Co., Inc.
5855 Beverly Avenue, Suite A
Mission, KS 66202

(913)677-3366
(913)677-3460 fax
www.repeditri.com

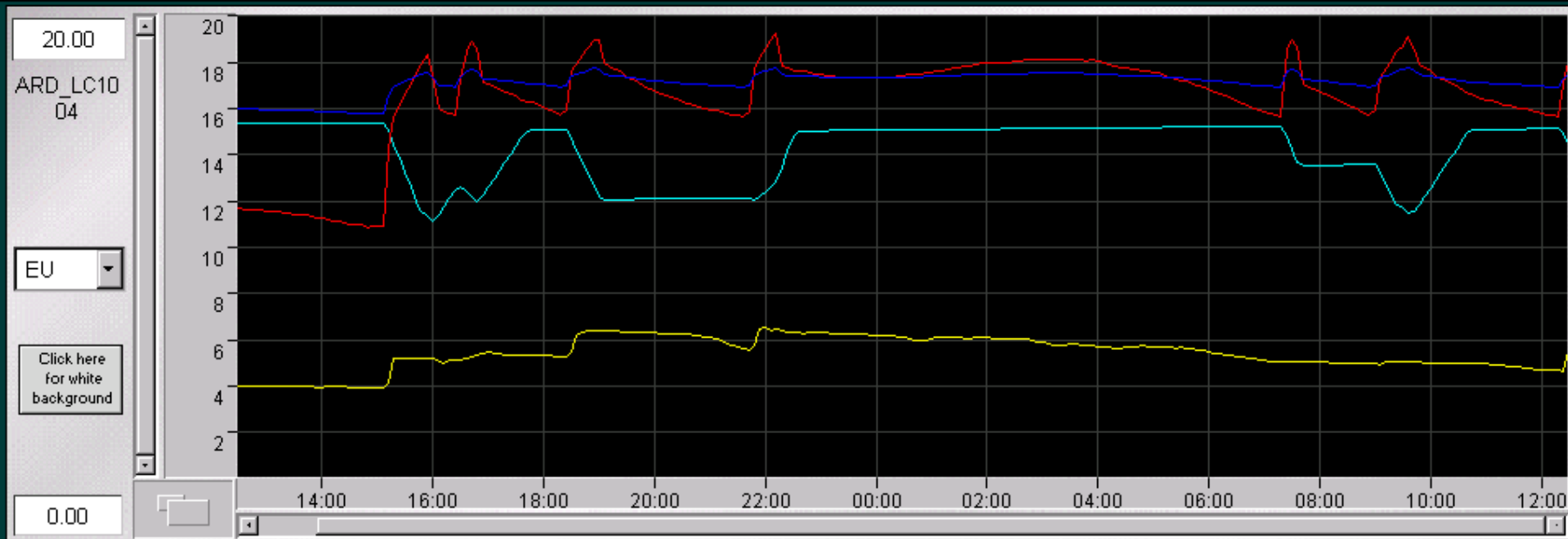
Time: 8:54:44 AM
Date: 8/17/2004

RETURN

UPDATE



Trend 20 Ardice Trend Type Multirange Samples 240 Interval 6 min avg



Pen on/off	Point ID	Parameter	Description	Range	value at:	12:35:51
☒	ARD_LC10040	PV	ARD GST High/Low/SP	0.00 20.00		13.820513 Ft
☐				0.00 100.00		
☐		PV		0.00 70.00		
☒	ARD_AI10030	PV	Chlorine Residue	0.00 5.00		1.4499999 ppm
☐				0.00 100.00		
☒	ARD_LI10029	PV	Ardice Tower Level	0.00 36.00		33.380768 Ft
☒	ARD_PC10029	PV	Ardice System Pres	0.00 65.00		57.307693 psi
☐				0.00 100.00		

History offset 0:00:00 Archive directory

Alarm Dialer

Pager Enable		Name	Phone No. Pager ID	Available Times Start Stop		Available Days M T W T F S S H							Page Alarms from Areas Assigned to Operator	Minimum Priority	
☒	1	Electrical	9353 7234	8:00	17:00	☒	☒	☒	☒	☒	☐	☐	☐	James Burns	Urgent
☒	2	Maintenance	9283 2821	1:00	0:00	☒	☒	☒	☒	☒	☒	☒	☐	Peter Davis	Low

Specific Alarms to Page			Nominated Pagers				
Enable	Point ID	Minimum priority	1	2	3	4	5
1 ☒	PANA567890123456	Urgent	Electrical				
2 ☒	P010	Urgent	Electrical				Electrical

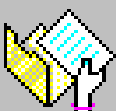
Message Content

- ☒ Date
- ☒ Time
- ☒ Point ID
- ☐ Alarm
- ☐ Priority
- ☐ Description
- ☒ Value
- ☒ Units
- ☐ Message Text

Computerized Maintenance Management Software

 **Job Cal**

File Reports Equipment Utilities Help

 Equipment
  Task
  Close
  Skip
  Delete
  Create
  Print View
  Print Wo
  Reports

	Week of 08/18/97	Week of 08/25/97	Week of 09/01/97
1	TRUCK // Change Oil	EffSampler // General	AB1 // Monthly Blower
2	TRUCK // Oil Change	InfFlowMeter // Flow Meter	AB1 // General Repair
3	EffFlowMeter // Flow Meter	EffFlowMeter // General	
4	TRUCK // General Repair	Pump 4 // General Repair	
5	Pump 3 // General Repair		
6	RAS PUMP 2 // General		
7	TRUCK // General Repair		
8			
9			
10			
11			
12			

Work Order

Edit/Close Work Order

Equipment: Date Due:

Task Description: Meter Due:

Last Meter Reading/Date: Closing Meter Reading:

Date Complete: Assigned To:

Work Order #:

Labor **Items Used** **WO Notes** **Task Instructions** **Equipment Notes**

Item#	Qty Used	UOM	Description
10W/30 Oil	4.00	Quart	10W/30 Oil
Fan Belt	1.00	unit	42" Fan Belt

Cost

Labor Cost: + Inventory Cost: + Misc Cost: = **TOTAL COST**:

REP R.E. Pedrotti Co.

