SAMCO

Separation from the ordinary

Reverse Osmosis System

SUBMITTAL

Customer: Plant Process Equipment, Inc.
Customer PO#: 2357-E005
SAMCO SO#: 5776

Submittal#: 001
Description: Front End Design
Revision: 1
Date: 2/22/2019

DOCUMENT	REV
SO5776 System Specification	0
Drawing 5776-F01 PFD	0
Drawing L01 P&ID Legend	0
Drawing 5776-Pxx P&ID	0
SO5776 Functional Description	0
SO5776 Pipe Spec – 316SS	0
SO5776 Pipe Spec – PVC80	0
SO5776 Coating Spec – CS Structural	0

FOR INFORMATION
RELEASE FOR CONSTRUCTION

THE EQUIPMENT FURNISHED BY SAMCO HEREUNDER IS SOLD OR SUPPLIED WITHOUT WARRANTY AGAINST PROPERTY DAMAGE OR INJURIES RESULTING FROM ITS USE.

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SAMCO
Separation from the ordinary

System Specification

SO#5776 Rev.0 2/5/19 RFC

Customer	Plant Process Equipment	**Unit**	Reverse Osmosis System
PO#	2357-E005	**Job Site**	North Las Vegas, NV

1 Description – The RO Assembly utilizes membrane arrays with chemical feed preatreatment to produce purified water for plant services

2 System Design Conditions

2.1 Feed Water

2.1.1 Composition: City Water, See Appendix 1

2.1.1.1 Feed source to be "membrane-like" filtration quality (<1NTU turbidity)

2.1.1.2 SDI <3

2.1.2 Flowrate

2.1.2.1 Normal: 240 gpm

2.1.3 Pressure

2.1.3.1 Minimum: 50 psig

2.1.3.2 Maximum: 90 psig

2.1.4 Temperature

2.1.4.1 Design: 60°F

2.1.4.1.1 Operation at lower than design temperature may yield less than design production rate

2.1.4.2 Minimum: 40°F

2.1.4.3 Maximum: 100°F

2.2 Permeate

2.2.1 Composition: See Membrane Projected Quality, Appendix 2

2.2.1.1 This quality is estimated and not guaranteed

2.2.2 Flowrate: 180 gpm

2.2.3 Back pressure

2.2.3.1 Maximum: 20 psig

2.2.4 Temperature: Same as feed water

3 Customer Utility Requirements

3.1 Electrical

3.1.1 Motor Power 460 VAC / 3-phase / 60 Hz, 45A

3.1.2 Control Power 120 VAC / 1-phase / 60 Hz, 10A

3.2 Instrument Quality Air

3.2.1 Quality ANSI/ISA-S7.0.01-1996

3.2.2 Flowrate 10 scfm

3.2.3 Pressure 80 psig (minimum)

3.3 Wastewater Drain

3.3.1 Maximum wastewater back pressure is 15 psig

3.3.2 Flow

3.3.2.1 Normal running: 60 gpm

3.3.2.2 Off spec dump: 240 gpm

4 Customer Chemical Requirements

4.1 Antiscalant, SAMCO 604000-VT3000

4.1.1	Quality:	N/A
4.1.2	Quantity:	55 gallon drum
4.1.3	Pressure:	Atmospheric
4.1.4	Temperature:	Ambient

4.2 Chlorine remover, SAMCO 604500-ACHL427

4.2.1	Quality:	N/A
4.2.2	Quantity:	55 gallon drum
4.2.3	Pressure:	Atmospheric
4.2.4	Temperature:	Ambient

5 System Electrical Design

5.1	Area Classification:	General Purpose Non Hazardous
5.2	Enclosures:	NEMA 4
5.3	Conduit:	PVC

6 Other

6.1	Instrument Tubing:	Polyethylene
6.2	Air Tubing:	Polyethylene
6.3	Support Structure	Carbon steel with epoxy/polyurethane finish coat
6.3.1	Reference SO5776 Coating Spec – CS Structural	

7 Site Conditions

7.1	Structural Design:	Per IBC2015
7.1.1	Seismic:	Site Class D, Importance Factor 1
7.1.2	Wind:	None
7.1.3	Snow:	None
7.2	Location:	Indoors, North Las Vegas, NV
7.3	Ambient Temperature	
7.3.1	Maximum:	100°F
7.3.2	Minimum:	55°F

Appendix 1 – City Water quality

ANALYTICAL RESULTS

CLIENT SAMPLE ID: **Kitchen Sink** DATE/TIME SAMPLED: 1/17/19 8:20
VERITAS SAMPLE ID: V19A049-01 DATE/TIME RECEIVED: 1/17/19 9:30

Matrix: Drinking Water

Analysis: Total Inorganics

PARAMETER	RESULT	RL (MRL)	UNITS	DF	METHOD	DATE ANALYZED	CAS NO.	SUB LAB/ QUAL
Alkalinity, Bicarbonate (as CaCO3)	130	20	mg/L	1	EPA 2320B	1/17/19	71-52-3	
Alkalinity, Carbonate (as CaCO3)	ND	20	mg/L	1	EPA 2320B	1/17/19	3812-32-6	
Alkalinity, Total (as CaCO3)	130	20	mg/L	1	Calculation	1/17/19	NA	
Chloride, Total	79	25	mg/L	5	EPA 300.0	1/17/19	16887-00-6	
Fluoride, Total	0.67	0.50	mg/L	5	EPA 300.0	1/17/19	16984-48-8	
Hardness, Total (as CaCO3)	260	2.5	mg/L	100	SM 2340B	1/28/19	NA	
Langlier Index	-0.28	-	NA	1	Calculation	1/28/19	NA	
Nitrate, Total (as N)	ND	0.50	mg/L	5	EPA 300.0	1/17/19	14797-55-8	
Nitrite, Total (as N)	ND	0.50	mg/L	5	EPA 300.0	1/17/19	14797-65-0	
Orthophosphate (as P)	ND	0.10	mg/L	1	EPA 300.0	1/18/19	98059-61-1	AST
pH	7.93	0.10	pH Units	1	SM 4500 H+B	1/17/19	NA	H5
Specific Conductance	1100	0.99	uS/cm	1	EPA 9050A	1/17/19	NA	
Sulfate, Total	210	25	mg/L	5	EPA 300.0	1/17/19	14808-79-8	
Total Dissolved Solids (TDS)	599	15	mg/L	1	SM 2540C	1/23/19	NA	
Total Organic Carbon (TOC)	133	2	mg/L	2	EPA 9060A	1/23/19	NA	PAN
Total Residual Chlorine	ND	0.50	mg/L	1	HACH 8167	1/17/19	7782-50-5	H5
Turbidity	ND	1.00	NTU	1	SM 2130B	1/18/19	NA	

