North Texas Chapter of NANT
13th Annual Symposium

Operating a Hemodialysis Water Treatment System

Burke A. West, P.E., CWS-VI

2012 November 4


DILBERT® by Scott Adams
OUR SAFETY DEPARTMENT HAS TESTED OUR DRINKING WATER AND FOUND NO PROBLEM.
THEN WHY DO YOU ONLY DRINK BOTTLED WATER?
BECAUSE THAT'S WHAT THE SAFETY DEPARTMENT DRINKS.
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Presentation is oriented to clinical nurses and others who use the water treatment system

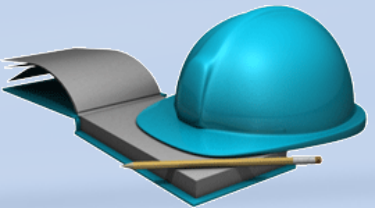
The goal of this presentation is to give the nurse the understanding necessary to operate the water treatment system correctly

- Water treatment systems are designed to use municipal water and provide AAMI standard water from it.

Example: Municipal Water Analysis VS AAMI Standard

Component	Feed Water mg/L	AAMI Standard mg/L
Calcium	13.700	2
Magnesium	20.200	4
Sodium	24.300	70
Potassium	4.500	8
Fluoride	0.600	0.2
Chlorine (Total)	2.400	0.5
Chloramines	2.400	0.1
Nitrate	0.090	2
Sulfate	29.000	100

Water treatment equipment operators are not expected to be water treatment experts – they are expected to know how to use the water treatment equipment



- TDH ESRD Facility Rules September 2003
- 117.33 b
- **(5)** Written policies and procedures for the operation of the water treatment system must be developed and implemented. **Parameters for the operation of each component of the water treatment system must be developed in writing and known to the operator.** Each major water system component shall be labeled in a manner that identifies the device; describes its function, how performance is verified and actions to take in the event performance is not within an acceptable range.

Learning the basics of the water treatment system is easy – everything that you need to know is waiting for you in the water treatment room.

The operator needs to become familiar with the documentation in the water treatment room

Water Treatment System Labeling

- 510 (k) compliance document
- System Hydraulic Drawing
- Valve Chart
- Equipment Labels
- Parameter Verification Labels
- Water flow direction arrows

Water Treatment System Labeling

- ***510 (k) compliance document***
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Water Treament System Labeling

Nelson Water Systems for Hemodialysis

Document of certification

This document certifies that this Water Treatment System for Hemodialysis complies with Nelson Water Systems for Hemodialysis' FDA 510 (k) Number K993877. Nelson Water Systems for Hemodialysis is registered with the Food and Drug Administration as a Medical Device Manufacturer and Accessory Supplier for Water Treatment Subsystems 78FIP Class II.

Facility:

Burke A. West, P.E.

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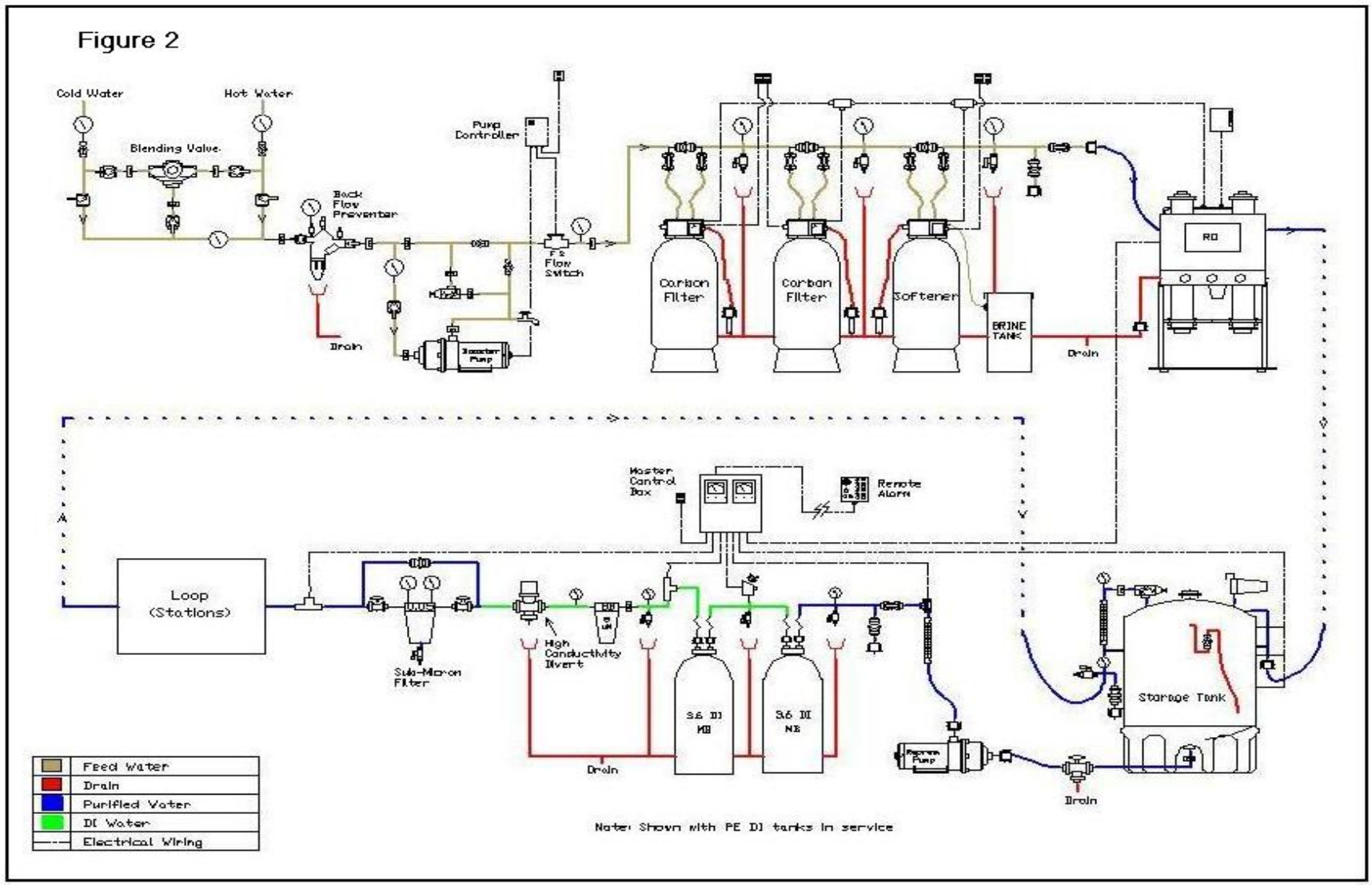

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Water Treatment System Labeling

