

# "Produced Water Monitoring: Performance Improvement using CIP: Results from the Past Two Years"

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# Inspiration

- ▶ Tired of orphaned monitors!!
- ▶ Plenty of heavy industrial examples of simple Clean In Place systems in use both on-shore and off-shore.
- ▶ Keeping any kind of sensor system operating in produced water applications is a challenge. Others are industries use CIP. Why not us?

# What is the single most aggravating problem with produced water monitors?

- ▶ Keeping them from fouling!!
- ▶ More important than precise measurement!
- ▶ “I would trade precision away for better reliability!” - Major Oil Company User

# So, why are we in this situation?

- ▶ If we look at it from an end user standpoint.....

# First, we listen to sales engineers



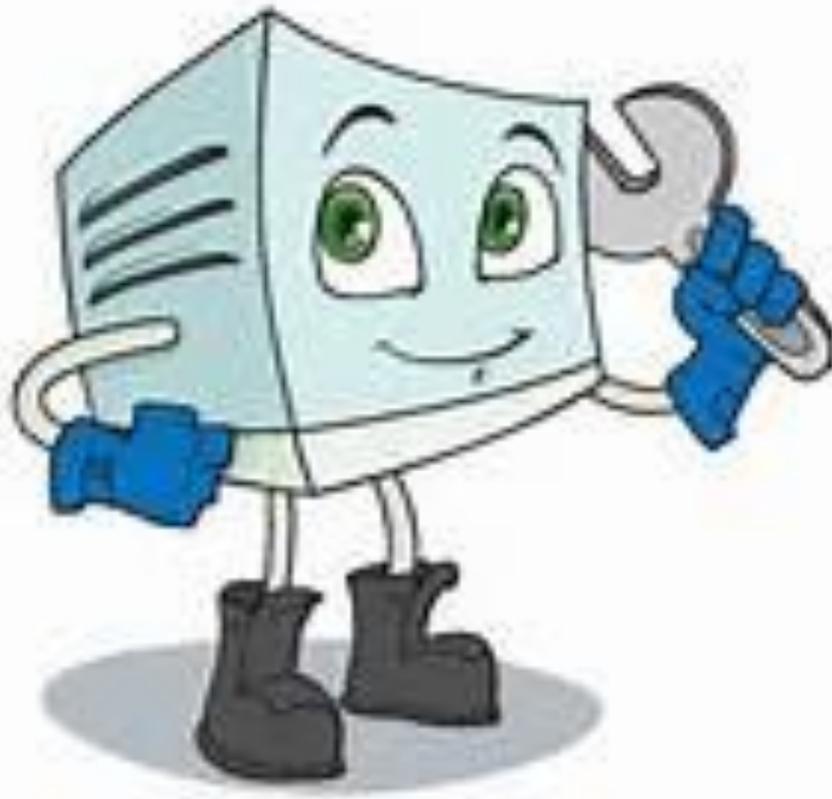
# Next, Write the Spec



# Next, Sign the Contract



# Next, Install the Monitor



# If Everything Works Great?



# Time Goes By



# And then::: Stuff Happens



**Salt Happens! Crystals from saturated brine produced water completely blocks it up!!**



**Oily Formation fines (clay) blocks up the sample lines and the drain!**



**Sand “happens”!!!**

# Sticky Oil Happens!



**Everything gets blocked up!!**

# Junk from 20' of 1/2" sample line



**Then, they become orphans!**



# So, why are we in this situation?

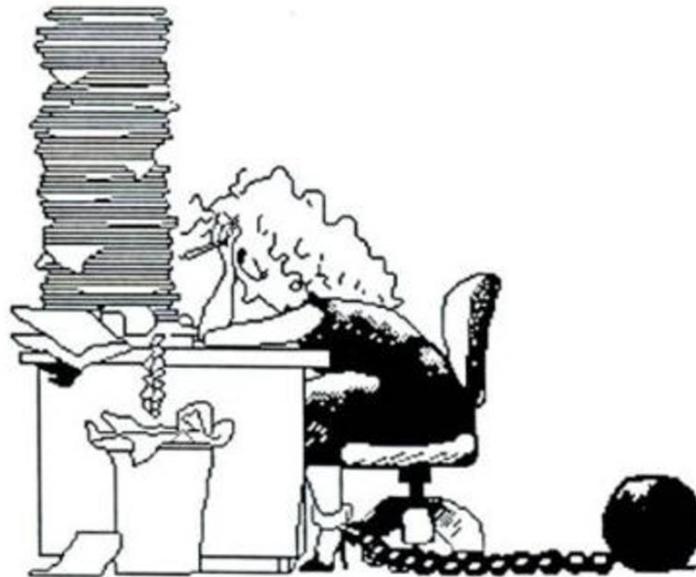
- ▶ If we look at it from a supplier standpoint.....

# Read the specifications



From supplier, system integrators, water treatment equipment suppliers, end users.

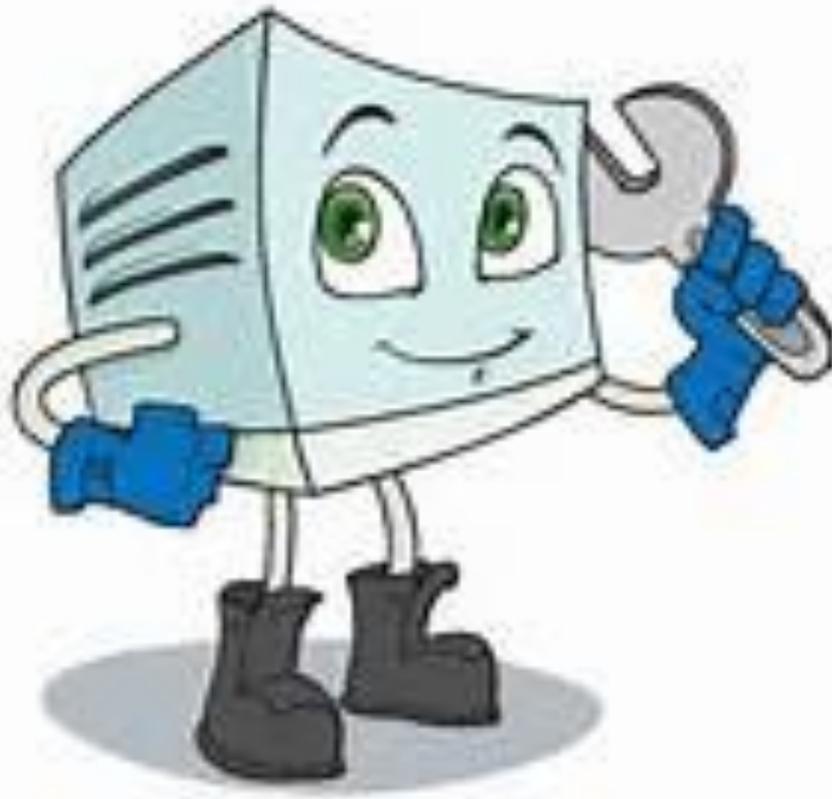
# Write the Proposal



# Next, Sign the Contract



# Next, Install the Monitor



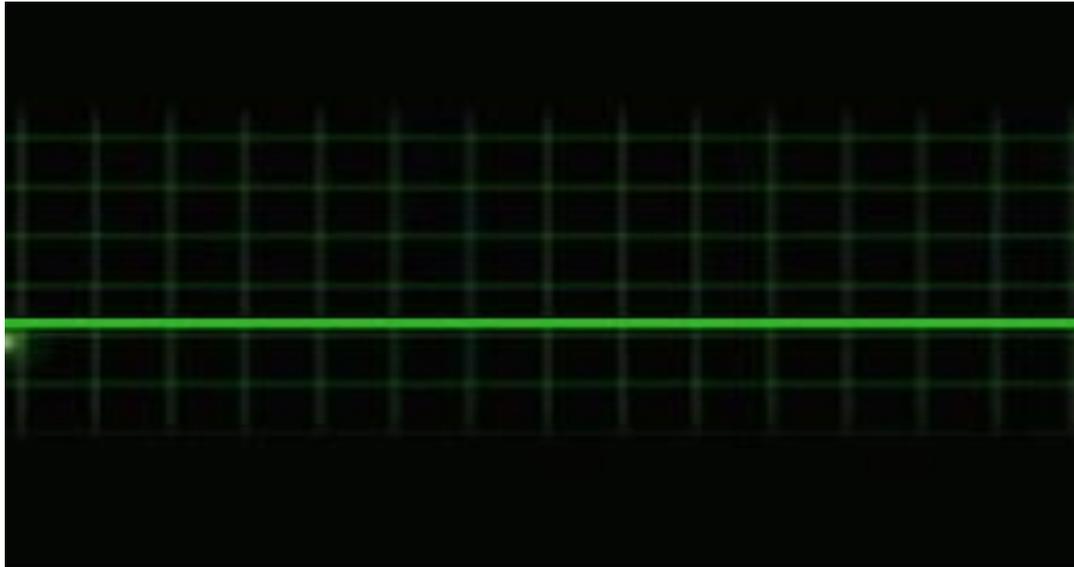
# If Everything Works Great!!



