DESIGN CALCULATIONS (PROCESS)

First Pass

	Plant Capacity	m3/D	1000	For 1 streams
		m3/hr.	41.67	
	Feed Water TDS	mg/l	48,000.00	
	Recovery ratio	%	40.0%	
	System High Pressure @ ro feed	bar	72.00	
	RO Plant Feed water requirement	m3/hr.	104.2	
A	**Design of Borewell pump / Intake pumps**			
	Raw Water Requirement (max)	m3/hr.	**104.2**	as RO Projection
	Backwash Flow required to fil the BW tank in 8 Hrs	m3/hr.	**7.7**	7.7
	Borewell pump provided (2 numbers provided duty)	m3/hr.	55.9	more than the required flow
	Calculation of pump head			
	Delivery line from Borewell pump to Raw water tank			
	Pump flow	m3/hr.	111.9	2 duty pumps
	Considering velocity	m/s	2	
	Required pipe diameter :	mm	141	
	Provide pipe of diameter :	mm	150	HDPE - 6"
	Actual velocity	m/s	1.8	(BY OTHERS)
	Head loss from B-Well pump to raw water tank (Ref. Attached sheet no. 1 for head loss calculations)			
	Minimum head required	m	21.03	As head loss
	Provide Borewell pump of			
	Capacity of flow	m/hr	55.93	SP
	Head	m	25	Grundfos
	Duty + standby	Nos	2+1	
B	**Raw Water Tank Capacity:**			
	Raw Water Requirement	m3/hr.	111.9	
	Min Retention Time	Hours	1	
	Volume required	m3	111.87	
	Provide tank of capacity	m3	150	(By Others)
	Actual rentention time	Hours	1.34	

DESIGN CALCULATIONS (PROCESS)

First Pass

C Design of MMF Feed Pump

Pre-treatment feed water requirement	m3/hr.	**104.2**	as RO Projection
Backwash flow requirement (to fill the tank)	m3/hr.	**7.7**	
Total Feed flow required	m3/hr.	**111.9**	

Calculation of pump head

Suction line from raw water tank to MMF feed pump

Pump flow	m3/hr.	111.9	
Considering velocity	m/s	1.5	
Required pipe diameter :	mm	162	
Provide pipe of diameter :	mm	150	uPVC -6"
Actual velocity	m/s	1.76	
Head loss from raw water tank to suction of feed pump (Ref. Attached sheet no.2 for head loss calculations)			
Minimum head required	m	2.13	**a**

Delivery line from MMF feed pump to MMF

Pump flow	m3/hr.	111.9	
Considering velocity	m/s	2.5	
Required pipe diameter :	mm	126	
Provide pipe of diameter :	mm	150	uPVC - 6"
Actual velocity	m/s	1.8	
Head loss from raw water feed pump to MMF (Ref. Attached sheet no. 3 for head loss calculations)			
Minimum head required	m	3.43	**b**

Head loss calculations in MMF

Maximum allowable head loss 1.5 bar			
Consider head loss in filter 15m during service flow	m	15	**c**

DESIGN CALCULATIONS (PROCESS)

First Pass

Delivery line from MMF outlet to Cartridge Filter inlet

Pump flow	m3/hr.	104.2	
Considering velocity	m/s	2.5	
Required pipe diameter :	mm	121	
Provide pipe of diameter :	mm	150	uPVC - 6"
Actual velocity	m/s	1.64	
Head loss from MMF to filtered water tank (Ref. Attached sheet no. 4 for head loss calculations)			
Minimum head required	m	2.36	**d**

Head loss calculations in Cartridge Filter

Maximum allowable head loss .8 bar			
Consider head loss in filter 8 m during service flow	m	8	**e**

Delivery line from Cartridge filter to HPP Suction

Pump flow	m3/hr.	104.2	
Considering velocity	m/s	2	
Required pipe diameter :	mm	136	
Provide pipe of diameter :	mm	150	uPVC - 6"
Actual velocity	m/s	1.64	
Head loss from cartridge filter to HPP suction (Ref. Attached sheet no. 8 for head loss calculations)			
Minimum head required	m	2.34	f

Provide 2 no. of MMF feed pump (Duty + Stand Spare)

Feed pump	m/hr	111.9	NB
Head (a+b+c+d+e+f+10)	m	43	Grundfoss

D Selection of Multi Media Filter (MMF)

RO feed flow	M3/hr	104.17	
Actual feed flow including BW flow	m3/hr	111.87	
Design Velocity	m/hr	11.00	10- 11M/Hr
Surface Area required	m2	10.17	
No of duty media	No	5.00	1 standby filter
Diameter of media filter required	Meter	1.61	
	Inch	63.35	
Media selected	Inch	63.00	63 x 72 MMF
Actual Velocity of filtration	Meter/hour	10.36	1.6002

E Selection of Backwash Tank

Backwash Water Requirement	m3/hr.	49.5	Each filter
	m3/min	4.1	for total MMF
Min Retention Time	Minutes	15	
Volume required	m3	61.9	
Provided tank of capacity	m3	100	as per client specs

DESIGN CALCULATIONS (PROCESS)

First Pass

	Actual rentention time	Minutes	24	By Others
F	**Design of Media Filter Backwash pump**			
	Backwash Velocity	m/hr	25	
	Media filter surface area	m2	1.98	
	Backwash flow Rate	m3/hr	49.49	
	Backwash duration	Min	15.00	
	R.O. Plant feed water requirement	cu.m/hr.	104.17	
	Backwash duration (@ minimum)	hrs	8.00	
	Backwash flow / day	cu.m./day	185.60	
	Backwash flow / hr	cu.m./hr	7.73	
	Calculation of pump head			
	Suction line Backwash Pump			
	Pump flow	cu.m/hr.	49.49	
	Considering velocity in suction line	m/s	1.5	
	Required pipe diameter :	mm	108	
	Provide pipe of diameter : 5" minimum	mm	100	uPVC - 4"
	Actual velocity	m/s	1.75	
	Head loss in the suction line backwash pump (Ref. Attached sheet no. 5 for head loss calculations)			
	Minimum head required	m	2.14	**a**
	Delivery line backwash pump			
	Pump flow	cu.m/hr.	49.49	
	Considering velocity in discharge line	m/s	2	
	Required pipe diameter	mm	94	
	Provide pipe of diameter :	mm	100	uPVC - 4"
	Actual velocity	m/s	1.75	
	Head loss for discharge pipe from Backwash pump to media filter inlet (Ref. Attached sheet no. 6 for head loss calculations)			
	Minimum head required	m	5.58	**b**
	Head loss for discharge pipe from media filter to drain (Ref. Attached sheet no. 7 for head loss calculations)			
	Minimum head required	m	2.91	**c**
	Head loss calculations in Media filters			
	Maximum allowable head loss- 1 bar			
	Hence consider head loss in filter as 10m	m	10	**d**
	Backwash Pump Head (a+b+c+d)	m	20.64	
	Provide 1 no. Backwash water pump of			
	Capacity	m3/hr	**49.49**	Grundofss

