Industria con necesidades de 10 000 m3 / Day

Capacity of drink water – 10 000 m^3/day

DESIGN BASIS

Proposal for the drink water treatment of the Mediterranean Sea water with membrane technologies utilizing Ultrafiltration and Reverse Osmosis processes to obtain high quality drink water. Equipment proposed herein is based on the information that raw surface Mediterranean Sea water quality. Plant is set to produce **10 000 m^3/day** and would work 24 hours a day and 365 days a year.

SUMMARY SCOPE OF SUPPLY AND WORKS

Proposed consists:

- 5 (five) Ultrafiltration (UF) machines with supporting equipment – Backwash (BW)/Chemical Enhanced Backwash (CEB) station;
- 3 (three) Reverse Osmosis (RO) machines with Pressure Exchanger (PEX);
- clean in place (CIP) station for cleaning of RO and UF membranes;
- 2 (two) Chemical feed skids for sodium hypochlorite dosing, 2 (two) Chemical feed skids for antiscalant dosing, 1 (one) Chemical feed skids for caustic dosing, 1 (one) Chemical feed skid for acid dosing and supporting equipment.

BRIEF DESCRIPTION PLANT

Capacity of drink water– 10000 m^3/day (460 m^3/hour).

Water use:

source water – 1150 m^3/hour;

reject (UF, RO) –640 m^3/hour;

Main electricity consumers:

for source water temperature +12C^0 - 2,72 kW/m^3 ;

Dimensions of Plant - 30m x 52 m (1560 m^2)

Feed Water Analysis/Guaranteed Outcome

Main Parameters	Feed Water	RO Permeate*	Unit
Calcium (Ca)	447	0,5-2,0	mg/l
Magnesium (Mg)	1400	1-3	mg/l
Sodium (Na)	12121	50-150	mg/l
Potassium (K)	431	3-7	mg/l
Sulfate (SO_4)	2862	2-4	mg/l
Chloride (Cl)	21740	80-220	mg/l
Boron (B)	4,6	<1,0	mg/l
Bicarbonate (HCO_3)	172	2-4	mg/l
pH	8,3	6,5-7,5	
Temperature	12-29	12-29	^{0}C
TDS	39200	100-500	mg/l