# Time Goes By



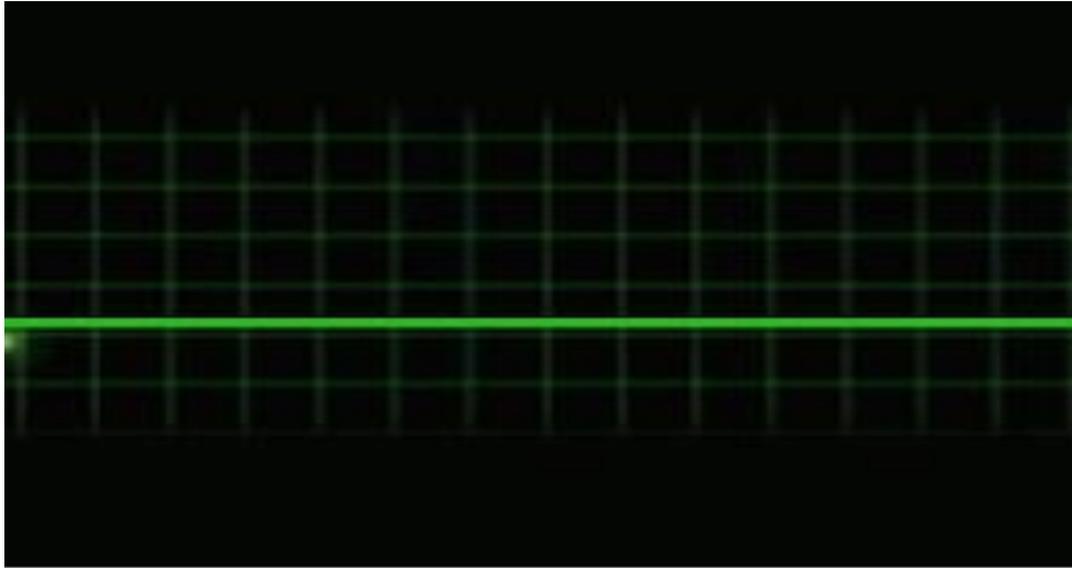
# Same Stuff Happens!!



**Then, they become orphans!**



# Flat line is good??



- ▶ Does it mean no maintenance required?? Or, does it mean “It works great!!”
  - or, Maybe we should take a look over the side??
- ▶ **Let's loose the flat line!!!**

- ▶ If we are going to purchase and install oil in water monitors, why not make sure they work??
- ▶ Otherwise buy an empty box!! – It's cheaper and guaranteed (not to work)!!

# What is the Problem???

- ▶ Why is continuous oil in water monitoring such a pain?
- ▶ What does it take to make these monitors perform?
- ▶ This has to be easy!!
- ▶ Let's just make it EASY!!!



# Defining the problem

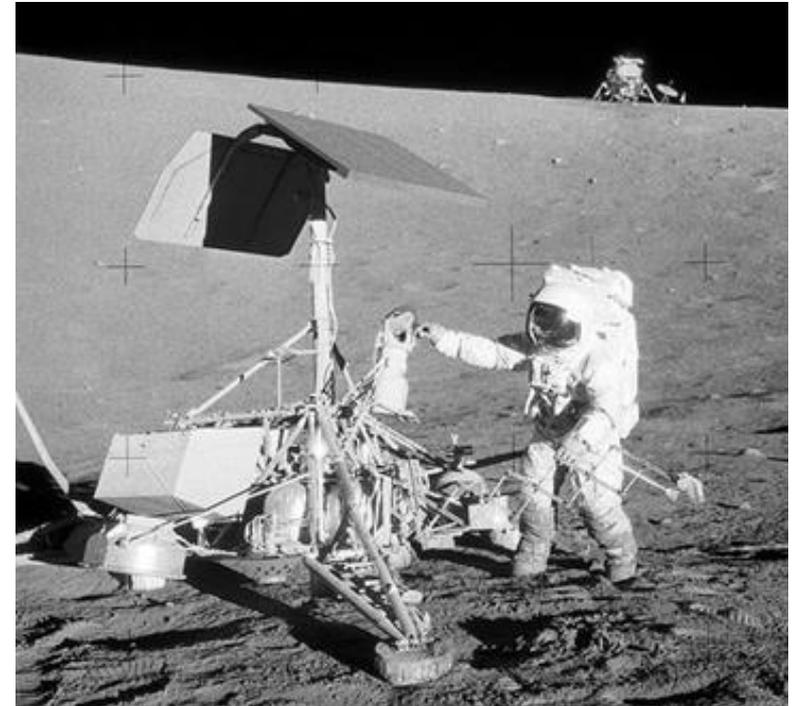
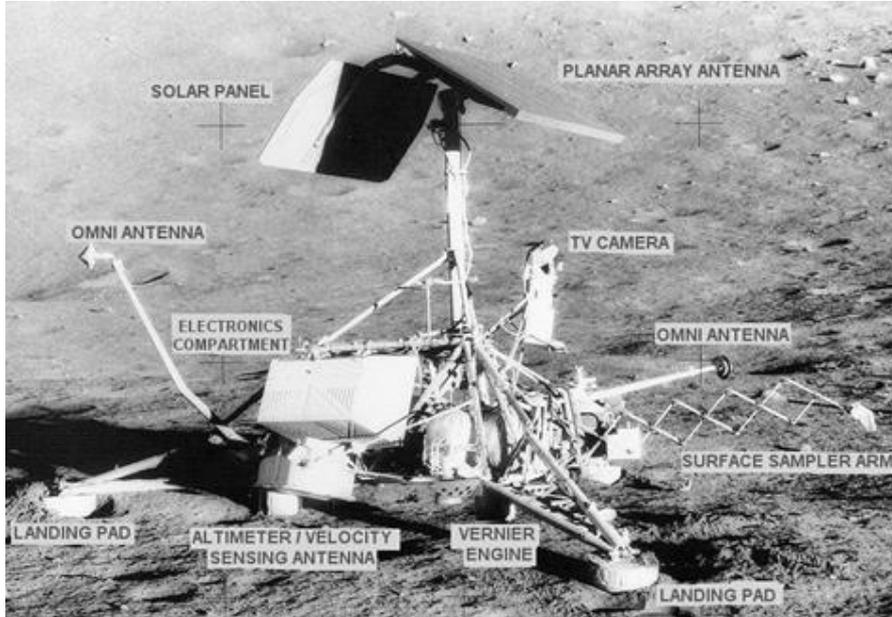
- ▶ Electronic or mechanical failure??
- ▶ Failure to make the measurement?
- ▶ Failure to meet maintenance expectations?

# Electronic or Mechanical Failures?

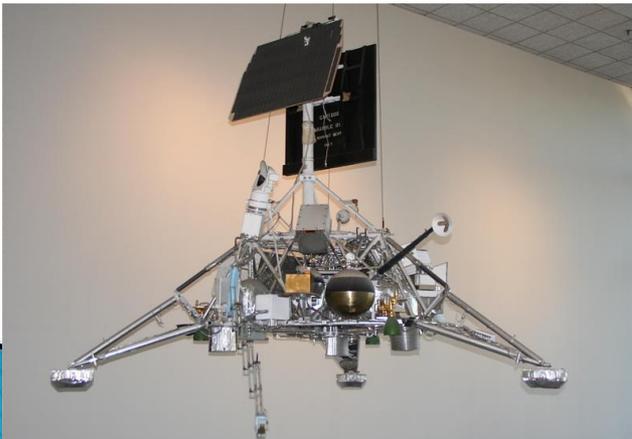
- ▶ Relatively simple instruments should not have this kind of failure!