Reports

3/21/98

Saukville WWTP

Equipment History Report

03/01/1998 To 03/21/1998

Equipment#

TRUCK

Ford Truck

Location

Garage

<u>Job Description</u>	<u>Due Date</u>	<u>Date Complete</u>	<u>Hours</u>	<u>Cost</u>	<u>Notes</u>
General Repair	3/26/98	3/26/98	1.00	30.00	flat TIRE
General Repair	3/27/98	3/27/98	2.00	34.00	flat tire
General Repair	3/27/98	3/27/98	2.00	3120.00	Tail gate
Change Oil, check Tires	3/26/98	3/31/98	0.50	38.00	exuffler might need
General Repair	4/ 3/98	4/ 3/98	2.00	312.00	oil leak
General Repair	4/14/98	4/14/98	0.50	38.00	flat tire
General Repair	4/13/98	4/13/98	0.50	37.50	OIL LEAK
General Repair	4/13/98	4/13/98	3.00	368.00	brakes
General Repair	4/16/98	4/16/98	1.00	32,200.00	engine
Oil Change	4/13/98	4/13/98	0.70	312.00	
Totals			<u>13.20</u>	<u>32,439.50</u>	

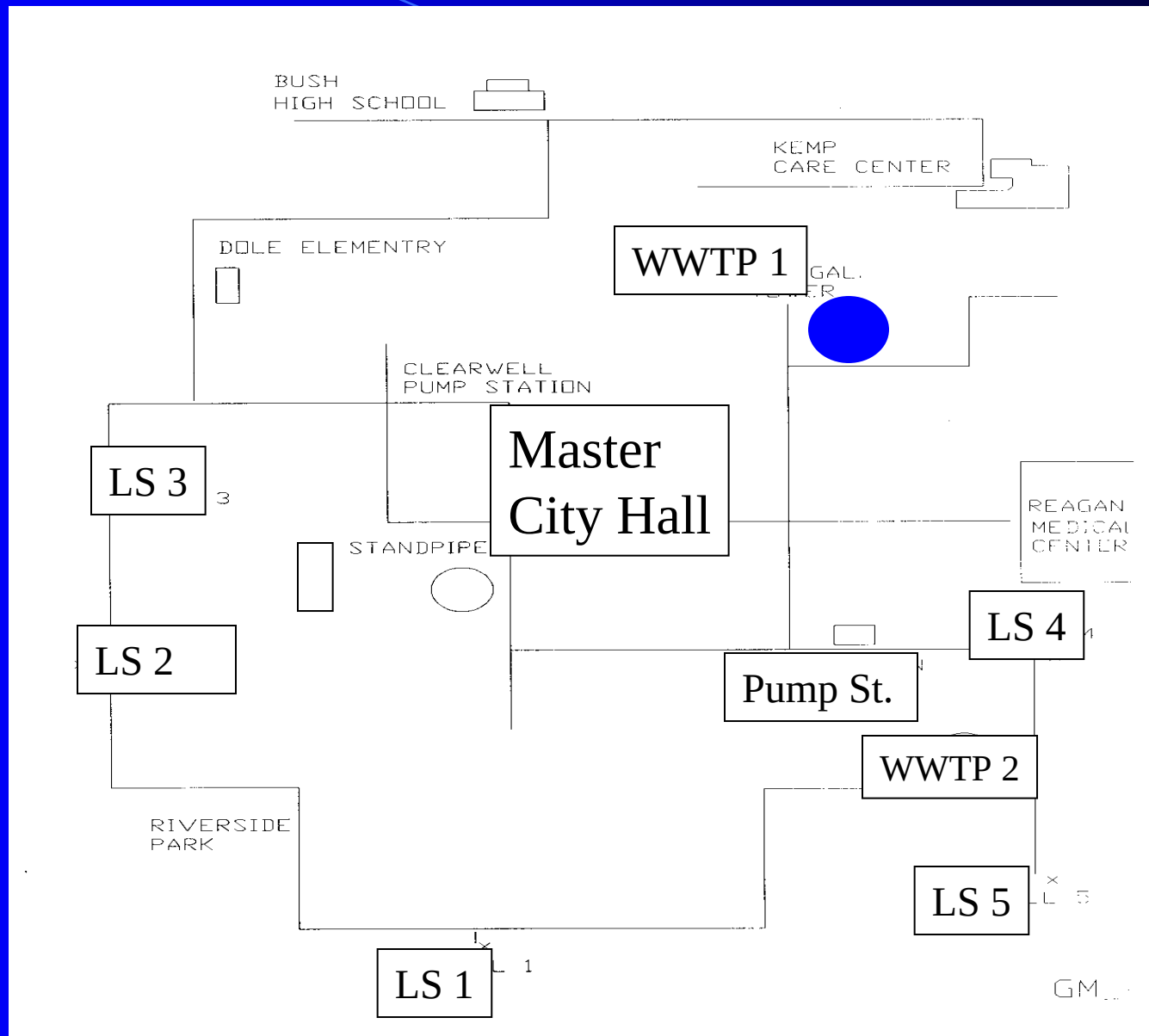
This report
shows you
everything
that has
happened
to a piece
of
equipment.

REP R.E. Pedrotti Co.