** water quality must comply with EU Standard specification for drink water*

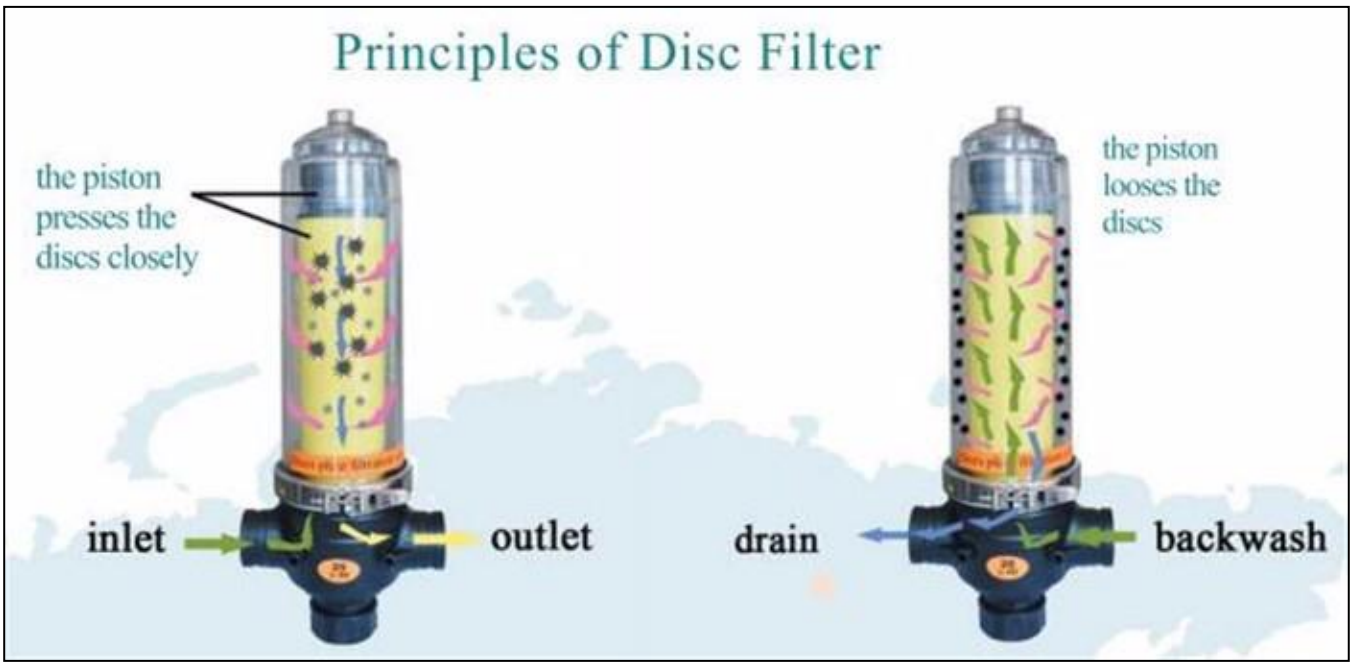
TECHOLOGY AND PROCESS DESCRIPTION – PRETREATMENT

- **Prefiltration (automatic disc filters);**
- **UF (Ultrafiltration);**

During Prefiltration stage on the automatic disc filter 200 micron and bigger particles rejected to protect membrane surface from sharp solid particles. This step immediately followed by the Ultrafiltration. All three technology phases synchronized in fully automated system that control the process to get the most from system operational.

Feed water enters disc filters, which are made from polymers. Outside surface of the filter element appears in cylinder shape after disc compression.

On each disc surface grooves are inflicted of the certain depth and width to achieve volumetric net structure, which is an actual filtration tool for smaller particles. During filtration phase discs are compressed by utilization of the spring. Compressed discs are creating the uniformed filtration structure.



During backwash (BW) stage, which starts after reception of the signal from the outside, pistons change direction of the water stream through the filter. Thus, disc packet expands. Under the skew stream that is created by special nozzles, discs start rotation and all particles from the surface are quickly and efficiently washed out into the drain under BW stream. At the end of the BW mode filters are rinsed by clean water.

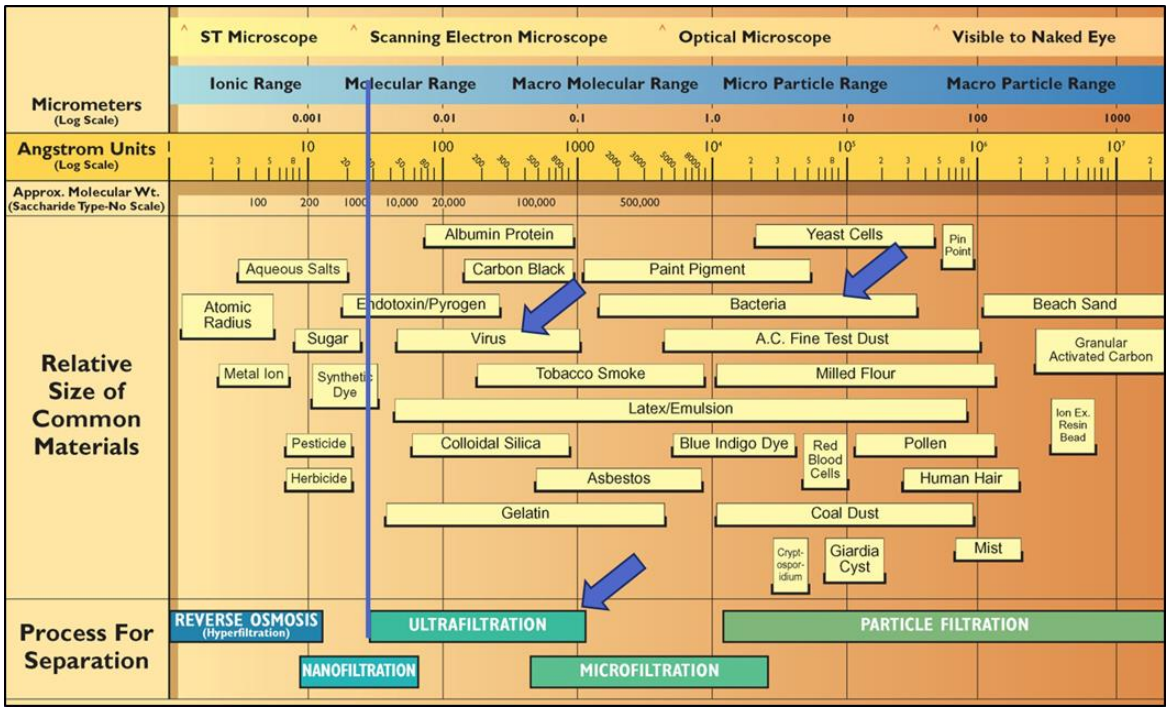
After pre-filtration water entering **Ultrafiltration** membranes (UF).