DESIGN CALCULATIONS (PROCESS)

First Pass

Head	m	**21**	NB

G Air Scouring Blower Calculation

Feed flow during normal service	m^3/hr	111.87	
Design Filtration velocity	$m^3/m^2/hr$	11.00	
Air scour velocity	$m^3/m^2/hr$	26.00	
Filtration area each filter	M^2	1.98	
Air scour rate required @ 0.5 bar	m^3/hr	51.47	

H Selection of Cartridge Filter

	micron	***5***	
Feed Flow	m3/hr	104.17	
Flow each 2.5"x40" - 5 Micron cartridge filter	M3/hr	4.00	
No of Cartridge filters	Nos	26.04	
CF housing each CF	Nos	9.00	
No of CF housing	Nos	2.89	
CF selected	Nos	3.00	1 standby

I Selection of Pressure Exchanger (ERI)

PX model		PX-140S	(Ref. ERI design)
Number of units		3	
PX unit flow	m3/hr	20.8	
Low pressure Inlet	bar	1.6	
High Pressure Outlet	bar	70.0	
High pressure Inlet	bar	70.5	
Low Pressure Outlet	bar	1.0	
PX efficiency	%	95.0%	
Operating capacity	%	65.5%	

J Selection of PX Booster Pump

ERI PX booster model	50 Hz	HP-1253	(Ref. ERI design projection)
Number of units		2	
PX booster efficiency	%	64%	
Motor Efficiency	%	91%	
Total PX booster flow rate	m3/hr	60.2	
Inlet Pressure	bar	70.0	
Outlet Pressure	bar	72.0	
Differential pressure	bar	2.0	
Total booster power	kW	5.8	

K Selection of High Presssure Pump

Max. inlet pressure required at the RO Plant module	bar	72.00	(Ref. RO Membrane design projection)
Select 1 number of HPP (1 duty)			
capcaity	m3	44	Membrane Projectn
pressure	bar	72	-

DESIGN CALCULATIONS (PROCESS)
First Pass

L	**Design of Reverse Osmosis Module**	no	7ele x 6nos	(Ref. Membrane
	Membrane - Hydranautics- SWC5 MAX	no	84	design projections)
	Pressure Vessel	no	12	For each 500 m3
	membrane per vessel	no	7	
	Design of HPP Discharge Pipeline			
	Pump flow	m3/hr	43.9	
	Considering velocity in pipeline	m/s	3	
	Required pipe diameter :	mm	72	
	Provide pipe of diameter :	mm	80	DSS - 3"
	Actual velocity	m/s	2.43	
	Design of Reject Pipeline			
	System flow	m3/hr	62.50	Membrane Projectn
	Considering velocity in pipeline	m/s	2.5	
	Required pipe diameter :	mm	94	
	Provide pipe of diameter :	mm	100	DSS - 4"
	Actual velocity	m/s	2.21	
	Design of PX booster Pump suction pipeline			
	Pump flow	m3/hr	62.50	Membrane Projectn
	Considering velocity in pipeline	m/s	2.5	
	Required pipe diameter :	mm	94	
	Provide pipe of diameter :	mm	100	DSS - 4"
	Actual velocity	m/s	2.21	
	Design of PX booster Pump Discharge pipeline			
	Pump flow	m3/hr	62.50	
	Considering velocity in pipeline	m/s	2.5	
	Required pipe diameter :	mm	94	
	Provide pipe of diameter :	mm	100	DSS - 4"
	Actual velocity	m/s	2.21	
	Design of High Pump suction pipeline			
	Pump flow	m3/hr	43.94	
	Considering velocity in pipeline	m/s	2	
	Required pipe diameter :	mm	88	
	Provide pipe of diameter :	mm	100	UPVC - 4"
	Actual velocity	m/s	1.55	
	Design of permeate pipeline			
	System flow	m3/hr	41.67	
	Considering velocity in pipeline	m/s	1.5	
	Required pipe diameter :	mm	99	
	Provide pipe of diameter :	mm	100	uPVC - 4"

DESIGN CALCULATIONS (PROCESS)

First Pass

Actual velocity	m/s	1.47	

M Design of Flushing Tank

Flushing volume required = volume of pressure tube with soaked membranes + residual solution in cleaning tank + vol. In interconnecting piping

Volume / soaked membrane	Ltrs	68	
	m3	0.068	
VoL.of pressure tube with soaked memb	**m3**	**5.9976**	
Pipe line size (Dia)	mm	100	
Pipe line size (Radius)	m	0.05	
Overall length of all interconnecting pipes	m	50	
Volume of interconnecting pipe	**m3**	**0.3925**	
Flush tank volume required	m3	6.39	
	Gallons	1686.9864	
Flushing tank volume Designed / Provided	m3	10.00	
	Gallons	2642	

N Design of flush pump

Total volume to be flushed out 100% in 5mins	gallons	2642	
Flow	gpm	528	
	m3/hr	120.01	
Flush flow rate selected	m3/hr	120	
Calculation of pump head:			
Suction line from flush tank to flush pump suction			
Pump flow	cu.m/hr.	120	
Considering velocity 2 m/s. in pump discharge line	m/s	2	
Required pipe diameter :	mm	146	
Provide pipe of diameter :	mm	150	uPVC - 6"
Actual velocity	m/s	1.89	
Head loss flush tank to flush pump suction (Ref.Attached sheet no.9 for head loss calculations)			
Minimum head required	m	1.73	**a**
Delivery line from flush pump to RO suction (outlet of CF)			
Pump flow (max)	cu.m/hr.	120	
Considering velocity in pump discharge line	m/s	2.5	
Required pipe diameter .	mm	130	
Provide pipe of diameter :	mm	150	uPVC - 6"
Actual velocity	m/s	1.89	
Head loss flush pump delivery to pressure vessels (Ref.Attached sheet no.10 for head loss calculations)			
Minimum head required	m	4.35	**b**