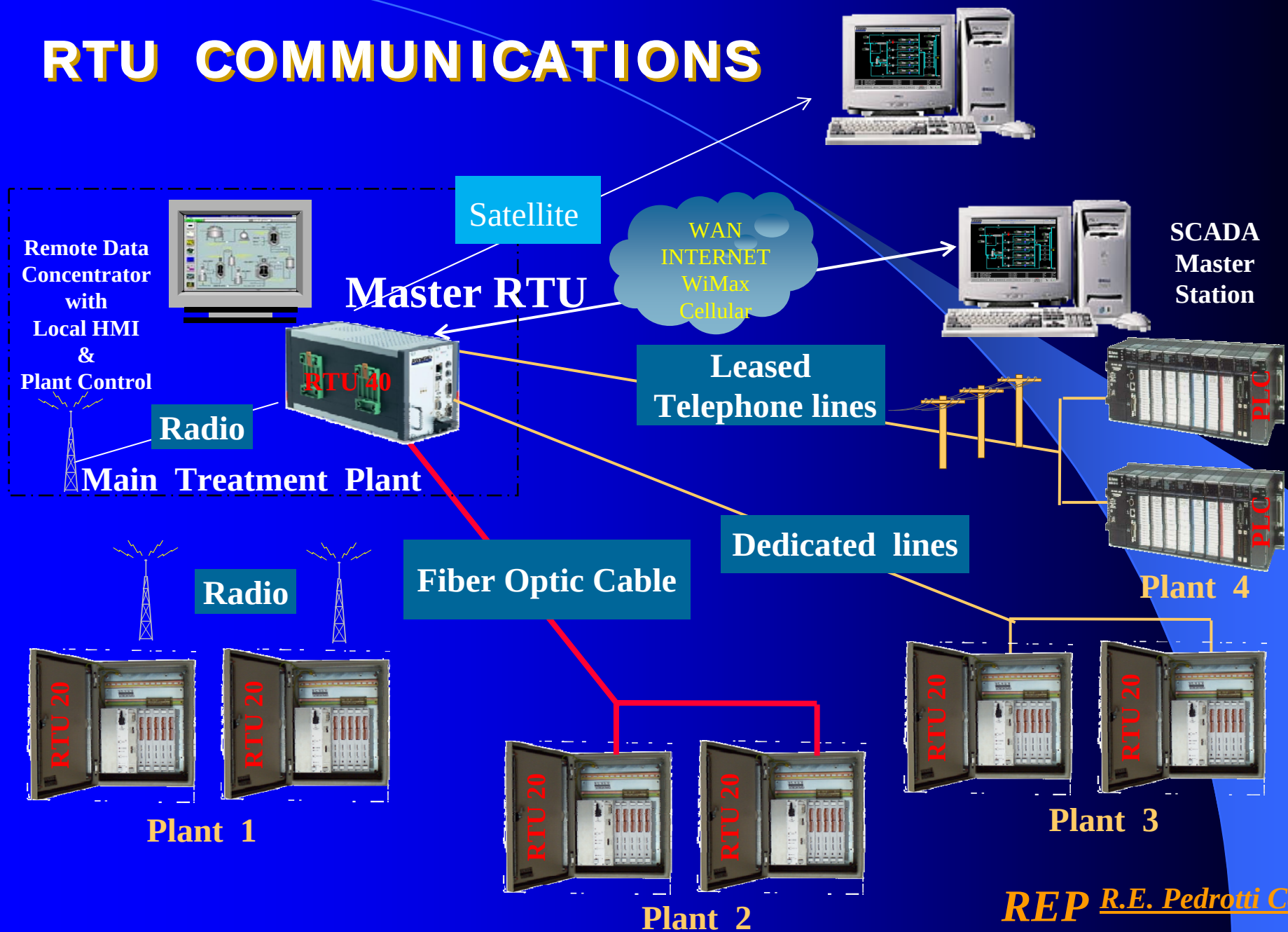
	A	B	C	D	E	F	G	H	I	J
1	R.E. Padretti Co.		Daily Flow Report							
2			30-Apr-04							
3	Print	North Zone				South Zone				
4	Calc									
5										
6										
7										
8	Day	Well 1 (kGal)	Well 2 (kGal)	Well 3 (kGal)	Well 4 (kGal)	Well 5 (kGal)	Well 6 (kGal)	Well 7 (kGal)	Well 8 (kGal)	
9	1:00 AM	0	0	0	0	0	0	0	0	
10	2:00 AM	0	0	0	0	0	0	0	0	
11	3:00 AM	0	0	0	0	0	0	0	0	
12	4:00 AM	0	0	0	0	0	0	0	0	
13	5:00 AM	0	0	0	0	0	0	0	0	
14	6:00 AM	0	0	0	0	0	0	0	0	
15	7:00 AM	0	0	0	0	0	0	0	0	
16	8:00 AM	0	0	0	0	0	0	0	0	
17	Shift Total	0	0	0	0	0	0	0	0	
18	9:00 AM	0	0	0	0	0	0	0	0	
19	10:00 AM	0	0	0	0	0	0	0	0	
20	11:00 AM	0	0	0	0	0	0	0	0	
21	12:00 PM	0	0	0	0	0	0	0	0	
22	1:00 PM	0	0	0	0	0	0	0	0	
23	2:00 PM	0	0	0	0	0	0	0	0	
24	3:00 PM	0	0	0	0	0	0	0	0	
25	4:00 PM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
26	Shift Total	0	0	0	0	0	0	0	0	
27	5:00 PM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
28	6:00 PM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
29	7:00 PM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
30	8:00 PM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
31	9:00 PM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
32	10:00 PM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
33	11:00 PM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
34	12:00 AM	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	INVALID!	
35	Shift Total	0	0	0	0	0	0	0	0	
36	DD Totalizer	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	
37	Total									
38	Average									
39	Maximum									
40	Minimum									
41										
42										

	A	B	C	D	E	F	G	H	I	J	K
1	R.E. Pedwell Co.		Monthly Chemical Usage Report								
2			January, 2004								
3	Print										
4	Calc		Line Feed		Ferric Sulfate	Ferric Sulfate	Chlorine Feed				
5		Aqua Ammonia (gals)	North Feeder 1 (lbs)	South Feeder 2 (lbs)	Feeder 1 (lbs)	Feeder 2 (lbs)	Feeder 1 Inferred Gas Flow (lbs)	Feeder 2 Inferred Gas Flow (lbs)	Feeder 3 Inferred Gas Flow (lbs)	Feeder 4 Inferred Gas Flow (lbs)	Combined Inferred Gas Flow (lbs)
6											
7											
8	Day										
9	1	0.0	2,653.0	127,281.3	66,325.3	66,325.3	0.0	0.0	10.0	0.0	10.0
10	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	10.0
11	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	5.0
12	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	0.0	7.4
14	6	3.2	Regular Flow	Regular Flow	Regular Flow	Regular Flow	0.0	0.0	7.7	0.0	7.7
15	7	15.0	38.2	3,383.6	0.0	115.4	0.0	0.0	6.0	0.0	6.0
16	8	16.0	38.2	4,347.7	0.0	124.4	0.0	0.0	6.0	0.0	6.0
17	9	17.0	38.2	4,345.7	0.0	124.4	0.0	0.0	6.0	0.0	6.0
18	10	16.0	31.6	4,188.0	0.0	125.0	0.0	0.0	5.3	0.0	5.3
19	11	17.0	32.2	4,118.3	0.0	124.4	0.0	0.0	4.8	0.0	4.8
20	12	16.3	31.5	4,232.5	0.0	125.0	0.0	0.0	5.4	0.0	5.4
21	13	3.6	83.6	3,382.7	0.0	37.5	0.0	0.0	5.7	0.0	5.7
22	14	12.0	38.2	3,613.4	0.0	103.3	0.0	0.0	10.0	0.0	10.0
23	15	0.0	31.2	3,663.0	0.0	105.6	0.0	0.0	5.0	0.0	5.0
24	16	0.0	31.1	3,888.2	0.0	103.4	0.0	0.0	0.0	0.0	0.0
25	17	6.0	31.4	2,511.0	0.0	33.2	0.0	0.0	7.0	0.0	7.0
26	18	7.0	38.2	2,587.5	0.0	31.2	0.0	0.0	0.0	0.0	0.0
27	19	6.0	38.2	3,320.6	0.0	105.2	0.0	0.0	7.0	0.0	7.0
28	20	3.0	31.2	3,313.5	0.0	113.3	0.0	0.0	7.0	0.0	7.0
29	21	3.0	31.2	3,738.5	0.0	111.3	0.0	0.0	7.0	0.0	7.0
30	22	3.0	31.2	3,534.2	0.0	112.3	0.0	0.0	6.0	0.0	6.0
31	23	7.0	32.2	3,827.6	0.0	33.2	0.0	0.0	6.0	0.0	6.0
32	24	6.0	32.2	2,835.7	0.0	83.7	0.0	0.0	6.0	0.0	6.0
33	25	6.0	33.2	1,313.2	0.0	68.1	0.0	0.0	6.0	0.0	6.0
34	26	5.7	38.7	2,258.3	0.0	78.3	0.0	0.0	8.2	0.0	8.2
35	27	0.0	31.2	3,523.3	0.0	107.3	0.0	0.0	11.0	0.0	11.0
36	28	0.0	31.6	3,286.0	0.0	113.3	0.0	0.0	11.0	0.0	11.0
37	29	7.3	83.0	3,788.6	0.0	111.4	0.0	0.0	10.4	0.0	10.4
38	30	0.0	83.2	3,311.5	0.0	112.3	0.0	0.0	5.0	0.0	5.0
39	31	0.0	38.2	3,551.4	0.0	112.3	0.0	0.0	0.0	0.0	0.0
40	COB Totals	243.5	2,238.4	88,448.1	0.0	2,633.6	0.0	0.0	243.3	0.0	
41	Total	243.5	2,238.4	88,448.1	0.0	2,633.6	0.0	0.0	243.3	0.0	
42	Average	3.6	138.1	8,252.4	66,325.3	2,676.3			7.3		7.07
43	Maximum	17.0	2,653.0	127,281.3	66,325.3	66,325.3			11.0		11
44	Minimum	3.2	83.0	1,313.2	66,325.3	68.1			4.8		4

System Layout



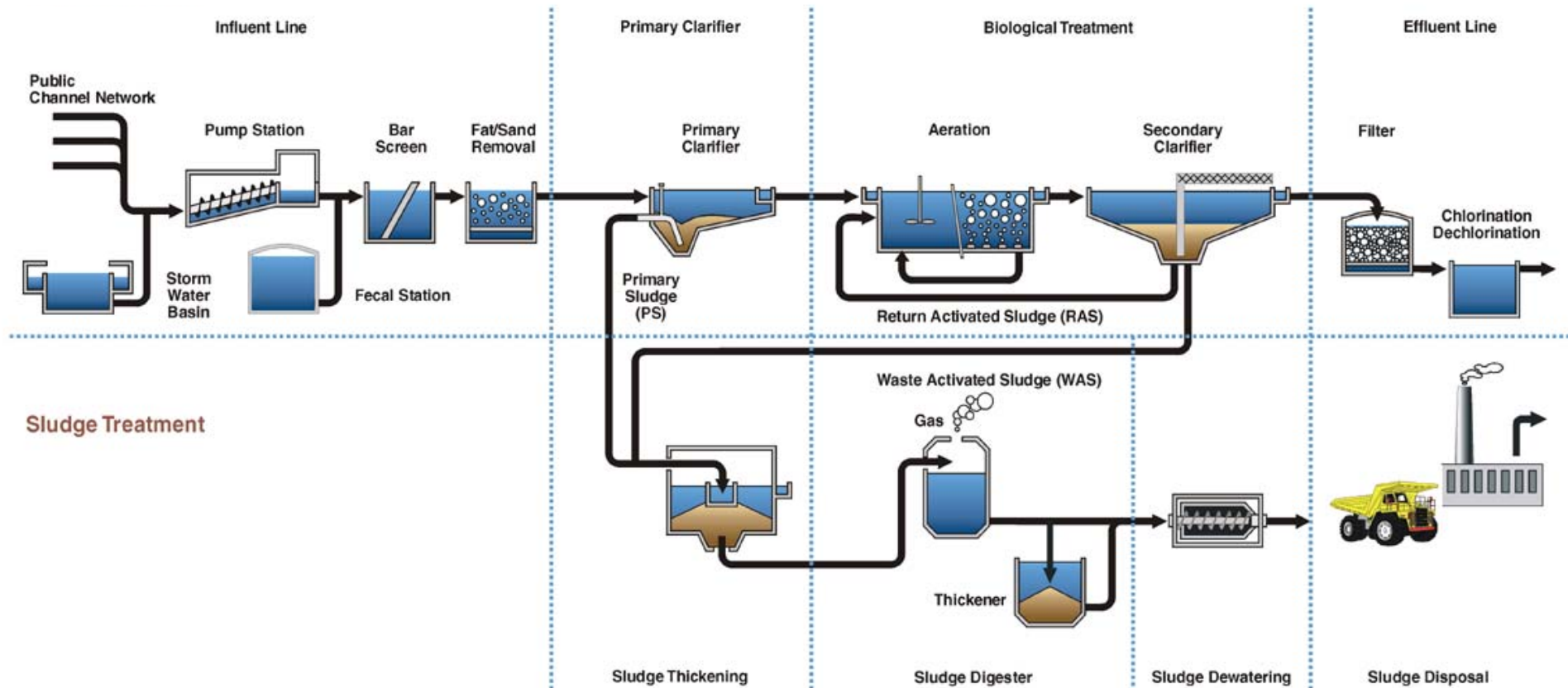
RTU COMMUNICATIONS



REP R.E. Pedrotti Co.

Wastewater Treatment Plant Overview

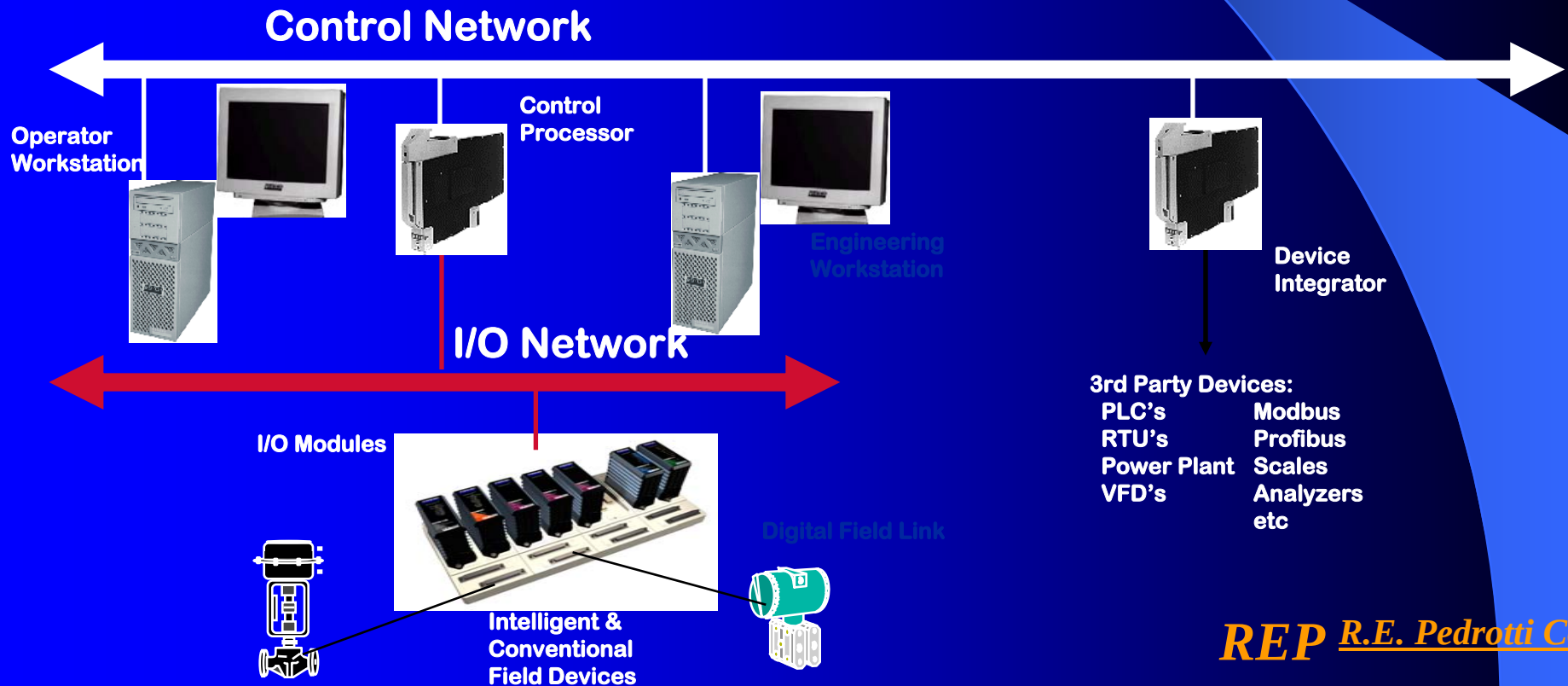
Wastewater Treatment



Desired Control & Status

- Start/Stop Pump Control & Status
- Open/Close Valve Control & Status
- Flow Monitoring
- Wetwell Level
- Discharge/Suction Pressure
- VFD Speed Control & Status
- Intrusion Alarm

Today's SCADA System



REP R.E. Pedrotti Co.

~~Tomorrow's~~ SCADA System

Today's

Information Network



Computers,
Workstations,
X-Terminals,
PC's etc



Control Network

Operator
Workstation



Control
Processor



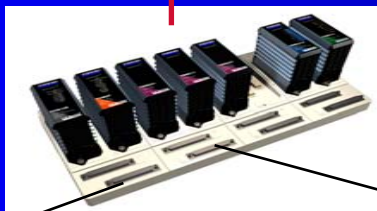
Engineering
Workstation



Device
Integrator

I/O Network

I/O Modules



Intelligent &
Conventional
Field Devices

Digital Field Link



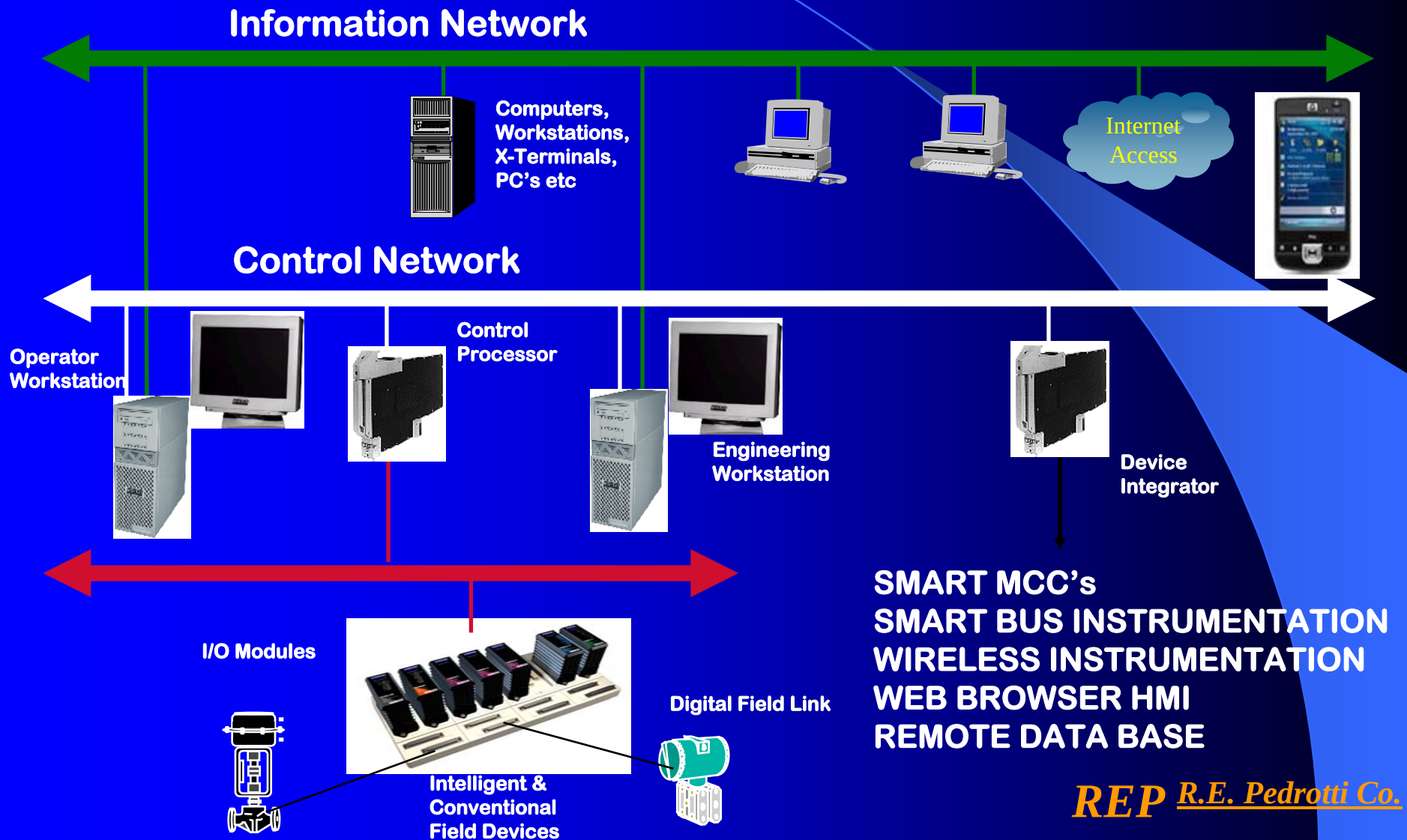
3rd Party Devices:

PLC's
RTU's
Power Plant
VFD's

Modbus
Profibus
Scales
Analyzers
etc

REP R.E. Pedrotti Co.

Tomorrow's SCADA System



Remote Access

- Dial-up
- Internet
- Cellular Modems
- Cell Phone
- Remote Monitoring and Control
- Real-time customer usage

Smart Devices for Energy Efficiency

- VFD's
- MCC's
- Switchgear
- Monitor "Smart Grid"
- Smart Instrumentation and Analyzers
- Power Quality
- Power Management

Marc Pedrotti, PE

R.E. Pedrotti Company, Inc.

