

“PROCESS OPTIMIZATION VIA AUTOMATED DATA CAPTURE & INTERPRETATION”

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The Rhythm of Nature

- ▣ “Make everything as simple as possible,
but not simpler”

- ▣ *-Albert Einstein*

The Rhythm of Nature



THE RHYTHM OF NATURE



“Duplication of Natural Processes”



“Duplication of Natural Processes”



“Duplication of Natural Processes”



- ▣ Because of the dynamic nature of many animal habitats and water treatment systems and the need for improved reliability and quality, a higher degree of precision is required in the monitoring and control of water treatment programs than that obtained through manual monitoring.
- ▣ To achieve the degree of precision needed, continuous on-line monitoring with automatic instrumentation is required

“ Process Control”

S.C.A.D.A.

Supervisory Control

- Giving an operator the ability to control processes and equipment without having to run out in the field and do everything manually.*

Data Acquisition

- Collecting process information from all over your plant, displaying it, and storing it for future reference.*

Historical Data Logging

Date _____	Operator _____	Shift _____				
	time	time	time	time		
LIVING SEAS						
Main Tank Level						
Manatee Pool Level						
Iso Pool Level						
Large Animal Holding Level						
Basin 1 Level						
Basin 2 Level						
Basin 3 Level						
B2 Turbidity NTU						
B2 ORP mV						
ATI ORP mV						
ATE ORP mV East / West	/	/	/	/		
M.T. Skimmer ORP mV						
Thio pumps spm East / West	/	/	/	/		
3 rd fl ATE ORP mV East / West	/	/	/	/		
3 rd fl Skimmer ORP mV						
O ₂ Basin 2 - in R or L						
% on line						
psi / flow	/	/	/	/		
O ₂ M (Main Line) - in R or L						
% on line						
psi / flow	/	/	/	/		
O ₂ M (Main Line) - in R or L						
% on line						
psi / flow	/	/	/	/		
NL & B2 Air Seps w/in parameters?						
O ₂ Gens - ML & B2 CW temp						
Jelly Fish Temperature						
	time	time	comments			
LIVING SEAS						
Main Tank temp			Once per shift check Temp by hand.			
Isolation Tank temp						
Large Animal Hold temp			Main Tank			
Large Animal Hold UV status			Large Animal			
Manatee pumps 11-18 psi			Iso Pool			
Manatee flow - gpm			Jelly Fish Exhibit			
Filter 11A			Mr. Ray's Lagoon	N / S		
Filter 11B				/		
Filter 12						
Seas Research Tanks- 3 rd Floor						
Pump PSI (~ 8)	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6
Temperature (22.0 to 26.0 C)	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6
Air Supply (OK or NOK)	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6

The Seas Automation Center

Main Tank Level		26.20
Manatee Tank Level	<div><div>64%</div></div>	12.85
Isolation Tank Level	<div><div>3%</div></div>	6.71
Large Animal Pool Level		4.62
Denite Basin 1 Level	<div><div>0%</div></div>	14.15
Basin 2 Level	3.48	Basin 3 Level 4.97
F12 Sump Level	2.0	F12 Basin Level 7.1
BW Basin Level	2.9	Salinity 1.2
B2 Turbidity	0.1030	B2 ORP 660.2
A T I ORP	534.4	A T E W 379.9 E 414.2
Main Tank Skimmer ORP		259.16

Main Aquarium Flow		2,892	
Main Aquarium Temperature		26.82 °C	
Isolation Tank Temperature		26.13 °C	
Large Animal Pool Temperature		26.13 °C	
Jelly Fish Tank Temperature		15.60 °C	
B2 03	PSU Disabled	M2 03	PSU Disabled
M1 03	PSU Disabled	D1 03	PSU Disabled
Denite Recirculation System		Off Line	
Denite Filtration System		Off Line	

Information Control Center



Rory Harvick Logged in at AK AS1

Thomas Nicodemo Logged in at Living Seas



Queue 0- 0- 0- 0- 0- 0- 0- 0- 0- 0

BW Timer 0

BW Delay **0** Restart ML Ozone System ???

Filter 1	-0.01	Manual
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Filter 2 10.31 Auto F Start BW

Filter 3	0.43	Manual
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Filter 4 -0.39 **Manual**

Filter 5 0.13 **Manual**

Filter 6 0.01 **Manual**

Filter 7 0.00 **Manual**

Filter 8 -0.02 **Manual**

Filter 9	0.35	Manual
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Filter10 0.01 **Manual**

Filter11 -0.19 **Manual**

Filter12 0.37 **Manual**

Filter 12 Selector switch in manual

“ Process Control”

What's going on in the computer?

- ▣ Sends information requests to the PLC and processes the results
- ▣ Compares values to defined alarm conditions, and announces them if appropriate
- ▣ Historically logs the values (time or trigger based)

“ Process Control”

What's going on in the computer?

- ▣ Displays the process information graphically
- ▣ Operator/event controls send new values out to PLC
- ▣ Generate reports (time or trigger based)
- ▣ Makes all data available to networked clients

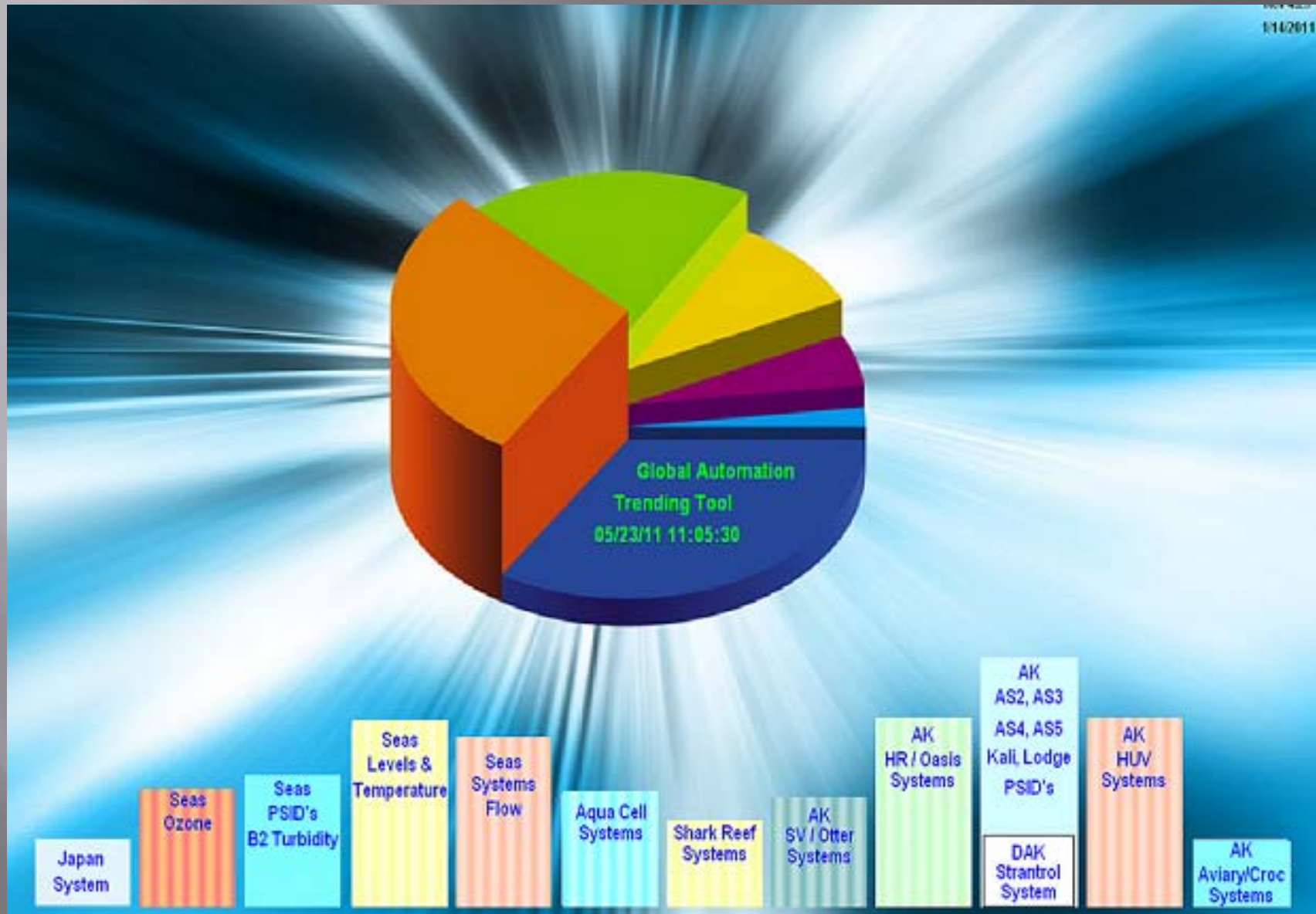
“ Process Control”

Now, we have our data...what can we do with it?