DESIGN CALCULATIONS (PROCESS)

First Pass

Head loss calculations in Pressure vessels

Maximum allowable head loss 1 bar			
Consider head loss in Pressure vessels 10 m	m	10	**c**
Head loss Delivery from RO to Brine pit			
Pump flow (max)	cu.m/hr.	120	
Considering velocity in pump discharge line	m/s	2	
Required pipe diameter .	mm	146	
Provide pipe of diameter :	mm	150	
Actual velocity	m/s	1.89	
Head loss from RO to Brine pit (Ref.Attached sheet no.11 for head loss calculations)			
Minimum head required	m	2.49	**d**
Provide 1 no. flush pump of			
Capacity	m3/hr	120.00	Grundfos
Head Required minimum	m	19	

O Design of CIP Tank

Flushing volume required = volume of pressure tube with soaked membranes + residual solution in cleaning tank + vol. In interconnecting piping

Volume / soaked membrane	Ltrs	68	
	m3	0.068	
VoL.of pressure tube with soaked memb	**m3**	**5.9976**	DOW MANUAL
Pipe line size (Dia)	mm	150	
Pipe line size (Radius)	m	0.075	
Overall length of all interconnecting pipes	m	50	
Volume of interconnecting pipe	**m3**	**0.883125**	
CIP tank volume required	m3	6.88	
	Gallons	1816.5114	
CIP tank volume Designed / Provided	m3	10.00	
	Gallons	2642	

P Design of CIP pump

Total volume to be recycled 100% in 5mins	gallons	2642	
Flow	gpm	528	
	m3/hr	120.01	
Cleaning flow rate selected	m3/hr	45	
Calculation of pump head:			
Suction line fromCIP tank to CIP pump suction			
Pump flow	cu.m/hr.	120	
Considering velocity 1 m/s. in pump discharge line	m/s	2	
Required pipe diameter :	mm	146	

DESIGN CALCULATIONS (PROCESS)

First Pass

Provide pipe of diameter :	mm	100	uPVC - 4"
Actual velocity	m/s	4.24	
Head loss CIP tank to CIP pump suction (Ref.Attached sheet no.12 for head loss calculations)			
Minimum head required	m	2.64	**a**
Delivery line from CIP pump to CIP Filter			
Pump flow (max)	cu.m/hr.	120	
Considering velocity in pump discharge line	m/s	2	
Required pipe diameter .	mm	146	
Provide pipe of diameter :	mm	150	uPVC - 6"
Actual velocity	m/s	1.89	
Head loss CIP pump delivery to CIP Filter (Ref.Attached sheet no.13 for head loss calculations)			
Minimum head required	m	2.68	**b**
Head loss calculations in cleaning cartridge filter			
Maximum allowable head loss 0.75 bar			
Hence considered head loss in filter as	m	7.5	**c**
Delivery line from cleaning cartridge filter to RO System			
Pump flow	cu.m/hr	120	
Considering velocity in pump discharge line	m/s	2.5	
Required pipe diameter	mm	130	
Provide pipe of diameter :	mm	150	uPVC - 6"
Actual velocity	m/s	1.89	
Head loss from cleaning cartridge filter to R.O. System (Ref.Attached sheet no.14 for head loss calculations)			
Minimum head required	m	2.68	**d**
Head loss calculations in R.O. System for cleaning operation			
Maximum allowable head loss across membranes 1 bar	m	10	**e**
Recirculation line from R.O. System in cleaning tank			
Pump flow	cu.m/.hr	120	
Considering velocity pump discharge line	m/s	2.5	
Required pipe diameter :	mm	130	
Provide pipe of diameter :	mm	150	uPVC - 6"
Actual velocity	m/s	1.89	
Head loss from recirculation line from RO System to cleaning tank (Ref. Attached sheet no.15 for head loss calculation)			
Minimum head required	m	1.75	**f**
Hence total pumping head required for cleaning pump:			

DESIGN CALCULATIONS (PROCESS)

First Pass

Total head loss from cleaning tank to suction of cleaning pump + pressure loss from cleaning pump to Cleaning cartridge filter + pressure loss across cleaning cartridge filter + head loss from cleaning cartridge filter to R.O. System + head loss across m

	a+b+c+d+e+f	m	28.0	
	Provide 1 no. cleaning pump of			
	Capacity	m3/hr	120	Grundfos
	Minimum head required	m	28	Grundfos

Q Selection of Cleaning Cartridge Filter

	Feed Flow	m3/hr	120	
	Max. flow handled by Dia 2.5" x 40"X long 9 nos cartridge of 5 micron nominal rating	m3/hr	30	
	Hence no. of cartridge required		4.00	
	No. of 2.5" x 40" x 7 Cartridge provided		4	considered UPVC
	Max Feed flow that can be handled		120	make filters

SECOND PASS

	Plant Capacity	m3/D	1000	1 x 100 m3 stream
R	**Plant Capacity**	m3/hr.	41.67	20.86 / stream
	Blending from first pass	m3/hr.	0.00	
	Permeate from Second pass	m3/hr.	41.67	
	Brine recirculation from pass 2	m3/hr.	0	
	Feed Water TDS	mg/l	500.00	
	Recovery ratio	%	90.0%	
	System High Pressure @ ro feed	bar	10.00	
S	RO Plant Feed water requirement	m3/hr.	46.30	
	Total feed flow		46.30	(Ref. RO Membrane design projection)

Intermedeate Water Tank Capacity:

Feed Water Flow	m3/Hr	46.30	
Min Retention Time	Min	5	
Volume required	Gal	1019	(Ref. Membrane
Provide tank of capacity	Gal	1000	design projections)
Actual rentention time	Min	4.9	

Selection of High Presssure Pump

Max. inlet pressure required at the RO Plant module	bar	10	
Select one number of HPP			
capcaity	m3	46.30	
pressure	bar	18	

DESIGN CALCULATIONS (PROCESS)
First Pass

Design of Reverse Osmosis Module	no	7ele x 6nos
Membrane - Hydranautics - SWC5 MAX	no	42
Pressure Vessel	no	6
membrane per vessel	no	7
Pressure Rating Minimum	psi	600