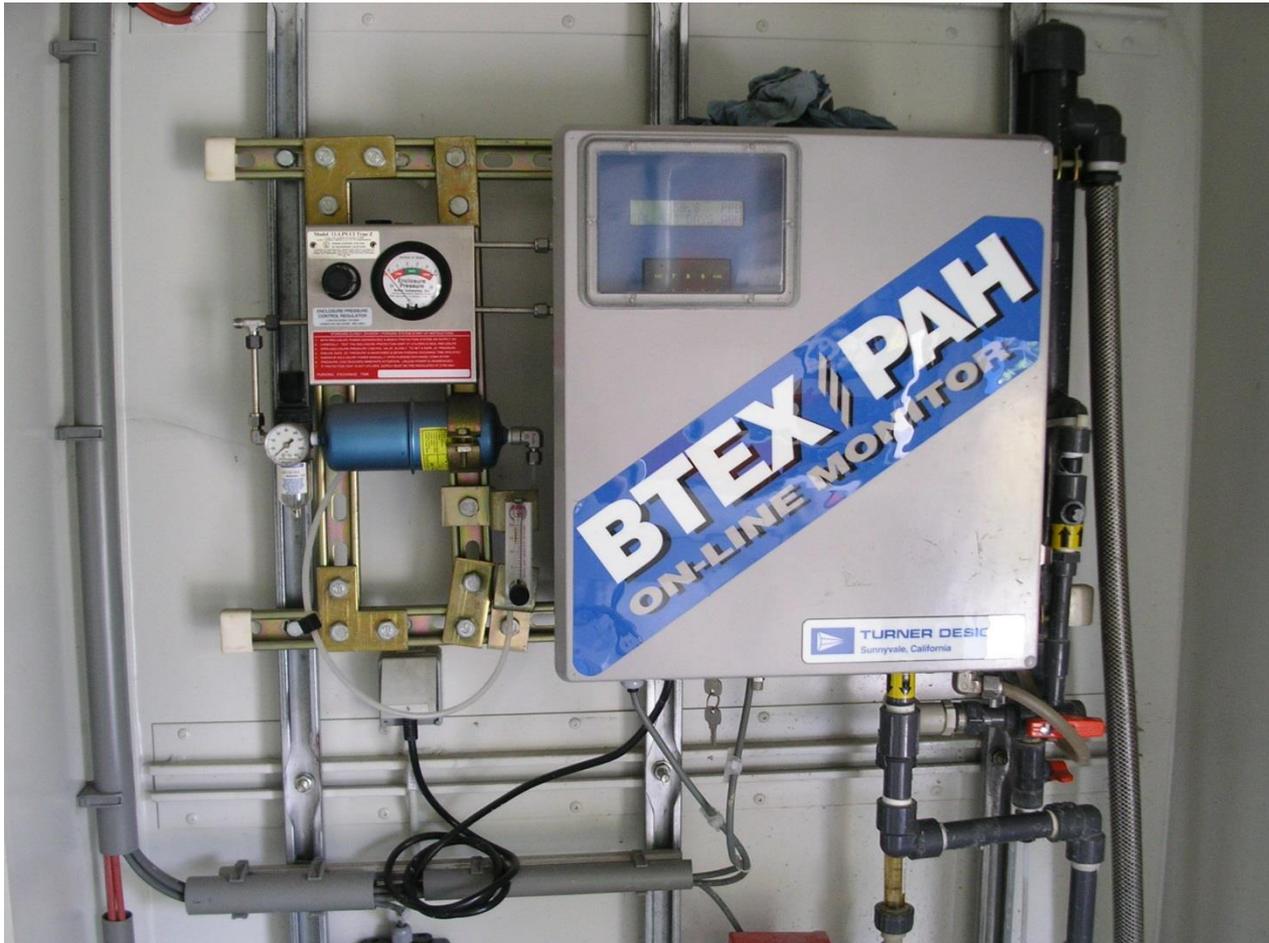
# 1<sup>st</sup> Surveyor Moon Lander 1966



Pete Conrad Apollo 12 visits Surveyor in 1969



# 20 years continuous 24/7 service on its second factory rebuild

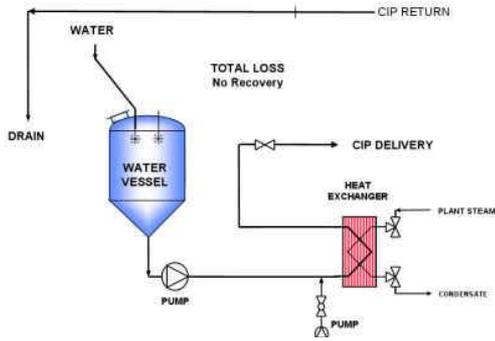


Electronics / making the measurement is not  
the problem.

Keeping them and the sample  
system *clean* is the problem!

# If Oil in Water Monitoring is important and you really want to make it work??

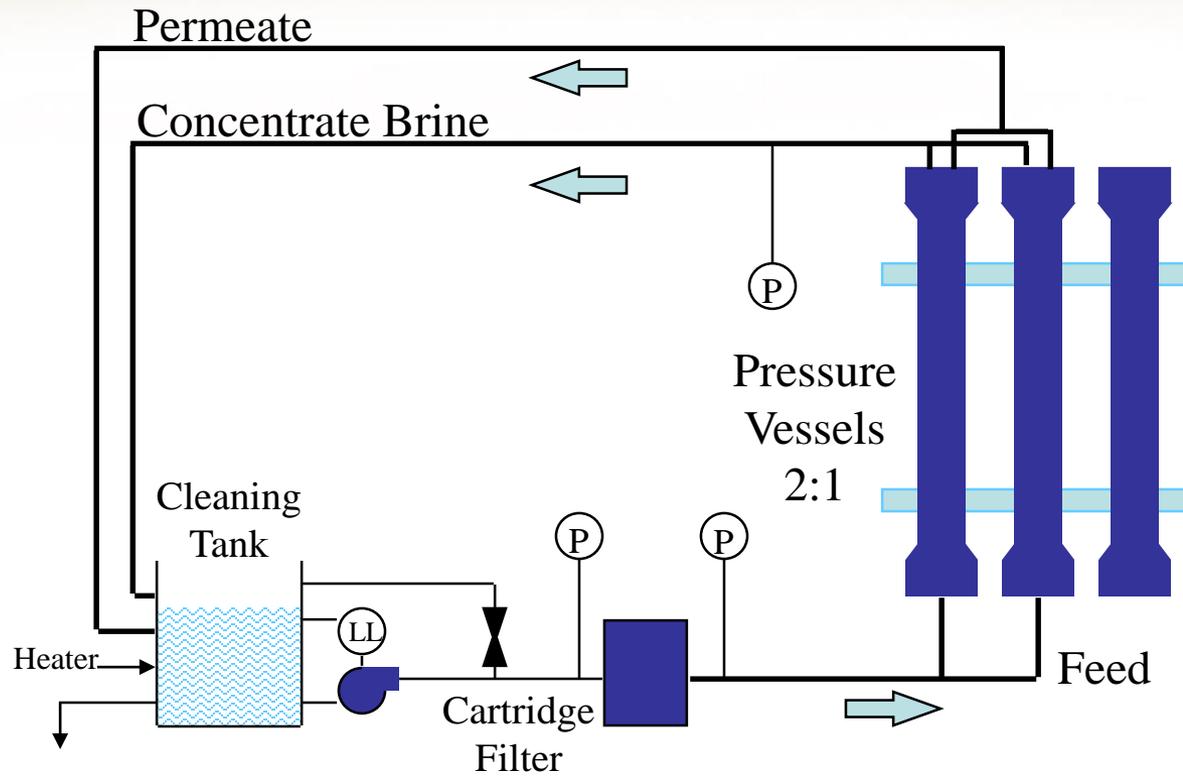
- ▶ There are ***Non-Destructive*** alternatives to Ultrasonic Cleaning which avoid mechanical damage.
- ▶ Ultrasonic cleaning of the measurement cell does not address the sample system.
- ▶ Viable Alternative: **Clean in Place** (CIP) for oil in water monitors!



# Companies involved in CIP

- ▶ <http://www.burnsmcd.com/Resources/Article/How-It-Works-Clean-in-Place-Systems>
- ▶ <http://www.genesysro.com/> Stephen Chesters
- ▶ <http://www.alfalaval.com/service-and-support/service-solutions/cleaning-and-chemicals/cleaning-in-place-pays-for-itself/pages/cleaning-in-place-pays-for-itself.aspx>
- ▶ <http://www.apexengineeringproducts.com/>
- ▶ Search: Clean in Place Systems
- ▶ Clean in place systems (local)

# Cleaning Circuit



# Reduce Reverse Osmosis Membrane Fouling with Good CIP Procedures

*By James McDonald, PE, CWT; Dave Christophersen, CWT; Chris Howell  
Originally Published: Ultrapure Water, April 2004, Volume 21, Number 3.*

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An integrated water management strategy to optimize a system's performance utilizes the best technical and operational principals combined with new or existing assets. Applying an existing asset to accomplish this goal with simple and economical standard operating procedures is like *having your cake and eating it too!*

Reverse osmosis (RO) systems are used to produce high purity water for boiler makeup water, process waters, wastewater reuse, and numerous other applications. In a well-managed system, operational parameters are measured on a regular basis to assess functionality of the machine and determine when RO membrane cleanings are required. The higher the dissolved and suspended solids in the RO feedwater, the more frequent and important the cleanings become.

Some RO systems do not operate 24 hours a day and are turned off for part of the day or week to support the operational requirements of the facility. Typically, when the RO shuts down, the impurities that have been concentrated on one side of the membrane remain in the membrane housing until flushed out with fresh makeup water when the RO starts back up. The system is essentially "put away dirty." Being "put away dirty" can allow for further inorganic deposits to develop or microbiological activity and fouling to increase. Both have negative affects on the RO membranes and performance.