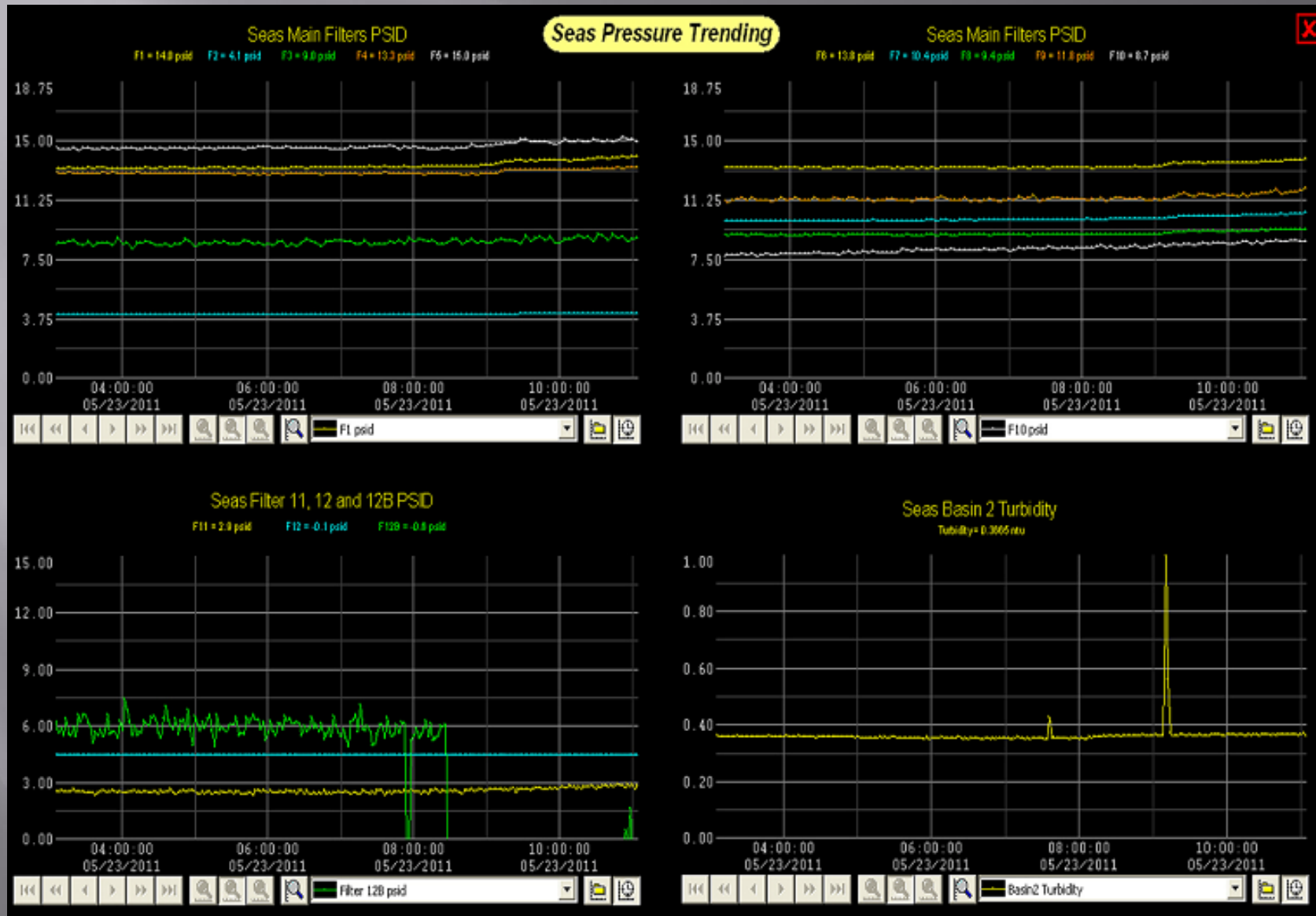
- ▣ Create meaningful displays for the operators
- ▣ Refine methods of control
- ▣ Historical data logging and trending including statistical analysis



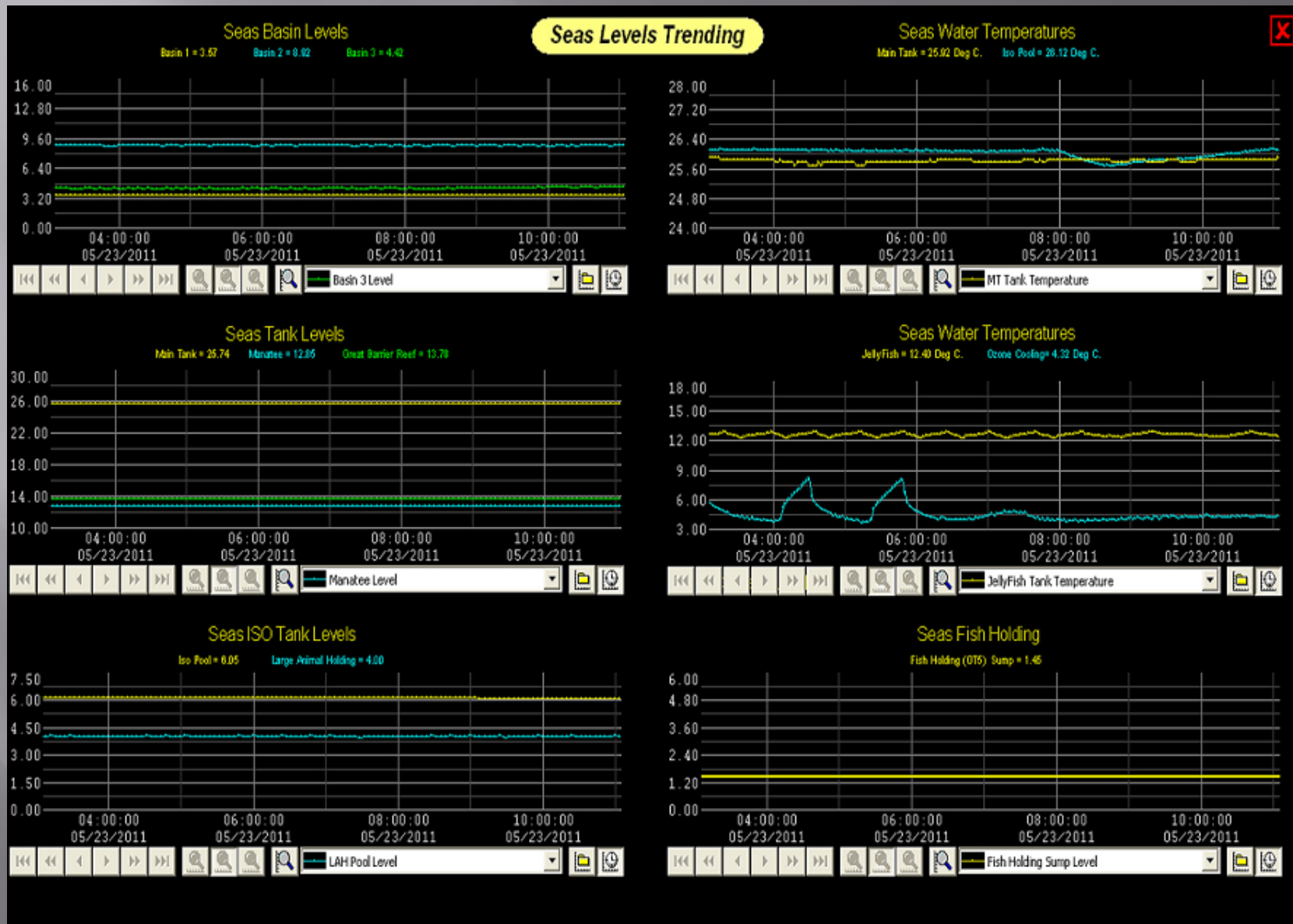
“Process Control”