Sheet No. 1
Head Loss Calculation

Head loss calculation for	=	**Borewell pump to Raw Water Tank**	
Flow (cum/hr)	=	111.9	m3/hr
Diameter (mm)	=	150	mm
Hence, velocity (m/sec)	=	1.76	m/sec
Constant C	=	130	
Straight length (m)	=	200	m
Static head (m)	=	15	m
Velocity Head ($v^2/2g$)	=	0.16	m

Head Loss In Fittings

Fitting	**Quantity**	**Reynolds Factor**	**Head Loss ($kv^2/2g$)**
Elbows, 90 deg	5	0.29	0.229
Elbows, 45 deg	3	0.14	0.066
Sudden contraction	2	0.88	0.277
Sudden engl.	2	1.76	0.554
Tee-90 deg	1	0.35	0.055
Valves	3	0.25	0.118
NRV	1	2	0.315
Strainer (approximate)	0	75	0.000
Exit	1	0.75	0.118
Total			**1.733**

Friction Loss in Pipes

According to the Empirical formulae for the calculation of friction loss:

Friction head loss $= 6.78 (v/C)^{1.852} (D)^{-1.165}$ = **0.0213813** m/m

Therefore friction loss in pipe 200 = **4.28** m

Total Head Loss (m) (Loss in Fittings + = **6.03 m**

Minimum Head Required (Total Head Loss + = **21.03** m

Sheet No. 2
Head Loss Calculation

1	**Head loss calculation for**	**:**	**Raw water tank to Suction of MMF feed pump**	
2				
3	Flow (cum/hr)	=	111.87	m3/hr
4	Diameter (mm)	=	150	mm
5	Hence, velocity (m/sec)	=	1.76	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	5	m
8	Static head (m)	=	1	m
9	Velocity Head ($v^2/2g$)	=	0.16	m
10				
11	**Head Loss In Fittings**			
12				

	Fitting	**Quantity**	**Reynolds Factor**	**Head Loss ($kv^2/2g$)**
14				
15	Elbows, 90 deg	3	0.29	0.137
16	Elbows, 45 deg	2	0.14	0.044
17	Sudden contraction	1	0.88	0.139
18	Sudden engl.	1	1.76	0.277
19	Tee-90 deg	2	0.35	0.110
20	Valves	4	0.2	0.158
21	NRV	0	2	0.000
22	Strainer (approximate)	0	75	0.000
23	Exit	1	0.75	0.118
24	**Total**			**0.983**

25				
26	**Friction Loss in Pipes**			
27	According to the Empirical formulae for the calculation of friction loss:			
28	Friction head loss	$= 6.78 (v/C)^{1.852}(D)^{-1.165}$	=	**0.025** m/m
29				
30	Therefore friction loss in pipe	5	=	**0.12** m
31				
32	Total Head Loss (m)	(Loss in Fittings +	=	**1.13 m**
33				
34	Minimum Head Required	(Total Head Loss +	=	**2.13** m

Sheet No. 3
Head Loss Calculation

Head loss calculation for	**:**	**Raw Water feed pump to MMF**	
Flow (cum/hr)	=	111.87	m3/hr
Diameter (mm)	=	150	mm
Hence, velocity (m/sec)	=	1.76	m/sec
Constant C	=	120	
Straight length (m)	=	3	m
Static head (m)	=	2	m
Velocity Head ($v^2/2g$)	=	0.16	m

Head Loss In Fittings

Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
Elbows, 90 deg	5	0.29	0.229
Elbows, 45 deg	3	0.14	0.066
Sudden contraction	1	0.88	0.139
Sudden engl.	1	1.76	0.277
Tee-90 deg	2	0.35	0.110
Valves	2	0.25	0.079
NRV	1	2	0.315
Strainer (approximate)	0	75	0.000
Exit	1	0.75	0.118
Total			**1.333**

Friction Loss in Pipes

According to the Empirical formulae for the calculation of friction loss:

Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.025** m/m
Therefore friction loss in pipe	3	=	**0.07** m
Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.43 m**
Minimum Head Required	(Total Head Loss + Static Head)	=	**3.43** m

Sheet No. 4
Head Loss Calculation

1	**Head loss calculation for**	**:**	**MMF outlet to Cartridge Filter inlet**	
2				
3	Flow (cum/hr)	=	104.17	m3/hr
4	Diameter (mm)	=	150	mm
5	Hence, velocity (m/sec)	=	1.64	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	5	m
8	Static head (m)	=	1	m
9	Velocity Head ($v^2/2g$)	=	0.14	m

Head Loss In Fittings

	Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
15	Elbows, 90 deg	5	0.29	0.198
16	Elbows, 45 deg	3	0.14	0.057
17	Sudden contraction	1	0.82	0.112
18	Sudden engl.	1	1.64	0.224
19	Tee-90 deg	2	0.35	0.096
20	Valves	2	0.25	0.068
21	NRV	1	2	0.273
22	Strainer (approximate)	0	75	0.000
23	Exit	2	0.75	0.205
24	**Total**			**1.233**

Friction Loss in Pipes

According to the Empirical formulae for the calculation of friction loss:

28	Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.022** m/m
30	Therefore friction loss in pipe	5	=	**0.11** m
32	Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.36 m**
34	Minimum Head Required	(Total Head Loss + Static Head)	=	**2.36** m

Sheet No. 5
Head Loss Calculation

1	**Head loss calculation for**	**:**	**Filtrate tank outlet to suction of Backwash pump**	
2				
3	Flow (cum/hr)	=	49.49	m3/hr
4	Diameter (mm)	=	100	mm
5	Hence, velocity (m/sec)	=	1.75	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	5	m
8	Static head (m)	=	1	m
9	Velocity Head ($v^2/2g$)	=	0.16	m
10				
11	**Head Loss In Fittings**			
12				

13	**Fitting**	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
14				
15	Elbows, 90 deg	4	0.29	0.181
16	Elbows, 45 deg	3	0.14	0.066
17	Sudden contraction	1	0.88	0.137
18	Sudden engl.	1	1.75	0.273
19	Tee-90 deg	1	0.35	0.055
20	Valves	2	0.25	0.078
21	NRV	0	2	0.000
22	Strainer (approximate)	0	75	0.000
23	Exit	1	0.75	0.117
24	**Total**			**0.907**
25				
26	**Friction Loss in Pipes**			
27	According to the Empirical formulae for the calculation of friction loss:			
28	Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.039** m/m
29				
30	Therefore friction loss in pipe	5	=	**0.20** m
31				
32	Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.14 m**
33				
34	Minimum Head Required	(Total Head Loss + Static Head)	=	**2.14** m