Valve Tag Sheet

VALVE NO.	VALVE IDENTIFICATION	NORMAL OPERATION VALVE POSITION
-	-	-
14	INLET VALVE – EMERGENCY WATER CONNECTION	NORMALLY CLOSED
15	INLET VALVE – BOOSTER PUMP	NORMALLY OPEN
16	RELIEV VALVE – BOOSTER PUMP OVER PRESSURE RELIEF	NORMALLY CLOSED
17	HOSE BIBB – HOSE BIBB FOR CARBON REBED USE	NORMALLY CLOSED
18	INLET VALVE – SEDIMENT FILTER	NORMALLY CLOSED
19	OUTLET VALVE – SEDIMENT FILTER	NORMALLY OPEN
20	BYPASS VALVE – SEDIMENT FILTER	NORMALLY CLOSED
21	INLET VALVE – SOFTENER	NORMALLY OPEN
22	OUTLET VALVE – SOFTENER	NORMALLY CLOSED

Water Treatment System Labeling

- 510 (k) compliance document
- System Hydraulic Drawing
- Valve Chart
- ***Equipment Labels***
- Parameter Verification Labels
- Water flow direction arrows

Water Treatment System Labeling

CARBON FILTER

6 FT^3 12X40 GAC ACID WASHED

REMOVES ORGANIC AND
OXIDANTS FROM WATER

$$EBCT = \frac{7.48 \text{ BED SIZE } (FT^3)}{\text{FLOW (GPM)}} MIN$$

=5.44 MIN

Water Treatment System Labeling

- 510 (k) compliance document
- System Hydraulic Drawing
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- Equipment Labels
- ***Parameter Verification Labels***
- Water flow direction arrows

Water Treatment System Labeling

SYSTEM PARAMETER VERIFICATION SHEET

LOCATION: After worker carbon tank (SP#1)

PARAMETER: Total chlorine

TEST PROCEDURE:

1. Run RO for a minimum of 15 minutes.
2. Draw sample through SP #1
3. Perform DPD test for total chlorine per test kit instructions
4. If any chlorine detected, draw a sample through SP#2. Advise Director of results after logging them.
5. If no chlorine detected, log results.

ACCEPTIBLE RANGE: 0 mg/L to 0.1 mg/L

ACTION LEVEL: Any detect level.

ACTION: Advise Director immediately. Call water vendor

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Water Treatment System Labeling

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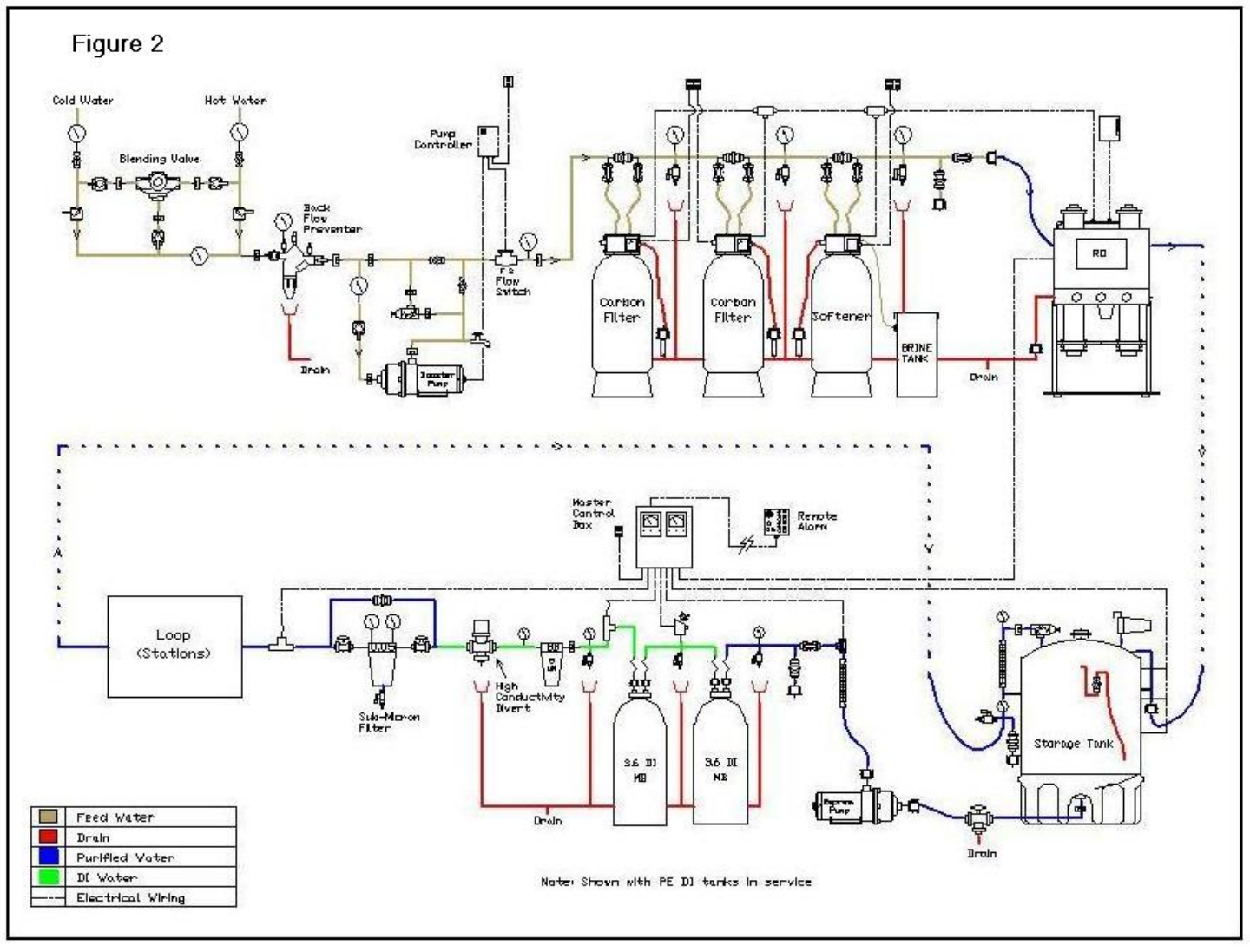

