Optimization of an Aeration System at an Industrial Wastewater Treatment Plant

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Outline

- Reduce O&M costs and optimize
- Focus on aeration system
- Apply reliability engineering and common sense
- Examine air requirements, blowers, instruments and controls, etc
- Implement improvements
- Results
- Application to other WWTPs

Description of Treatment Plant

- Average flow: 1.44 MGD (1,000 GPM)
- Average influent BOD: 195 mg/l
- Average influent ammonia: 40 mg/l
- 4 aeration tanks, 2 zones each
- 3 centrifugal blowers, 300HP , 5,500 scfm each

Splitter Box, Equalization Tanks and Scrubber

Aeration Tank/Clarifier Unit

Clarifier Inside Aeration Tanks

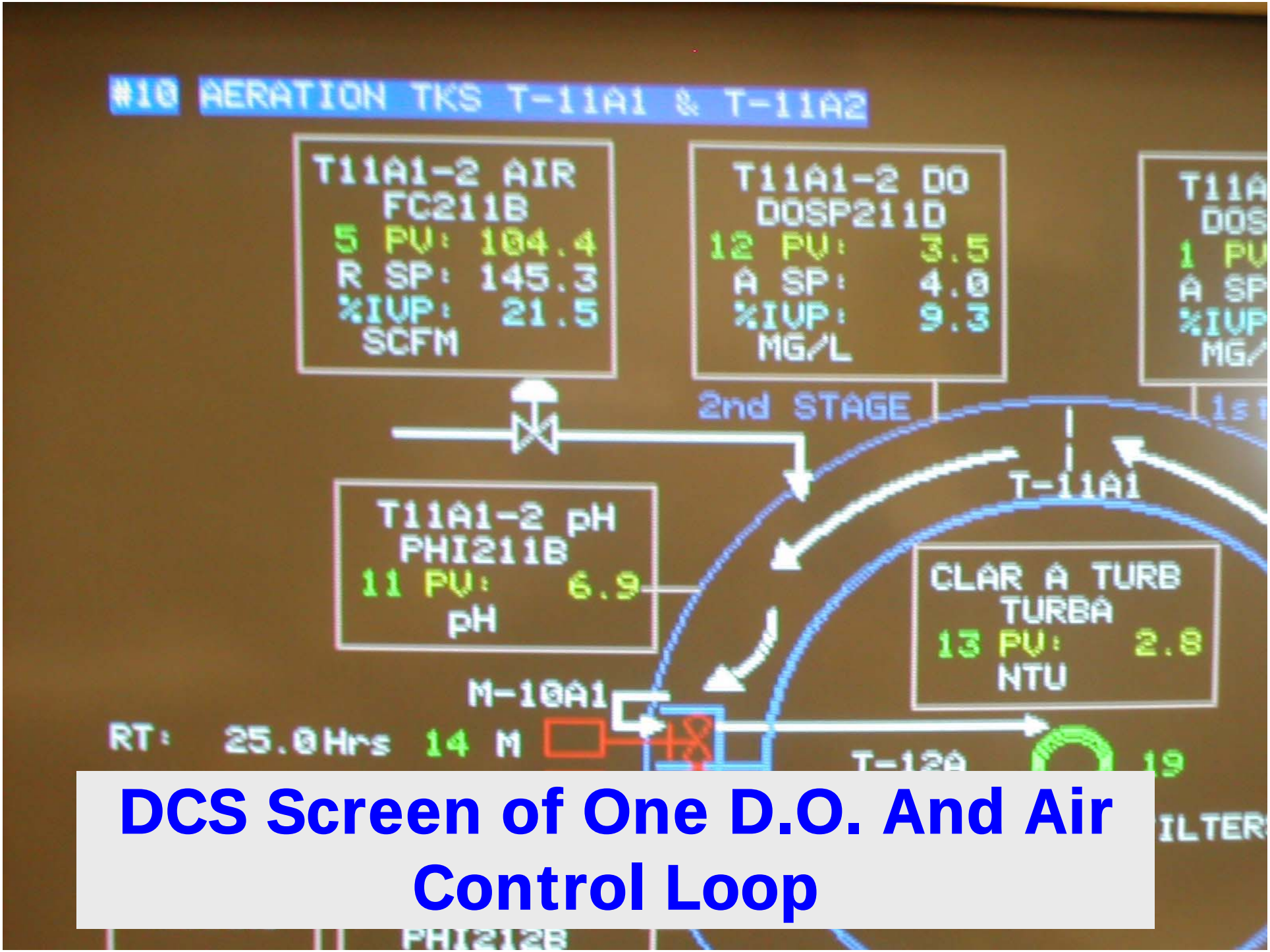