Main advantage of the UF system is to achieve high level of product quality without any change of high permeate (product) quality. Ultrafiltration membranes allow you to retain fine and colloidal impurities, algae, unicellular microorganisms, cysts, bacteria, viruses. The degree of filtration of the membrane (pore size) is 0.02 microns. In this regard, there is no reagent disinfection of water - viruses and bacteria do not pass through the pores of the membrane.

The operating mode of the unit is a dead end, without discharge of concentrate during filtration.

For UF operation only 0.5-1 bar of the working pressure needed, therefore energy consumption of the process is low.

Filtration Spectrum:



Permeate from each machine enters common pipe followed by the automatic valve that distribute water flow further to the RO machines. No intermediate tanks, transfer pumps and cartridge filter system is needed for this design.

Small portion of the UF permeate would be used for the BW and Chemical Enhanced Backwash (CEB) of the UF membranes.

These processes would be done in a fully automatic mode either. To clean membrane surface from absorbed contamination designed BW process by clean product water.

BW implemented by specially consigned pump. BW process designed to bring water in opposite to a filtration mode direction – “out-in”. BW volume usually make up 3-5% of the feed water volume. Time duration – 30 secs, every 40-70 min.

To clean membrane even further, every 24 hours or so, CEB is held. During CEB chemicals (normally acid and caustic) are used.

To enhance UF process even more, prior to UF normally used hypochlorite chlorination (in our case periodically) of the feed water.

TECHOLOGY AND PROCESS DESCRIPTION DESALINATION – REVERSE OSMOSIS (RO)

The proposed 6 (six) RO units would produce total 48960 m^3/Day of desalinated water, or 340 m^3/hour per skid. Proposal offers one SWRO skid have one hundred fifty-five (155) 6-ling housing with 6 membranes in each.

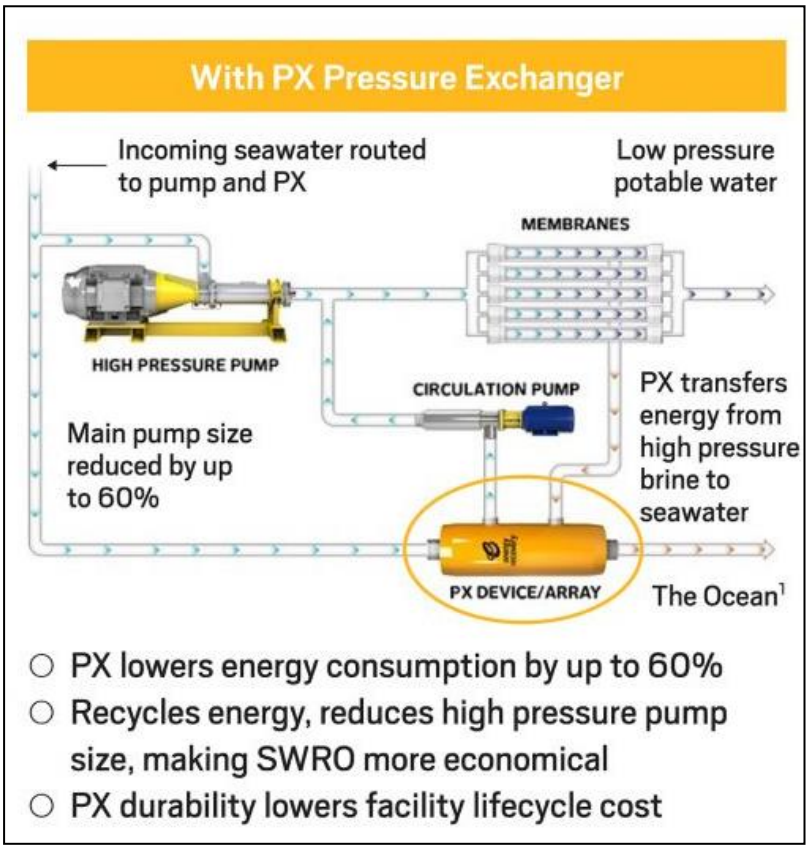
The main advantage of this design is that it uses French made **Knappe** housings, and is therefore much more compact than traditional round housing design. Victaulic couplings don't need to be used in this skid design except piping connections. We have attached presentation of the **Knappe** housings as an attachment to this proposal.