Many RO's have clean-in-place (CIP) equipment installed as an integral part of the system. Smaller RO applications may contract to have a CIP performed on an as-needed basis. A typical CIP for polyamide membranes is outlined below:

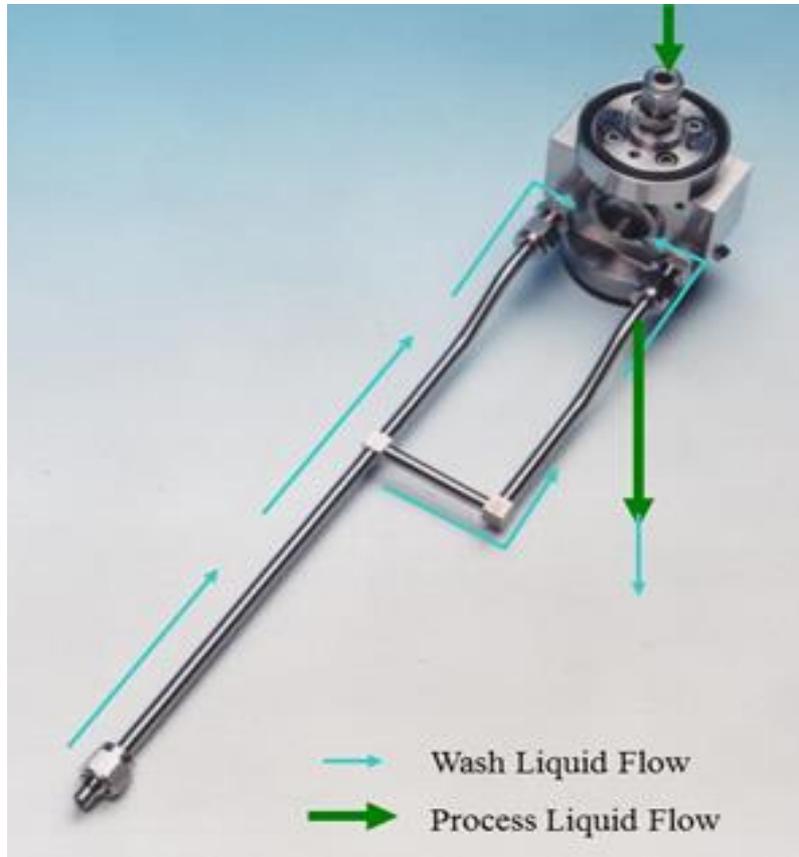
# Clean in Place Systems

- ▶ Dairy and other food processing
- ▶ Heat Exchangers
- ▶ Membranes
- ▶ Cooling towers

And now.....

- ▶ Oil in Water Monitors

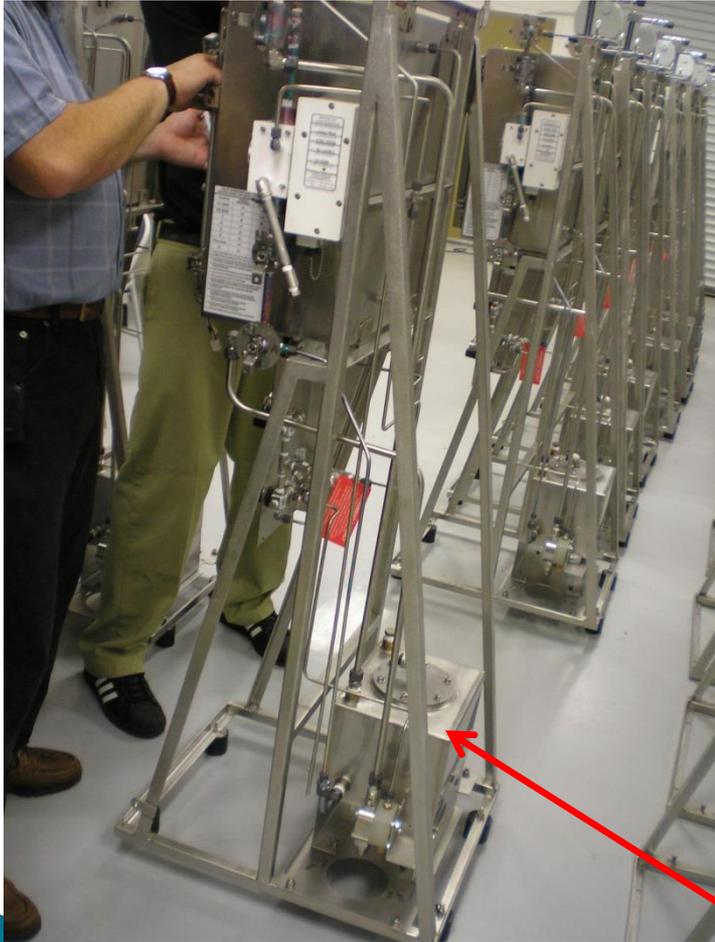
# High Velocity Flow Cell Cleaning



High velocity water / chemical CIP can clean the flow cell or the entire sample system

Photo Courtesy of Jorin, Ltd.

# 2006



**Early Clean in Place Systems**

# Development of CIP for oil in water monitors

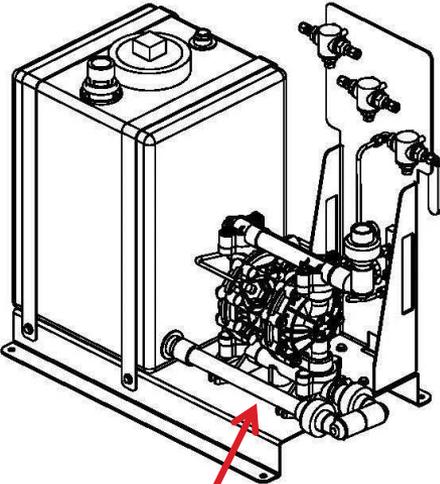
- ▶ Early CIP did not address the sample lines



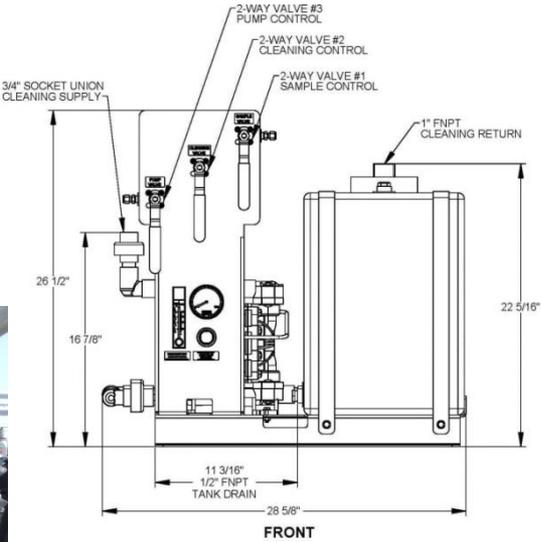
# New Designs clean entire system from sample take off to monitor drain connection.



# Clean in Place (CIP) cleans entire system



Pneumatic valves, diaphragm pump



Water, not a chemical spill



Continuous on-line  
produced water monitor  
on the overboard line  
GOM

Simple CIP with  
Rydlyme controls  
fouling in sample  
system

Rydlyme biodegradable  
cleaning product from  
Apex Engineering. 10g  
tank ½ full.

# Results

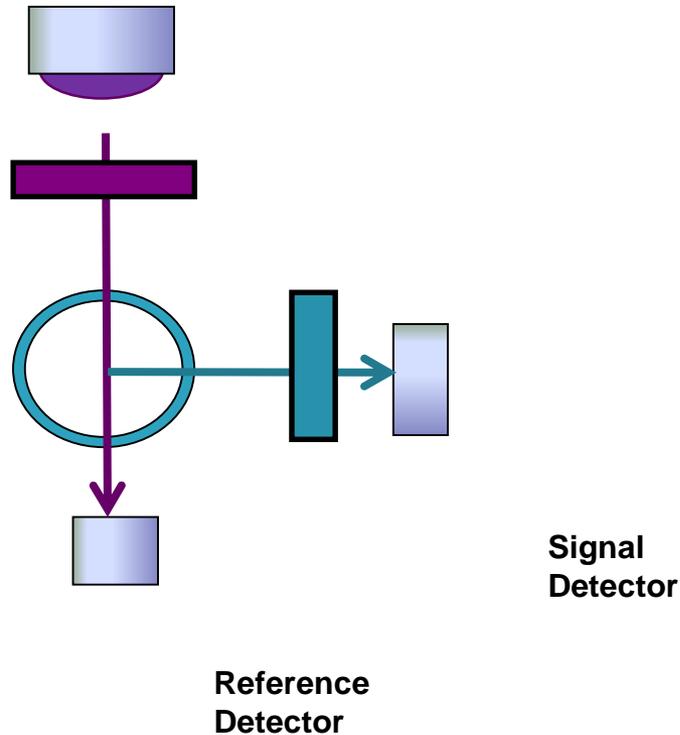
- ▶ (Installed in March 2013) “Cleaning unit is still used once per week for 10 minutes. The Rydlyme was refreshed after 12 months of service. And, very little maintenance is required on the monitor except to check the optical windows”.
- ▶ “One other thing to remember about the data and to possibly mention when you discuss it is that the monitor was purchased in 1999. It was also removed from its original location and re-installed twice more and is still in operation. That’s pretty reliable in my book and there were no failures of components (electronic). Just routine maintenance for bulbs etc. and calibration.” - a happy customer Major Oil Company