Effluent Sand Filters

300 HP Centrifugal Aeration Blower

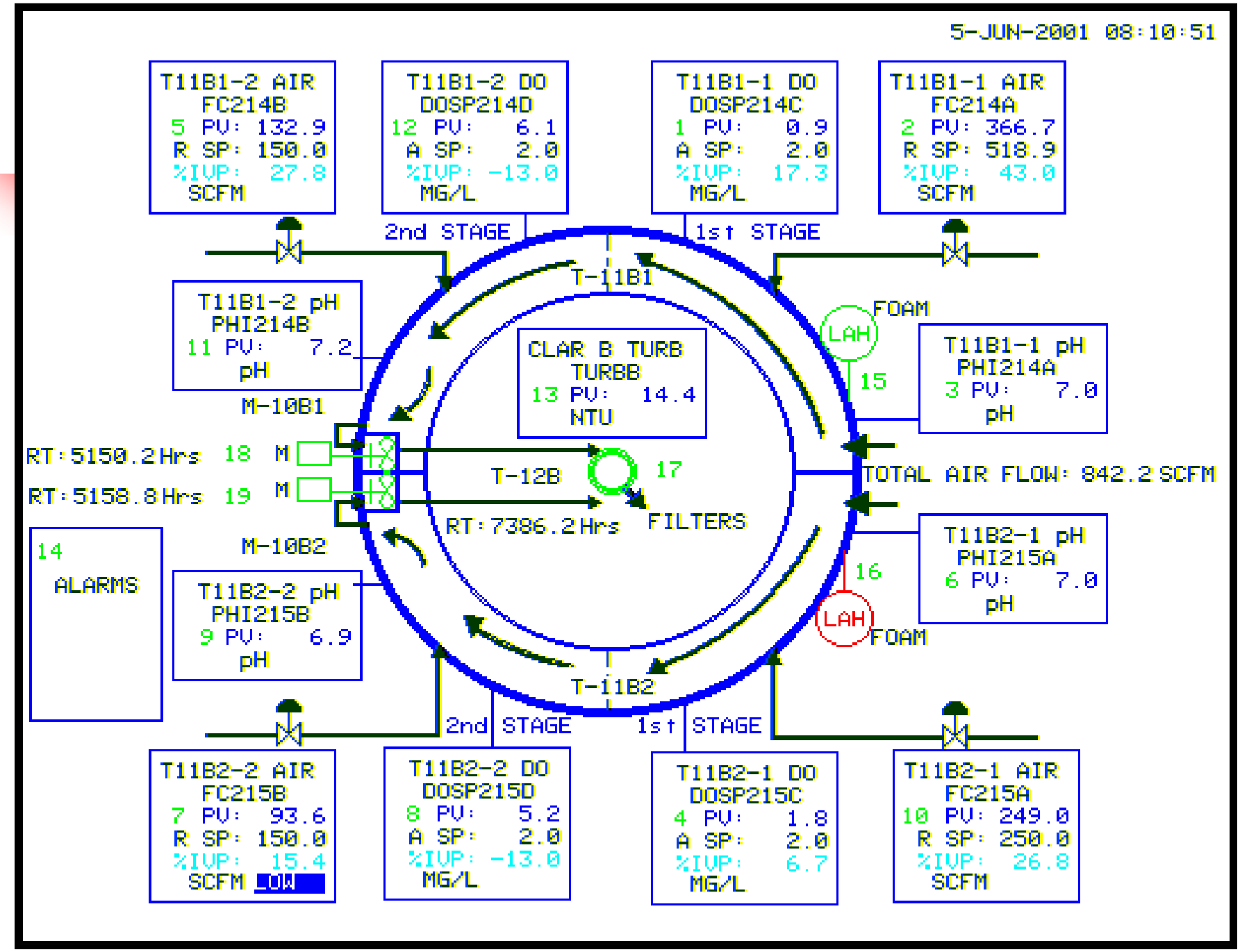

20” Diameter Fine Bubble
Diffuser With EPDM Cover

Mass Flow Meter

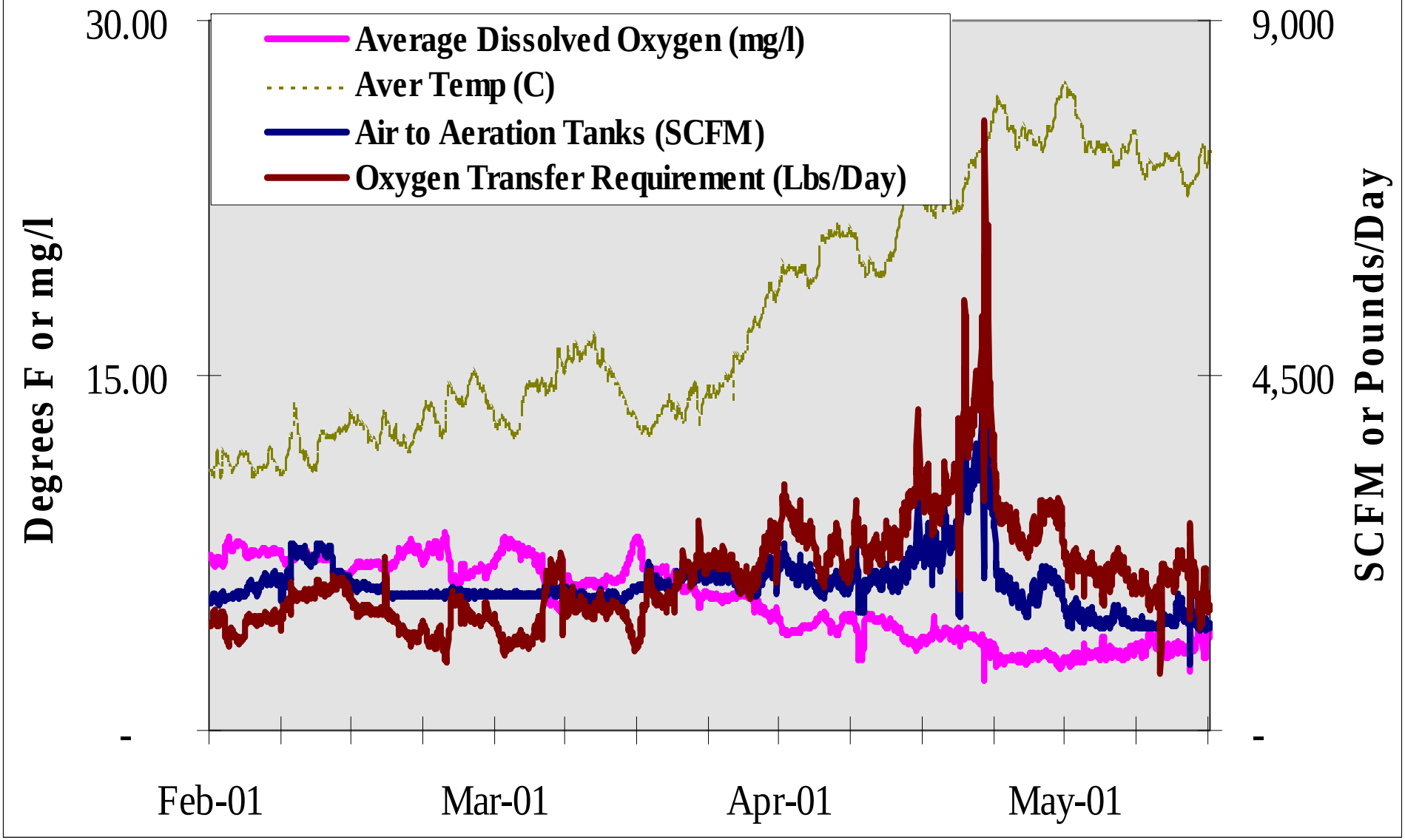
Main Instrument Panel and DCS Consoles in Control Room



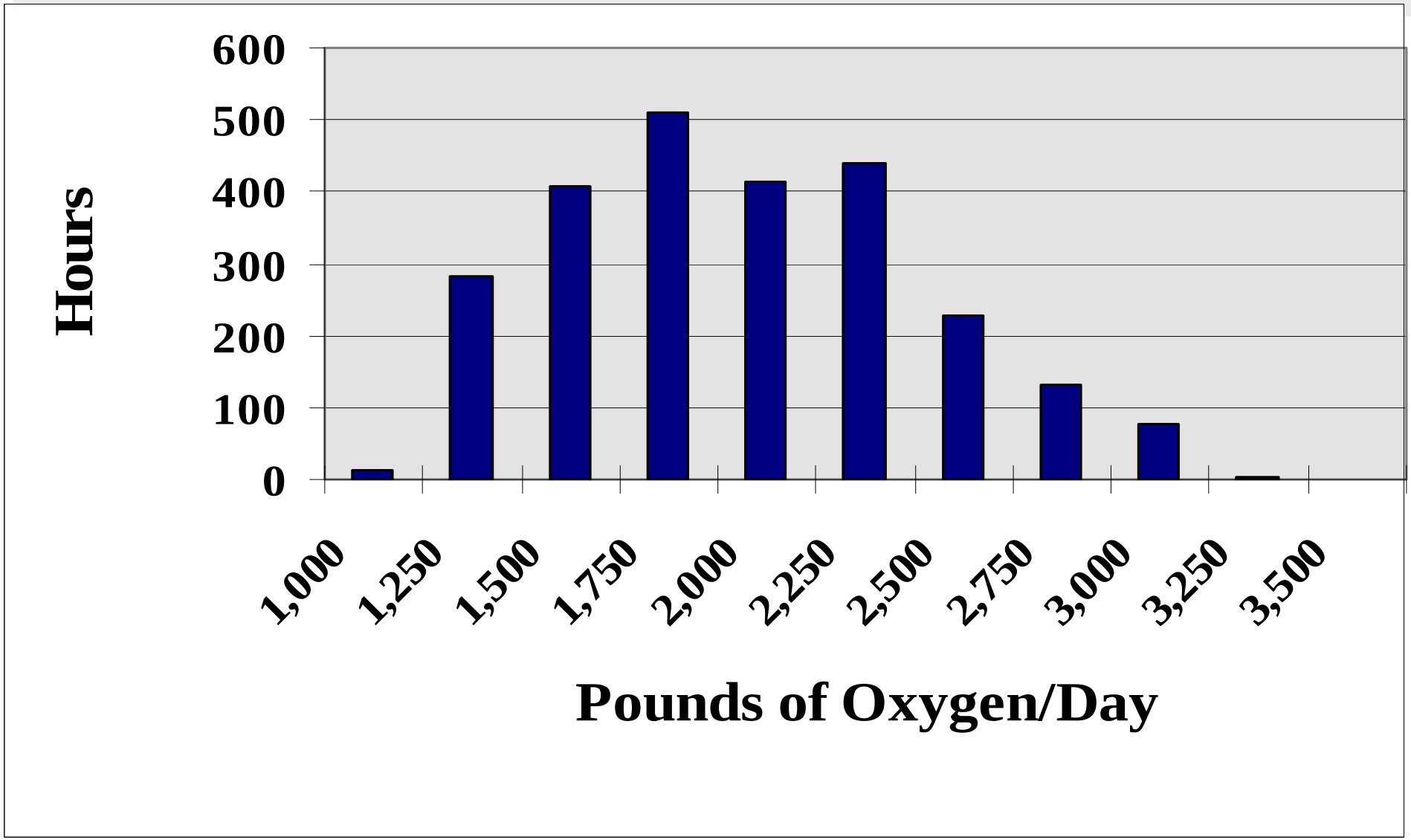
DCS Screen of One D.O. And Air Control Loop