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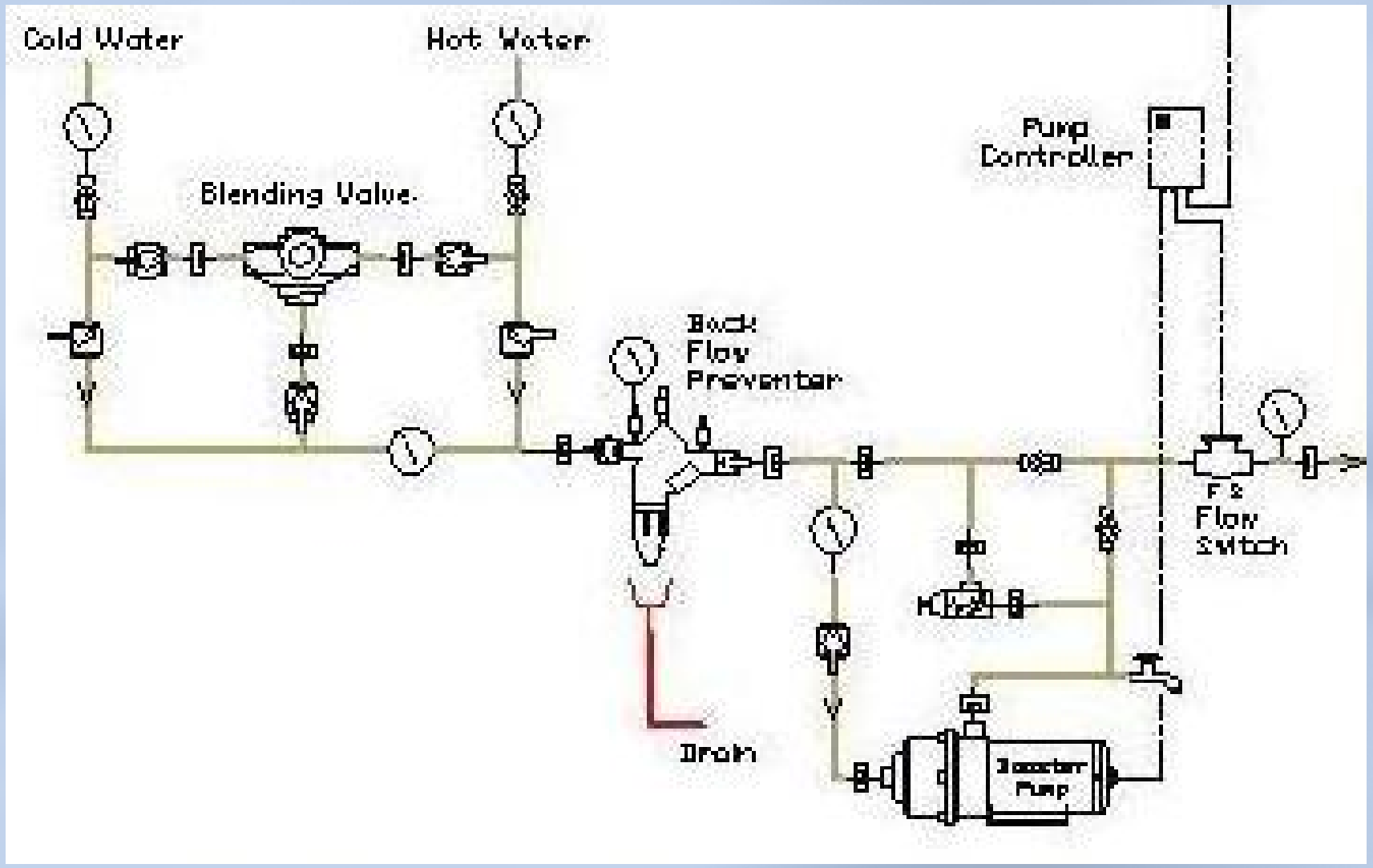

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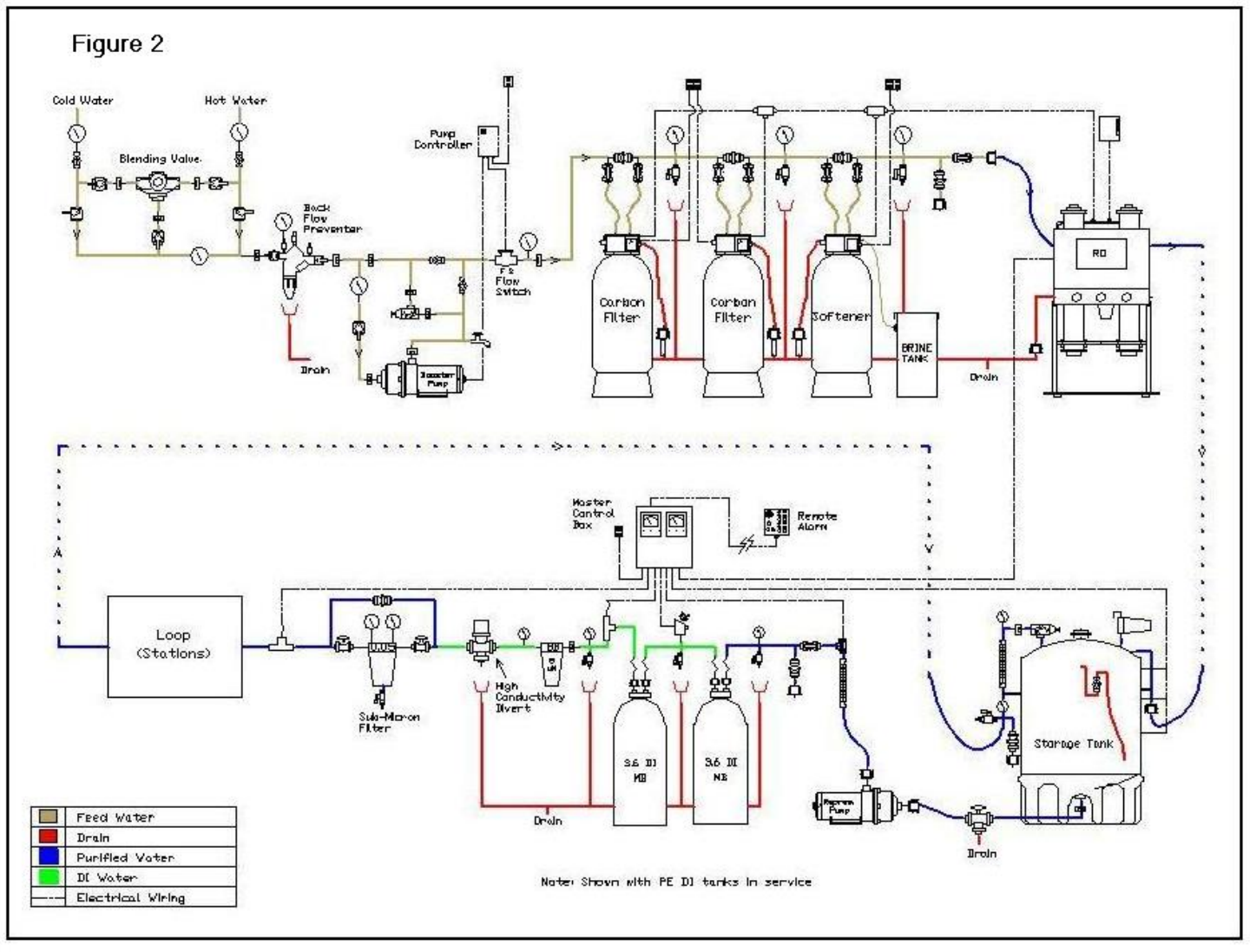

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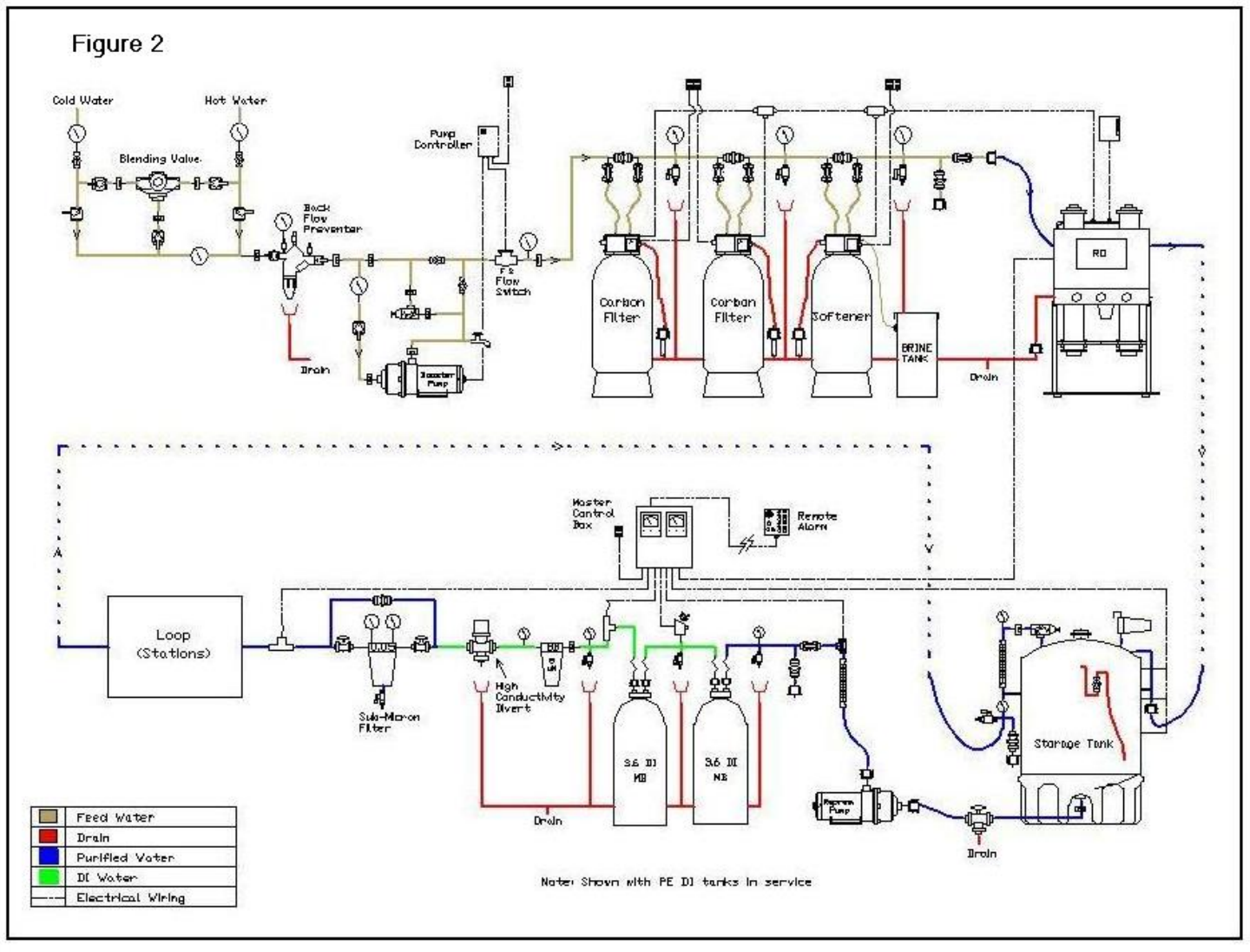

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REMOVES ORGANIC AND
OXIDANTS FROM WATER

$$EBCT = \frac{7.48 \text{ BED SIZE } (FT^3)}{\text{FLOW (GPM)}} MIN$$

=5.44 MIN

Water Treatment System Labeling

SYSTEM PARAMETER VERIFICATION SHEET

LOCATION: After polisher carbon tank (SP#2)

PARAMETER: Total chlorine

TEST PROCEEDURE:

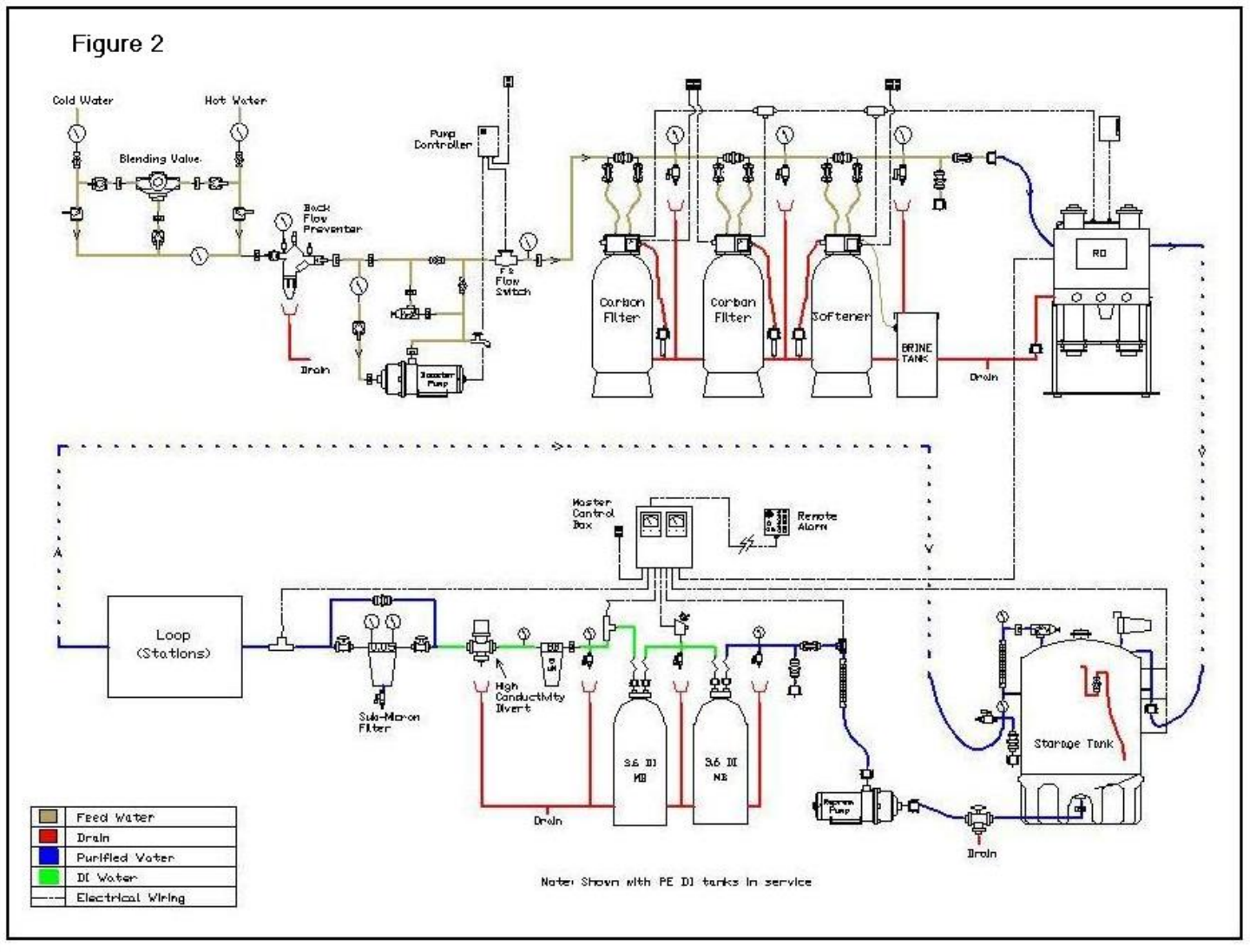
1. Run test only if total chlorine detected at SP#1
2. Draw sample through SP #2
3. Perform DPD test for total chlorine per test kit instructions
4. If any chlorine detected, advise Director of results after logging them.
5. If no chlorine detected, log results.

ACCEPTIBLE RANGE: 0 mg/L to 0.1 mg/L

ACTION LEVEL: Any detect level.

ACTION: Advise Director immediately. Call water vendor

Water Treatment System Labeling



Water Treatment System Labeling

SOFTENER

5 FT^3 MEDIA
150,000 GRAIN

REMOVES HARDNESS IONS (Ca, Mg, etc) FROM WATER AND REPLACES WITH SODIUM IONS

Water Treatment System Labeling

SYSTEM PARAMETER VERIFICATION SHEET

LOCATION: After softener (SP#4)

PARAMETER: Water hardness

TEST PROCEEDURE:

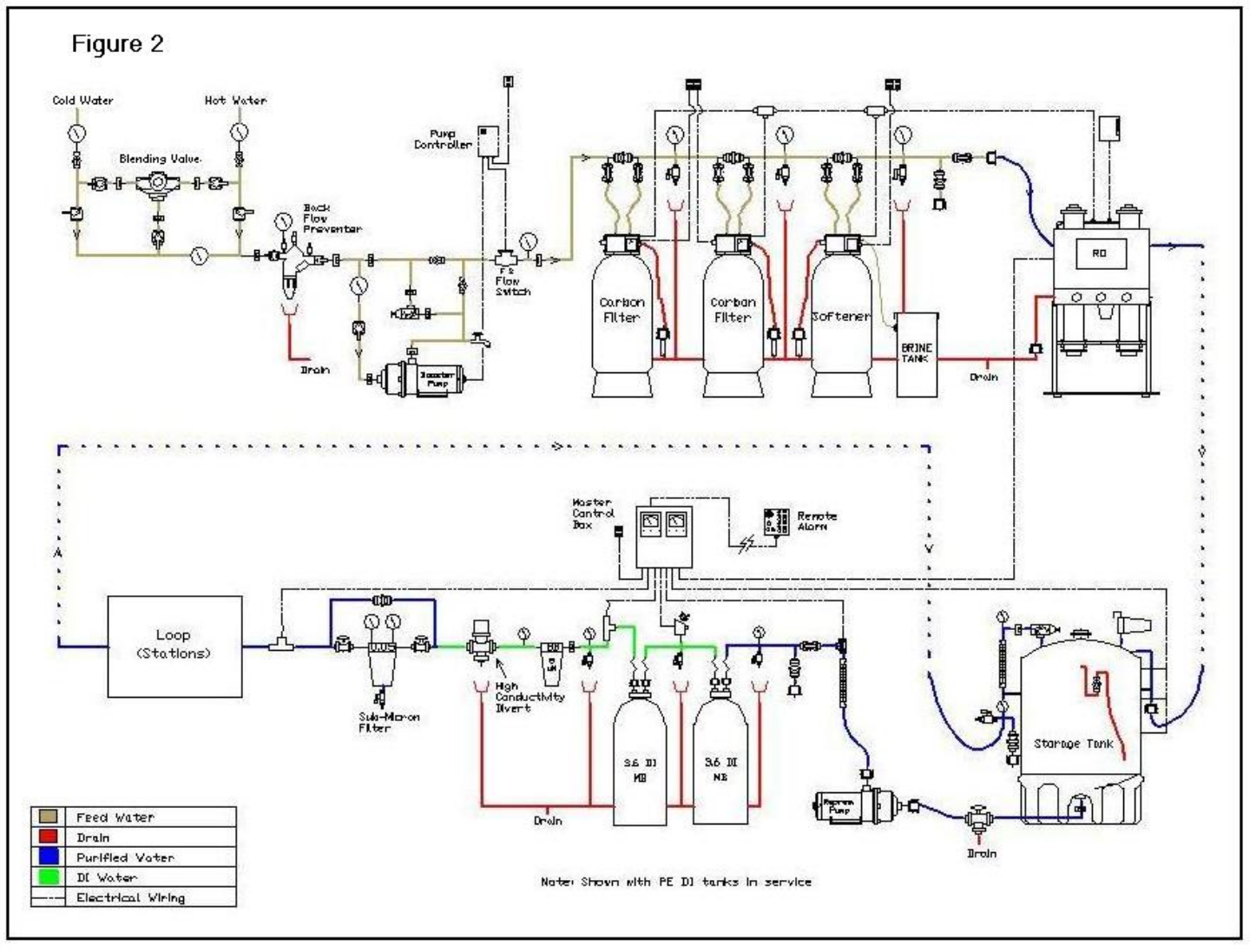
1. Draw sample at the end of the day through SP #3, after a 1 to 2 second flush
2. Perform hardness test using a Hach 5B hardness test kit by following the test kit instructions
3. Each drop indicates 1 grain per gallon of hardness in the water.

ACCEPTIBLE RANGE: 0 to 3 drops

ACTION LEVEL: 3 drops or a trend towards 3 drops over a few days.

ACTION: Call water vendor

Water Treatment System Labeling



Water Treatment System Labeling

REVERSE OSMOSIS MACHINE

THREE 4"X40" MEMBRANES

Reverse osmosis machines remove ionized metal salts from the supply water. The higher the valence of the ion, the greater the reduction in the permeate (purified water stream). The concentrate water stream contains the water impurities and is sent to drain. RO machines normally reject about 97% of the metal ions. RO machine recovery (% of permeate flow/feed flow) is usually between 50% and 75%.

Water Treatment System Labeling

SYSTEM PARAMETER VERIFICATION SHEET

LOCATION: RO permeate flow stream

PARAMETER: Conductivity of RO permeate

TEST PROCEEDURE:

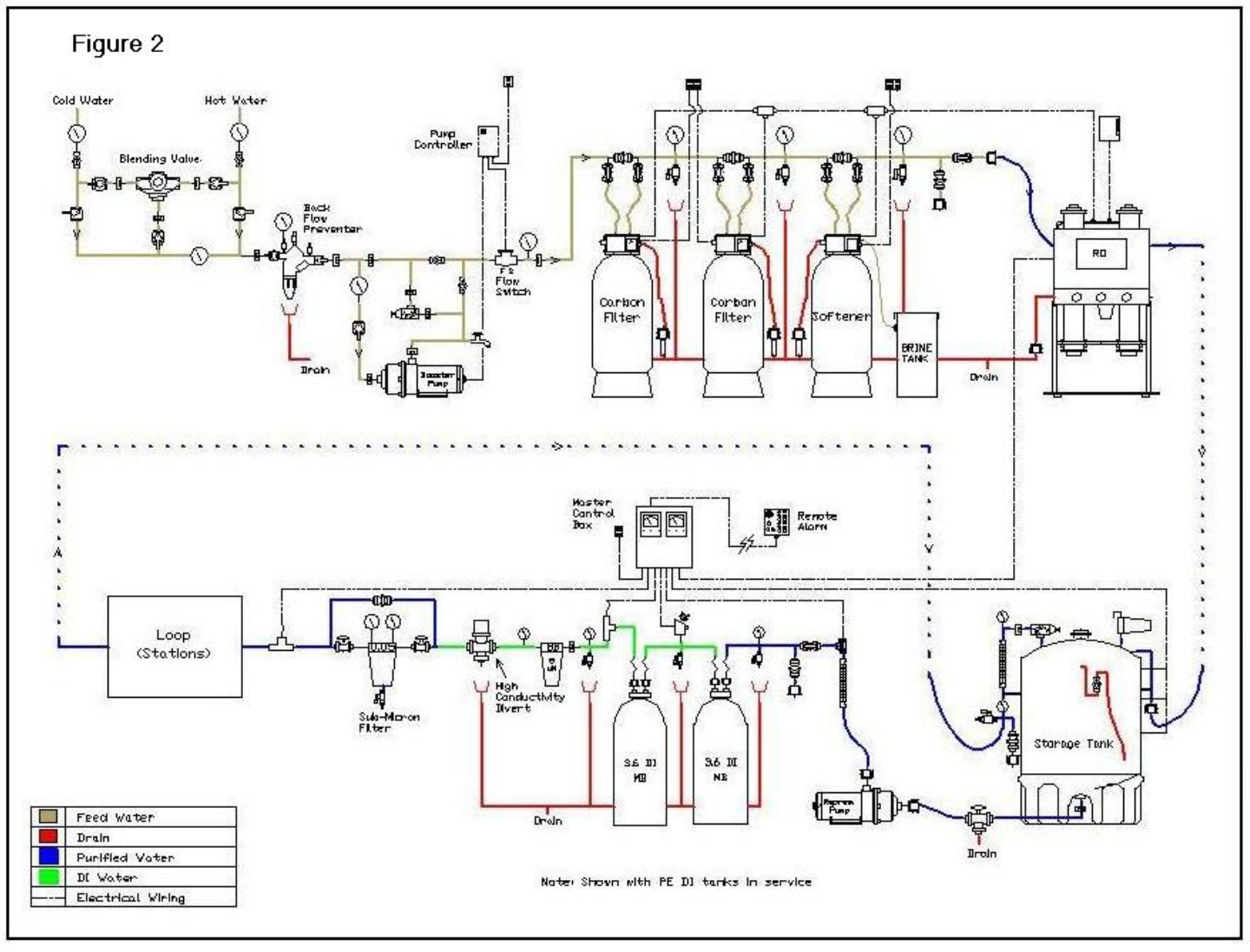
1. Draw sample through RO permeate sample port, after a 1 to 2 second flush
2. Note and log the reading from the hand held conductivity monitor

ACCEPTIBLE RANGE: 0 mg/L to 75 mg/L

ACTION LEVEL: 30 mg/L or when an increasing trend is developing.

ACTION: Call water vendor

Water Treatment System Labeling



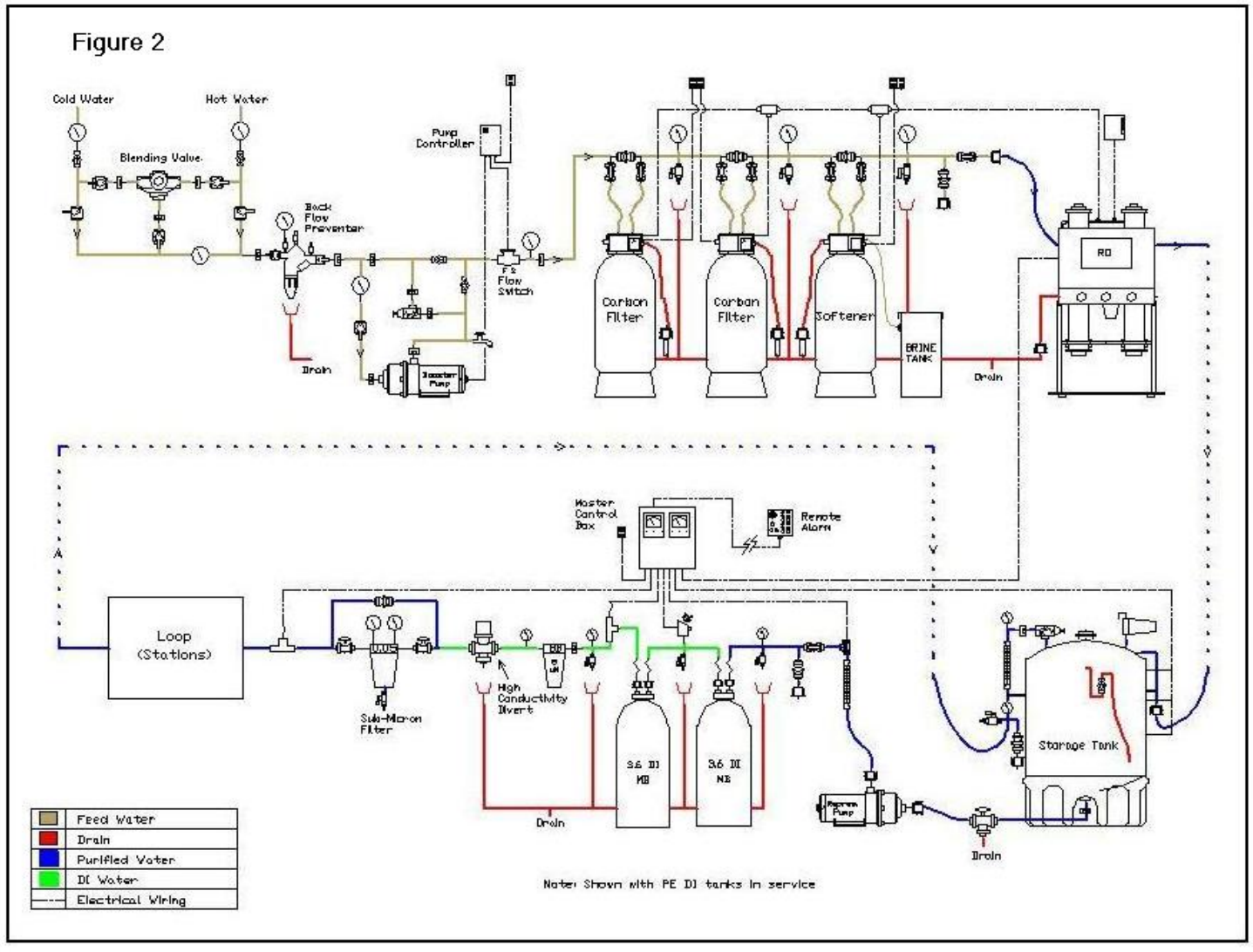
Water Treatment System Labeling

CONICAL-BOTTOM STORAGE TANK

HERMETICALLY-SEALED HDPE TANK
CAP. OF TANK: 250 GALLONS

The purified water storage tank is used to store the purified water ready to send to the patient station loop. It includes a 0.2 um absolute breather filter, a self-siphoning, back-flow-prevented over-fill system, bottom feed with drain valve, return system with pressure relief regulator, sample port, pressure gauge, tank sprayers and power drain valve, and non-intrusive tank level control system for controlling the RO unit.

Water Treatment System Labeling



Water Treatment System Labeling

DEIONIZATION

POLISHING

1.2 FT^3 OF MIXED BED (MB) MEDIA

IN PORTABLE EXCHANGE (PE) TANKS

Mixed bed DI media exchanges the ionized metal salts that pass through the reverse osmosis unit (mostly sodium and chloride ions) for hydrogen and hydroxil ions that combine to produce pure water.

Water Treatment System Labeling

SYSTEM PARAMETER VERIFICATION SHEET

LOCATION: After the worker DI tank (SP#7)

PARAMETER: Resistivity of the worker DI output

TEST PROCEEDURE:

1. Observe the color of the lamp – red or green
2. If it is red, the tank is exhausted and needs to be replaced.
3. If it is green, the DI tank still has capacity left.

ACCEPTIBLE RANGE: Green

ACTION LEVEL: Red light.

ACTION: Call water vendor

Water Treatment System Labeling

SYSTEM PARAMETER VERIFICATION SHEET

LOCATION: After the polisher (#2) DI tank

PARAMETER: Resistivity of the polisher DI output

TEST PROCEEDURE:

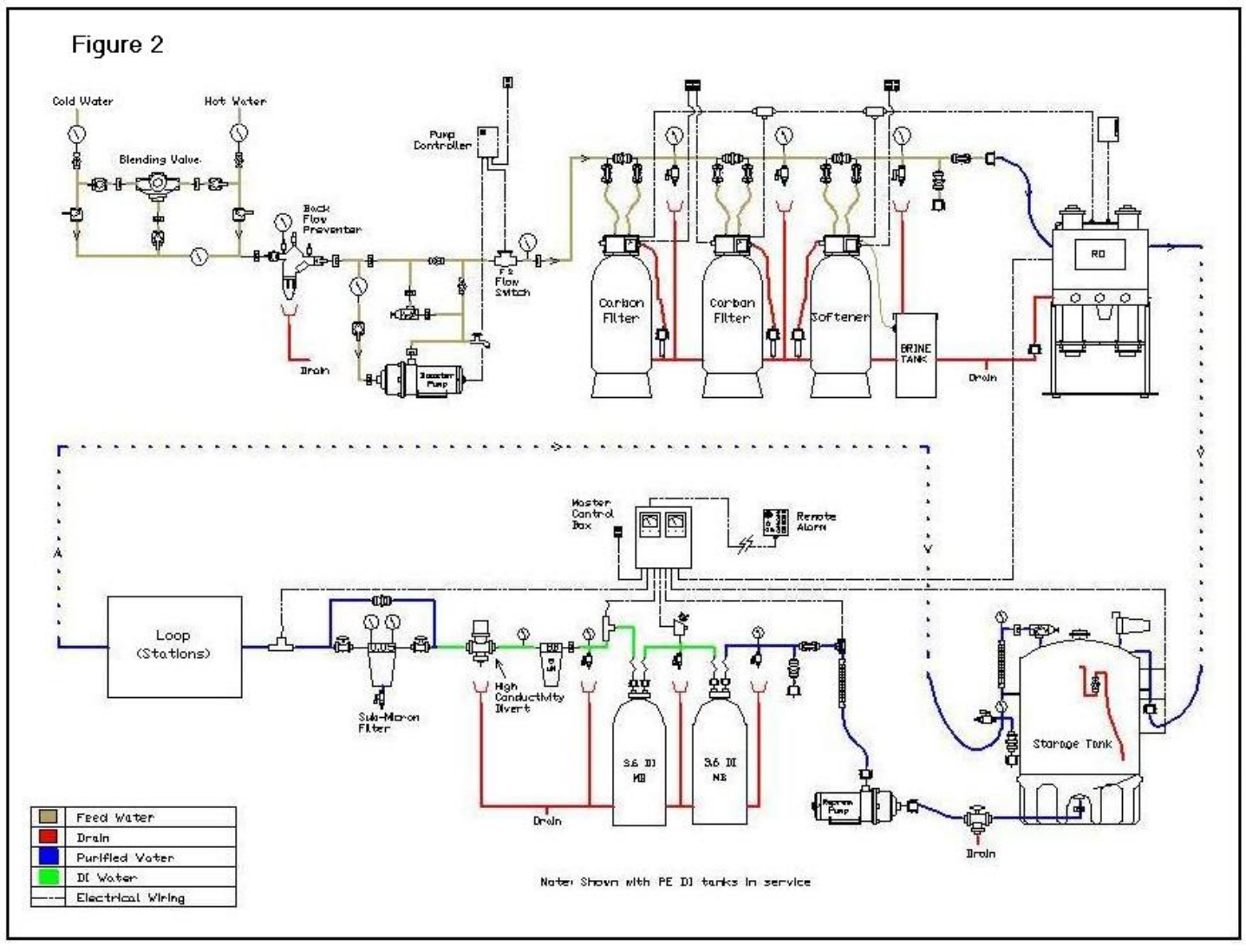
1. Read the resistivity monitor mounted on the RO control box face. It should read between 10 megohm and 18 megohm.
2. Log reading. Observe for any trends.

ACCEPTIBLE RANGE: 1 megohm to 18 megohm

ACTION LEVEL: 5 megohm or trend downward of resistivity

ACTION: Call water vendor

Water Treatment System Labeling



Water Treatment System Labeling

ULTRAFILTER

0.05-UM ABSOLUTE X 20”
CARTRIDGE FILTER

Ultrafilters remove all solid particles (such as bacteria, endotoxins, and other pyrogens) down to their rated pore size.

Water Treatment System Labeling

SYSTEM PARAMETER VERIFICATION SHEET

LOCATION: Ultrafilter

PARAMETER: Delta Pressure

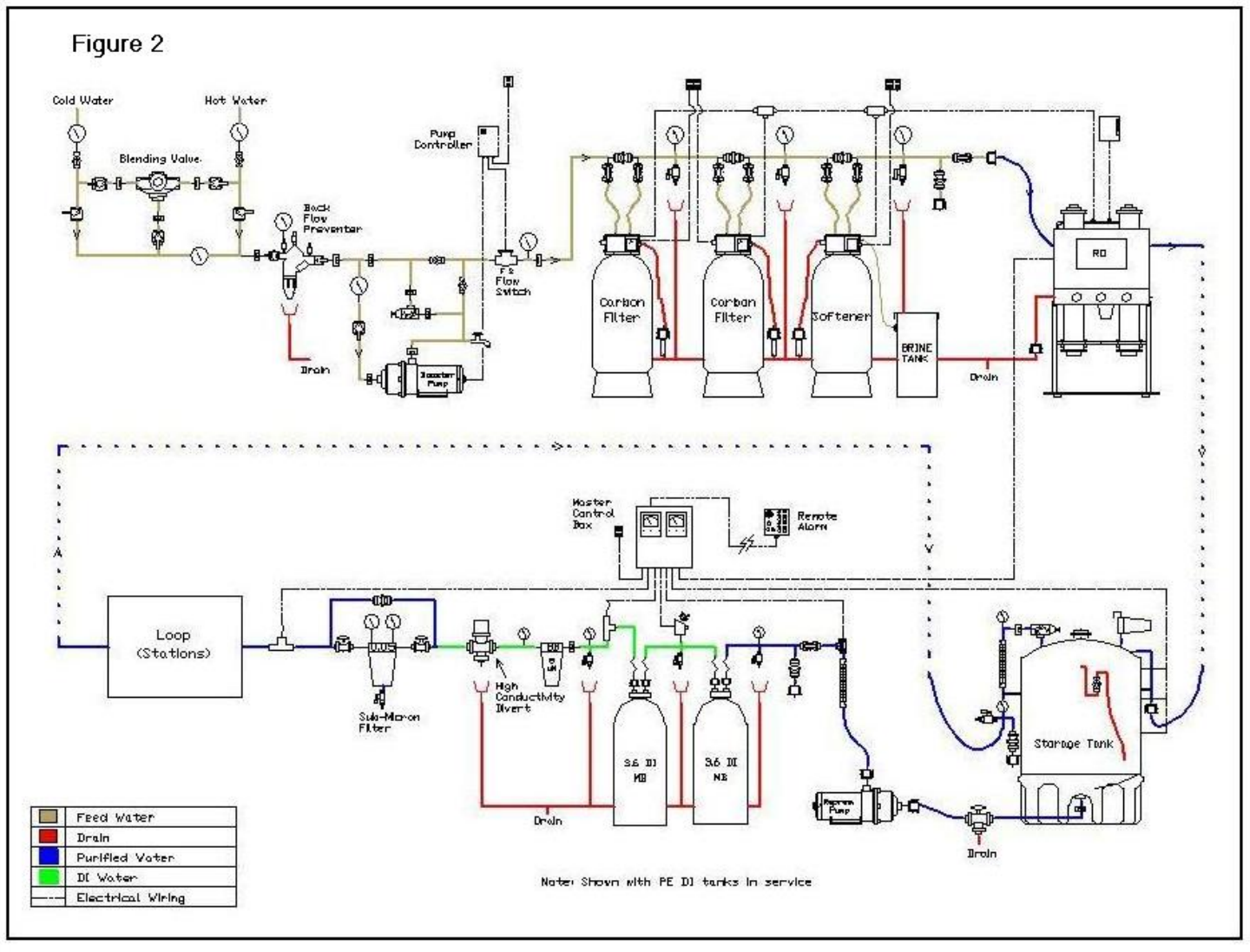
TEST PROCEEDURE:
Read the pre and post pressure gauges on the Ultrafilter and compare the different between the gauges to the original reading written on filter housing.

ACCEPTIBLE RANGE: original delta pressure to the value of the original delta pressure plus 10 - 12psi.

ACTION LEVEL: When the delta pressure is the original delta pressure plus 10 psi

ACTION: Call water vendor

Water Treatment System Labeling



Water Treatment System Log

- **The log is the most important document in the water treatment room.**
- **Is a legal document.**
- **The operator initials the data that he/she enters.**
- **Most water treatment operator mistakes are made entering data into the log.**
- **Use the log carefully and accurately.**

Water Treatment System Log

Hemodialysis Water Treatment System Weekly Log		
NOTE: WATER SYSTEM MUST BE RUNNING FOR 15 MINUTES BEFORE RECORDING CHLORINE DATA		
Day	Monday	Tuesday
Date	/ /	/ /
Time RO Turned on in Flush Mode	/	/
Nurse or Technicians Initials		
Salt Level In Brine Tank (Y or N)	-	
Pre #1GAC Pressure, P1 (> 25 psi)		
Pre #2 GAC Pressure, P2 (> 25 psi)		
Pre-Softener Pressure, P3 (> 25 psi)		
Pre-RO Filter Pressure, PR1 (>20 psi)		
Post-RO Filter, PR2 (PR2 - PR1 < 10 psi)	/	/
RO Pump Pressure, PR3 (125 - 225 psi)		
RO Reject Pressure, PR4 (75 - 225 psi)		
RO Feed TDS (Cin on RO Screen), (us)		
RO Product TDS (Cout on RO Screen), (< 75 us) *Action Level : if Cout > 30 us		

Water Treatment System Log

RO Reject Pressure, PR4 (75 - 225 psi)	
RO Feed TDS (Cin on RO Screen), (us)	
RO Product TDS (Cout on RO Screen), (< 75 us) *Action Level : if Cout > 30 us	
R.O. Percent Rejection (>90%)	
Reject Flow (780 - 950 lph)	
Permeate Flow (> 600 lph)	

Water Treatment System Log

Be Careful (your signature is recorded)

- Record exactly what you see (not what it should be)
- Do not make an entry unless you have observed the reading
- Make sure the reading is within the acceptable range and notify your supervisor if not within range.
- Always use a ball point pen (not gel tips or pencil) cross through mistakes with a single line and initial (do not blacken out nor use white out.)

Water Treatment System Log

Use the log as a tool:

- Be proactive - Looking at the data differentiates the best operators from the rest. Identifying trends can save much reactive work later on.

Water Treatment System Alarms

Water treatment systems have alarms to alert the operator that either some event has occurred that needs immediate attention or some event may occur that needs attention

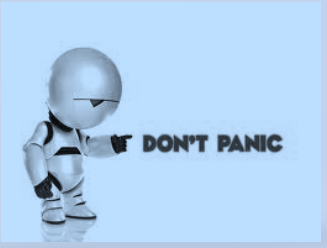
Water Treatment System Alarms

TDH regulations require:

- All alarms that are present as part of the water treatment system must also have a remote audio-visual alarm that is located near and in sight of the nurses' station;
- If mutable, the alarm must re-set after 3 minutes

Water Treatment System Alarms

- Operators must pay attention to alarms because they are designed into the system for a reason. Don't mute and ignore!
- On the other hand, don't panic! Safeguards are designed into hemodialysis water treatment systems to protect the health and safety of patients.



Water Treatment System Alarms

- Operators are responsible for knowing what each alarm is for and how to respond to each alarm.
- Each alarm should be clearly labeled. However, the action to take for each alarm is not usually in the vicinity of the remote alarm. The operator must know where these instructions are located.

In Summary

1. Operators are responsible for knowing how to operate the water treatment system:

   - What each component does,
   - The associated parameters,
   - The acceptable range for each,
   - Action level and required action.

In Summary

2. Operators are responsible for filling out the system log sheet:

   - Accurately
   - Verify readings are within range
   - Document actions taken if not within range

In Summary

3. Operators must pay attention to alarms:

- Know what each alarm is for
- Take appropriate action to resolve alarm condition
- Document event

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Questions?