# New field test in 2014

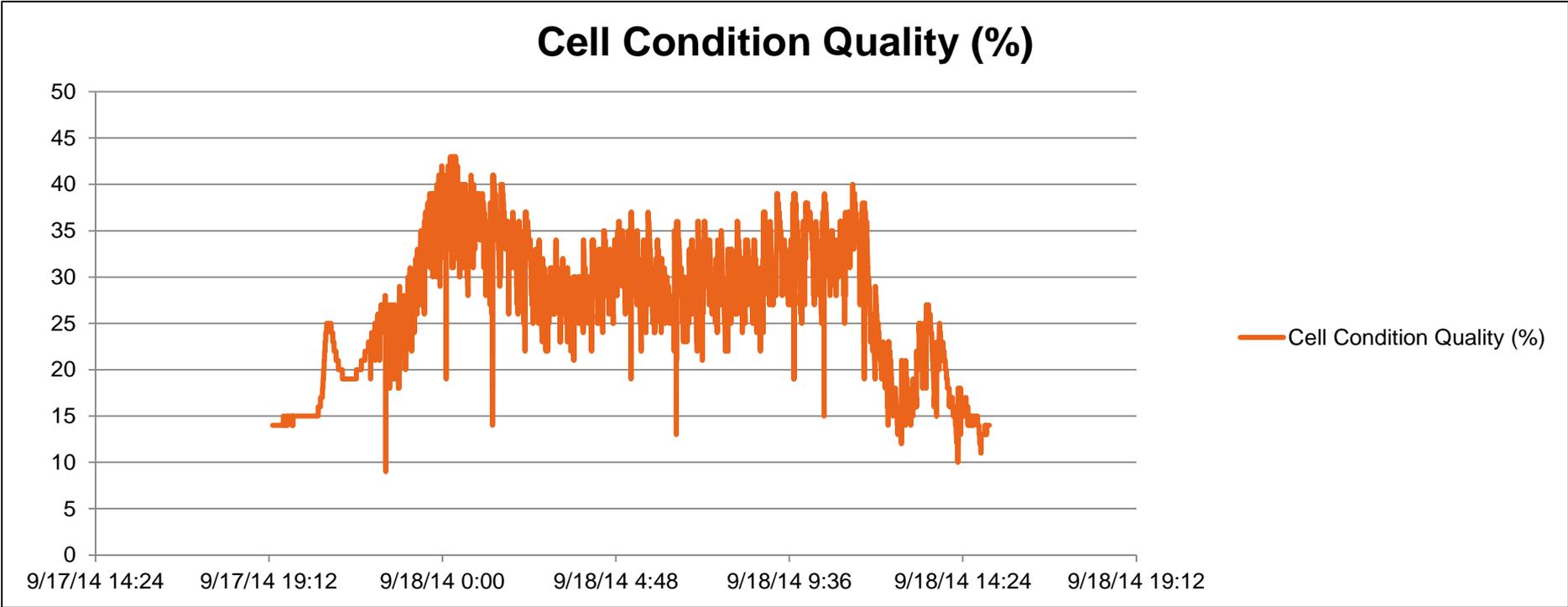


# Results from 2014

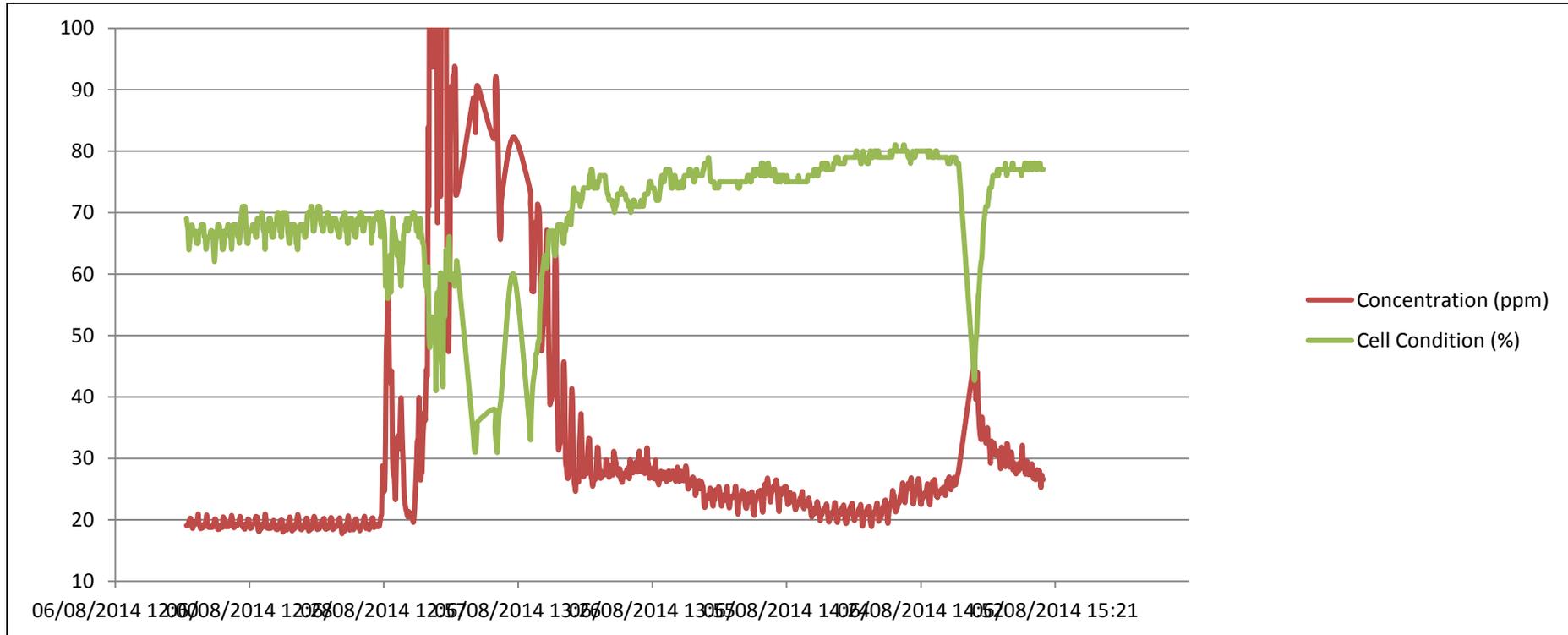
# Flow cell has cell condition monitor built in.



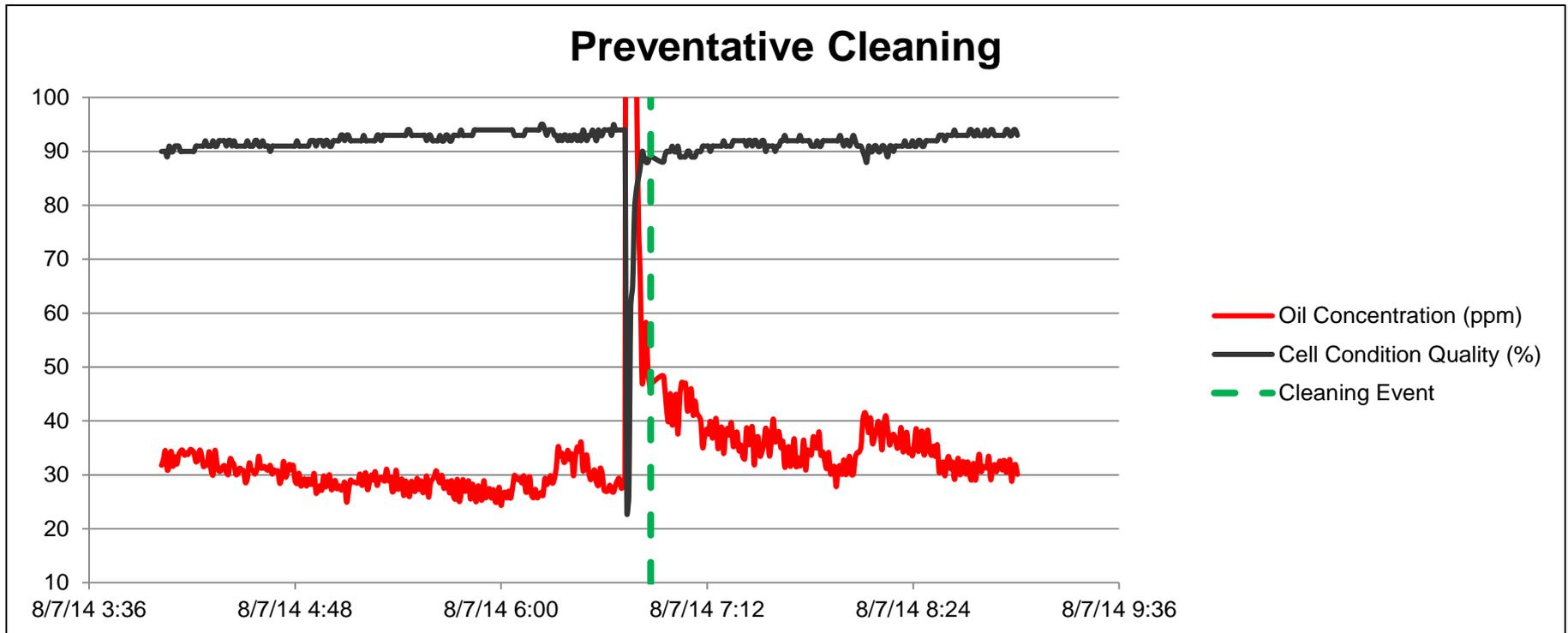
# This is what happens when CIP is not used! Cell Condition reduces to meaningless state