Operating RO is simple, especially in case of utilizing VFDs to control high pressure pumps, which we do. RO is operating in continuous mode, so programming of the RO portion of the system is basically control of the pressure drop to initiate timely cleanings in place (CIP) of the skids (each skid separately, when necessary)

Demanded variations of the product output will be additionally addressed by turning on/off skids based on a level in the product tank. Skid would have 3 enclosures: electrical, instrumentation, air-conditioned VFD enclosure. If necessary, information from the PLC, which would be displayed at local Panel View can be picked up by the main plant computer. Automatic valve actuator proposed to be electric. All flow, pressure, conductivity, and pH data would be shown on the Panel View screen.

Prior to the skid we'll have 2 chemical skids for Sodium metabisulfite (to avoid any possibility of oxidizers breakthrough, ORP analyzer would still be installed to check on this, RO membranes made from PA (polyamide), which is sensitive to oxidizing agents and will be destroyed overtime, if left unprotected and antiscalant to avoid any sulfate related fouling.

An important part of the design is the **Pressure Exchanger (PEX),** which allows to recover concentrate pressure and add it to the pressure generated by the high-pressure pump.



In our case we are proposing ERI PX set up, which would also require additional circulation pump. Anticipated energy consumption for the system would be below 3.0 kW per 1 m³ of the product produced.

PERFORMANCE DATA (SWRO SKID UNIT)

Design Permeate Flow	230 m^3/h
Feed Flow	500 m^3/h
Concentrate Feed Flow	270 m^3/h
Recovery	45-50 %
Design Temperature	12-29 °C
Design pH	8.1
System Inlet Pressure	2,0 bar
System Operating Pressure (max)	62 bar

Controls

The control system ensures uniformity of loading of pumping units, UF and RO machines, and provides an optimal load of pump machines and motors. The control algorithm used in A PROCESS control system has the following characteristics:

1. increasing the efficiency of pumping equipment to the maximum possible for this equipment (the use of a special control algorithm);
2. improving the efficiency of equipment management;
3. increase of reliability and fault tolerance;
4. energy saving (reduction of electricity consumption);
5. resource saving (reducing the number of equipment breakdowns, increasing the overhaul interval);
6. maintenance of optimal control range;
7. increase of cavitation stability of pumping units;
8. transmission and accumulation of reliable information about the actual operating modes of pumping stations with the possibility of remote control from the CDP.

For control and visualization of the technological process, the dispatcher's workstation is provided, made based on the SIEMENS industrial system unit (or analogue) with a color graphic monitor 15''. SCADA system SIEMENS WinCC 7.0 (or analogue) is installed on the workstation, which will allow you to visually monitor the progress of the technological process, archive the parameters of the equipment, as well as respond more quickly to emergency situations.

Components

Processor	PLC - Siemens S7 1200
Enclosure	IP66, RO Skid Mounted
Operator Interface	Siemens TP1200 Touchpanel
Communications	Ethernet

Control Screens Included

Security access screen
System overview
System data display
Alarm history
Individual component display of operational status, 4-20 mA instruments and control
Alarm status and indication
Alarm description
Set point screens

Main consumption of technological process

Consumers of electricity:

The main consumers of electricity of the technological process are:

- feed water pumps – work constantly;
- back wash pumps work periodically;
- dosing pumps work periodically;
- high pressure pump of reverse osmosis works constantly.

Variable Frequency drives (VFD) used for every pump, which helps to manage the process more effectively, reacting to requested flow and water temperature changes regardless of the nominal power of the pump

Power Consumption, while Producing Maximum Output, 10 000 m^3/Day

Name of position	Working time per day, hour	Power consumption per hour, kW	Power consumption per day, kW
Pump of Source water	24	300	7200
Back Wash UF	2,1	132	272
High pressure pump RO	24	546	13104
Circular RO pump	24	20	480

Chemical Usage

For CEB process we are using acid and caustic.

Caustic (NaOH 40%) – used to achieve high pH (9-9.5) for effective cleaning from organics and microbiological fouling. It will be done few times a week and depends on how quickly pressure UF skid high drop appears. It will be done more often during the summer and less often during winter time.

Sulphur Acid (H2SO4 44%) – used to achieve low pH (2-2.5) for effective cleaning from inorganic fouling. Acid CEB likely to be performed once in 36 hours or so.

CEB performed by dosing chemical by means of dosing pump directly into the pipeline, while UF permeate for the BW tank pumped into the skid. After completion of the CEB cleaning, which may also include several minutes soaking step skid is rinsing by clean permeate water before bringing back to service.

Water with chemicals is pumped out from the skid and after neutralization with either acid or caustic to neutral pH will be dumped into the sewage system. Our technology suggests usage of Sulphur Acid (44%), which is within the requirements of using it without any restriction

Antiscalant dosing - to avoid any sulfate or calcium related fouling.

Chemicals Usage, while Producing Maximum Output – 1000 m^3/Day:

Caustic, 40% - 4,6 kg/day

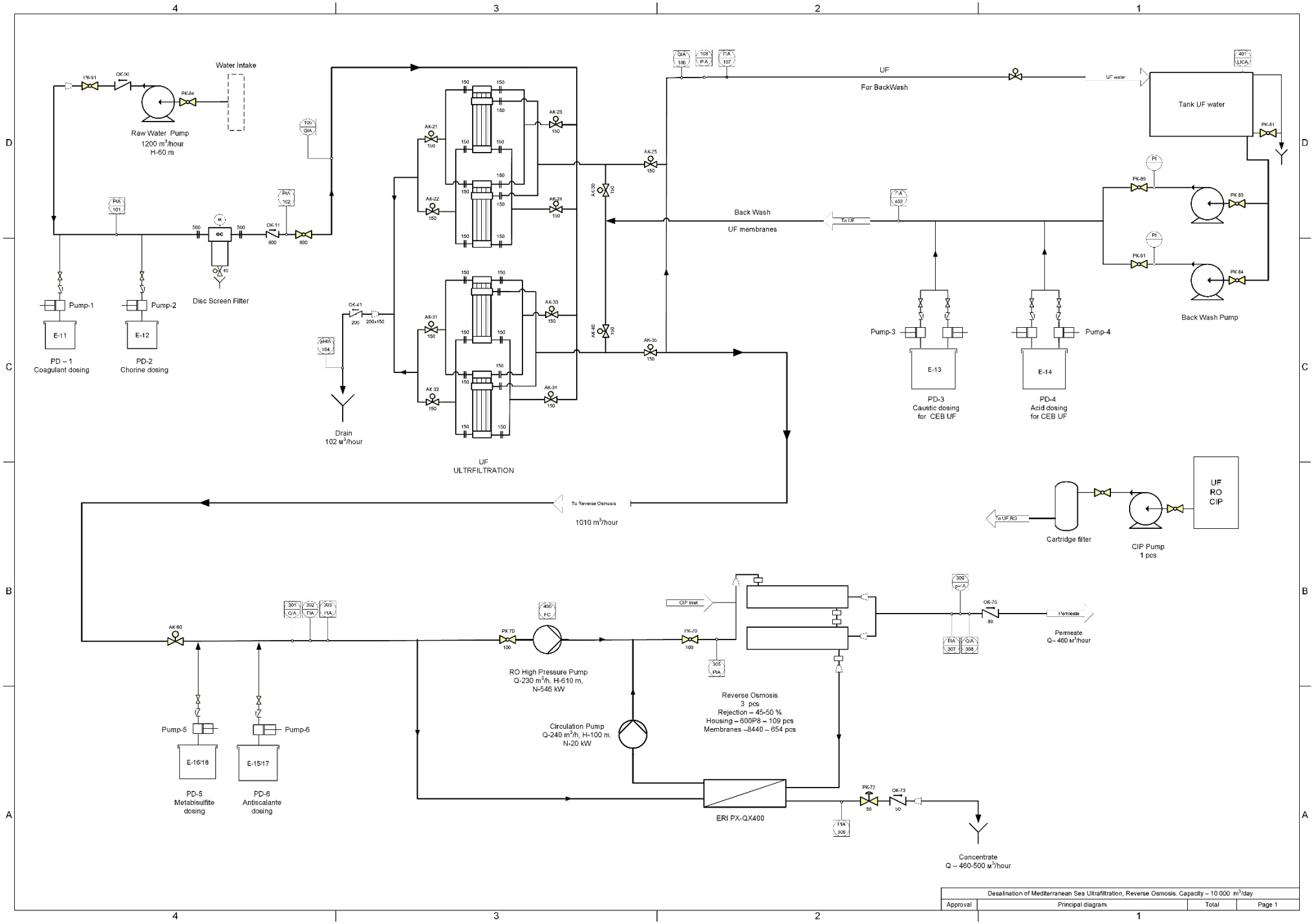
Sulphur acid, 44% -32 kg/day

Antiscalant 100% - 40,6 kg/day

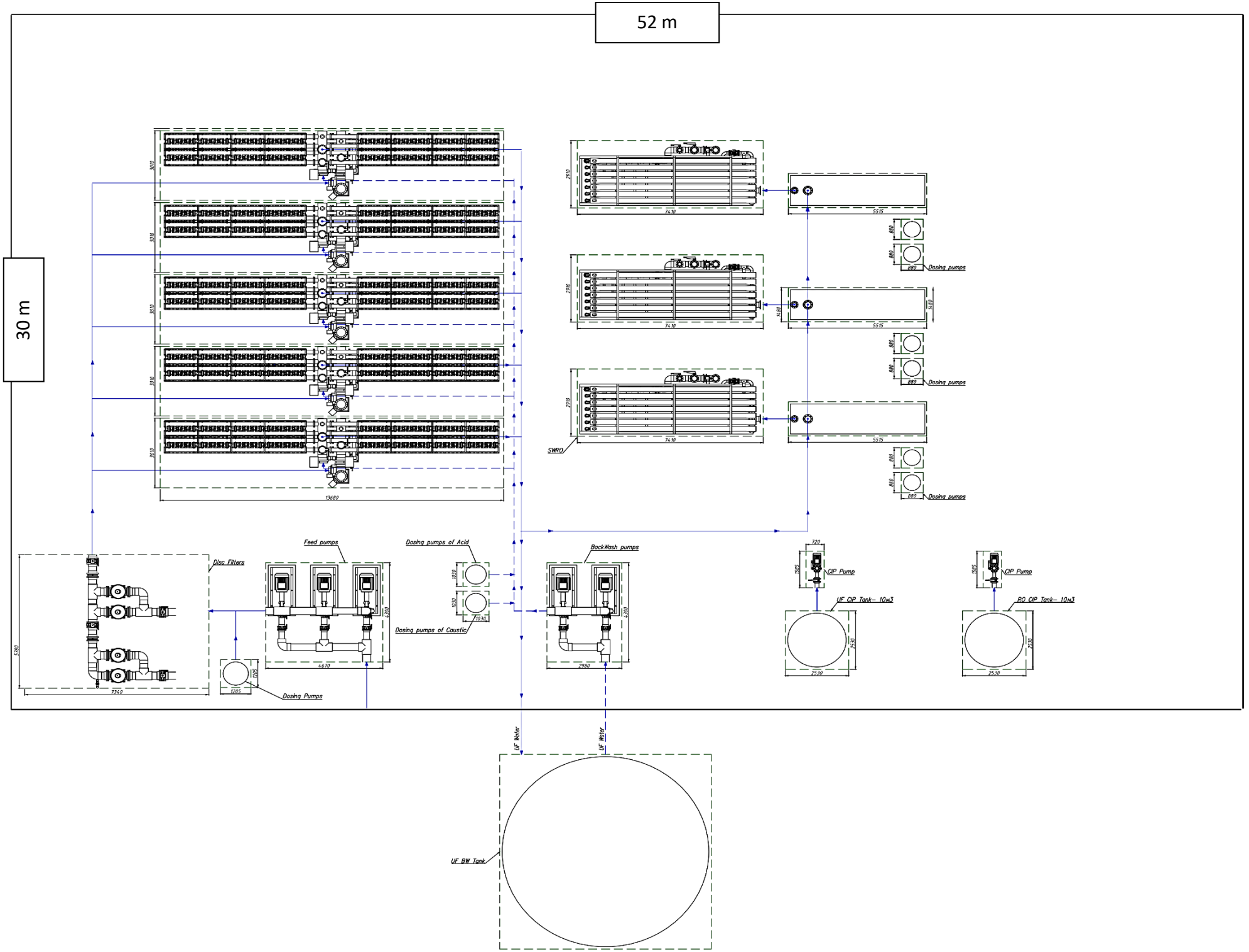
Specification of main equipment

№ п/п	Name	Description	Q-ty
	Feed source water		
1	Feed pumps	Q-1300 m^3/hour, H-60 m, N -315 kW	2
2	Frequency converter	N-315 kW	2
3	Motor cabinet for Pumps	N-315 kW	1
4	Dosing station of hypochlorite	Q-10 L/hour, H-50v, N-0,6 kW	2
5	Tank of coagulant	V-1000 L	2
6	Automatic self-cleaned disc filter	Q-760 m^3/hour 2” Spin Klin, 200	2
	Ultrafiltration (4+1)		
7	Ultrafiltration	MB 0,9-80	270
8	Automatic valves with electrical gearbox	Dn-150,250 mm	5
9	Pipe and hand valves of ultrafiltration	PVC	5
10	Automatic pressure sensors	0-10 bar	10
11	Flow transmitter	0-1200 m^3/hour	5
12	Turbidity transmitter	0-10 NTU	5
13	Back wash pumps	Q-1000 m^3/hour, H-35 m, N -132kW	2
14	Frequency converter	N -132 kW	2
15	Motor cabinet for Pumps	N 132 kW	2
16	Tank for Back Wash UF	PP V-50,0 m^3	1
17	Acid dosing station	Q-200 L/hour, H-50m, N-0,6 kW	2
18	Caustic dosing station	Q-200 L/hour, H-50m, N-0,6 kW	2

19	PLC station	Siemens	5
	Reverse Osmosis (2+1)		
20	High pressure pump	Q- 250 m^3/hour, H-610 m, N -630kW	3
21	Frequency converter	N-630 kW	3
22	Motor cabinet for Pumps	N -630 kW	3
23	Circulation Pump	Q- 259 m^3/hour, H-30 m, N -22 kW	3
24	Pressure Exchanger	Q-260 m^3/hour, H-600 m,	12
25	Membranes Housing	440	327
26	RO Membranes	SWRO 8040	1962
27	Automatic pressure sensors	0-16 bar	9
28	Flow transmitter	0-300 m^3/hour	6
29	Conductometer	0-1000 ppm	6
30	Dosing station of antiscalant	Q-1 L/hour, H-50m, N-0,6 kW	3
31	Dosing station of bisulfite	Q-1 L/hour, H-50 m, N-0,6 kW	3
32	Control Panel	Siemens	3
	CIP (Clean in Place) station for UF and RO		
33	Tank	PP V-15,0 m3	1
34	Pump of CIP	Q-570 m3/год, H-35 m, N -55 kW	1
35	Frequency converter	N-55 kW	1
36	Motor cabinet for Pump	N -55 Kw	1
37	Control panel		1



Desalination of Mediterranean Sea water capacity 10 000 m^3/Day


52 m
30 m
13680
7410
5515
SWRO
Dosing pumps
Disc Filters
7340
Feed pumps
4670
Dosing pumps of Acid
Dosing pumps of Caustic
1036
BackWash pumps
2980
Dosing Pumps
1205
CIP Pump
UF CIP Tank– 10м3
RO CIP Tank– 10м3
2530
UF Water
UF BW Tank

Desalination of Mediterranean Sea water capacity 10 000 m^3/Day