Analysis: Total Metals

PARAMETER	RESULT	RL (MRL)	UNITS	DF	METHOD	DATE ANALYZED	CAS NO.	SUB LAB/ QUAL
Aluminum, Total	ND	0.10	mg/L	1	EPA 200.7	1/28/19	7429-90-5	
Arsenic, Total	ND	0.030	mg/L	1	EPA 200.7	1/28/19	7440-38-2	
Barium, Total	0.11	0.0030	mg/L	1	EPA 200.7	1/28/19	7440-39-3	
Beryllium, Total	ND	0.0030	mg/L	1	EPA 200.7	1/28/19	7440-41-7	
Boron, Total	0.11	0.030	mg/L	1	EPA 200.7	1/28/19	7440-42-8	
Cadmium, Total	ND	0.0030	mg/L	1	EPA 200.7	1/28/19	7440-43-9	
Calcium, Total	66	1.0	mg/L	10	EPA 200.7	1/28/19	7440-70-2	
Chromium, Total	ND	0.0050	mg/L	1	EPA 200.7	1/28/19	7440-47-3	
Copper, Total	0.81	0.050	mg/L	10	EPA 200.7	1/28/19	7440-50-8	
Iron, Total	ND	0.10	mg/L	1	EPA 200.7	1/28/19	7439-89-6	
Lead, Total	ND	0.015	mg/L	1	EPA 200.7	1/28/19	7439-92-1	
Lithium, Total	0.038	0.0050	mg/L	1	EPA 200.7	1/28/19	7439-93-2	
Magnesium, Total	22	10	mg/L	100	EPA 200.7	1/28/19	7439-95-4	
Manganese, Total	ND	0.0050	mg/L	1	EPA 200.7	1/28/19	7439-96-5	
Molybdenum, Total	ND	0.0050	mg/L	1	EPA 200.7	1/28/19	7439-98-7	
Nickel, Total	ND	0.0050	mg/L	1	EPA 200.7	1/28/19	7440-02-0	
Potassium, Total	4.0	0.10	mg/L	1	EPA 200.7	1/28/19	7440-09-7	
Selenium, Total	ND	0.050	mg/L	1	EPA 200.7	1/28/19	7782-49-2	
Silica, Total	9.1	0.064	mg/L	100	EPA 200.7	1/28/19	7440-21-3	
Silver, Total	0.038	0.010	mg/L	1	EPA 200.7	1/28/19	7440-22-4	
Sodium, Total	78	2.0	mg/L	10	EPA 200.7	1/28/19	7440-23-5	
Strontium, Total	0.98	0.0050	mg/L	1	EPA 200.7	1/28/19	7440-24-6	
Thallium, Total	ND	0.030	mg/L	1	EPA 200.7	1/28/19	7440-28-0	
Tin, Total	ND	0.050	mg/L	1	EPA 200.7	1/21/19	7440-31-5	AST
Uranium, Total	0.0047	0.0010	mg/L	1	EPA 200.8	1/18/19	7440-61-1	AST
Vanadium, Total	ND	0.010	mg/L	1	EPA 200.7	1/28/19	7440-62-2	
Zinc, Total	0.13	0.0050	mg/L	1	EPA 200.7	1/28/19	7440-66-6	

CLIENT SAMPLE ID: **Inside Plant Hose Bib** DATE/TIME SAMPLED: 1/30/19 15:10
VERITAS SAMPLE ID: V19A108-01 DATE/TIME RECEIVED: 1/30/19 15:45

Matrix: Aqueous

Analysis: Total Inorganics

PARAMETER	RESULT	RL (MRL)	UNITS	DF	METHOD	DATE ANALYZED	CAS NO.	SUB LAB/ QUAL
Total Organic Carbon (TOC)	2.4	1.0	mg/L	1	EPA 9060A	1/31/19	NA	PAN

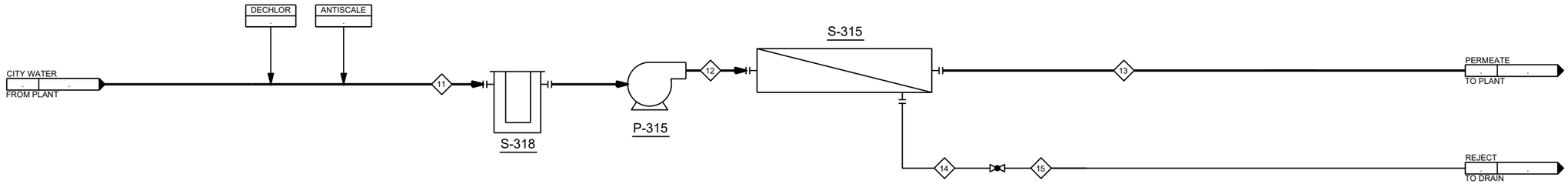
Appendix 2 –Membrane projected quality (estimated, not guaranteed)

RO Solute Concentrations - Pass 1

Concentrations (mg/L as ion)						
	Feed	Concentrate		Permeate		
		Stage1	Stage2	Stage1	Stage2	Total
NH_4^+	0.00	0.00	0.00	0.00	0.00	0.00
K^+	4.00	8.90	15.87	0.03	0.07	0.04
Na^+	92.91	207.0	369.2	0.51	1.34	0.73
Mg^{+2}	22.00	49.12	87.82	0.03	0.07	0.04
Ca^{+2}	66.00	147.4	263.5	0.08	0.21	0.12
Sr^{+2}	0.98	2.19	3.91	0.00	0.00	0.00
Ba^{+2}	0.11	0.25	0.44	0.00	0.00	0.00
CO_3^{-2}	1.07	4.25	10.39	0.00	0.00	0.00
HCO_3^-	158.5	348.9	616.1	1.18	2.92	1.63
NO_3^-	0.00	0.00	0.00	0.00	0.00	0.00
Cl^-	79.00	176.2	314.8	0.22	0.60	0.32
F^-	0.67	1.49	2.66	0.00	0.01	0.01
SO_4^{-2}	210.0	468.9	838.4	0.23	0.59	0.32
SiO_2	9.10	20.27	36.17	0.05	0.13	0.07
Boron	0.11	0.22	0.34	0.02	0.05	0.03
CO_2	2.69	3.78	5.49	2.93	4.27	3.29
TDS*	645.0	1,436	2,562	2.46	6.24	3.45
pH	7.9	8.1	8.1	5.9	6.1	6.0

Footnotes:

*Total Dissolved Solids includes ions, SiO_2 and $B(OH)_3$. It does not include NH_3 and CO_2



					Total				
ID	Description	Composition	Flowrate	Units	Flow	Units	P (psig)	T (F)	Notes
11	RO Assembly Feed Water	City Water	240	gpm	345600	gal/day	50	60	
12	RO Assembly Array Feed	City Water	240	gpm	345600	gal/day	165	60	Pressure at RO inlet
13	RO Assembly Permeate	Low TDS Product Water	180	gpm	259200	gal/day	20	60	
14	RO Assembly Reject	High TDS Water	60	gpm	86400	gal/day	102	60	
15	RO Assembly Reject	High TDS Water	60	gpm	86400	gal/day	15	60	