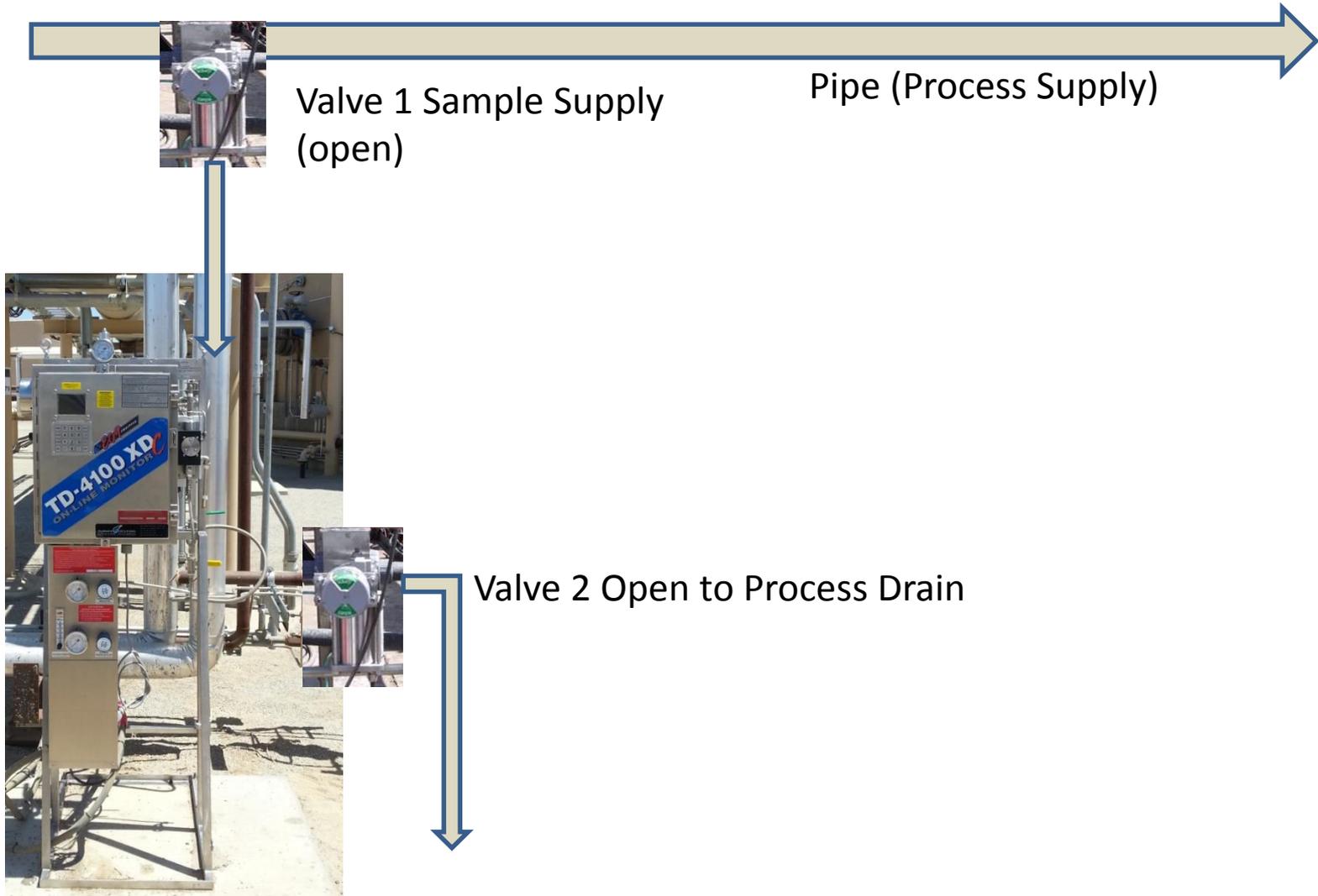
# Cell condition at 65% still catches upset!!



# Preventative cleaning every 12 hours keeps it running!

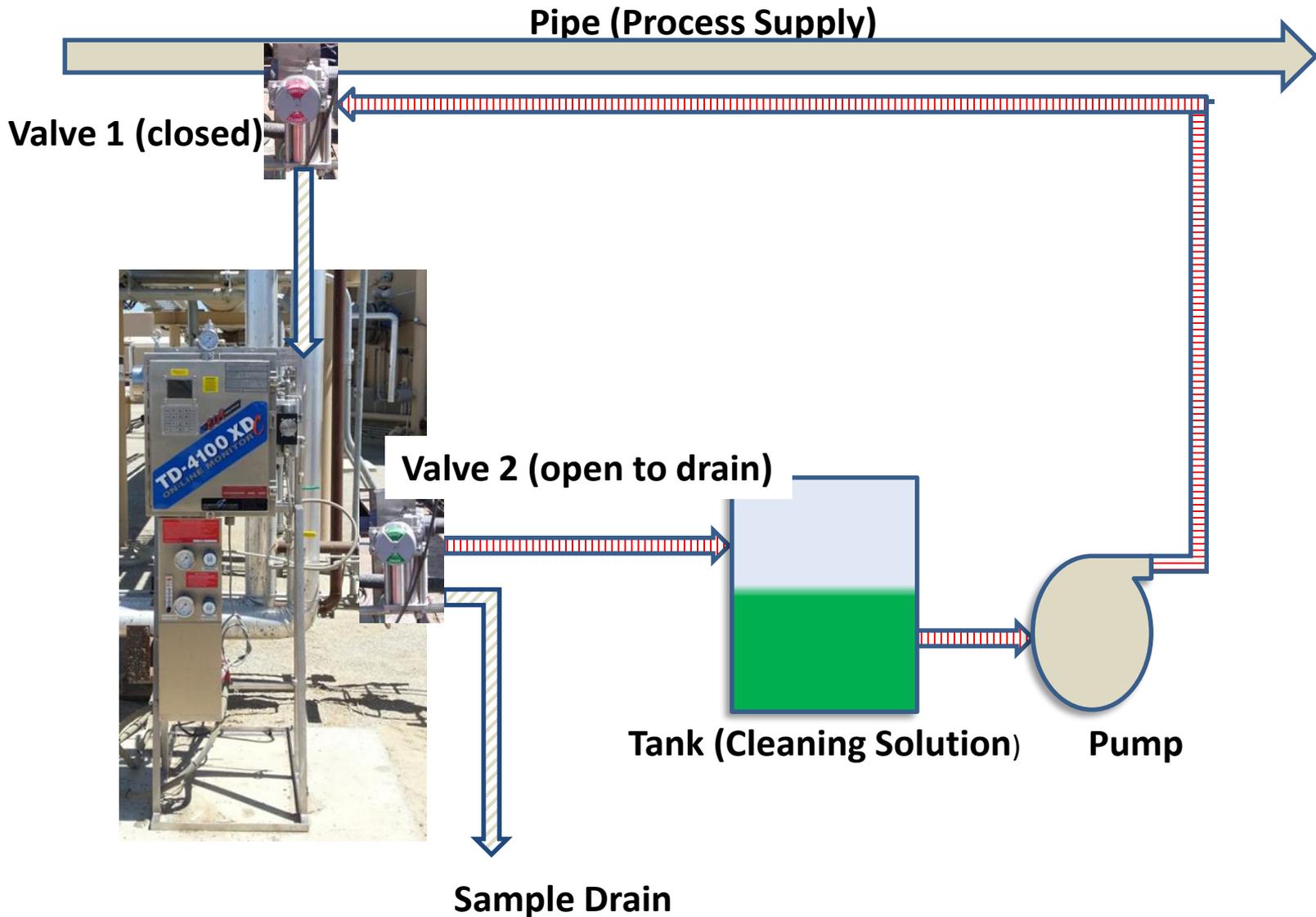


# Normal Process Flow



# CIP System Cleaning: Step 1

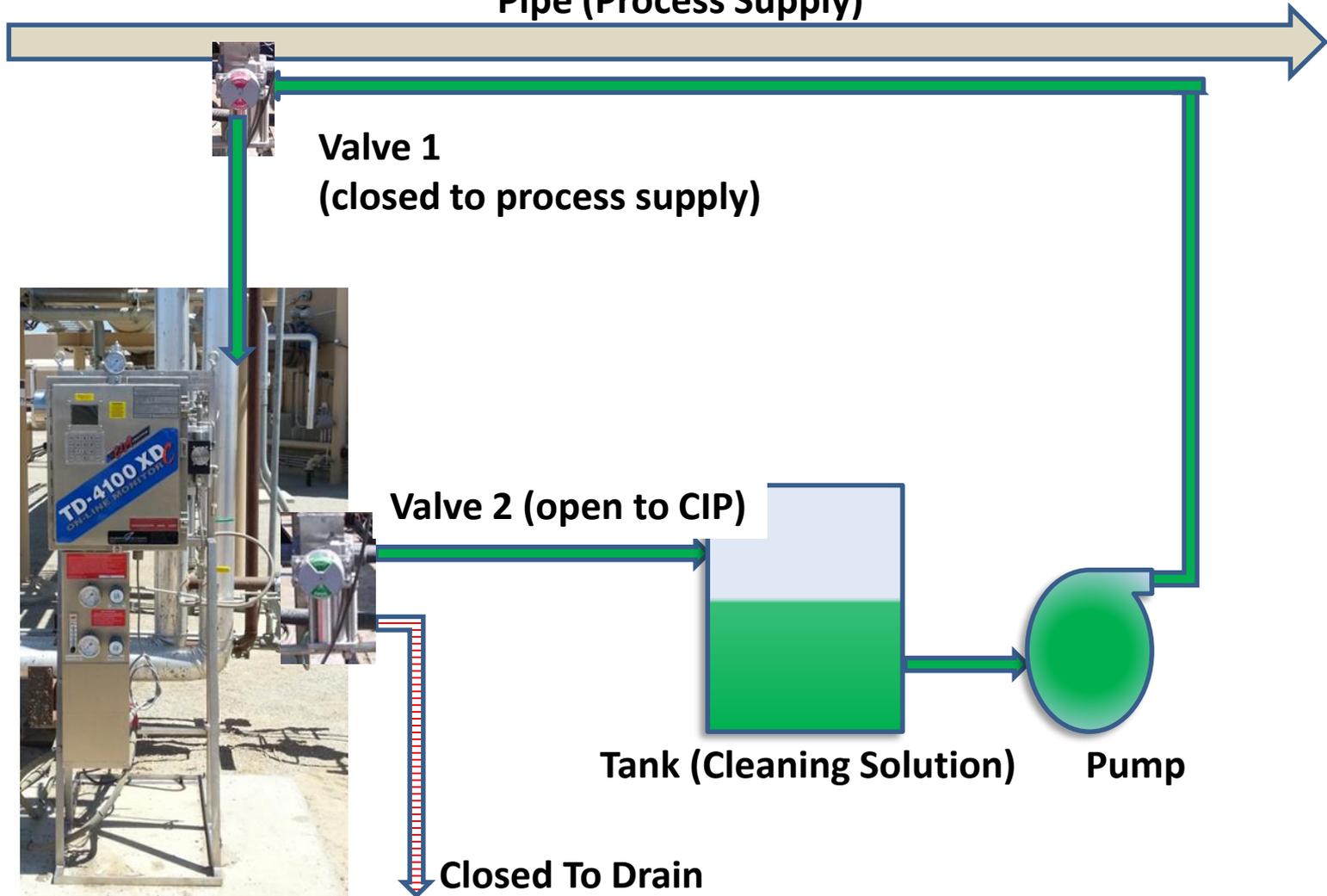
*Drain the supply and return lines*



# CIP System Cleaning: Step 2

*Open valves to CIP, and pump cleaning solution*

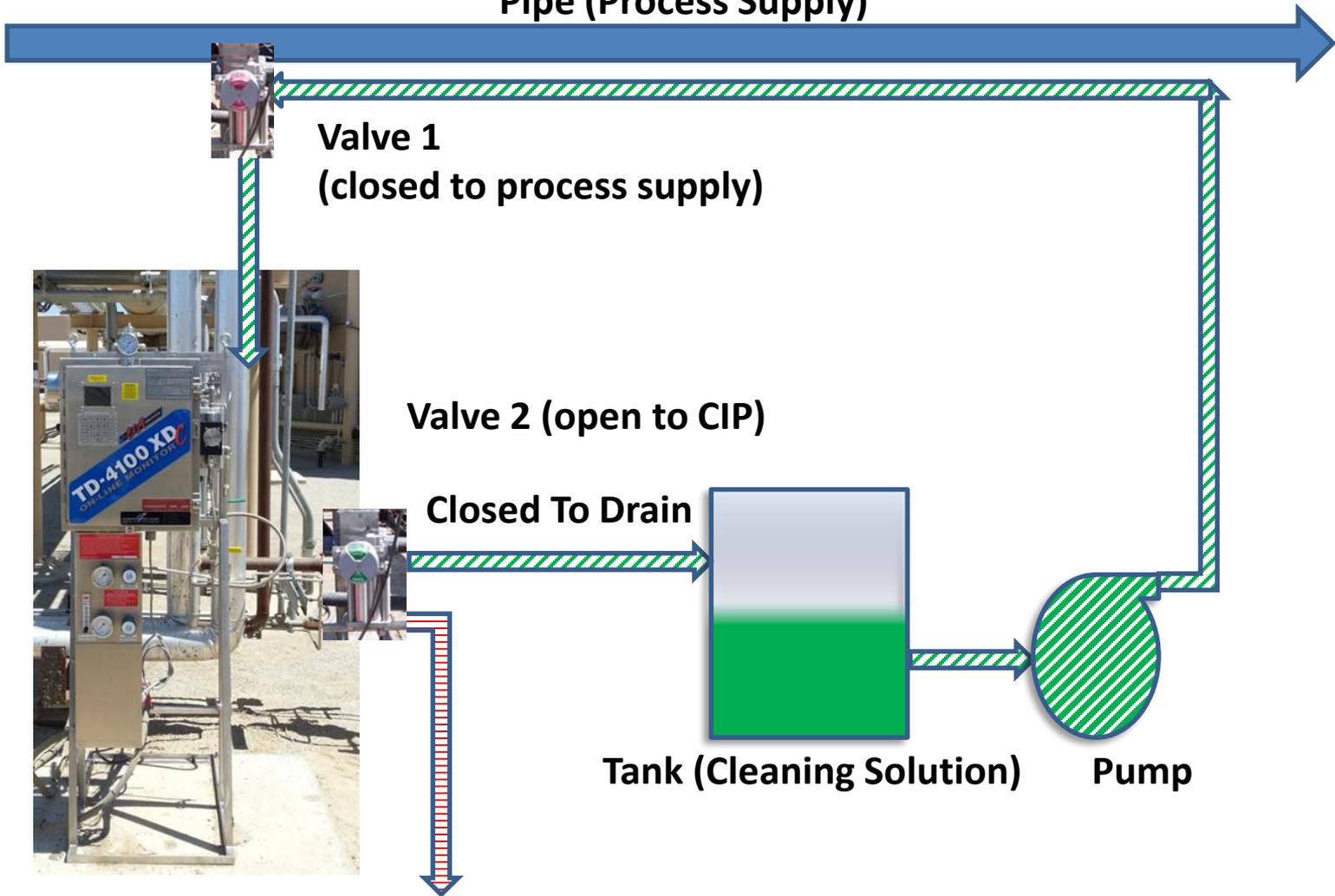
Pipe (Process Supply)



# Cleaning: Step 3

*Drain cleaning solution from lines*

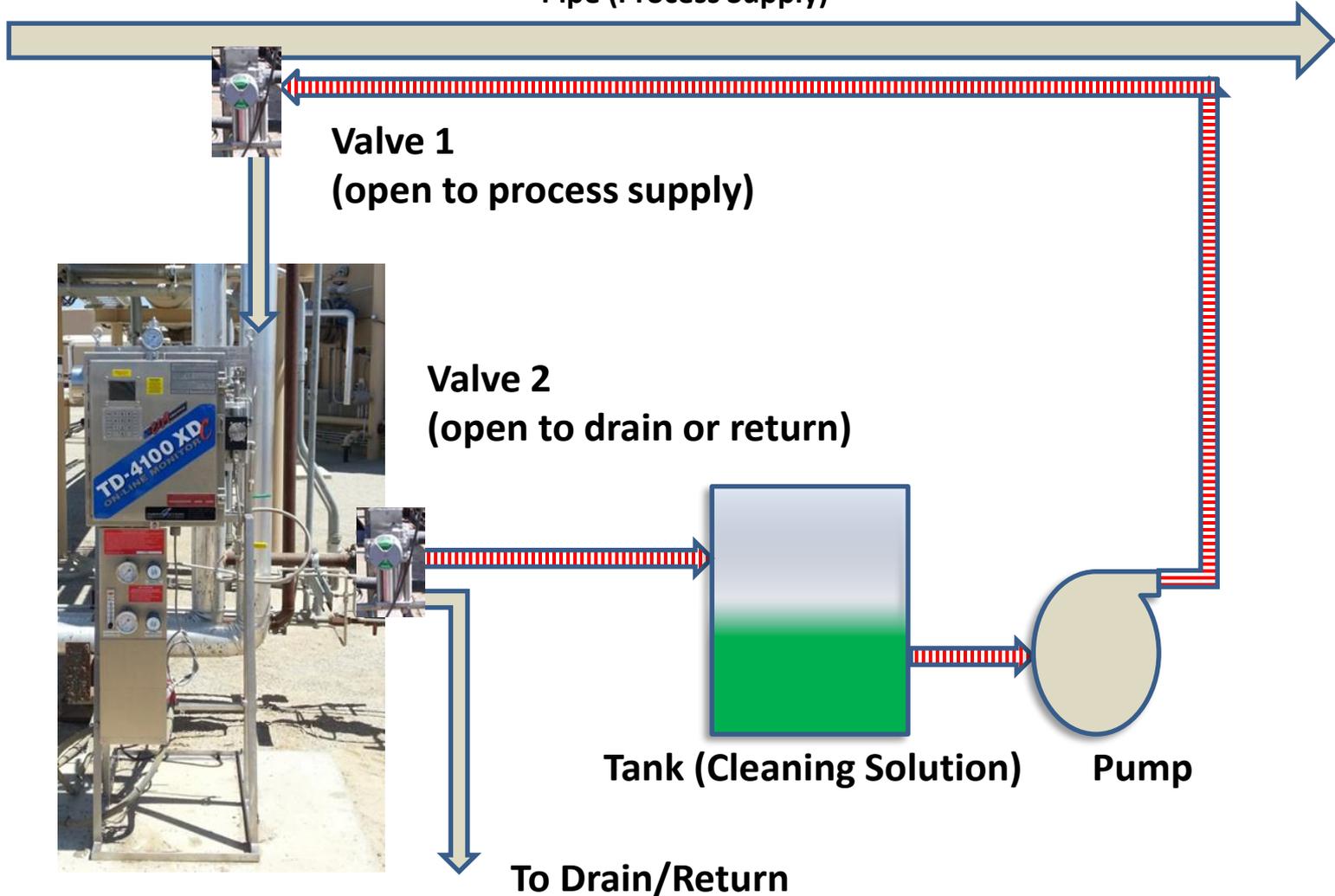
Pipe (Process Supply)