Sheet No. 6
Head Loss Calculation

1	**Head loss calculation for**	**:**	**Backwash Pump to MMF**	
2				
3	Flow (cum/hr)	=	49.49	m3/hr
4	Diameter (mm)	=	100	mm
5	Hence, velocity (m/sec)	=	1.75	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	20	m
8	Static head (m)	=	3	m
9	Velocity Head ($v^2/2g$)	=	0.16	m
10				
11	**Head Loss In Fittings**			
12				

	Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
13				
14				
15	Elbows, 90 deg	5	0.29	0.226
16	Elbows, 45 deg	4	0.14	0.087
17	Sudden contraction	2	0.88	0.273
18	Sudden engl.	2	1.75	0.547
19	Tee-90 deg	2	0.35	0.109
20	Valves	2	0.25	0.078
21	NRV	1	2	0.312
22	Strainer (approximate)	0	.75	0.000
23	Exit	1	0.75	0.117
24	**Total**			**1.751**

25					
26	**Friction Loss in Pipes**				
27	According to the Empirical formulae for the calculation of friction loss:				
28	Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.039**	m/m
29					
30	Therefore friction loss in pipe	20	=	**0.79**	m
31					
32	Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**2.58**	**m**
33					
34	Minimum Head Required	(Total Head Loss + Static Head)	=	**5.58**	m

Sheet No.7
Head Loss Calculation

Head loss calculation for	**:**	**Back wash drain from MMF unit to brine pit**		
Flow (cum/hr)	=	49.49	m3/hr	
Diameter (mm)	=	100	mm	
Hence, velocity (m/sec)	=	1.75	m/sec	
Constant C	=	120		
Straight length (m)	=	25	m	
Static head (m)	=	1	m	
Velocity Head ($v^2/2g$)	=	0.16	m	

Head Loss In Fittings

Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
Elbows, 90 deg	6	0.29	0.272
Elbows, 45 deg	0	0.14	0.000
Sudden contraction	0	0.88	0.000
Sudden engl.	1	1.75	0.273
Tee-90 deg	2	0.35	0.109
Valves	3	0.25	0.117
NRV	0	2	0.000
Strainer (approximate)	0	75	0.000
Exit	1	0.75	0.117
Total			**0.889**

Friction Loss in Pipes

According to the Empirical formulae for the calculation of friction loss:

Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.039**	m/m
Therefore friction loss in pipe	25	=	**0.99**	m
Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.91**	**m**
Minimum Head Required	(Total Head Loss + Static Head)	=	**2.91**	m

Sheet No. 8
Head loss Calculation

1	**Head loss calculation for**	**:**	**Cartridge filter outlet to High Pressure pump suction**	
2				
3	Flow (cum/hr)	=	104.17	m3/hr
4	Diameter (mm)	=	150	mm
5	Hence, velocity (m/sec)	=	1.64	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	10	m
8	Static head (m)	=	1	m
9	Velocity Head ($v^2/2g$)	=	0.14	m
10				
11	**Head Loss In Fittings**			
12				

13	**Fitting**	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
14				
15	Elbows, 90 deg	8	0.29	0.317
16	Elbows, 45 deg	2	0.14	0.038
17	Sudden contraction	1	0.82	0.112
18	Sudden engl.	1	1.64	0.224
19	Tee-90 deg	0	0.35	0.000
20	Valves	1	0.25	0.034
21	NRV	1	2	0.273
22	Strainer (approximate)	0	75	0.000
23	Exit	1	0.75	0.102
24	**Total**			**1.101**
25				
26	**Friction Loss in Pipes**			
27	According to the Empirical formulae for the calculation of friction loss:			
28	Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.022** m/m
29				
30	Therefore friction loss in pipe	10	=	**0.22** m
31				
32	Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.34 m**
33				
34	Minimum Head Required	(Total Head Loss + Static Head)	=	**2.34** m

Sheet No. 9
Head Loss Calculation

1	**Head loss calculation for**	**:**	**Flush tank outlet to Suction of flushpump**	
2				
3	Flow (cum/hr)	=	120	m3/hr
4	Diameter (mm)	=	150	mm
5	Hence, velocity (m/sec)	=	1.89	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	3	m
8	Static head (m)	=	1	m
9	Velocity Head ($v^2/2g$)	=	0.18	m
10				
11	**Head Loss In Fittings**			
12				

	Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
14				
15	Elbows, 90 deg	5	0.29	0.263
16	Elbows, 45 deg	0	0.14	0.000
17	Sudden contraction	1	0.94	0.171
18	Sudden engl.	0	1.89	0.000
19	Tee-90 deg	0	0.35	0.000
20	Valves	1	0.25	0.045
21	NRV	0	2	0.000
22	Strainer (approximate)	0	75	0.000
23	Exit	1	0.75	0.136
24	**Total**			**0.615**

25					
26	**Friction Loss in Pipes**				
27	According to the Empirical formulae for the calculation of friction loss:				
28	Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.028**	m/m
29					
30	Therefore friction loss in pipe	3	=	**0.08**	m
31					
32	Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**0.73**	**m**
33					
34	Minimum Head Required	(Total Head Loss + Static Head)	=	**1.73**	m

Sheet No. 10
Head Loss Calculation

Head loss calculation for	**:**	**Flush pump to RO suction**		
Flow (cum/hr)	=	120	m3/hr	
Diameter (mm)	=	150	mm	
Hence, velocity (m/sec)	=	1.89	m/sec	
Constant C	=	120		
Straight length (m)	=	3	m	
Static head (m)	=	2	m	
Velocity Head ($v^2/2g$)	=	0.18	m	

Head Loss In Fittings

Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
Elbows, 90 deg	7	0.29	0.368
Elbows, 45 deg	2	0.14	0.051
Sudden contraction	1	0.94	0.171
Sudden engl.	1	1.89	0.342
Tee-90 deg	2	0.35	0.127
Valves	4	0.25	0.181
NRV	2	2	0.725
Strainer (approximate)	0	75	0.000
Exit	2	0.75	0.272
Total			**2.238**

Friction Loss in Pipes

According to the Empirical formulae for the calculation of friction loss:

Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.028** m/m
Therefore friction loss in pipe	3	=	**0.08** m
Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**2.35 m**
Minimum Head Required	(Total Head Loss + Static Head)	=	**4.35** m