Mission, Kansas

(913) 677-3366

marcp@repedrotti.com

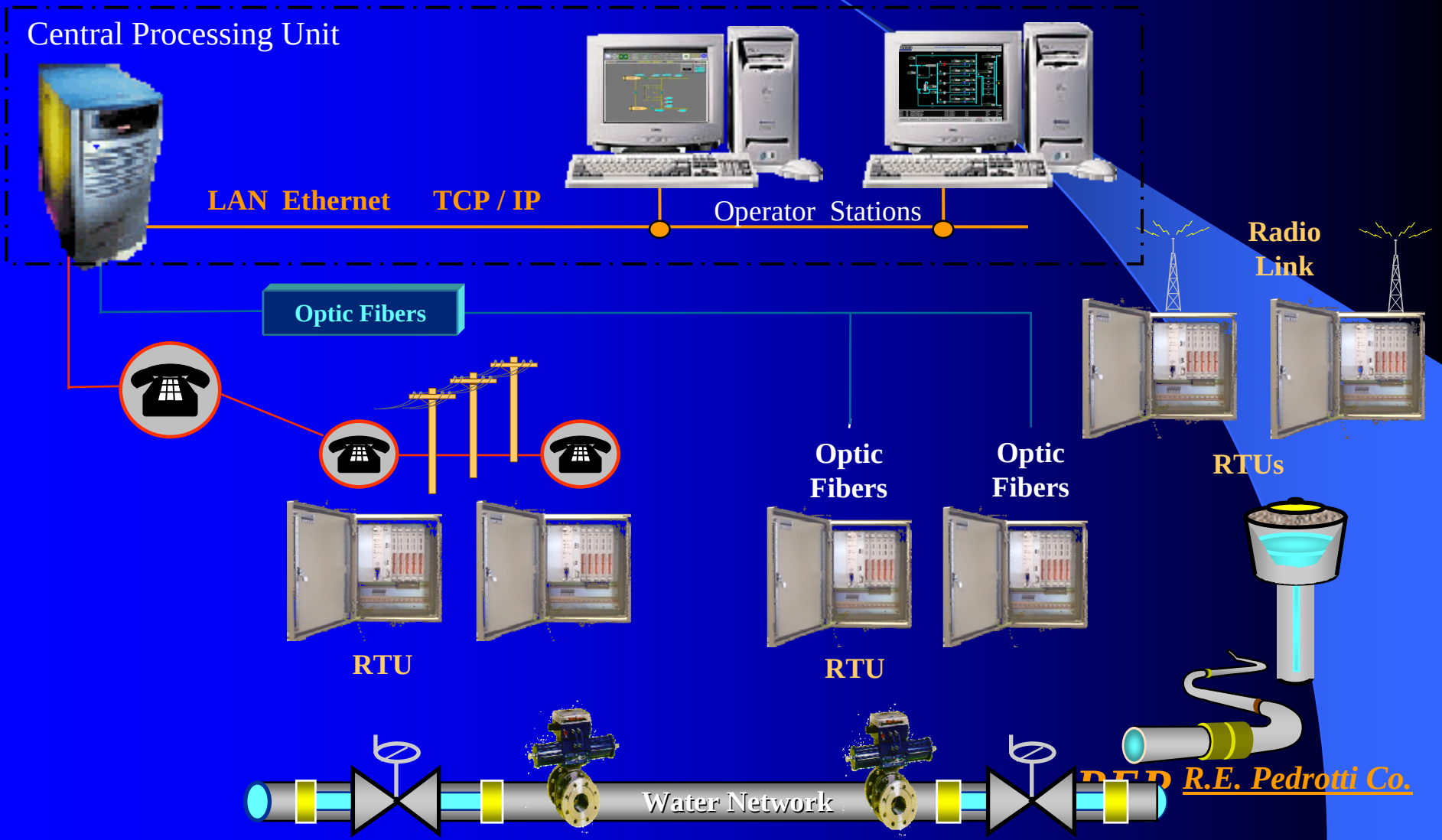
Overview

- Basics of SCADA
 - Understanding the Alphabet Soup
 - Integrating the Enterprise
- Managed Ethernet Networks
- Communication Methods
 - Radio VHF/UHF
 - Spread Spectrum and Ethernet Radios
 - Fiber Optic Communications
 - Cellular Communications
 - VoIP/RoIP Networking

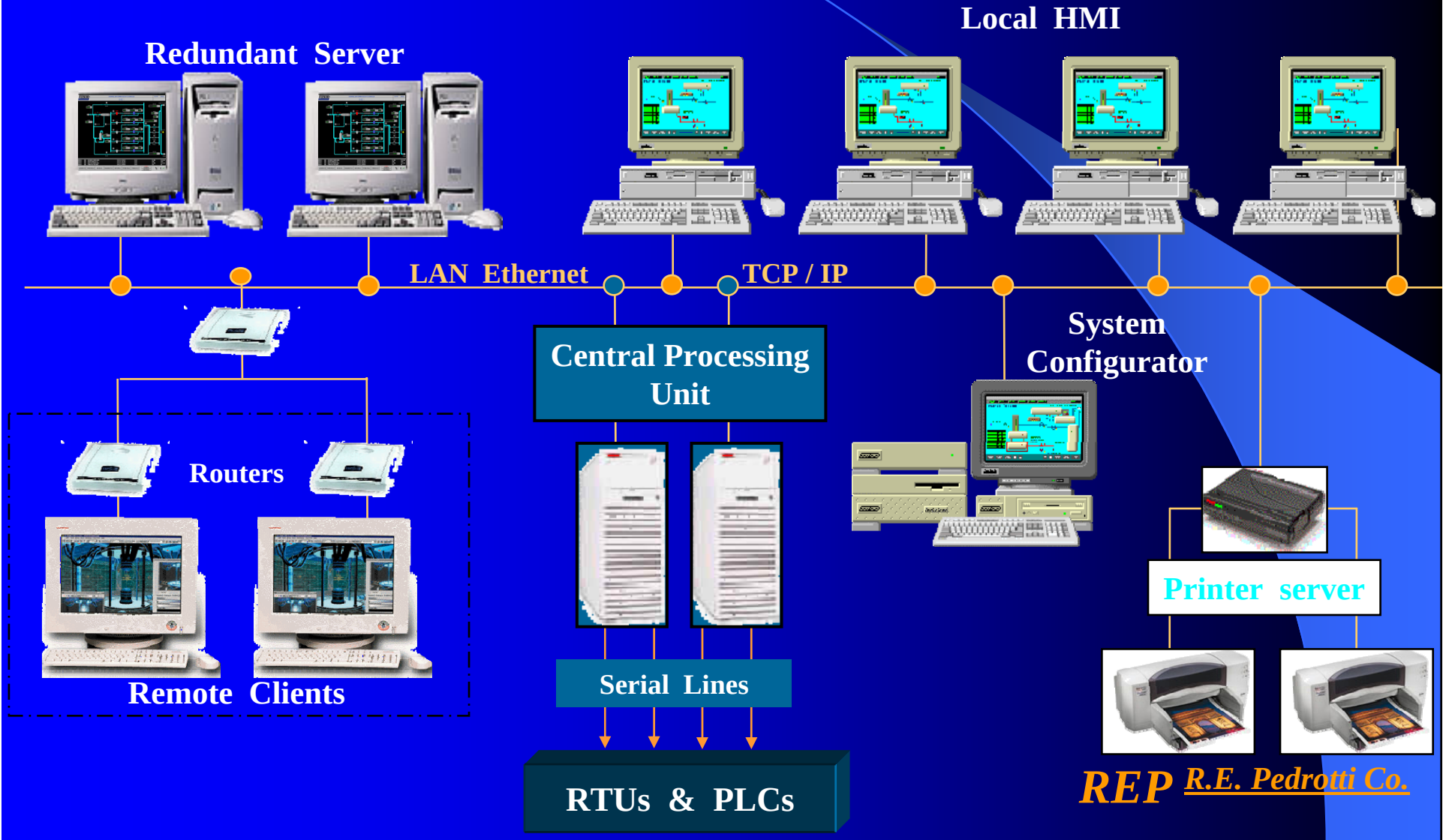
Future of SCADA

- Satellite Communication
- Infrared Communication
- Wireless Instrumentation
- Palm Pilot Interface