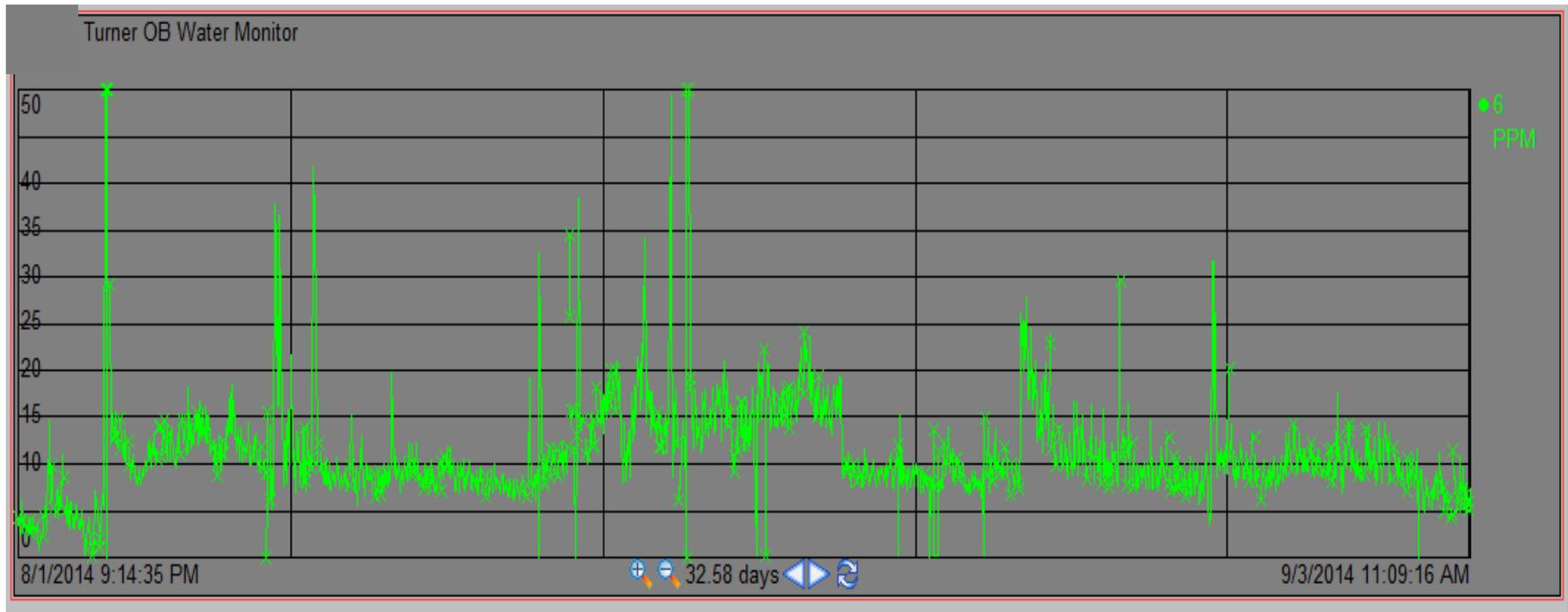
# Return to Normal Process

*Open valves to process supply and return*

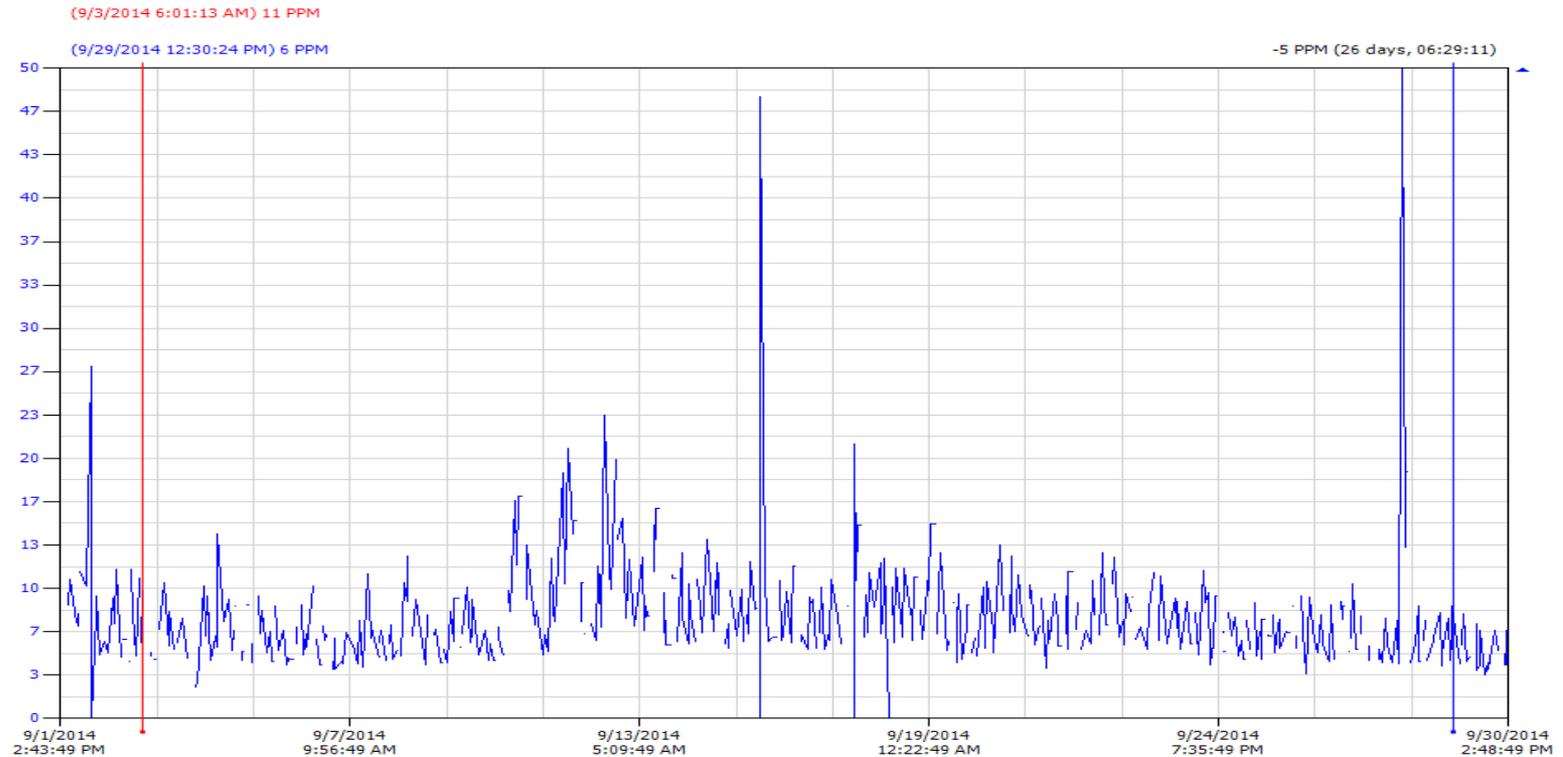
Pipe (Process Supply)



# Loose the flat line!!



# No flat line allowed!!



# Conclusions:

## Clean in place systems.....

- ▶ Keep your oil in water monitoring system clean
- ▶ Very low cost of operation
- ▶ Allows you to see the full value of the monitor
- ▶ Can be purchased or we will provide the drawings for local fabrication.
- ▶ Expensive cleaning schemes are not needed.
- ▶ Levels the playing field for end users. Oil in water monitors can be evaluated on their measurement capability. CIP can be used on any oil in water monitoring system.

# Lessons Learned:

- ▶ The required chemical is most likely already on the facility.
- ▶ Cleaning frequency varies with the location.
- ▶ The chem rep is your friend.
- ▶ Automatic system is better than manual.
- ▶ Best system is the one you use!!

# Do it yourself!!

- ▶ You can buy these CIP systems from various suppliers or make it yourself. I will supply the drawings too anyone who wants to make it themselves or have it fabricated locally anywhere in the world.
- ▶ CIP works everywhere, why not on analyzer sample systems??

# Specify:

- ▶ “Automated, self contained clean in place (CIP) system that cleans from the sample take off to the drain connection.”



# THANK YOU!!

Gary Bartman,

Derrick Martinez, Chumin Campos, Chip Westaby

**Turner Designs Hydrocarbon Instruments,**

**Fresno, CA**

**Made in USA!!**

**24th Annual Produced Water Society Seminar**

**Houston, TX, USA, January 14-16th, 2014**