5-JUN-2001 08:10:51
T11B1-2 AIR
FC214B
5 PV: 132.9
R SP: 150.0
%IVP: 27.8
SCFM
T11B1-2 DO
DOSP214D
12 PV: 6.1
A SP: 2.0
%IVP: -13.0
MG/L
T11B1-1 DO
DOSP214C
1 PV: 0.9
A SP: 2.0
%IVP: 17.3
MG/L
T11B1-1 AIR
FC214A
2 PV: 366.7
R SP: 518.9
%IVP: 43.0
SCFM
2nd STAGE
1st STAGE
T-11B1
T11B1-2 pH
PHI214B
11 PV: 7.2
pH
M-10B1
CLAR B TURB
TURBB
13 PV: 14.4
NTU
FOAM
LAH
15
T11B1-1 pH
PHI214A
3 PV: 7.0
pH
RT: 5150.2 Hrs 18 M
RT: 5158.8 Hrs 19 M
T-12B
17
RT: 7386.2 Hrs
FILTERS
TOTAL AIR FLOW: 842.2 SCFM
14
ALARMS
M-10B2
T11B2-2 pH
PHI215B
9 PV: 6.9
pH
16
LAH
FOAM
T11B2-1 pH
PHI215A
6 PV: 7.0
pH
T-11B2
2nd STAGE
1st STAGE
T11B2-2 AIR
FC215B
7 PV: 93.6
R SP: 150.0
%IVP: 15.4
SCFM LOW
T11B2-2 DO
DOSP215D
8 PV: 5.2
A SP: 2.0
%IVP: -13.0
MG/L
T11B2-1 DO
DOSP215C
4 PV: 1.8
A SP: 2.0
%IVP: 6.7
MG/L
T11B2-1 AIR
FC215A
10 PV: 249.0
R SP: 250.0
%IVP: 26.8
SCFM

Hourly Average Aeration System Performance
Data Collected Between Feb and June 2001



Histogram of Hourly Average Oxygen Transfer Data Collected Between Feb and June 2001

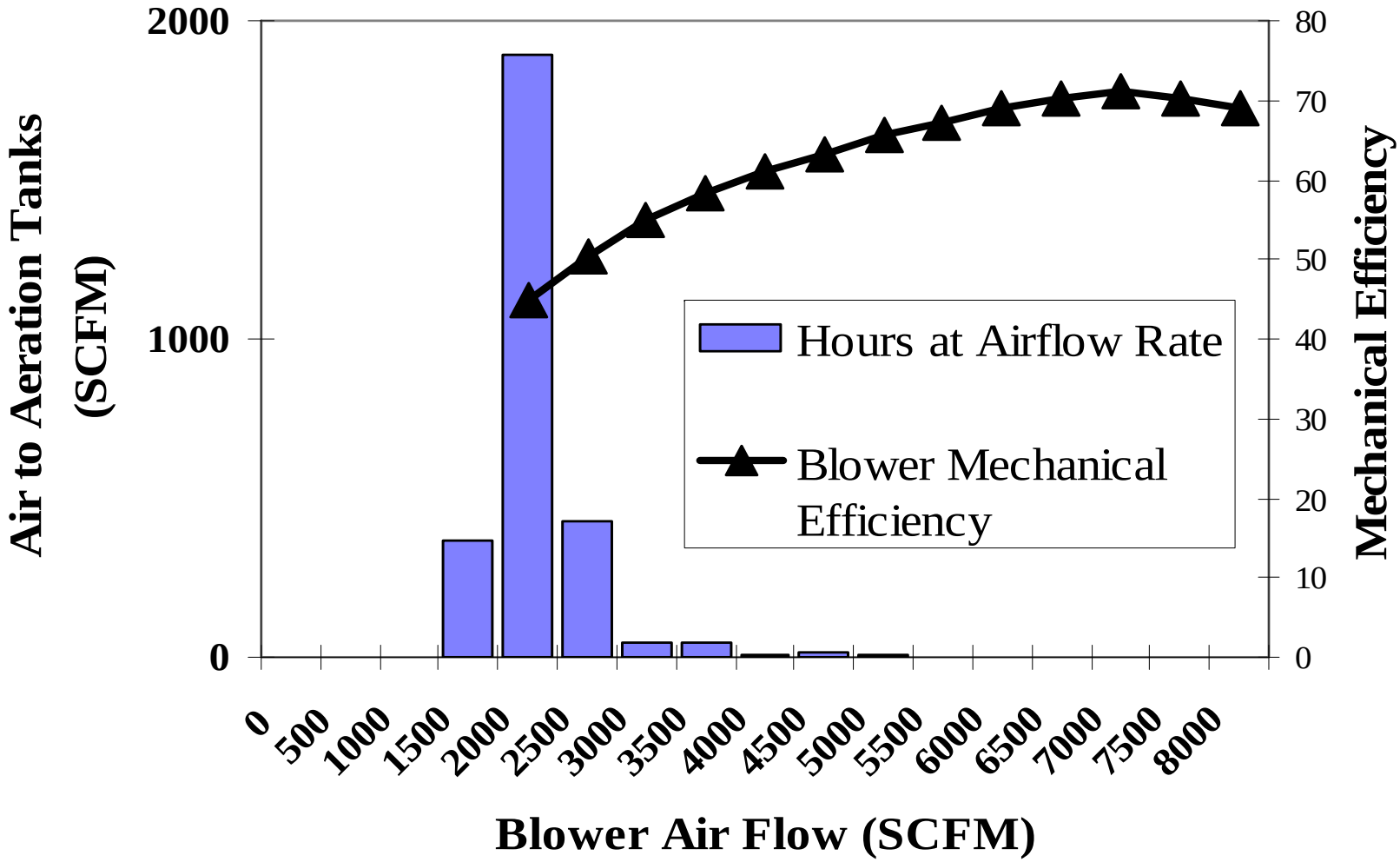


Calculated Air Requirements for Various WWTP Operating Conditions

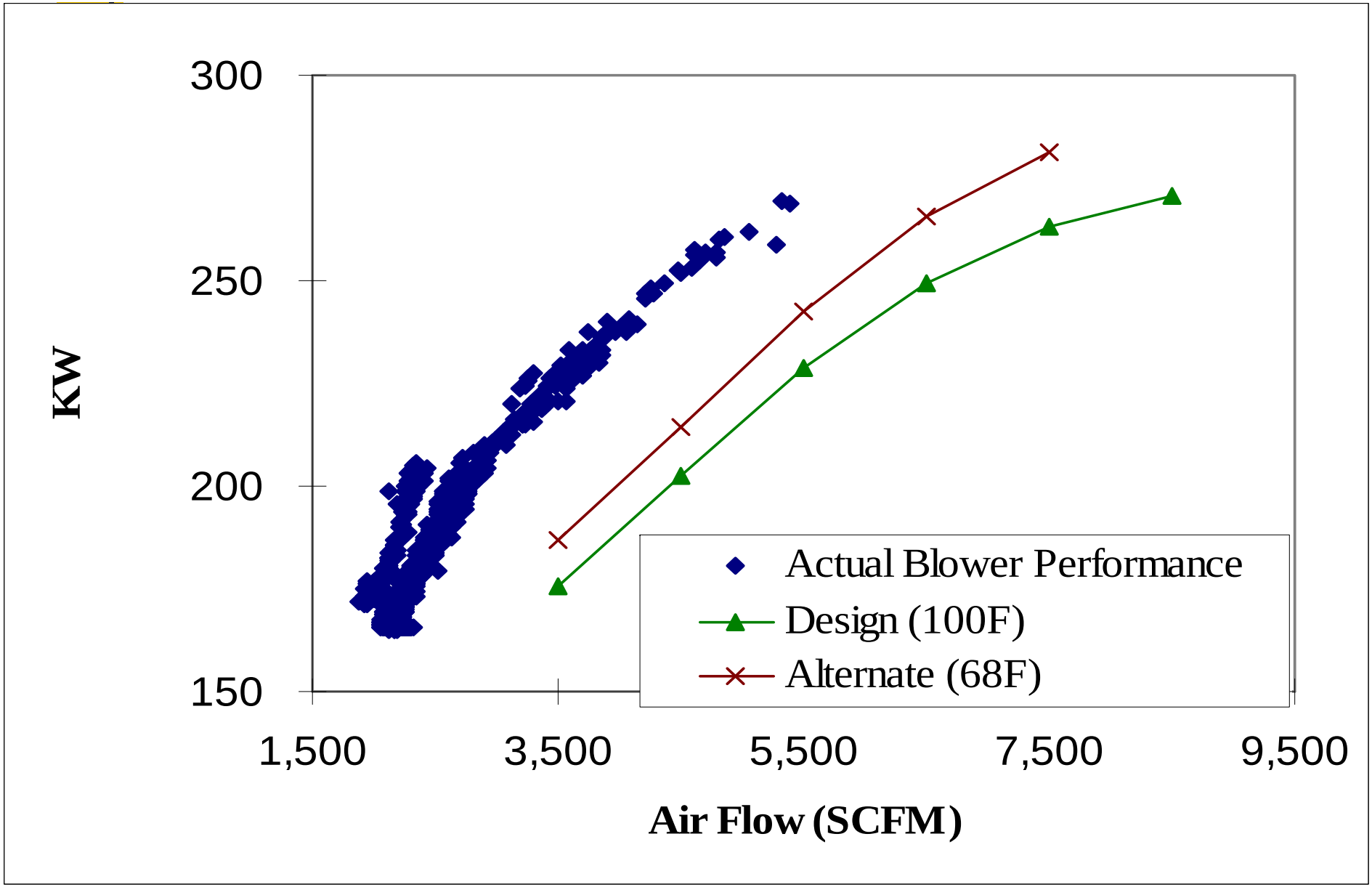
Temperature (C)		Target DO (mg/l)		OTR (#s/Day)		SCFM (Caculated)
30	Max	4	Max	1900	Average	1250
30	Max	4	Max	3200	Max	2105
12	Min	4	Max	1900	Average	1915
12	Min	4	Max	3200	Max	3225
30	Max	2	Optimal	1900	Average	866
30	Max	2	Optimal	3200	Max	1458
12	Min	2	Optimal	1900	Average	1327
12	Min	2	Optimal	3200	Max	2235
30	Max	0.5	Min	3200	Max	1183
12	Min	0.5	Min	1900	Average	1079
12	Min	0.5	Min	3200	Max	1817

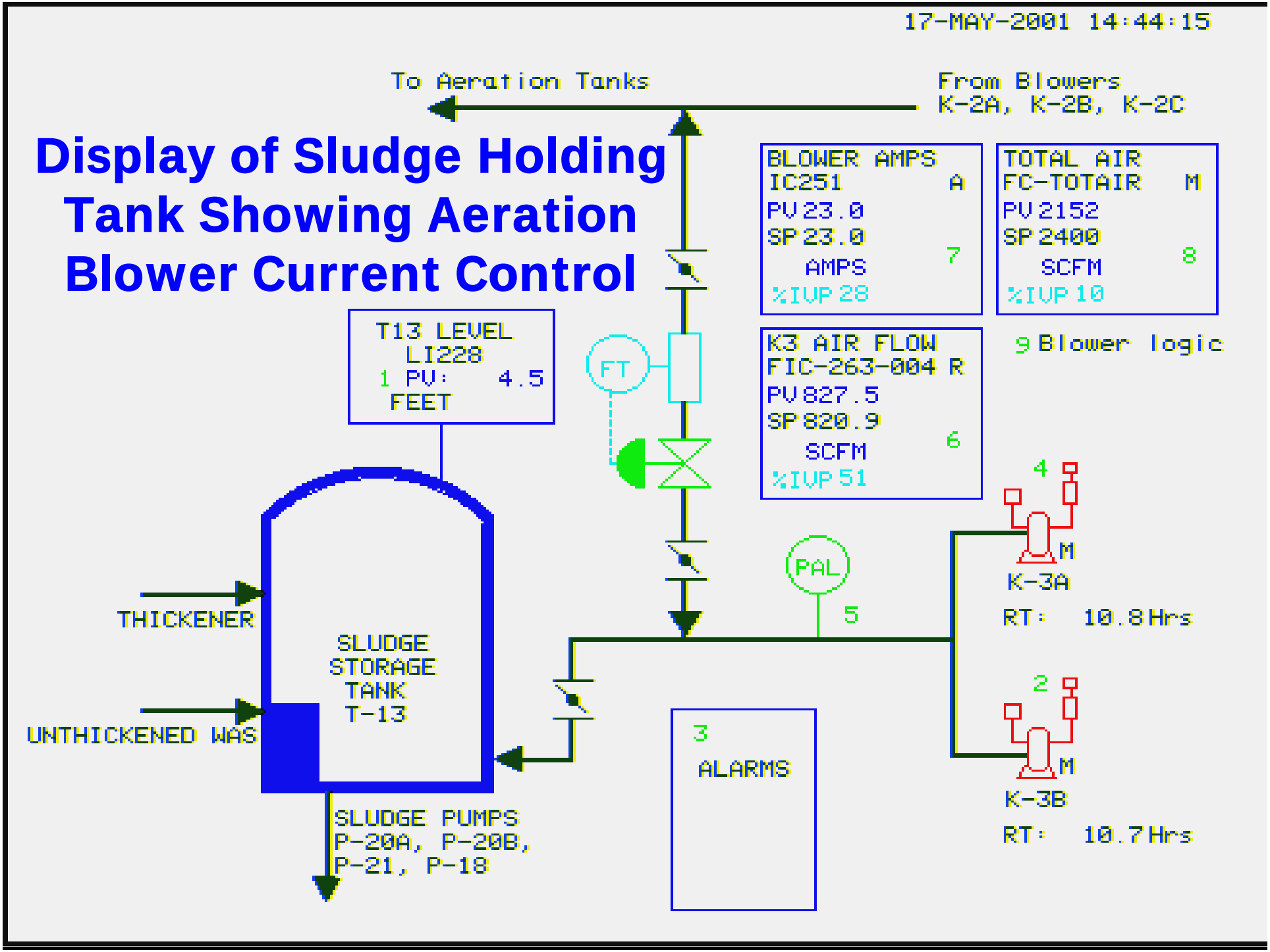
T (C)	DO (mg/l)	OTR (#s/Day)	SCFM
12	2	1900	1327

Mechanical Efficiency of 300 HP Blower and Histogram of Air Demand

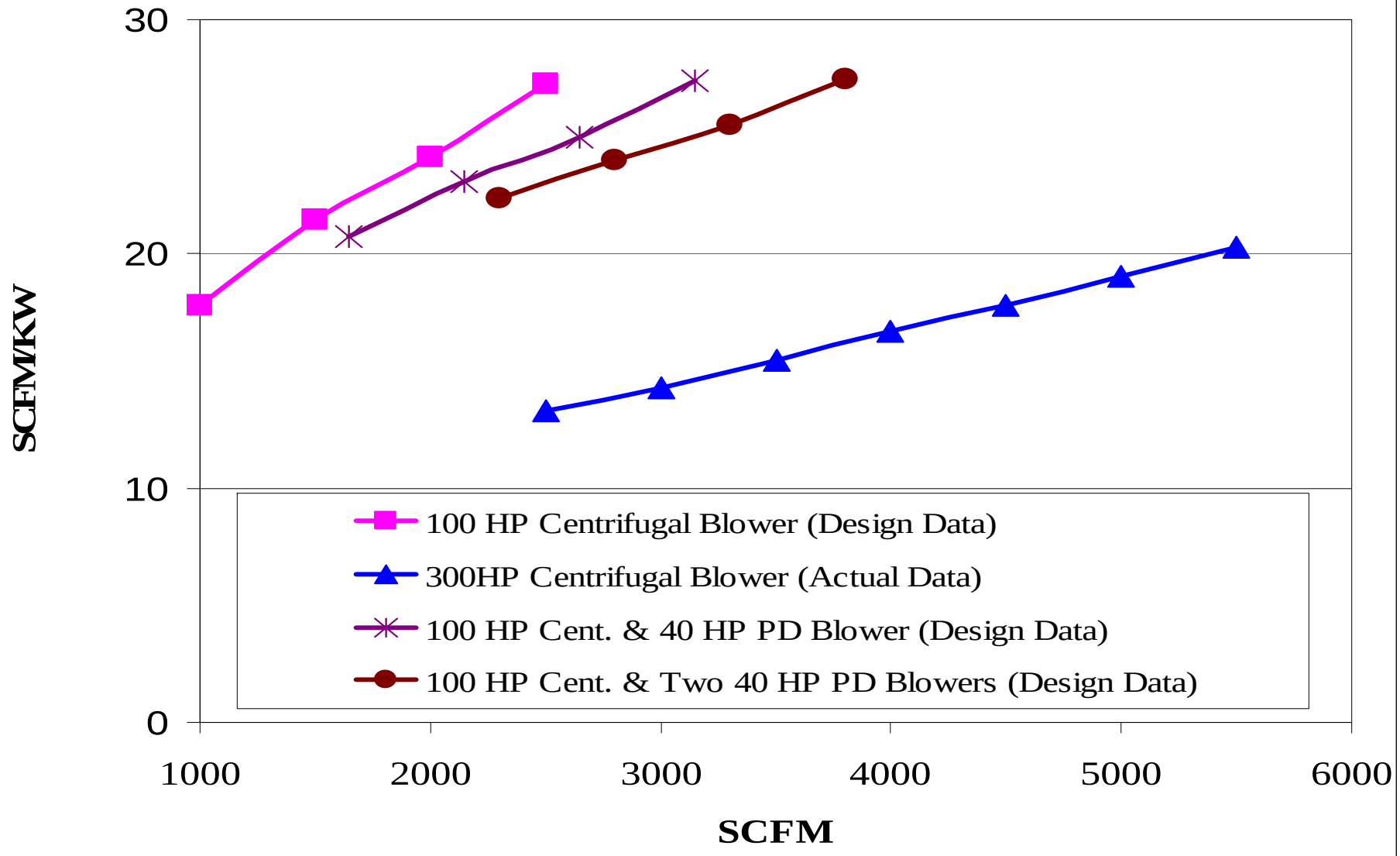


300 HP Centrifugal Blower Curves, Actual and Two Design Conditions (68F and 100F) – SCFM/KW

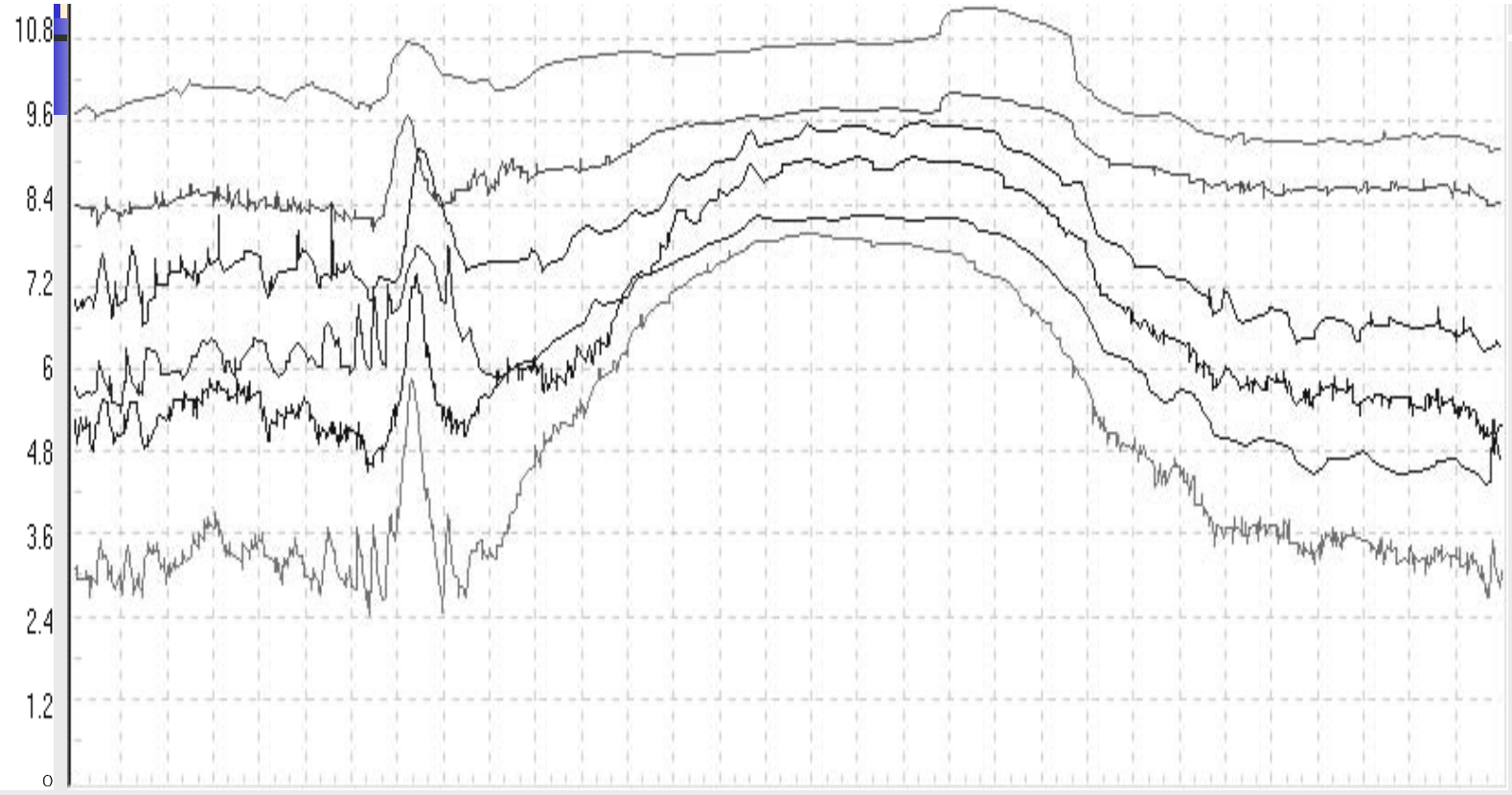



17-MAY-2001 14:44:15
To Aeration Tanks
From Blowers
K-2A, K-2B, K-2C
Display of Sludge Holding Tank Showing Aeration Blower Current Control
BLOWER AMPS
IC251 A
PV 23.0
SP 23.0
AMPS
7
%IVP 28
TOTAL AIR
FC-TOTAIR M
PV 2152
SP 2400
SCFM
8
%IVP 10
T13 LEVEL
LI228
1 PV: 4.5
FEET
FT
K3 AIR FLOW
FIC-263-004 R
PV 827.5
SP 820.9
SCFM
6
%IVP 51
9 Blower logic
PAL
5
4
M
K-3A
RT: 10.8 Hrs
2
M
K-3B
RT: 10.7 Hrs
THICKENER
UNTHICKENED WAS
SLUDGE STORAGE TANK T-13
SLUDGE PUMPS P-20A, P-20B, P-21, P-18
3
ALARMS

Operational Scenarios Possible With One 100 HP Blower, Two 40 HP Blowers, and One 300 HP Blower (Air Flow/KW)



Dissolved Oxygen (Mg/l) Versus Time Demonstrating Inhibitory Substance Elevating Dissolved Oxygen Levels (Screen Print From Data Acquisition System)



Name	Serve	Descripti	Value	Statu	Plot Mi	Plot Ma	Aggregat	Eng. Uni	Map
DOSP211C.PV	ip21cru	T11A1-1 DO	8.42975	Good	0	12		GALS	IP_ANALO...
DOSP211D.PV	ip21cru	T11A1-2 DO	9.19053	Good	0	12		GALS	IP_ANALO...
DOSP214C.PV	ip21cru	T11B1-1 DO	5.1572	Good	0	12		GALS	IP_ANALO...
DOSP214D.PV	ip21cru	T11B1-2 DO	6.33259	Good	0	12		GALS	IP_ANALO...
DOSP215C.PV	ip21cru	T11B2-1 DO	3.00939	Good	0	12		GALS	IP_ANALO...
DOSP215D.PV	ip21cru	T11B2-2 DO	4.66108	Good	0	12		GALS	IP_ANALO...

Results of Project

- Reduced Operating and Maintenance Costs
- Control Room Alarms reduced by 90%
- Improved staff response to Alarms
- Improved Operator Attitudes
- More stable and responsive operation
- Real time window into the biological process

Conclusions

- Better On-Line Data Acquisition allows for discovery of Optimization Opportunities
- Traditionally Engineered Aeration Systems may be Inefficient, only actual Operating Data reveals actual System Performance
- Dissimilar sized equipment (blowers, pumps, etc.) may allow more efficient operation
- Improve your knowledge and data concerning your process and you will reduce total cost

What should you do?

- Consider plant design efficiency at normal operating conditions.
- Establish accurate DO, Airflow and Blower current measurement programs.
- Evaluate data to relate system/blower performance at normal turndown to process needs.

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