“Process Control”



"Process Control"



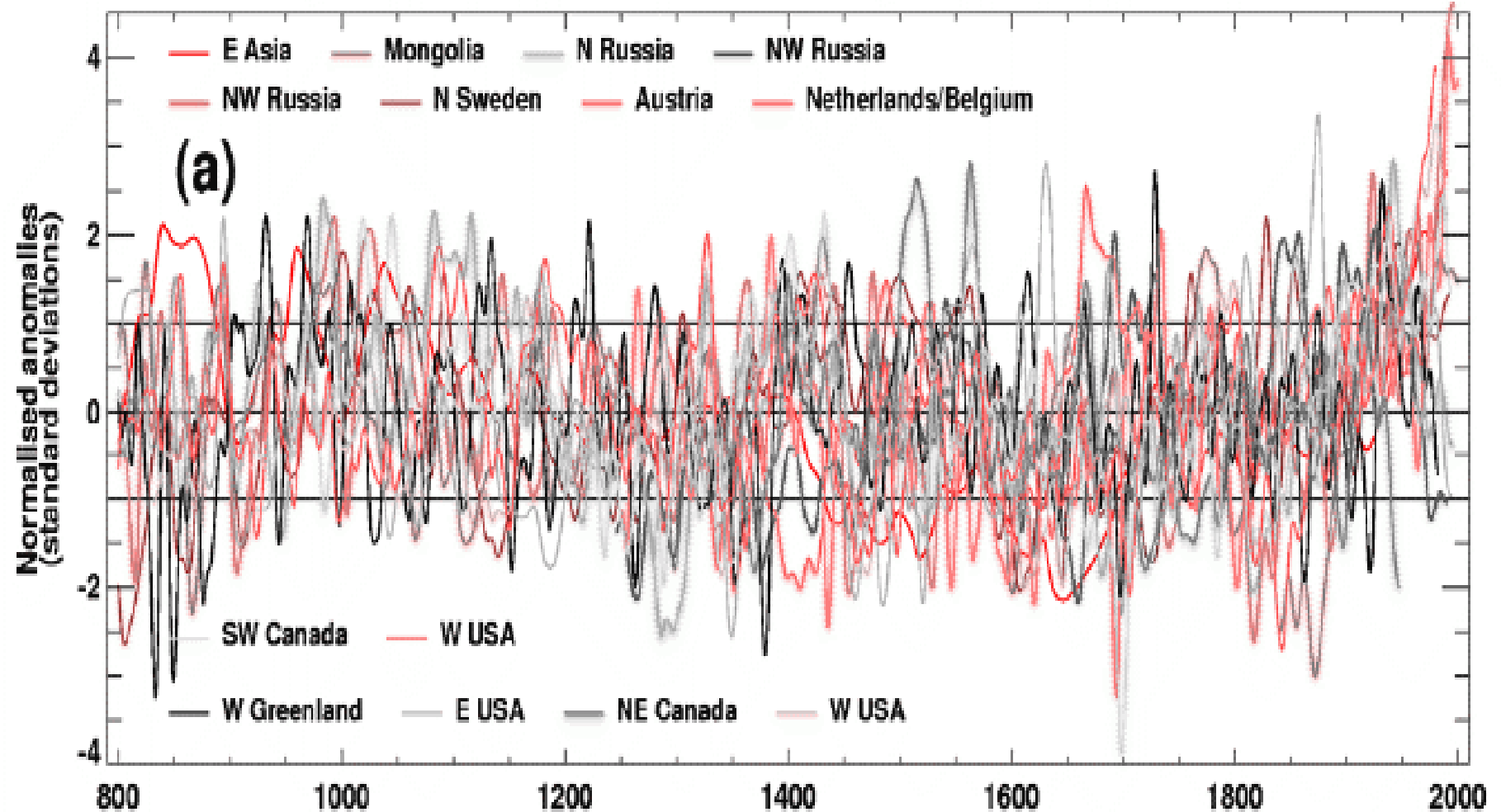
“Trend Applications”

- ▣ Enhanced Process Monitoring
- ▣ Troubleshooting Mechanical Problems
- ▣ Enhanced Chemical Feed Monitoring
- ▣ System Water Loss Tracking

“ Benefits of Using Trend Applications”

- ▣ More complete overview of systems operation
- ▣ Greater ease for Operators in assessing system operation
- ▣ Comparison of Operation parameter variables
- ▣ Easier access and display of historical data

“Information is not knowledge”



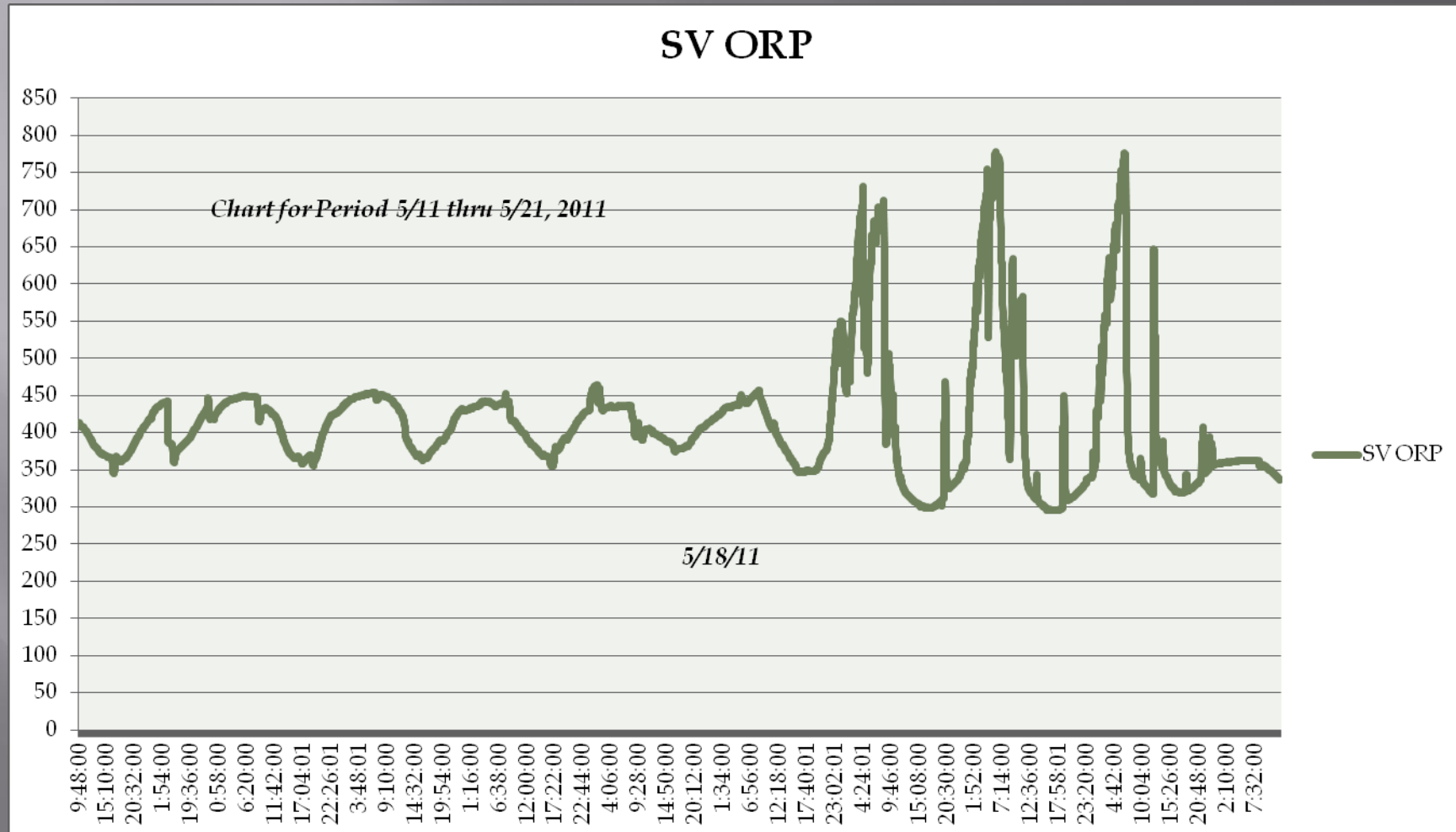
Process Control Trends

- ▣ *Trend charts show process data over time; they can help staff quickly spot systematic changes. Effective trend charts can tell plant staff if there has been a significant change in process mean or process variation over time.*
- ▣ *Process data lists can display raw data, but they are often difficult to interpret because gradual trends and patterns can be hidden in the list.*