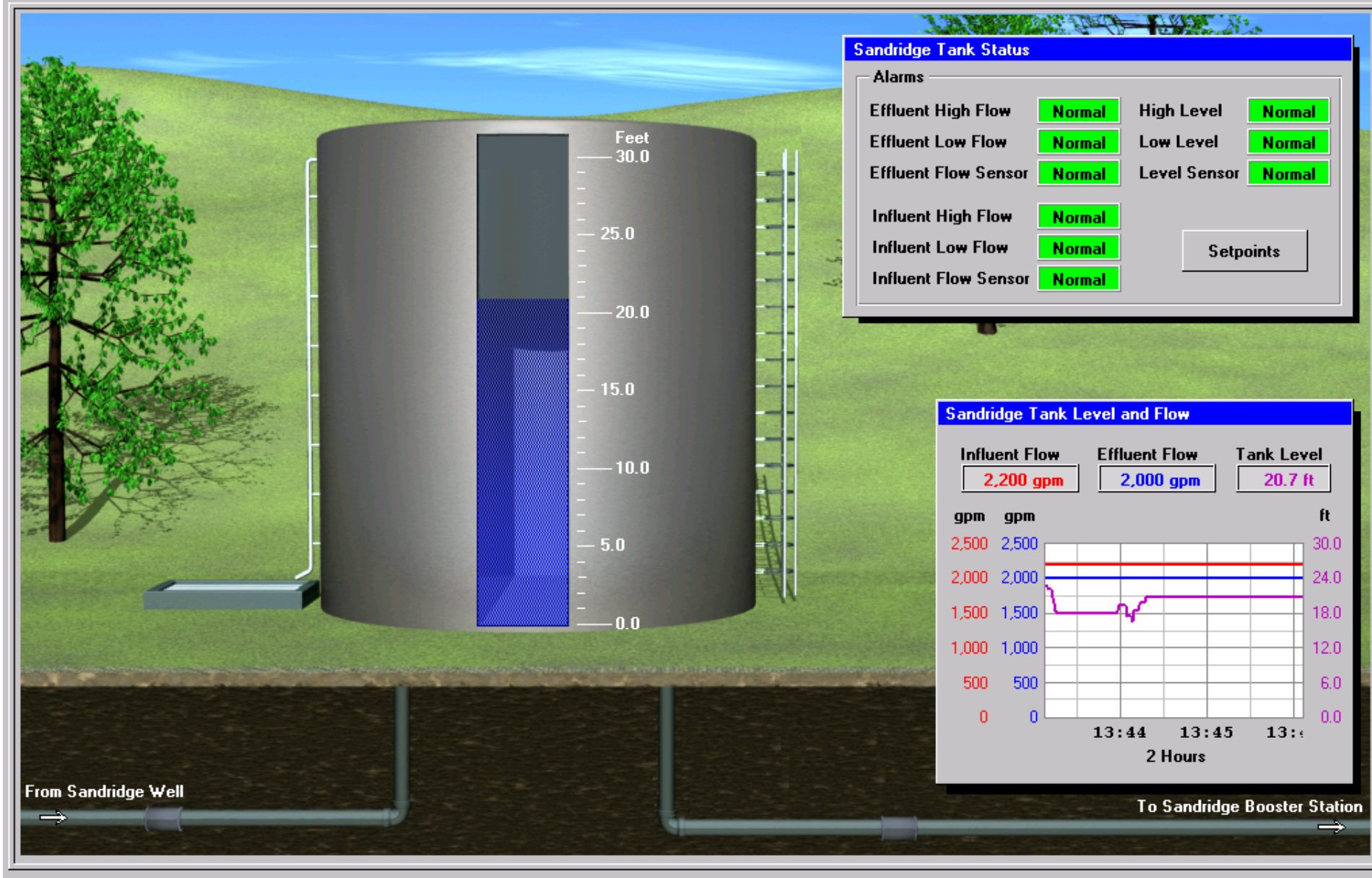
SIMPLE SCADA CONFIGURATION



MEDIUM SIZE SCADA MASTER STATION CONFIGURATION

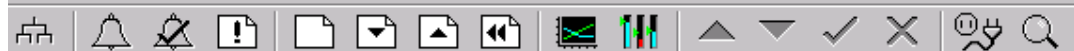


REP R.E. Pedrotti Co.



Station - default.stn - Blowers (305)

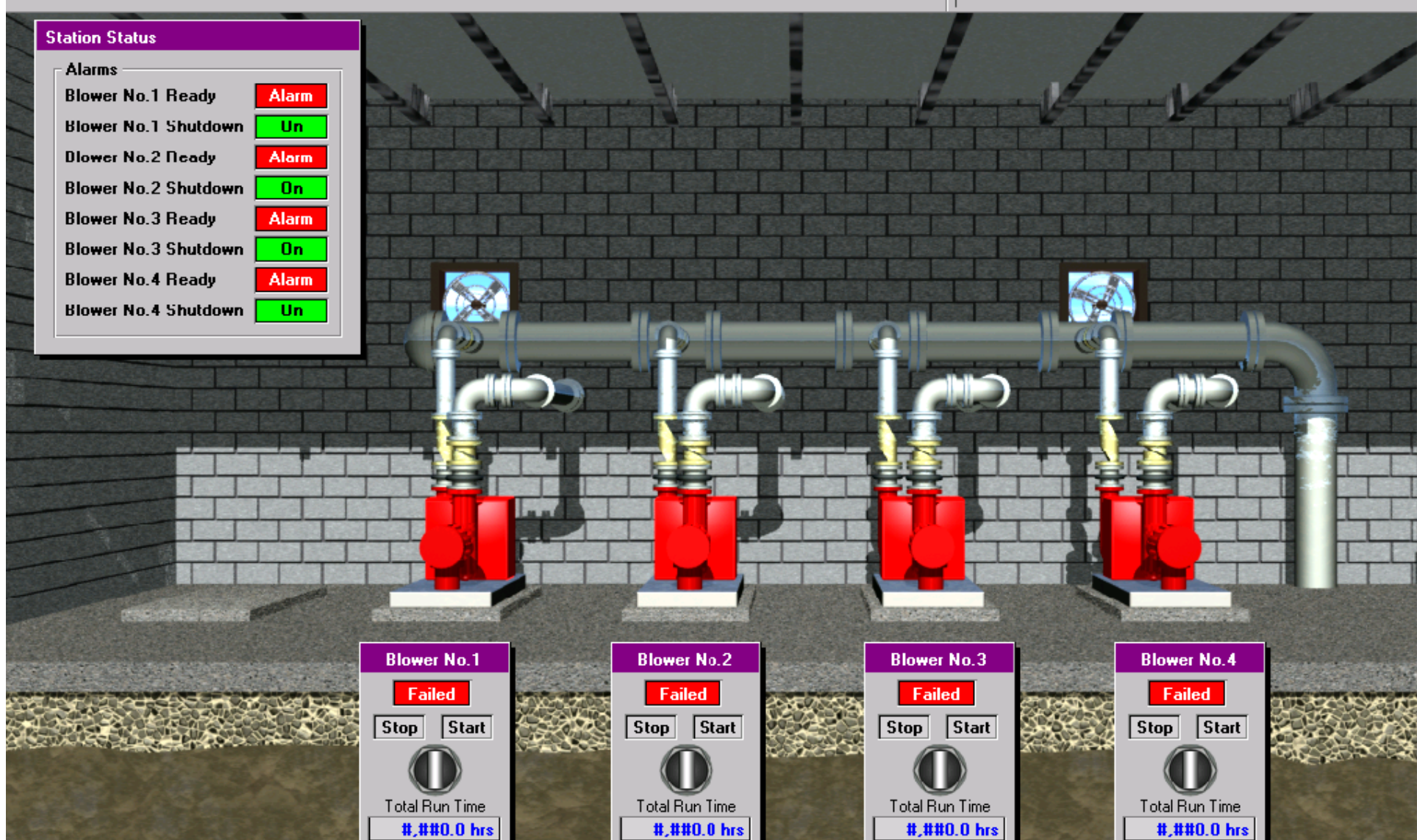
Station Edit Schematic View Control Action Configure Help



Station Status

Alarms

Blower No.1 Ready	Alarm
Blower No.1 Shutdown	Un
Blower No.2 Ready	Alarm
Blower No.2 Shutdown	On
Blower No.3 Ready	Alarm
Blower No.3 Shutdown	On
Blower No.4 Ready	Alarm
Blower No.4 Shutdown	Un



Blower No.1

Failed

Stop Start



Total Run Time

###0.0 hrs

Blower No.2

Failed

Stop Start



Total Run Time

###0.0 hrs

Blower No.3

Failed

Stop Start



Total Run Time

###0.0 hrs

Blower No.4

Failed

Stop Start



Total Run Time

###0.0 hrs

23-Mar-01 11:25:10

localhost

Stn01

Oper

Start

Station - default.stn - ...

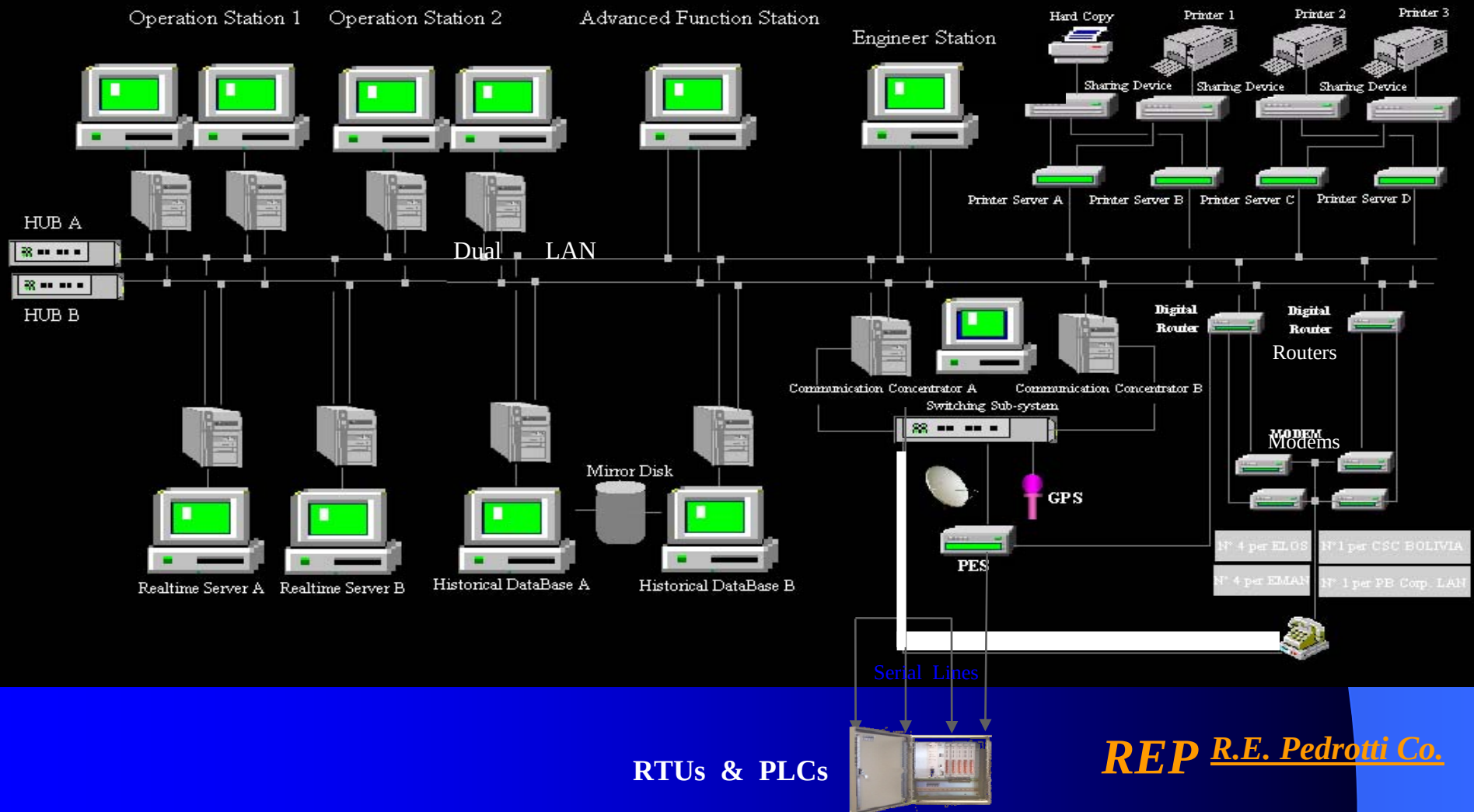
untitled - Paint

 11:25 AM

Graphical User Interface

- Overview
- Alarm
- Trends
- Alarm Dialer Software
- Maintenance Management Software

COMPLEX SCADA MASTER STATION CONFIGURATION



REP R.E. Pedrotti Co.