Sheet No. 11
Head Loss Calculation

1	**Head loss calculation for**	**:**	**RO To Brine pit**	
2				
3	Flow (cum/hr)	=	120	m3/hr
4	Diameter (mm)	=	150	mm
5	Hence, velocity (m/sec)	=	1.89	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	25	m
8	Static head (m)	=	1	m
9	Velocity Head ($v^2/2g$)	=	0.18	m
10				
11	**Head Loss In Fittings**			
12				

13	**Fitting**	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
14				
15	Elbows, 90 deg	4	0.29	0.210
16	Elbows, 45 deg	0	0.14	0.000
17	Sudden contraction	0	0.94	0.000
18	Sudden engl.	0	1.89	0.000
19	Tee-90 deg	0	0.35	0.000
20	Valves	1	0.25	0.045
21	NRV	1	2	0.363
22	Strainer (approximate)	0	75	0.000
23	Exit	1	0.75	0.136
24	**Total**			**0.754**
25				
26	**Friction Loss in Pipes**			
27	According to the Empirical formulae for the calculation of friction loss:			

28	Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.028** m/m
29				
30	Therefore friction loss in pipe	25	=	**0.71** m
31				
32	Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.49 m**
33				
34	Minimum Head Required	(Total Head Loss + Static Head)	=	**2.49** m

Sheet No. 12
Head Loss Calculation

1	**Head loss calculation for**	**:**	**CIP tank outlet to Suction of CIP pump**	
2				
3	Flow (cum/hr)	=	120	m3/hr
4	Diameter (mm)	=	100	mm
5	Hence, velocity (m/sec)	=	4.24	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	3	m
8	Static head (m)	=	1	m
9	Velocity Head ($v^2/2g$)	=	0.92	m
10				
11	**Head Loss In Fittings**			
12				

	Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
14				
15	Elbows, 90 deg	5	0.29	0.263
16	Elbows, 45 deg	0	0.14	0.000
17	Sudden contraction	1	2.12	0.385
18	Sudden engl.	0	4.24	0.000
19	Tee-90 deg	0	0.35	0.000
20	Valves	1	0.25	0.045
21	NRV	0	2	0.000
22	Strainer (approximate)	0	75	0.000
23	Exit	1	0.75	0.136
24	**Total**			**0.829**

25

26 **Friction Loss in Pipes**

27 According to the Empirical formulae for the calculation of friction loss:

28	Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.203** m/m
29				
30	Therefore friction loss in pipe	3	=	**0.61** m
31				
32	Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.64 m**
33				
34	Minimum Head Required	(Total Head Loss + Static Head)	=	**2.64** m

Sheet No. 13

1Head Loss Calculation- 1

Head loss calculation for	**:**		**CIP Pump to Cleaning Cartridge Fitler**	
Flow (cum/hr)	=	120	m3/hr	
Diameter (mm)	=	150	mm	
Hence, velocity (m/sec)	=	1.89	m/sec	
Constant C	=	120		
Straight length (m)	=	5	m	
Static head (m)	=	1.5	m	
Velocity Head ($v^2/2g$)	=	0.18	m	

Head Loss In Fittings

Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
Elbows, 90 deg	4	0.29	0.210
Elbows, 45 deg	0	0.14	0.000
Sudden contraction	0	0.94	0.000
Sudden engl.	1	1.89	0.342
Tee-90 deg	0	0.35	0.000
Valves	2	0.25	0.091
NRV	1	2	0.363
Strainer (approximate)	0	75	0.000
Exit	0	0.75	0.000
Total			**1.006**

Friction Loss in Pipes

According to the Empirical formulae for the calculation of friction loss:

Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.028** m/m
Therefore friction loss in pipe	5	=	**0.14** m
Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.18 m**
Minimum Head Required	(Total Head Loss + Static Head)	=	**2.68** m

Sheet No.14

1Head Loss Calculation- 1

Head loss calculation for	**:**		**Cleaning cartridge filter to RO system**	
Flow (cum/hr)	=	120	m3/hr	
Diameter (mm)	=	150	mm	
Hence, velocity (m/sec)	=	1.89	m/sec	
Constant C	=	120		
Straight length (m)	=	5	m	
Static head (m)	=	1.5	m	
Velocity Head ($v^2/2g$)	=	0.18	m	

Head Loss In Fittings

Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
Elbows, 90 deg	4	0.29	0.210
Elbows, 45 deg	0	0.14	0.000
Sudden contraction	0	0.94	0.000
Sudden engl.	1	1.89	0.342
Tee-90 deg	0	0.35	0.000
Valves	2	0.25	0.091
NRV	1	2	0.363
Strainer (approximate)	0	75	0.000
Exit	0	0.75	0.000
Total			**1.006**

Friction Loss in Pipes

According to the Empirical formulae for the calculation of friction loss:

Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.028** m/m
Therefore friction loss in pipe	5	=	**0.14** m
Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**1.18 m**
Minimum Head Required	(Total Head Loss + Static Head)	=	**2.68** m

Sheet No. 15
Head Loss Calculation

1	**Head loss calculation for**	**:**	**Recirculation line from RO system to Chem cleaning tank**	
2				
3	Flow (cum/hr)	=	120	m3/hr
4	Diameter (mm)	=	150	mm
5	Hence, velocity (m/sec)	=	1.89	m/sec
6	Constant C	=	120	
7	Straight length (m)	=	10	m
8	Static head (m)	=	1	m
9	Velocity Head ($v^2/2g$)	=	0.18	m
10				
11	**Head Loss In Fittings**			
12				

	Fitting	**Quantity**	**Reynolds Factor (k)**	**Head Loss ($kv^2/2g$)**
14				
15	Elbows, 90 deg	4	0.29	0.210
16	Elbows, 45 deg	0	0.14	0.000
17	Sudden contraction	0	0.94	0.000
18	Sudden engl.	0	1.89	0.000
19	Tee-90 deg	0	0.35	0.000
20	Valves	2	0.23	0.091
21	NRV	0	2	0.000
22	Strainer (approximate)	0	75	0.000
23	Exit	1	0.75	0.136
24	**Total**			**0.437**

25					
26	**Friction Loss in Pipes**				
27	According to the Empirical formulae for the calculation of friction loss:				
28	Friction head loss	$= 6.78 (v/C)^{1.852} (D)^{-1.165}$	=	**0.028**	m/m
29					
30	Therefore friction loss in pipe	10	=	**0.28**	m
31					
32	Total Head Loss (m)	(Loss in Fittings + Friction Loss in pipe)	=	**0.75**	**m**
33					
34	Minimum Head Required	(Total Head Loss + Static Head)	=	**1.75**	m