Process Control Trends

- ▣ *The first step in process data analysis is to convert the raw data into charts that can help show important trends and patterns.*
- ▣ *Trend charts show process data over time; they can help staff quickly spot systematic changes.*
- ▣ *Effective trend charts can tell plant staff if there has been a significant change in process mean or process variation over time. Has there been any significant change in finished water over the past year, month, week?*

Process Control Trends



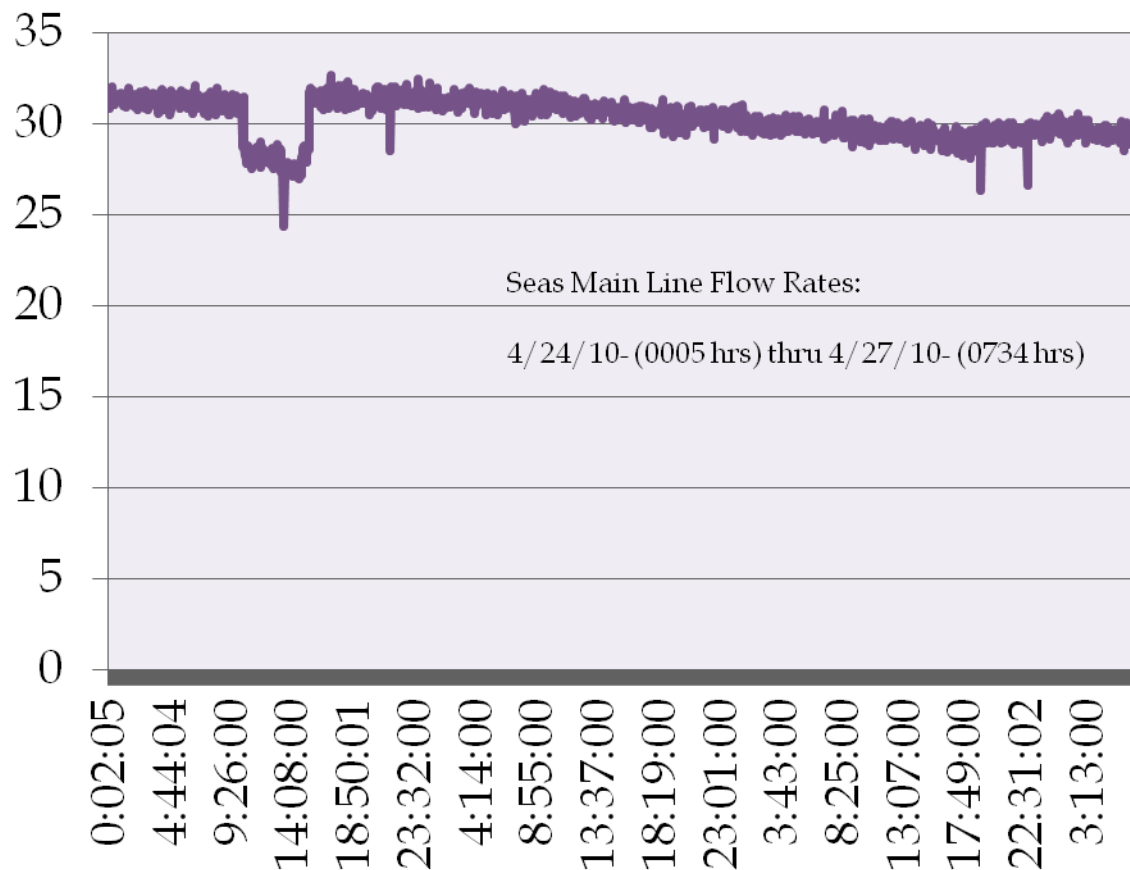
Process Control Trends

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Equipment Problem Diagnostic Trends

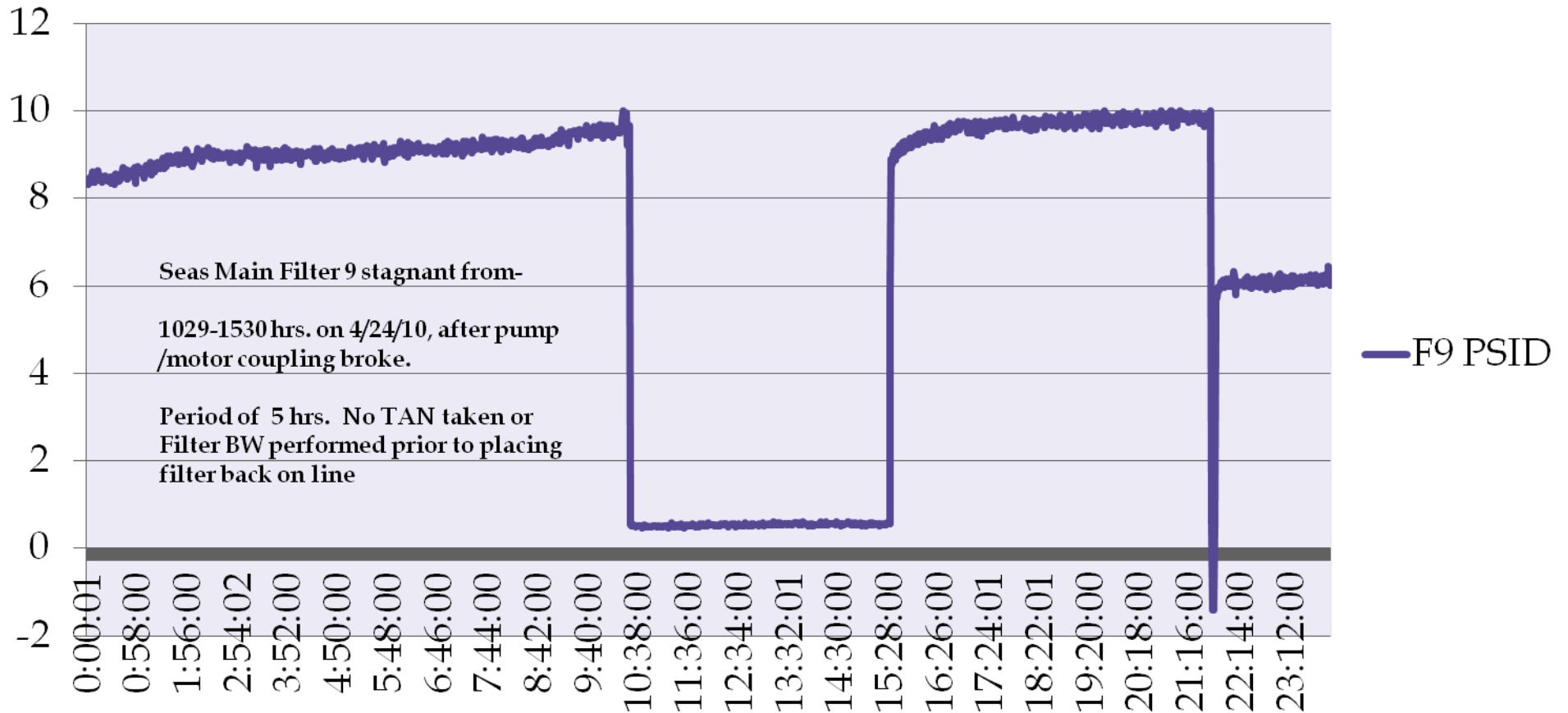
Main Line Total Flow



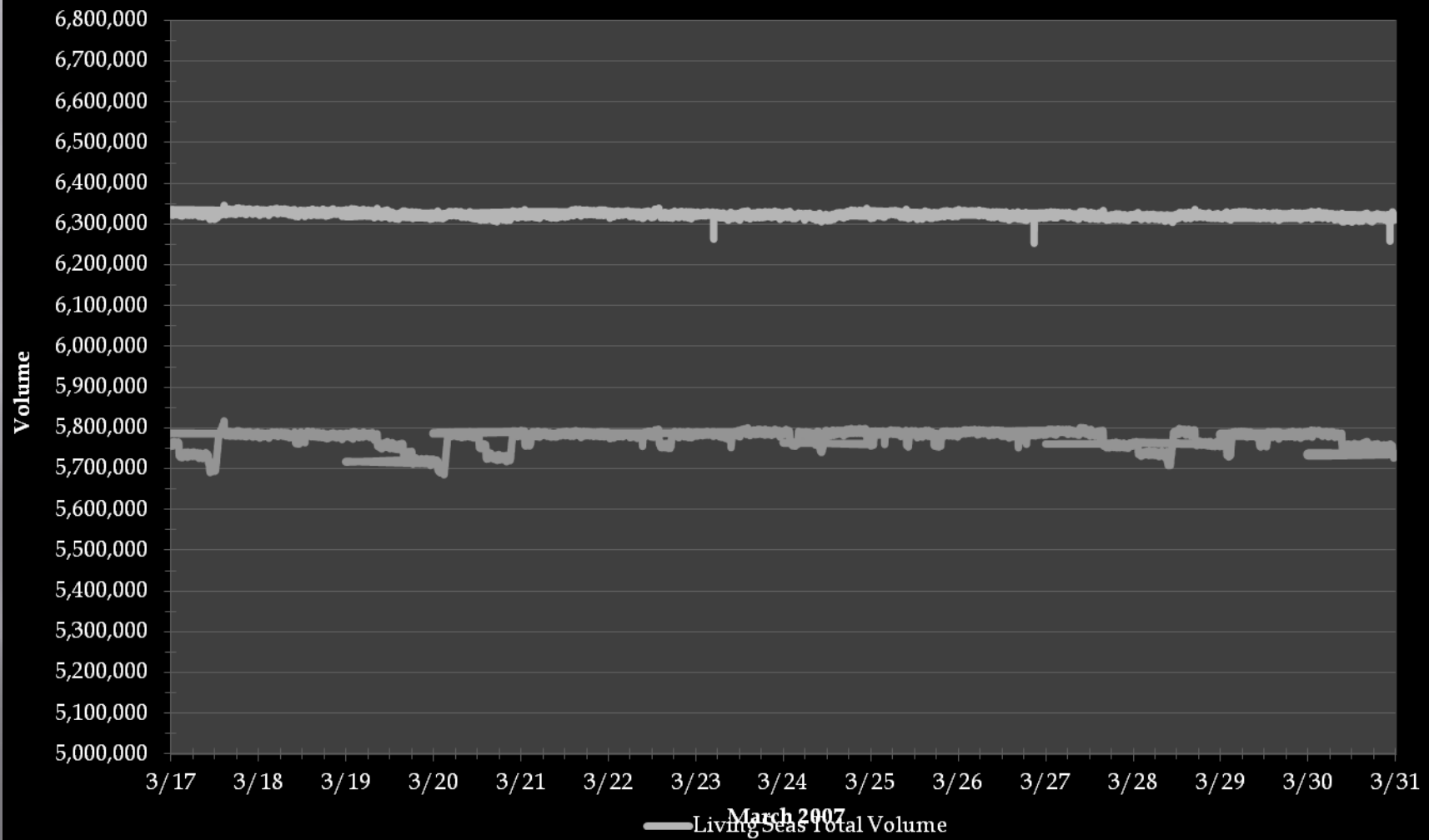
— Main Line Total Flow

Equipment Problem Diagnostic

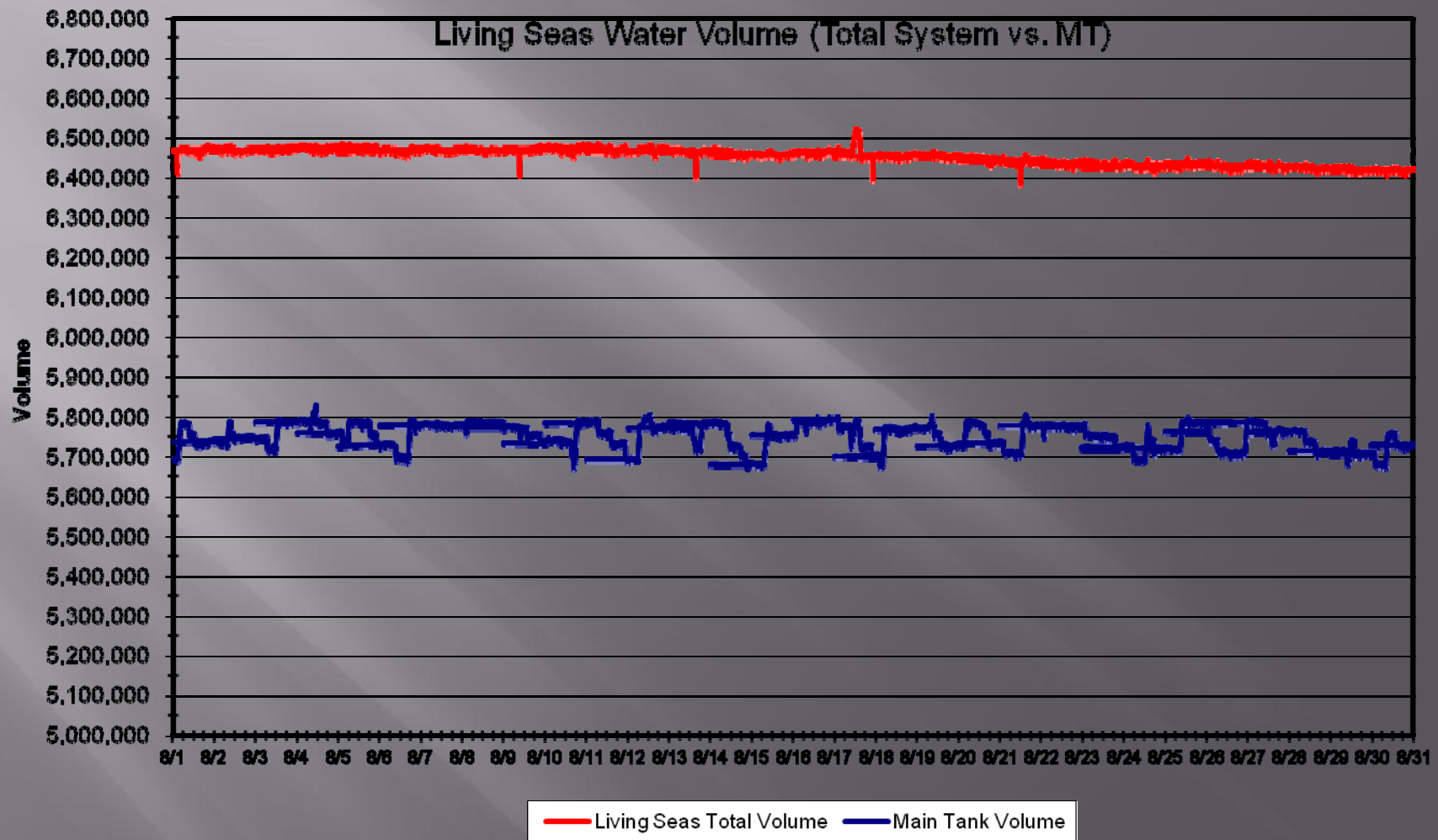
F9 PSID



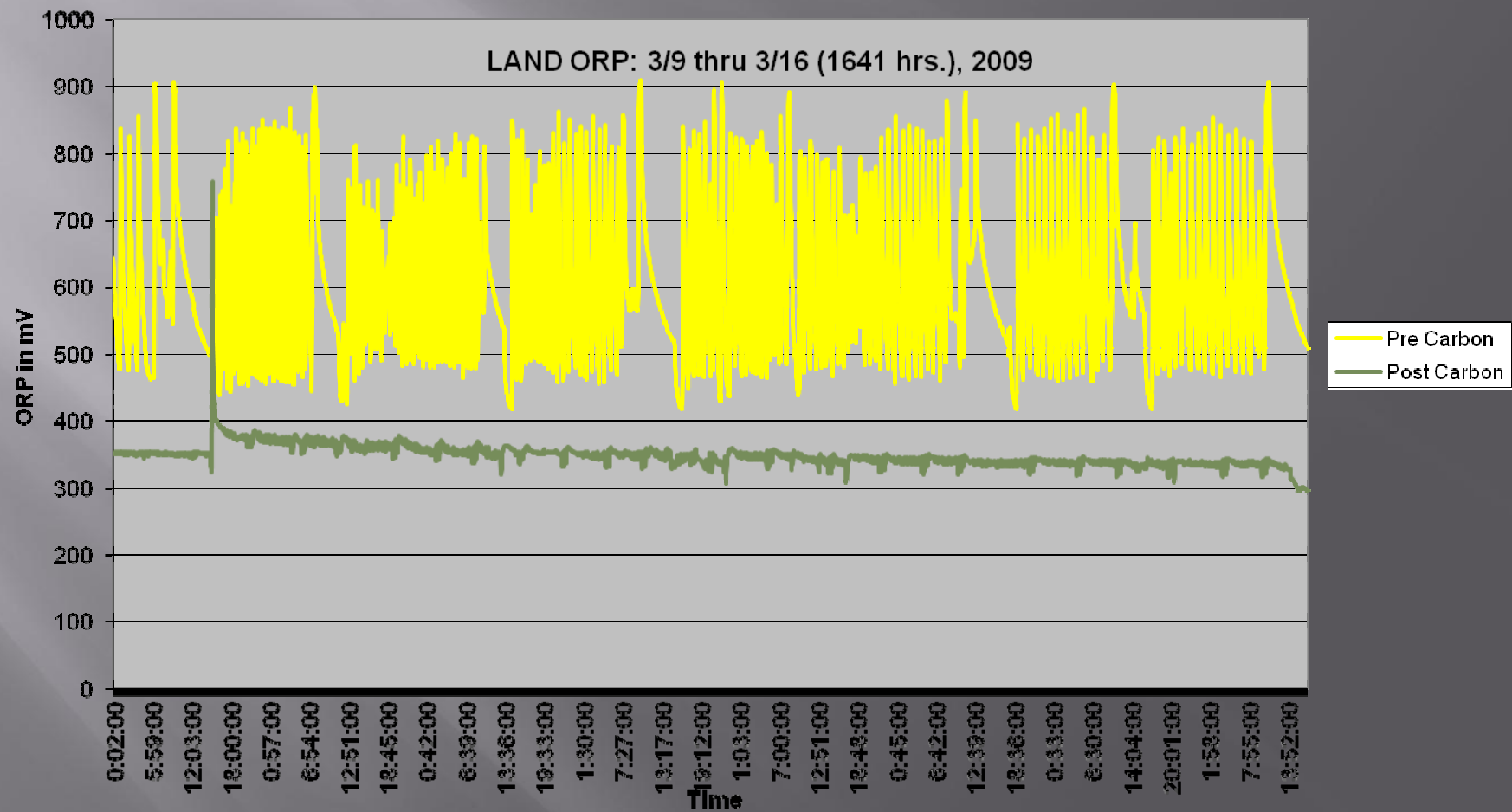
Living Seas Water Volume (Total System vs. MT)



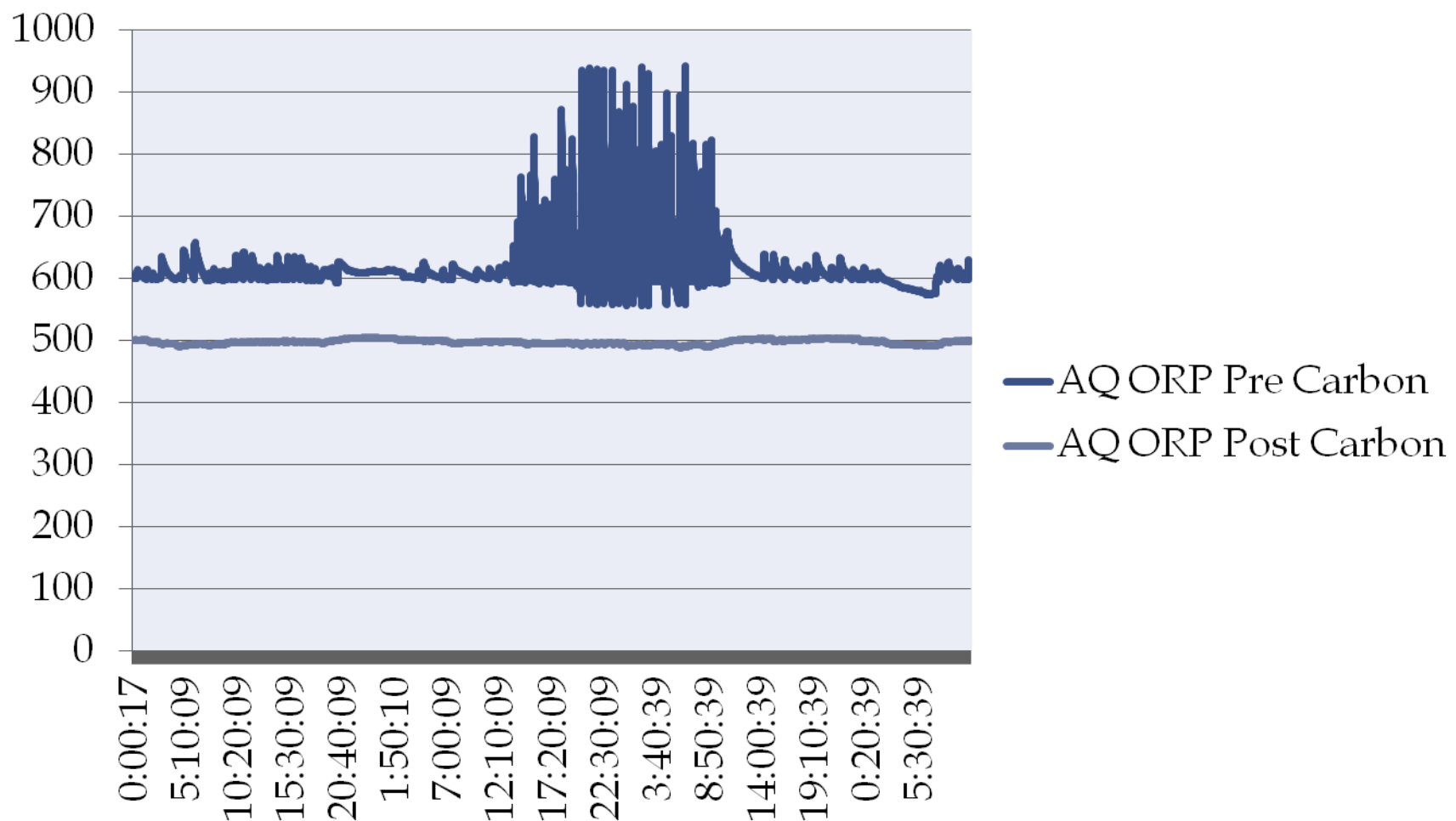
Water Loss Diagnostic Trends



Process Control Trends

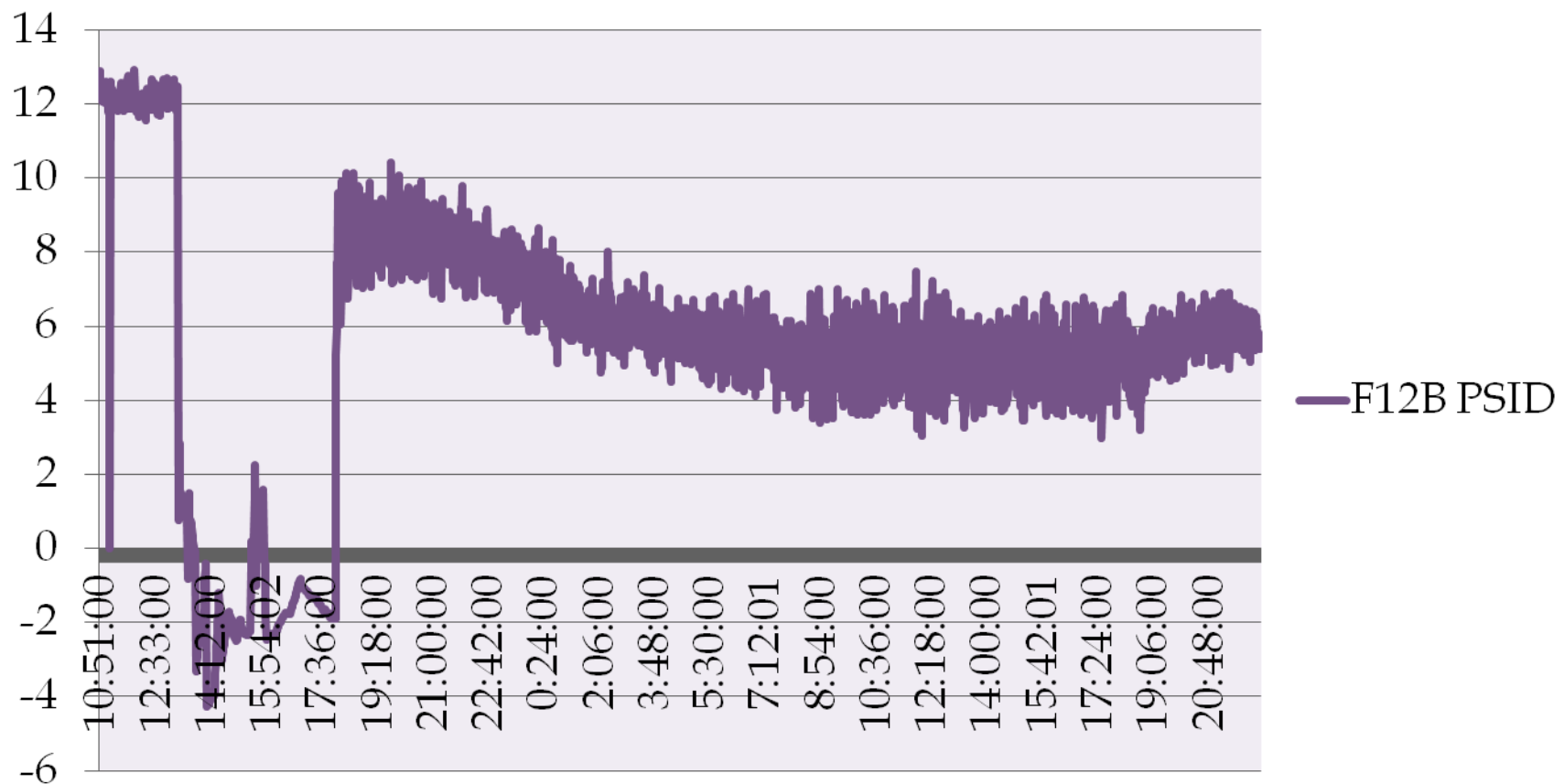


Process Control Trends

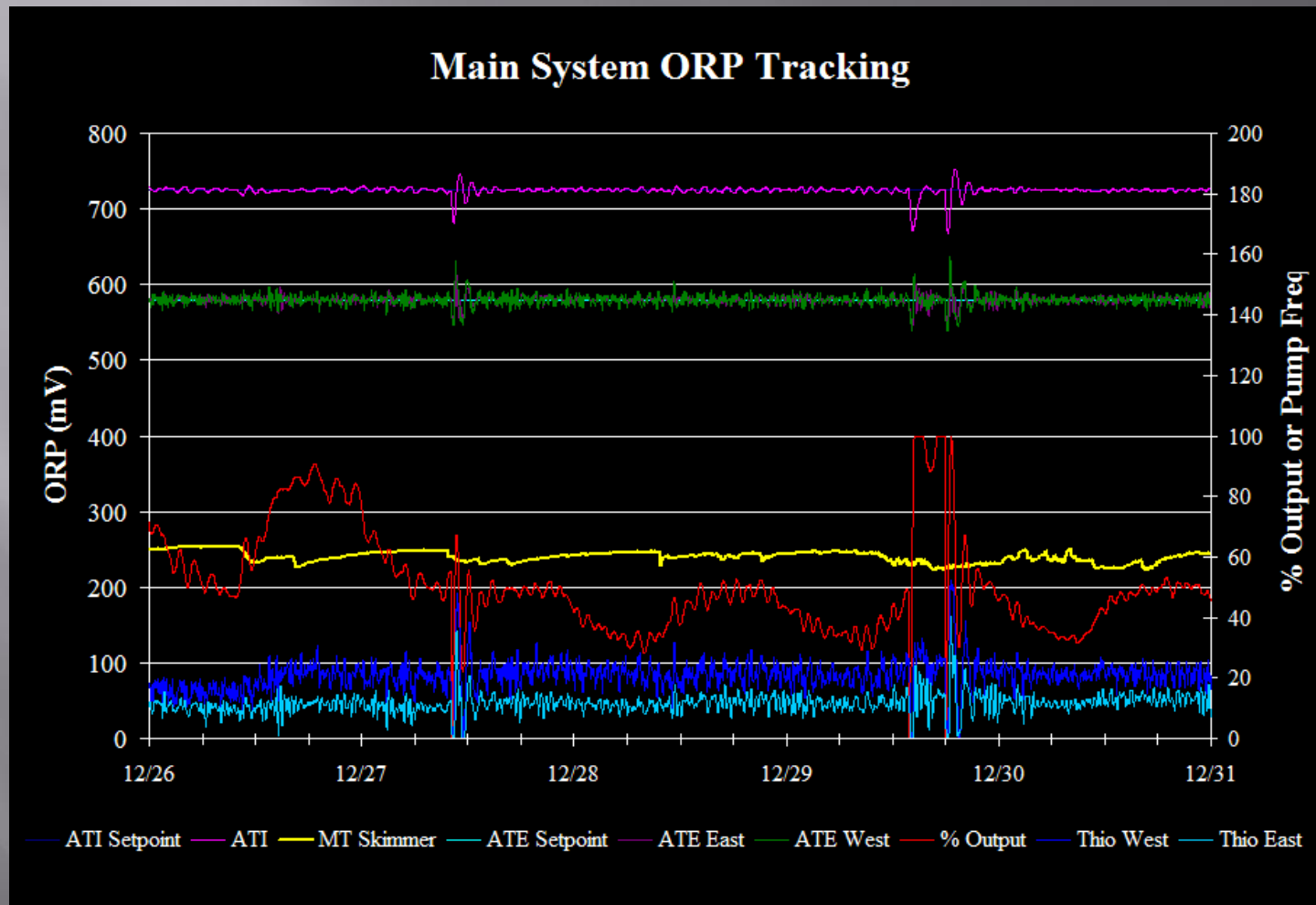


Process Control Trends

F12B PSID



Process Control Trends



Process Control Trends

- ▣ **Process Variation**

- ▣ - “random process variation”, also called common cause variation that is inherent in the processes
- ▣ “special cause variation” caused by a specific problem or event.

Process Control Trends

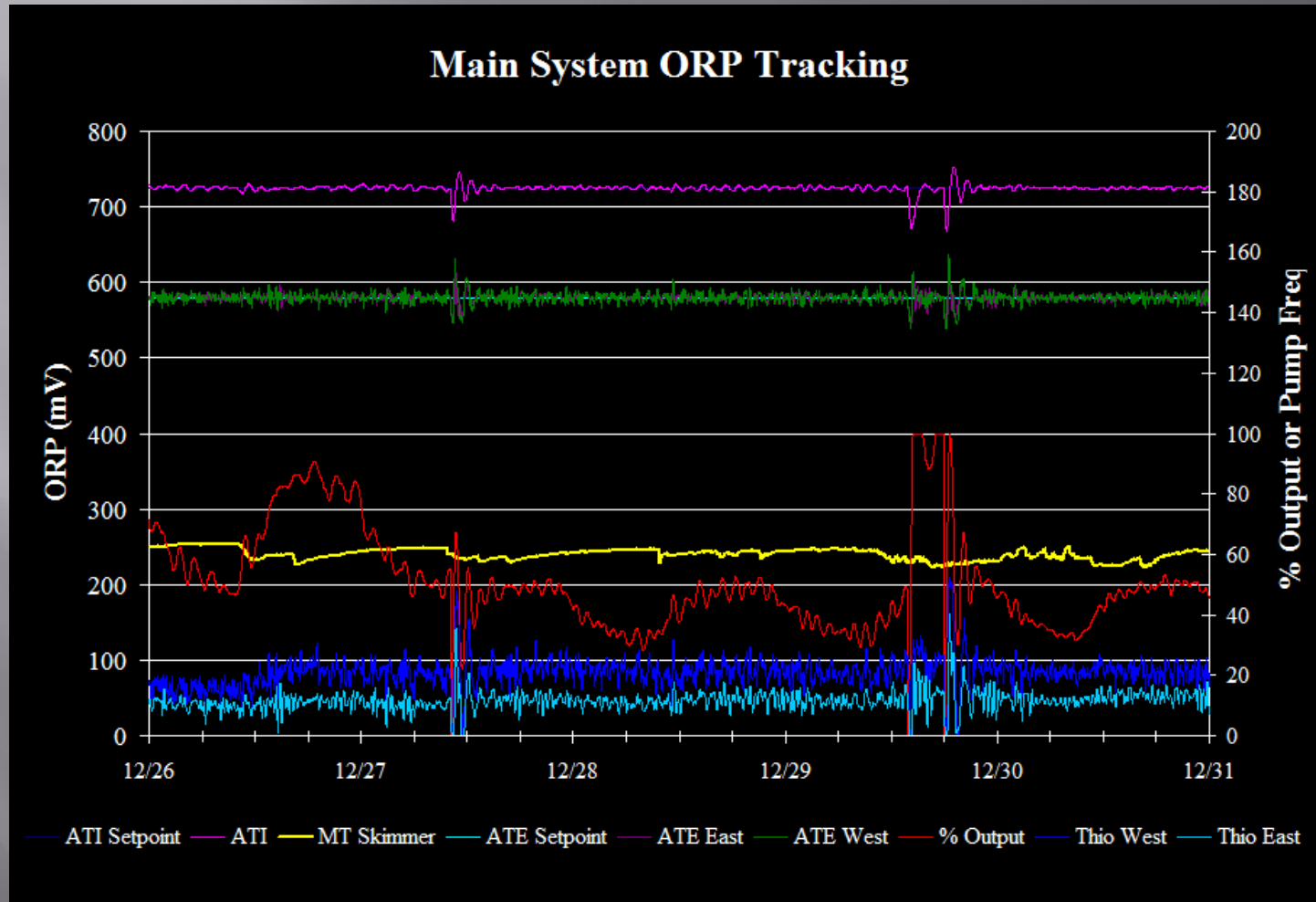
- ▣ A process is said to be in a state of statistical control when common causes are the only source of variation.

Common causes of variation are the only source of variation if the performance indicator standard deviation is stable (not changing) over time, and the data is normally distributed.

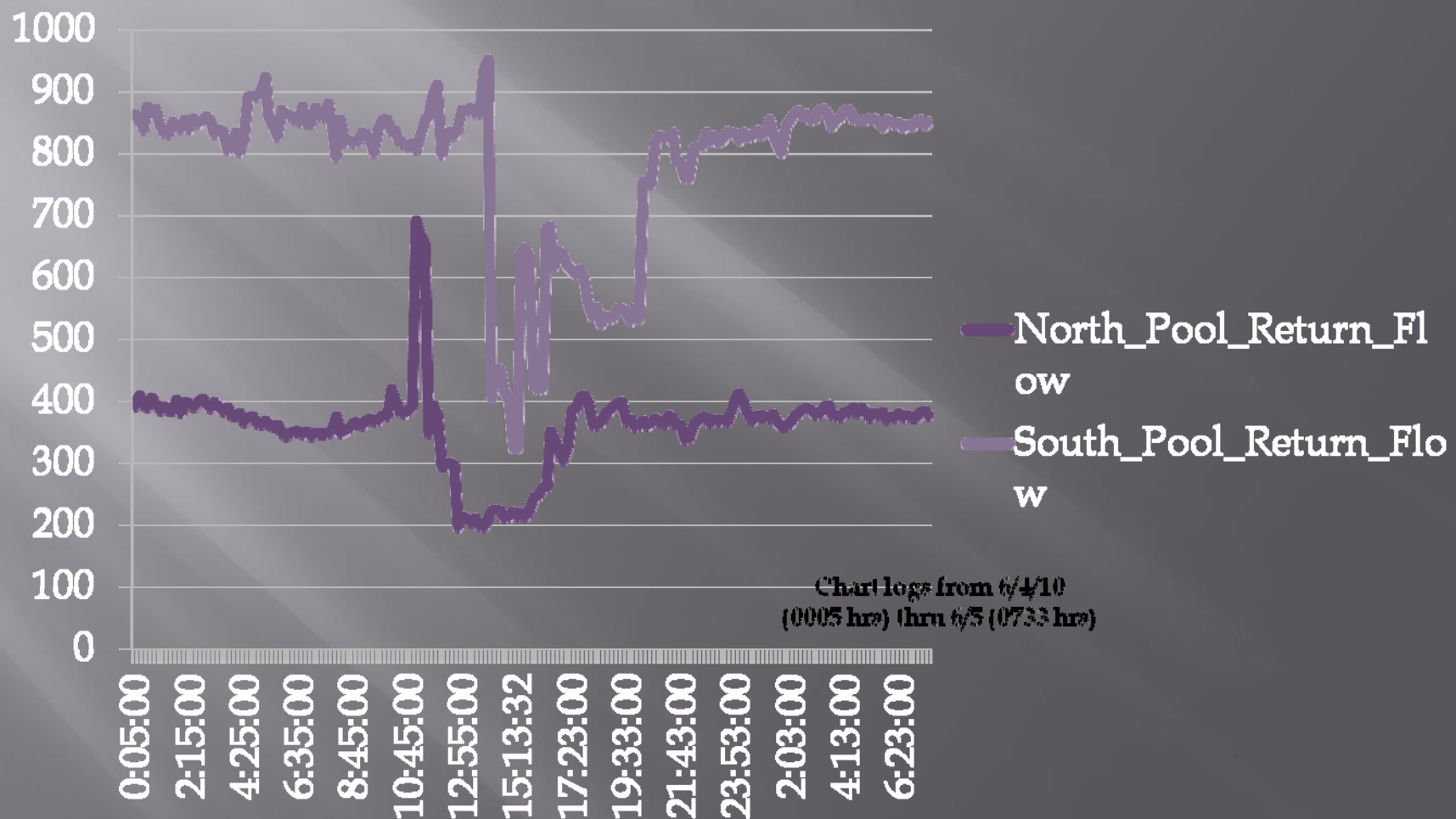
Process Control Trends

- ▣ **Standard deviation** is a widely used measurement of variability or diversity used in statistics and probability theory. It shows how much variation there is from the average or expected value.
- ▣ A low standard deviation indicates that the data points tend to be very close to the mean (expected value of variable), whereas high standard deviation indicates that the data are spread out over a large range of values.

Multiple Process Assessment



Process Control Trends



As a training Tool

- ▣ “Something vs. What”
- ▣ The staffers at treatment plants new to SCADA/trend applications or at those looking to add an updated, more efficient automation solution may resent or fear having to learn a new way of operating their plants. The good news, though, is that SCADA systems have become easier to learn and run

Other Considerations

- ▣ Trending applications cannot totally replace visual assessments.
- ▣ Designed and customized for your operation
- ▣ Data Tracking intervals

Other Considerations

- ▣ Operator Input-The beauty of a well-made SCADA system is that it doesn't force users into using it in a specific, set-in-stone way,"
- ▣ Do not hesitate to visit or call other operators with SCADA data logging systems in your region and ask their opinions about equipment and vendors.

Other Considerations

- ▣ Try to “keep it simple” whenever possible.
- ▣ Get the operators involved in the initial design of the SCADA data logging system. They are the best source of day-to-day operation and planning information
- ▣ Process Control vs. Data Feedback Perspective

Other Considerations



“QUESTIONS ?