NOTES
1. ALL TOTALS BASED ON 24 HOURS/DAY, 7 DAYS/WEEK OPERATION

NOTES
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NO.	REVISION/ISSUE	DATE
0	FOR CONSTRUCTION	2/5/19

RELEASE SIGN OFF

SIGNED:

DATE:

JOB NUMBER: 5776
DRAWN DATE: 2/5/19
DRAWN BY: MJB
ENG MANAGER: JAG
PROJECT MANAGER: SEB

RELEASE FOR CONSTRUCTION

SAMCO
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P.O. BOX 1047
BUFFALO, NY 14207
PHONE: (716) 743-9000

PLANT PROCESS EQUIPMENT
NORTH LAS VEGAS, NV
REVERSE OSMOSIS SYSTEM

PROCESS FLOW DIAGRAM

DRAWING NUMBER: 5776-F01
REV: 0
SIZE: D
SCALE: NTS
SHEET: 1 OF 1

EQUIPMENT

- AIR COMPRESSOR
- BLOWER
- CLARIFIER - INCLINED PLATE
- CONVEYOR
- DEGASIFIER
- DISSOLVED AIR FLOTATION UNIT
- DRUM
- EDI SYSTEM
- FILTER HOUSING - BAG
- FILTER HOUSING - CARTRIDGE
- FILTER HOUSING - TUBE
- FILTER PRESS
- HEAT EXCHANGER
- HEAT EXCHANGER - SHELL AND TUBE
- HEAT EXCHANGER - PLATE AND FRAME
- HEATER
- MIXER
- MIXER - STATIC
- OIL WATER SEPARATOR
- PUMP - AIR OPERATED DIAPHRAGM
- PUMP - CENTRIFUGAL
- PUMP - METERING
- PUMP - PD (GENERAL)
- PUMP - SUBMERSIBLE
- PUMP - SUMP
- PUMP - WELL
- PRESSURE VESSEL
- PRESSURE VESSEL - ADI
- PRESSURE VESSEL - FLUID CONTACTING
- PRESSURE VESSEL - FLUID CONTACTING
- PRESSURE VESSEL - W/ TOP MOUNT VALVE
- SEPARATION UNIT (RO ARRAY, UF, ETC.)
- REVERSE OSMOSIS MEMBRANE HOUSING
- STRAINER
- TANK - CLOSED TOP, FLAT BOTTOM
- TANK - CONE BOTTOM
- TANK - DOME TOP, FLAT BOTTOM
- TANK - OPEN TOP, FLAT BOTTOM
- UV UNIT

PROCESS

- CALIBRATION COLUMN
- DIAPHRAGM SEAL
- DRAIN - CLOSED
- DRAIN - OPEN
- EDUCTOR
- FILTER / REGULATOR
- FLUME
- INSULATION
- MT — MEDIA TRAP
- MOTOR
- MUFFLER
- ORIFICE
- PULSATION DAMPENER
- RT — RESIN TRAP
- ROTAMETER
- SIGHT GLASS
- ST — STEAM TRAP
- XXX YYY — SPEC BREAK
- U-VENT
- VENTURI
- Y-STRAINER

VALVES

- 3-WAY BALL VALVE
- 3-WAY PLUG VALVE
- 3-WAY VALVE
- ANGLE VALVE
- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE
- DIAPHRAGM VALVE
- GATE VALVE
- GLOBE VALVE
- NEEDLE VALVE
- PLUG VALVE

CONTROL VALVES

- BACK PRESSURE REGULATOR
- BACK PRESSURE REGULATOR - ANGLE
- FLOW CONTROL VALVE - 3-WAY BALL (PNEUM. ACT, SPRING RETURN)
- FLOW CONTROL VALVE - 3-WAY PLUG (PNEUM. ACT, SPRING RETURN)
- FLOW CONTROL VALVE - ON/OFF BALL (ELEC. ACT. SPRING RETURN)
- FLOW CONTROL VALVE - ON/OFF BALL (PNEUM. ACT, SPRING RETURN)
- FLOW CONTROL VALVE - ON/OFF BFLY (PNEUM. ACT, SPRING RETURN)
- FLOW CONTROL VALVE - ON/OFF PLUG (PNEUM. ACT, SPRING RETURN)
- FLOW CONTROL VALVE - MODULATING - BALL (PNEUMATIC)
- FLOW CONTROL VALVE - MODULATING - BUTTERFLY (PNEUM.)
- S — SOLENOID VALVE
- SOLENOID VALVE - 3-WAY

IN-LINE INSTRUMENTS

- M — MAGNETIC FLOWMETER
- VORTEX FLOWMETER

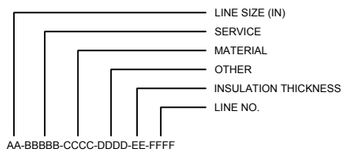
FITTINGS

- ACCESS POINT
- ACCESS POINT - FLANGED
- CAP
- EXPANSION JOINT
- FLANGED CONNECTION
- FLEX CONNECTOR
- HOSE CONNECTION - FEMALE
- HOSE CONNECTION - MALE
- PLUG
- REDUCER

RELIEF DEVICES

- PRESSURE RELIEF VALVE
- PRESSURE RELIEF VALVE - ANGLE
- PRESSURE RELIEF RUPTURE DISC
- VACUUM RELIEF RUPTURE DISC
- VACUUM RELIEF VALVE

PIPELINE ANNOTATION



CCCCC = MATERIAL

304	304 STAINLESS STEEL
304L	304L STAINLESS STEEL
316	316 STAINLESS STEEL
316L	316L STAINLESS STEEL
A20	ALLOY 20
BS	BLACK STEEL
CPVC	CHLORINATED PVC
CS	CARBON STEEL
CU	COPPER
DSS	DUPLEX STAINLESS STEEL
FRP	FIBERGLASS REINFORCED PLASTIC
HDPE	HIGH-DENSITY POLYETHYLENE
PPLS	POLYPROPYLENE LINED STEEL
PVC40	POLYVINYL CHLORIDE SCHEDULE 40
PVC80	POLYVINYL CHLORIDE SCHEDULE 80
PPT	POLYPROPYLENE TUBING
TFLN	TEFLON
TLS	TEFLON LINED STEEL

BBBBB = SERVICE

ALUM	ALUM
AS	ANTISCALANT
ASE	AIR STRIPPER EFFLUENT
ASH	SODA ASH
BA	BLOWER AIR
BI	SODIUM BISULFITE
BR	BRINE
BC	BICARBONATE
BLEACH	BLEACH
BWS	BACKWASH SUPPLY
BWW	BACKWASH WASTE
CA	COMPRESSED AIR
CITR	CITRIC ACID
CLE	CLARIFIER EFFLUENT
CLN	CLEANING SOLUTION
COAG	COAGULANT
CONC	CONCENTRATE
COND	CONDENSATE
DE	DIATOMACEOUS EARTH
DEF	DEFOAMER
DIW	DEIONIZED WATER

BBBBB = SERVICE (CON'T)

EFF	EFFLUENT
FEED	FEED WATER
FILT	FILTERED WATER
FLOC	FLOCCULANT
GW	GROUND WATER
HCL	HYDROCHLORIC ACID
HYPO	SODIUM HYPOCHLORITE
IA	INSTRUMENT AIR
INF	INFLUENT
KMN	POTASSIUM PERMANGANATE
LIME	LIME
MBS	SODIUM METABISULFITE
NE	NEUTRALIZED EFFLUENT
NG	NATURAL GAS
NUT	NUTRIENT
OG	OFF-GAS
OF	OVERFLOW
PA	PLANT AIR
PERM	PERMEATE
POLY	POLYMER
PROD	PRODUCT
PW	PLANT WATER
RCY	RECYCLE
ROW	RO WATER
RW	REGENERATE WASTE
SA	SULFURIC ACID
SANW	SANITARY WASTE
SFTW	SOFTENED WATER
SH	SODIUM HYDROXIDE
SL	SLUDGE
ST	STEAM
TWE	TREATED WATER EFFLUENT
UW	UTILITY WATER
V	VENT
WW	WASTEWATER

DD = OTHER

DC	DOUBLE CONTAINED
HT	HEAT TRACED (NOT INSULATED)
IN	INSULATED (NOT HEAT TRACED)
HTI	HEAT TRACED & INSULATED

EQUIPMENT ANNOTATION

B	BLOWER
C	COMPRESSOR
CF	CHEMICAL FEEDER
E	EVAPORATOR
F	FILTER
FP	FILTER PRESS
HX	HEAT EXCHANGER
IPC	INCLINED PLATE CLARIFIER
IX	ION EXCHANGER
LGAC	LIQUID PHASE GAC UNIT
MMF	MULTIMEDIA FILTER
MX	MIXER
P	PUMP
PLF	PRESSURE LEAF FILTER
R	REACTOR
RO	REVERSE OSMOSIS UNIT
RTO	REGENERATIVE THERMAL OXIDIZER
S	SEPARATION UNIT
ST	AIR STRIPPER
T	TANK
UV	ULTRAVIOLET UNIT
VGAC	VAPOR PHASE GAC UNIT

VALVE ANNOTATION

ARV	AIR RELEASE VALVE
BFP	BACKFLOW PREVENTER
BPV	BACK PRESSURE VALVE
BV	BLOCK VALVE
CV	SELF-CONTAINED CONTROL VALVE
FCV	FLOW CONTROL VALVE
HV	HAND VALVE (MANUAL)
LCV	LEVEL CONTROL VALVE
PCV	PRESSURE CONTROL VALVE
PRV	PRESSURE RELIEF VALVE
PSV	PRESSURE SAFETY VALVE
SV	SOLENOID VALVE
TCV	TEMPERATURE CONTROL VALVE
VRV	VACUUM RELIEF VALVE
XV	CONTROL VALVE

GENERAL ANNOTATION

ALKY	ALKALINITY
CL2	CHLORINE
COD	CHEMICAL OXYGEN DEMAND
CP-X	CONTROL PANEL X
DO	DISSOLVED OXYGEN
FC	FAIL CLOSE
FCL2	FREE CHLORINE RESIDUAL
FO	FAIL OPEN
HDNS	HARDNESS
HOA	HAND/OFF/AUTO
LEL	LOWER EXPLOSIVE LIMIT
L/R	LOCAL/REMOTE
MCC-X	MOTOR CONTROL CENTER X
MW	MANWAY
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OCA	OPEN/CLOSE/AUTO
O/O	ON/OFF
ORP	OXIDATION REDUCTION POTENTIAL
PH	PH
S/S	START/STOP
TOC	TOTAL ORGANIC CARBON
TURB	TURBIDITY

INSTRUMENTATION ANNOTATION

	FIRST LETTER		SUCCEEDING LETTERS		
	PROCESS OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY				
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOWRATE				
G	GAUGE		GLASS	GATE	
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION				MIDDLE
N	USER'S CHOICE		USER'S CHOICE		USER'S CHOICE
O	USER'S CHOICE		ORIFICE		
P	PRESSURE (OR VACUUM)		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT	INTEGRATE	INTEGRATE		
R			RECORD OR POINT		
S	SPEED OR FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VISCOSITY			VALVE OR DAMPER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED		UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, OR PRESENCE			RELAY OR COMPUTE	
Z	POSITION			DRIVER, ACTUATOR OR UNCLASSIFIED FINAL CONTROL ELEMENT	

INSTRUMENTATION SYMBOLS

- FIELD MOUNTED
- LOCAL CONTROL PANEL MOUNTED
- BACK OF LOCAL PANEL
- MAIN CONTROL PANEL - OPERATOR INTERFACE ANNUNCIATED
- MAIN CONTROL PANEL MOUNTED
- BACK OF MAIN CONTROL PANEL
- YIC / XX — PROGRAMMABLE LOGIC CONTROLLER (PLC)

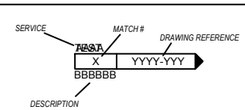
LINE LEGEND

- MAJOR PROCESS
- MINOR PROCESS
- ELECTRICAL SIGNAL
- PNEUMATIC SIGNAL
- CAPILLARY TUBE

UTILITY ANNOTATION

CA	COMPRESSED AIR	HCL	HYDROCHLORIC ACID
CHR	CHILLED WATER RETURN	FLOC	FLOCCULANT
CHS	CHILLED WATER SUPPLY	IA	INSTRUMENT AIR
COAG	COAGULANT	PA	PLANT AIR
CND	CONDENSATE	PW	POTABLE WATER
CWR	COLD WATER RETURN	STM	STEAM
CWS	COLD WATER SUPPLY	SW	SOFT WATER
DIW	DEIONIZED WATER	SH	SODIUM HYDROXIDE

STREAM ANNOTATION



NOTES

NO.	REVISION/ISSUE	DATE
0	RELEASE FOR CONSTRUCTION	02/22/19

RELEASE SIGN OFF

SIGNED: DATE:

JOB NUMBER	S05776
DRAWN DATE	02/22/19
DRAWN BY	JWN
ENG MANAGER	MJB
PROJECT MANAGER	SB

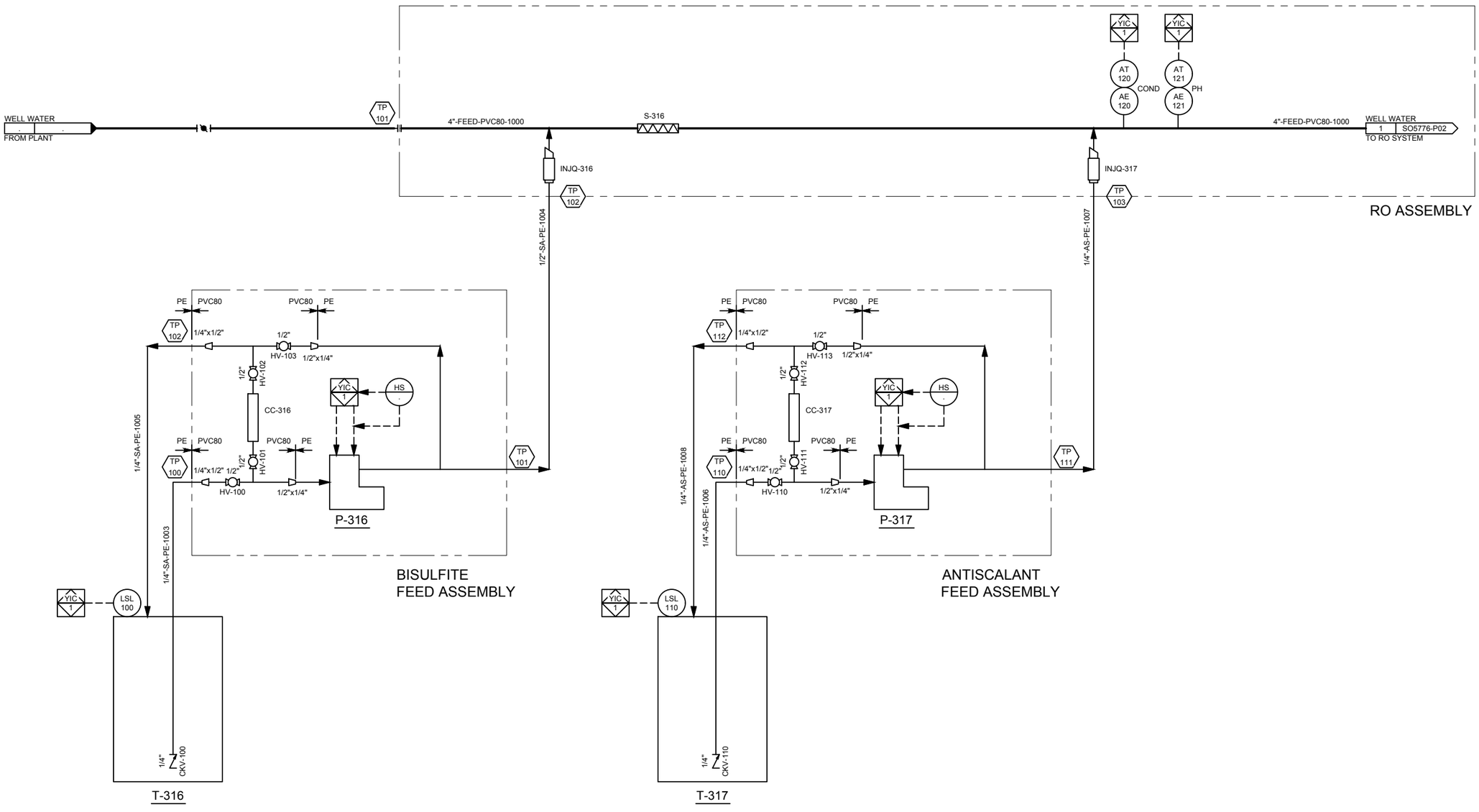
RELEASE FOR CONSTRUCTION

1 RIVER ROCK DRIVE
P.O. BOX 1047
BUFFALO, NY 14207
PHONE: (716) 743-9000

PLANT PROCESS EQUIPMENT, INC.
NORTH LAS VEGAS, NV
REVERSE OSMOSIS SYSTEM
LEGEND
PROCESS & INSTRUMENTATION DIAGRAM

DRAWING NUMBER 5776-L01 REV 0

SIZE: D | SCALE: NTS | SHEET: 1 OF 1



T-316
BISULFITE TANK
18IN D X 42.5IN O.A.H.
HDPE @

P-316
BISULFITE FEEDER
PERISTALTIC METERING, SANTOPRENE, 120V
0.21 GPH (MAX.) @100 PSI (MAX)

T-317
ANTISCALANT TANK
18IN D X 42.5IN O.A.H.
HDPE @

P-317
ANTISCALANT FEEDER
PERISTALTIC METERING, SANTOPRENE, 120V
0.21 GPH (MAX.) @ 100 PSI (MAX.)

NOTES

NO.	REVISION/ISSUE	DATE
0	RELEASE FOR CONSTRUCTION	02/04/19
A	FOR REVIEW	01/18/19

RELEASE SIGN OFF

SIGNED: DATE:

JOB NUMBER: SO5776
DRAWN DATE: 01/07/2019
DRAWN BY: JWN
ENG MANAGER: MJB
PROJECT MANAGER: SEB

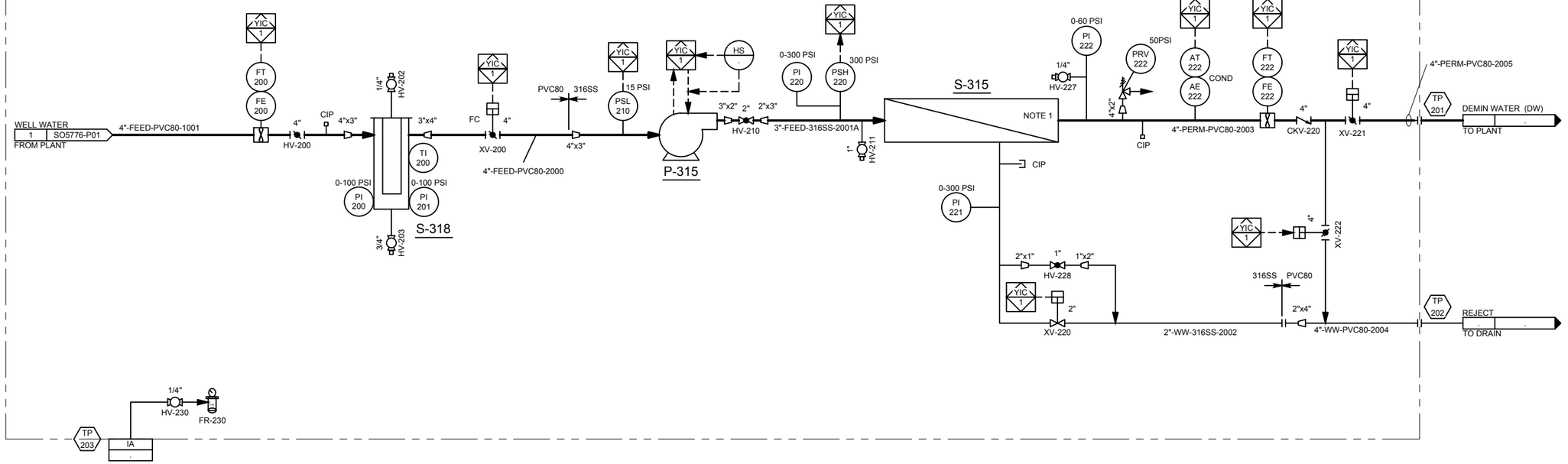
RELEASE FOR CONSTRUCTION

SAMCO
1 RIVER ROCK DRIVE
P.O. BOX 1047
BUFFALO, NY 14207
PHONE: (716) 743-9000

PLANT PROCESS EQUIPMENT, INC.
NORTH LAS VEGAS, NV
REVERSE OSMOSIS SYSTEM
CHEM FEED ASSEMBLIES
PROCESS & INSTRUMENTATION DIAGRAM

DRAWING NUMBER: 5776-P01
REV: 0
SIZE: D | SCALE: NTS | SHEET: 1 OF 1

RO ASSEMBLY



S-318
PREFILTER
SS HOUSING
5 MICRON

P-315
RO BOOSTER PUMP
CENTRIFUGAL, SS, 40 HP, 460 V
240 GPM @ 185 PSI

S-315
RO ARRAY
FIBERGLASS HOUSINGS, 4X2 6M 8"
180 GPM PERMEATE
300 PSIG (MAX.), 190°F (MAX.)

NOTES

1. EACH HOUSING HAS A PERMEATE SAMPLE VALVE. SAMPLE VALVES TO BE NUMBERED HV-221 TO HV-226.

NO.	REVISION/ISSUE	DATE
0	RELEASE FOR CONSTRUCTION	02/04/19
A	FOR REVIEW	01/18/19

RELEASE SIGN OFF

SIGNED: DATE:

JOB NUMBER: SO5776
DRAWN DATE: 01/07/19
DRAWN BY: JWN
ENG MANAGER: MJB
PROJECT MANAGER: SEB

RELEASE FOR CONSTRUCTION

SAMCO
1 RIVER ROCK DRIVE
P.O. BOX 1047
BUFFALO, NY 14207
PHONE: (716) 743-9000

PLANT PROCESS EQUIPMENT, INC.
NORTH LAS VEGAS, NV
REVERSE OSMOSIS SYSTEM
RO ASSEMBLY
PROCESS & INSTRUMENTATION DIAGRAM

DRAWING NUMBER: 5776-P02
REV: 0
SIZE: D | SCALE: NTS | SHEET: 1 OF 1

Customer	Plant Process Equipment	**Unit**	Reverse Osmosis System
PO#	2357-E005	**Job Site**	North Las Vegas, NV

The following describes the functions and automated operating sequence for the Reverse Osmosis System (System). This description is meant to outline how the system operates normally, with emphasis on automated functions, and is not meant to encompass all operator interactions with the system (i.e. system maintenance).

System Overview

The DW System consists of the following major components:

- Chem Feed Assembly (P-316, P-317)
- RO Unit (S-318, P-315, S-315)
- Main Control Panel (MCP) w/ programmable logic controller (PLC) & human machine interface (HMI)

1. Chem Feed Assembly (P-316, P-317)

Metering pumps are provided to meter pretreatment chemicals into the city water feed to control scaling on the RO membranes and remove chlorine to prevent membrane damage. The pumps draw from customer supplied drums which are manually refilled as part of normal system operation. A level switch is provided for each drum to alert when level is low.

Bisulfite Feeder P-316

Dechlorinating solution (bisulfite) is fed to eliminate chlorine in the feed water. The pump includes an HOA switch to control its operation. In HAND mode the pump runs regardless of alarms, etc. In AUTO mode the pump runs when receiving a run permissive. The PLC sends a run permissive:

- when RO Unit is in *Delay Before RUN, RUN – Divert, RUN or FLUSH* mode (see Section 2)

Pump speed is automatically controlled by the PLC, with P-316 being run at a speed proportional to the feed flowrate to achieve the dose set in the process setpoints (see **Table 2**).

DW Antiscalant Feeder P-317

Antiscalant solution is fed to increase the solubility of sparingly soluble compounds. The pump includes an HOA switch to control its operation. In HAND mode the pump runs regardless of alarms, etc. In AUTO mode the pump runs when receiving a run permissive. The PLC sends a run permissive:

- when RO Unit is in *Delay Before RUN, RUN – Divert, RUN or FLUSH* mode (see Section 2)

Pump speed is automatically controlled by the PLC, with P-317 being run at a speed proportional to the feed flowrate to achieve the antiscalant dose set in the process setpoints (see **Table 2**).

2. RO Unit (S-318, P-315, S-315)

The RO Unit is a single pass 4x2 6M array fitted with 8 inch RO membranes, a prefilter, and a multistage centrifugal booster pump. The assembly includes a number of instruments to monitor performance and for alarming:

- Flow sensors: Feed, Product
- Pressure gauges: Prefilter in/out, RO array inlet, product, reject
- Pressure switches: RO Booster Pump suction (low) and RO Array Feed (high)
- Conductivity sensor: RO system feed, Unit permeate
- Temperature: RO System feed
- pH: RO system feed

Chemically treated and filtered water is pumped to the RO membrane array by RO Booster Pumps P-315. The RO Booster Pumps is a multistage, fixed speed centrifugal pumps. The RO Booster Pump includes an HOA Switch. In HAND mode, the pump runs regardless of alarms, etc. In AUTO mode, the pump runs when receiving a run permissive. The PLC sends a run permissive when the RO unit is in *RUN* mode.

RO Unit Modes

During operation, the RO Unit sequences through the RO modes of operation described below and summarized in **Table 1**.

0 - ***OFF:*** The ON/OFF pushbutton allows each RO unit to be manually turned OFF for maintenance or long-term shutdown and turned back ON when operation is needed. When the RO Unit is turned ON, it cycles through modes 1 through 5 as per **Table 1**. When the RO Unit is OFF, it will not run until it is turned back ON.

1 - ***STANDBY***: When the RO Unit is turned ON, or when the *FLUSH* duration is complete, the RO Unit moves to *STANDBY* with all valves closed and pumps off until a start request is received.

2 - ***Delay Before RUN:*** When the RO unit is in *STANDBY* and requested to start by the *Start RO* interlock or the *Start RO* pushbutton (and a stop request or alarm preventing the RO from running is not being received), the actuated RO feed & divert valves open and the chemical feeders turn on. There is a 10 second delay before the RO Booster Pump starts. RO permeate is directed to drain.

3 - ***RUN – Divert***: Once the 10s delay is complete, the RO Booster Pump starts. RO permeate continues to be directed to drain for the divert duration (see **Table 2**).

4 - ***RUN:*** Once the divert duration is complete the divert valve closes and the product valve opens to send the permeate water to the point of use.

5 - ***FLUSH***: When the RO unit is in *RUN* and is requested to stop by the *Stop RO* interlock or the *Stop RO* pushbutton, the RO Booster Pump turns off, and the RO flushes sending both permeate and reject to drain for the flush duration (see **Table 2**) to rinse the contaminants from the membrane surface prior to moving to *STANDBY*.

Table 1 – RO Unit Modes

	Mode		Feed Valve XV-200	Product Valve XV-221	Permeate Divert Valve XV-222	Flush Valve XV-220	Booster Pump P-315	Bisulfite Feeder P-316	Antiscalant Feeder P-317
	0	OFF			O				
ON	1	STANDBY			O				
ON	2	Delay Before RUN	O		O			O	O
ON	3	RUN – Divert	O		O[1]		O	O	O
ON	4	RUN	O	O[1]			O	O	O
ON	5	FLUSH	O		O	O		O	O

O = Open/On

Alarms that move the RO unit to FLUSH and then to *STANDBY* and prevent it from moving to *RUN* are as follows:

- Fault - RO Booster Pump
- Level - Low - Antiscalant Drum
- Level - Low - Bisulfite Drum
- Pressure – Low – RO Booster Pump Suction
- Pressure – High – RO Array Inlet

3. Control System with PLC and HMI

Control of the System is through the System Main Control Panel (MCP) which includes a programmable logic controller (PLC) for system automation and a human machine interface (HMI) to allow the operator to monitor and control system operations. Operator adjustable system settings include process and alarm setpoints as shown in **Table 3** and **Table 4**. HMI functions included are detailed below.

HMI Functions

- Displays fully accessible to all users
  - *Main*
    - Display for RO unit mode
    - Display for calculated RO Unit concentrate flowrate (Feed Flow – Permeate Flow) [=] gpm
    - Display for calculated RO Unit recovery (Permeate Flow / Feed Flow) x 100 [=] %
    - RO ON/OFF
    - RO START/STOP
  - *Alarms*
- Displays accessible to "op2" login (in addition to those above)
  - *Setpoints*
    - Process and Alarm Setpoint adjustment
    - Hand-Off-Auto (HOA) switches for interlock signals from the customer
    - HMI configuration access
  - *Valves*
    - Open-Closed-Auto (OCA) switches for each on/off valve
  - *Chemical Feeders*
    - Bisulfite Pump – Speed Control (Auto/Manual)
    - Antiscalant Pump – Speed Control (Auto/Manual)

Process Setpoints

Table 2 - Process Setpoints

	Range	Initial Factory Setting
Divert Duration	0 - 10.0 minutes	2.0 minutes
Flush Duration	0 - 60.0 minutes	10.0 minutes
Antiscalant Dose	0 – 9.9 ppmv	2.0 ppmv
Bisulfite Dose	0- 9.9 ppmV	4.0 ppmv

Interlocks

The System includes interlocks for communication between SAMCO and customer controls. These interlocks are described in **Table 3**. All interlocks include soft Hand-Off-Auto (HOA) Switches on the HMI to allow the operator to override the automatic functionality as needed. In HAND or OFF mode, the interlock is ON (enabled) or OFF (disabled), respectively, regardless of the signal status. In AUTO mode, the interlock status is dictated by the signal.

Table 3 - Interlocks

	Interlock	Type	Enabled	Disabled
1	Start RO	Hardwired (Start is enabled when discrete input is on.)	System moves to *Delay Before RUN* if in *STANDBY* (unless Interlock 2 is enabled or alarm preventing *RUN*)	No action.
2	Stop RO	Hardwired (Stop is enabled when discrete input is off.)	RO Unit moves to *FLUSH* if in *RUN*. Prevents RO Unit from moving out of *STANDBY*.	No action.

Control Loops

There are no control loops in this system.

Alarms

System alarms are described in **Table 5 - Alarms** which lists the trigger, entry range, initial setting, delay and result for each alarm. When an alarm occurs an Alarm Banner will appear on the HMI describing the alarm condition and a horn will sound. The HMI will have a Silence pushbutton that silences the alarm(s) but the alarm condition(s) will persist after the horn is silenced. The HMI will also have a Reset pushbutton that silences the alarm(s) and resets the alarm condition(s). If left untouched an alarm(s) horn will sound for 15 minutes before silencing itself - the alarm condition(s) will persist after the horn is automatically silenced.

Table 5 - Alarms

Alarm	Trigger	Factory SP	SP Range	Delay (sec)	Result
Conductivity – RO Permeate - High	AE/AT-222, during *RUN*	30 uS/cm	1-99 uS/cm	30	Sounds Horn.
Fault – RO Booster Pump	P-315 starter, during *RUN*	N/A	N/A	10	Sounds Horn. Initiates FLUSH, prevents RO unit from moving to RUN
Flow – RO Permeate – Low	FE/FT-222, during *RUN*	150 gpm	0-999 gpm	10	Sounds Horn.
Level – Bisulfite Drum – Low	LSL-100	N/A	N/A	10	Sounds Horn. Initiates FLUSH, prevents RO unit from moving to RUN
Level – Antiscalant Drum – Low	LSL-110	N/A	N/A	10	Sounds Horn. Initiates FLUSH, prevents RO unit from moving to RUN
Pressure – RO Array Inlet – High	PSH-220	300 psig	N/A	10	Sounds Horn. Initiates FLUSH, prevents RO unit from moving to RUN
Pressure – RO Booster Pump Suction – Low	PSL-210, during *RUN – Divert*, *RUN*, and *FLUSH*	15 psig	N/A	10	Sounds Horn. Initiates FLUSH, prevents RO unit from moving to RUN
System Stop	System Stop Button (hard)	N/A	N/A	0	Sounds Horn Removes power from Pumps and Digital Outputs (Pumps turn off, valves close). Turns RO to OFF

Notes

1. Alarms will not occur when the RO Units are OFF via the ON/OFF pushbutton at the HMI

SAMCO
Separation from the ordinary

Pipe Specification

SO#5776 Rev 0 2/5/19 RFC

Customer	Plant Process Equipment	**Unit**	Reverse Osmosis System
PO#	2357-E005	**Job Site**	North Las Vegas, NV

Designation:	**316SS**	**Description:**	316L Stainless Steel

----------1. Design Information----------			
Piping Max Design Temp:	100°F		
Piping Max Design Pressure:	300 psig	Hydrotest Pressure	350 psig
Fluid Service	Feed Water (FEED) Reject (WW)		
Corrosion Allow.	0”		

----------2. Paint Information----------	
Pipe & Fittings-Uninsulated:	N/A
Pipe & Fittings-Insulated:	N/A
Color:	N/A

----------3. Hardware Information----------	
Bolt/Stud Specification:	ASTM F593 18/8 Stainless Steel coarse thread
Nut Specification:	ASTM F594 18/8 Stainless steel hex nut

----------4. Gasket Information----------	
Gasket Type:	Connection <=230 psig: EPDM, 150# full face, 1/8” thick, 60 durometer Connection >230 psig: Sprial wound, 300#, 1/8” thick, 304SS winding and inner ring, graphite filler, CS outer ring. ASME B16.20
Notes:	Spiral wound to be Flexitallic type CGI (or equal)

Designation:	316SS	Description:	316L Stainless Steel

A. Specifications for Pipe and Fittings

1. Pipe
    a. ASTM A312/SA312 grade 316/316L Stainless Steel Schedule 40, electofusion welded
        i. Up to 4" IPS
2. Flanges:
    a. For connection to lines with design pressure <= 230 psig
        i. For line sizes <2", ASTM A182/SA182 or ASTM A240 Stainless Steel, with ANSI B16.5 Class 150 RF bolting patterns. Flanges supplied shall be Socketweld or Threaded types as determined by SAMCO.
        ii. For line sizes ≥2", ASTM A182/SA182 or ASTM A240 Stainless Steel, with ANSI B16.5 Class 150 RF bolting patterns. Flanges supplied shall be weldneck with schedule 40 bore.
    b. For connection to lines with design pressure > 230 psig
        i. ASTM A182/SA182 or ASTM A240 Stainless Steel, with ANSI B16.5 Class 300 RF bolting patterns. Flanges supplied shall be weldneck with schedule 40 bore.
3. All Fittings supplied (defined as Tees, Crosses, Elbows, Couplings, Reducers, etc.)
    a. Fittings supplied shall be Schedule 10 ASTM A312/SA312 type 316/316L buttweld conforming to dimensional standard ASME B16.11.
4. All Olets (threadolets, weldolets, sockolets) supplied shall be ASTM A182/SA182 type 316/316L forged stainless steel class 3000
5. Nipples shall be ASTM A312/SA312 grade 316L Stainless Steel, schedule 40 wall thickness
6. Grooved pipe connections shall be cut grooved and attached with Gruvlok Figure 7000 (or equal) galvanized couplings

B. Method of Branching and reducing

This table describes SAMCOs standard method for connecting pipe and fittings of differing sizes.

Table 1: Branch Connection Table

BRANCH SIZE	HEADER SIZE										
	4	**3**	**2**	**1-1/2**	**1**	**3/4**	**1/2**	**1/4**			
1/4	WOL	WOL	WOL	WOL	WOL	WOL	RTE	TEE	X		
1/2	WOL	WOL	WOL	WOL	WOL	RTE	TEE	X			
3/4	WOL	WOL	WOL	WOL	RTE	TEE	X				
1	WOL	RTE	RTE	RTE	TEE	X					
1-1/2	WOL	RTE	RTE	TEE	X						
2	WOL	RTE	TEE	X							
3	RTE	TEE	X								
4	TEE	X									
	X										

Where:
TEE is a tee with equal legs
RTE is a reducing tee with the branch leg smaller than the main line.
WOL is an Olet connection (threadolet, weldolet, or sockolet)

SAMCO
Separation from the ordinary

Pipe Specification

SO#5776 Rev 0 2/5/19 RFC

Customer	Plant Process Equipment	**Unit**	Reverse Osmosis System
PO#	2357-E005	**Job Site**	North Las Vegas, NV

Designation:	**PVC80**	**Description:**	PVC schedule 80

----------1. Design Information----------			
Piping Max Design Temp:	100°F		
Piping Max Design Pressure:	93 psig	Hydrotest Pressure	150 psig
Fluid Service	Feed Water (FEED) Permeate (PERM) Reject (WW)		
Corrosion Allow.	0”		

----------2. Paint Information----------	
Pipe & Fittings-Uninsulated:	N/A
Pipe & Fittings-Insulated:	N/A
Color:	N/A

----------3. Hardware Information----------	
Bolt/Stud Specification:	ASTM F593 18/8 Stainless Steel coarse thread
Nut Specification:	ASTM F594 18/8 Stainless steel hex nut

----------4. Gasket Information----------	
Gasket Type:	EPDM, 150# full face, 1/8” thick, 60 durometer, ANSI B16.21
Notes:	

Designation:	PVC80	Description:	PVC schedule 80

A. Specifications for Pipe and Fittings

1. All pipe supplied shall be Schedule 80 ASTM D 1785 PVC rigid pipe.
2. All Flanges supplied shall be ASTM D 2467 PVC socketweld one piece or vanstone (two piece) flanges as determined by SAMCO with 150# bolt pattern conforming to ANSI B16.5.
3. All Fittings supplied (defined as Tees, Crosses, Elbows, Couplings, Reducers, etc.) shall be Schedule 80 ASTM D 2467 PVC type socket fittings as determined by SAMCO.
4. Adherent used for pipe and fittings:
    a. Supplied Primer shall conform to ASTM F-656, clear color.
    b. Supplied Cement shall conform to ASTM D-2564, grey color.
5. Nipples shall be Schedule 80 ASTM D 1784 PVC

B. Method of Branching and reducing

This table describes SAMCOs standard method for connecting pipe and fittings of differing sizes.

Table 1: Branch Connection Table

BRANCH SIZE	HEADER SIZE										
	12	**10**	**8**	**6**	**4**	**3**	**2**	**1-1/2**	**1**	**3/4**	**1/2**
1/2	SAD	SAD	SAD	SAD	SAD	SAD	RTE	RTE	RTE	RTE	TEE
3/4	SAD	SAD	SAD	SAD	SAD	SAD	RTE	RTE	RTE	TEE	X
1	SAD	SAD	SAD	SAD	SAD	RTE	RTE	RTE	TEE	X	
1-1/2	SAD	SAD	SAD	SAD	SAD	RTE	RTE	TEE	X		
2	SAD	SAD	SAD	SAD	SAD	RTE	TEE	X			
3	RTE	RTE	RTE	RTE	RTE	TEE	X				
4	RTE	RTE	RTE	RTE	TEE	X					
6	RTE	RTE	RTE	TEE	X						
8	RTE	RTE	TEE	X							
10	RTE	TEE	X								
12	TEE	X									

Where:
TEE is a tee with equal legs
RTE is a reducing tee with the branch leg smaller than the main line or straight tee with reducer coupling or reducer bushing.
SAD is a saddle connection (thread or socket)

SAMCO
Separation from the ordinary

Coating Specification

SO#5776 Rev 0 2/5/19 RFC

Customer	Plant Process Equipment	**Unit**	Reverse Osmosis System
PO#	2357-E005	**Job Site**	North Las Vegas, NV

Designation:	**CS STRUCTURAL**	**Description:**	Universal Alkyd primer / Polyurethane Finish

Preparation	
Surface Preparation	SSPC-SP6
Weld Preparation	In accordance with NACE SP0178 Appendix C Designation E

Coating Application	
1st Coat	Sherwin Williams Kem Kromik Universal Metal Primer B50 Series, 4-5 MDFT
2nd Coat	Sherwin Williams High Solids Polyurethane B65 Series, 4-5 MDFT
Finish Color	As specified on SAMCO drawing. Generally: • All handrails, stairs, kickplates, and ladders to be Safety Yellow (color code SW 4084) • Structural steel to be Slate Grey (color code SW 4026) • Vessel exterior to be Slate Grey (color code SW 4026)

Notes
Applies to carbon steel structural members