BRINE REJECT SYSTEM DESIGN CALCULATIONS

MMF Backwash	=	49.49 m3/hr
Brine RO	=	62.50 m3/hr
Total Waste Water dischare per day	=	**1549.49** m3/Day
Total Waste Water Discharge per day from the PROPOSED PLANT with 10% margin	=	**1704.44 m3/day**

DOSING CALCULATIONS

I	**Design of Pre chlorination - RO upstream**					
1	Feed Flow	=		111.87	m^3/hr	
2	Pre – Chlorine dose	=		2.00	mg/l	
3	% Solution	=		20.00	%	
4	Chlorine rate	=		223.73	gm/hr	
5	Hypo chlorite Rate - 12 %	=		1864.44	gm/hr	
6	Solution Rate reqd	=		9.32	l/hr	@ 2.4 bar
7	Dosing Pump Cap	=		6.00	l/hr	@ 6.2 bar
8	Dosing Stroke adj	=		155.37	%	
9	Dosing Solution reqd per day	=		223.73	lit	
10	Dosing tank capacity provided	=	*	100.00	lit	
11	Solution preparation frequency	=		11	hr	
II	**Design of Coagulant - RO upstream**					
1	Feed Flow	=		111.87	m^3/hr	
2	Coagulant dose	=		5.00	mg/l	
2	% Solution	=		20.00	%	
3	Coagulant rate	=		559.33	gm/hr	
4	Ferric Chloride Rate - 33 %	=		1694.95	gm/hr	
5	Solution Rate reqd	=		8.47	l/hr	@ 2.4 bar
6	Dosing Pump Cap	=		6.00	l/hr	@ 6.2 bar
7	Dosing Stroke adj	=		141.25	%	
8	Dosing Solution reqd per day	=		203.39	lit	
9	Dosing tank capacity provided	=	*	100.00	lit	
10	Solution preparation frequency	=		12	hr	
III	**Design of SMBS Dosing**					
1	Feed Flow	=		111.87	m^3/hr	
2	Pre Chlorine dose	=		2.00	mg/l	
3	Sodium Metabisulpite dose	=	*	5.00	mg/l	
4	% Solution	=	*	10.00	%	
5	Dosing Rate	=		559.33	gm/hr	
6	SMBS Rate - 65 %			860.51	gm/hr	
7	Solution Rate	=		8.61	l/hr	@ 3.3 bar
8	Dosing pump cap	=	*	6.00	l/hr	@ 6.2 bar
9	Dosing stroke adj.	=		143.42	%	
10	Dosing solution reqd. per day	=		206.52	lit	
11	Dosing tank capacity provided	=	*	100.00	lit	
12	Solution preparation frequency	=		11.62	hr	

DOSING CALCULATIONS

IV	**Design of Antiscalant Dosing**					
1	Feed Flow	=		111.87	m^3/hr	
2	Antiscalant dose	=	*	5.00	mg/l	
3	% Solution	=	*	6.00	%	
4	Dosing rate	=		559.33	gm/hr	
5	Antiscalant Rate - 100 %			559.33	gm/hr	
6	Solution Rate	=		9.32	l/hr	@ 3.3 bar
7	Dosing pump cap	=		6.00	l/hr	@ 6.2 bar
8	Dosing stoke adj.	=		155.37	%	
9	Dosing solution reqd. per day	=		223.73	lit	
10	Dosing tank capacity provide	=		100.00	lit	
11	Solution preparation frequency	=		10.73	hr	
V	**Design of Post Chlorination Dosing**					
1	Product Flow	=		41.67	m^3/hr	
2	Post – Chlorine dose	=		2.00	mg/l	
3	% Solution	=		10.00	%	
4	Chlorine rate	=		83.33	gm/hr	
5	Hypochlorite Rate	=		694.44	gm/hr	
6	Solution Rate	=		6.94	l/hr	@ 3.3 bar
7	Dosing pump cap	=		6.00	l/hr	@ 6.2 bar
8	Dosing stroke adj.	=		115.74	%	
9	Post Dosing solution reqd per day	=		166.67	lit	
10	Dosing tank capacity provided	=		100.00	lit	
11	Solution preparation frequency	=		14.40	hr	
VI	**Design of Alkali Dosing**					
1	Product Flow	=		41.67	m^3/hr	
2	Dosage	=	*	2.00	mg/l	
3	% Solution	=	*	2.00	%	
4	Dosing rate	=		83.33	gm/hr	
5	Alkali Rate %	=		166.67	gm/hr	
6	Solution Rate	=		8.33	l/hr	@ 3.3 bar
7	Dosing pump cap	=		6.00	l/hr	@ 6.2 bar
8	Dosing stoke adj.	=		138.89	%	
9	Dosing solution reqd. per day	=		200.00	lit	
10	Dosing tank capacity provide	=		100.00	lit	
11	Solution preparation frequency	=		12.00	hr	

PIPE SERVICE & SIZING DETAILS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SERVICE FLUID	Borewell pump to Raw Water Tank	Raw water tank to MF Feed Pump Suction	MMF Feed pump to MMF	MMF outlet to Cartridge filter Inlet	Cartridge filter outlet to High Pressure Pump & PX Suction	High Pressure pump suction line	PX suction line	High Pressure pump discharge line	PX discharge line	Brine disposal	Flush pump suction	Flush pump discharge to RO Modules	CIP Pump suction	CIP Pump discharge
Flow m3/hr	55.93	111.9	111.9	104.2	104.2	43.94	62.50	9.87	9.11	62.50	#####	120.0	120.0	120
Press. Bar	2.5	4.3	4.3	1.3	1.2	1.0	1.0	41.0	41.0	38.5	0.17	1.9	0.3	2.8
Pipe Size (mm).	150	150	150	150	150	100	100	50	50	100	150	150	100	150
Pipe Size Required(in)	6	6	6	6	6	4	4	2	2	4	6	6	4	6
MOC - PIPE	HDPE	UPVC	UPVC	UPVC	UPVC	UPVC	UPVC	Duplex SS	Duplex SS	UPVC	UPVC	UPVC	UPVC	UPVC

LIST OF DRIVES

Sl. No.	Description	Qty.				Capacity of pump	Total discharge head	Starter	Make	Model	MOC
		Duty	St/By	Store	Total						
		Nos	Nos	Nos	Nos	m3/hr	m				
1	Well Pump	2	1	0	3	55.93333333	25	DOL	Grundfos	SP	SS 904 L
2	Feed Water pump	1	1	0	2	115	43	VFD	Ampco	NB	DSS-2205
3	Backwash Pump	1	0	1	2	160	21	Star delta	Grundofss	NB	DSS-2205
4	High Pressure pump	1	0	1	2	43.9	720	VFD	Grundfos	BME	SS 904L
5	PX Booster pump	1	0	1	2	60.2	72	VFD	ERI PX booster model	HP-1253	DSS-CD3MC
6	Flush pump	1	0	1	2	75.00	30	DOL	Ampco	Z series	DSS-2205
7	CIP Pump	1	0	1	2	75.00	30	DOL	Ampco	Z series	DSS-2205
8	Air Scouring blower	1	0	0	1	274.00	5	DOL	Mapro	CL42/21	CI/MS
9	Dosing Pumps	13	13	0	26	Various		DOL	Jesco		PP/PVDF

POWER CONSUMPTION OF RO PLANT EQUIPMENTS

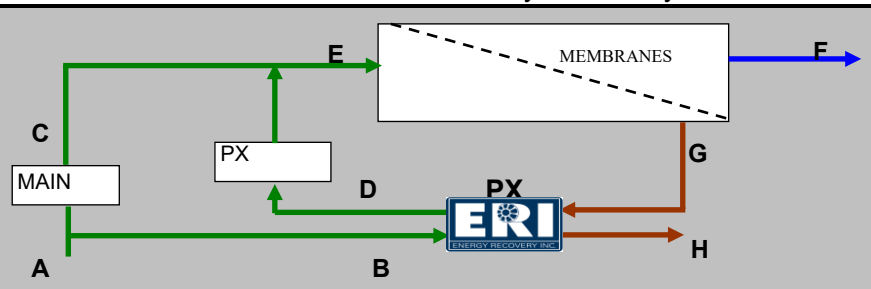
Sl. No.	Description	Qty.				Capacity of pump	Total discharge head	Pump efficiency	BKW	Motor efficiency	Couplig loss	Power consumption	Working Hours / Day	Power consumption	Power requirement
		Duty	St/By	Store	Total										
		Nos	Nos	Nos	Nos	m3/hr	m	%	kw	%	%	kw	hr	kwhrperday	KW
1	Feed Water pump	1	1	0	2	115	43	75.0%	18.07	87%	98%	21.19	24.00	508.58	21.19
	Backwash Pump	1	0	1	2	160	21	68.0%	13.46	87%	98%	15.78	1.00	15.78	15.78
2	High Pressure pump	1	0	1	2	44	720	73.0%	118.02	87%	98%	138.42	24.00	3322.13	138.42
3	PX Booster pump	1	0	1	2	60	72	90.0%	13.12	91%	98%	14.71	24.00	353.13	14.71
4	Flush pump	1	0	1	2	75	30	67.0%	9.15	87%	98%	10.73	0.00	0.00	10.73
5	CIP Pump	1	0	1	2	75	30	67.0%	9.15	87%	98%	10.73	0.0000	0.00	0.00
6	Air Scouring blower	1	0	0	1	274	5	-		-	-	-	-	0.00	-
7	Dosing Pumps	13	13	0	26	Various	0	-							
8	Instrumentation Load											0.50	24.00	0.00	0.00
	TOTAL POWER CONSUMPTION													**4199.63**	200.84
														1000	
														4.20	
														kwhr/m3	

Sl. No.	Description	Qty.				Capacity of pump	Total discharge head	Pump efficiency	BKW	Motor efficiency	Couplig loss	Power consumption	Working Hours / Day	Power consumption	Power requirement
		Duty	St/By	Store	Total										
		Nos	Nos	Nos	Nos	m3/hr	m	%	kw	%	%	kw	hr	kwhrperday	KW
1	Well Pump	2	1	0	3	56	50	74.0%	10.29	82%	99%	12.68	18.00	456.41	25.36
															25.36

Pump efficiency is considered on a conservative side

16/11/2004

PX System Analysis



FLOW AND PRESSURE TABLE

		A	B	C	D	E	F	G	H
FLOW	US gpm	459	265	193	265	459	183	275	275
	m^3/hr	104.2	60.2	43.9	60.2	104.2	41.7	62.5	62.5
	m^3/day	2,500	1,445	1,055	1,445	2,500	1,000	1,500	1,500
PRESSURE	psi	23	23	1044	1015	1044	0	1022	15
	Bar	1.6	1.6	72.0	70.0	72.0	0.0	70.5	**1.0**
QUALITY	n/a	SEA	SEA	SEA	SEA	SEA	PERM	BRINE	BRINE

PX PERFORMANCE

PX model	n/a	PX-140S
Number of units	n/a	3
PX unit flow	m3/hr	20.8
PX lubricant per array	m3/hr	2.3
PX differential HP side	bar	0.5
PX differential LP side	bar	0.6
PX efficiency	%	95.0%
Operating capacity	%	65.5%

HIGH PRESS. PUMP POWER

HP pump efficiency	%	69%
Motor efficiency	%	92%
HP pump flow rate	m3/hr	43.9
Differential pressure	bar	70.4
Power	kW	136.2

PX BOOSTER PUMP POWER

ERI PX booster model	50 Hz	HP-125
Number of units	n/a	2
PX booster efficiency	%	84%
Motor Efficiency	%	91%
Total PX booster flow rate	m3/hr	60.2
Differential pressure	bar	2.0
Total booster power	kW	5.8

SEA WATER FEED PUMP	kW	0.0

INPUT DESCRIPTIONS **INPUTS**

Units Metric or English	M or E	**m**
Manual or auto efficiencies	m or a	**a**
Motor power Hz	50 or 60	**50**
Permeate flow	m3/day	**570**
RO recovery rate	%	**40%**
RO feed pressure	bar	**72.0**
Membrane DP	bar	**1.5**
Main HP Pump efficiency	%	
Main HP Pump motor efficiency	%	
PX Booster efficiency	%	
PX booster motor efficiency	%	
PX design margin	%	

PX SYSTEM POWER RESULTS

Total RO process (kW)	142.0
kWh/m^3 permeate	3.41
kWh/Kgal permeate	12.9

Power savings per year @ $0.10/kWh	$ 158,545

Warnings	**NONE**
Suggestions	**NONE**

Notes: