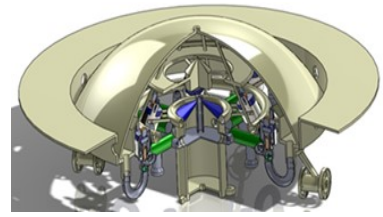


RENEWABLY - POWERED UNIVERSAL DESALINATION STATION AND FARM

100 % renewably –powered,
universal desalination station and
farm, the station is based on
vacuum distilling processor,
pull/pushing pumping assembly
and near-zero liquid discharge
filtering processor with modular
capacities from 100 to 10000 GPD.

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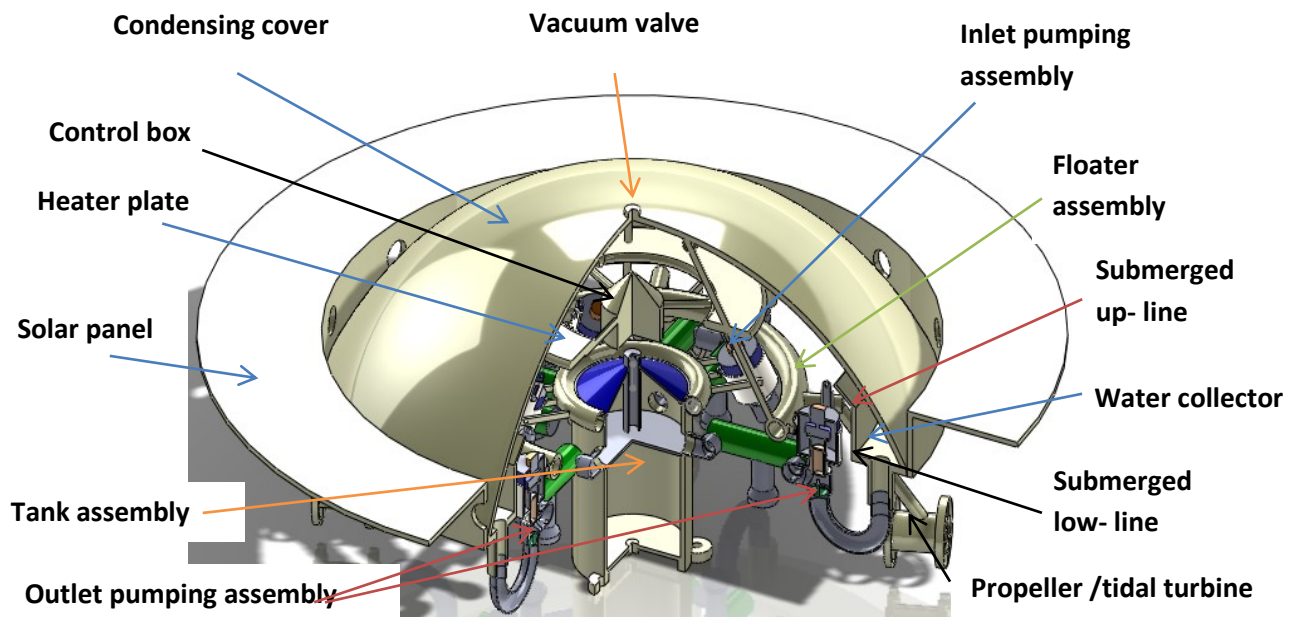
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1. Novel

The renewably –powered, universal desalination station and farm, the station includes a vacuum distilling processor, multiple filtering processors supported by multiple hybrid pumping assemblies for any saline with water and has modular capacities from 1000 to 10000 GPD to connected to any city waterlines, water towers or pumping stations and is deployable and moveable to any saline water sites with up to 300,000 ppm under GPS guide.

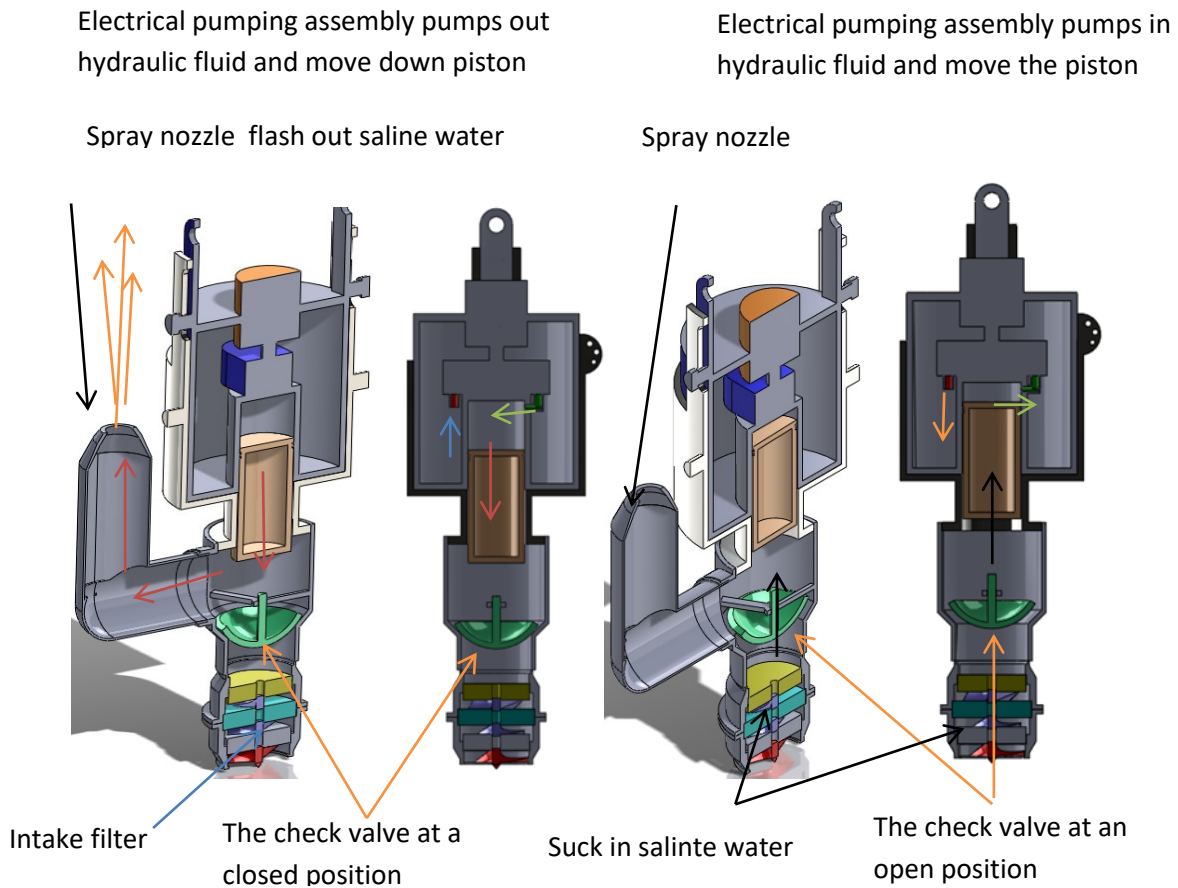
1.1 The vacuum distilling processor, saline, up to 300,000 ppm

The processor has a floater assembly, a submerged, transparent condensing cover with a water collector defined by a submerged upper-line and a submerged down-line, and a vacuum valve. The condensing, transparent cover is submerged under any saline water to form a vacuum chamber through a vacuum pump, as the solar radiations come in the vacuum distillation chamber through the transparent condensing cover to evaporate the saline water, because the atmospheric pressure is reduced, thus lowering the temperature is required to evaporate the water. With a lower temperature, the evaporated water would condense on the internal surface of the condensing cover and flow into the water collector, while the centralized vacuum distilling facilities are large, expensive with brine disposal issue.

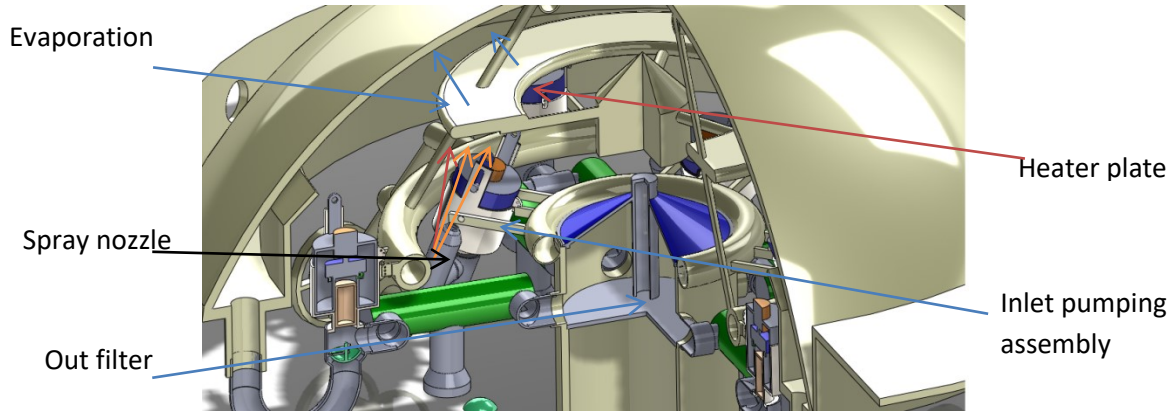


1.2 Spraying evaporation processor with an inlet pumping assembly

The processor is designed to enhance evaporation process and has an inlet pumping assembly and heater plate and a spray nozzle, the inlet pumping assembly is based on a push/pull pumping mechanism and has a cylinder assembly with an electrical gear pump and a piston disposed in the cylinder assembly filled with hydraulic fluid through an inlet port /outlet port, and check valve. As the electrical gear pump is pumped in the hydraulic fluid from the outlet port to the inlet port and move the piston up as a pulling action and suck in saline water with the check valve at an open position and pumped out hydraulic fluid from the inlet port to the outlet port to move the piston down as a pushing action to pressurize the water with the check valve at a closed position through spray nozzle to hit the heater plate through convection and conduction and speed up evaporation process, the plate is made out of dark metal to absorb all radiation energy .

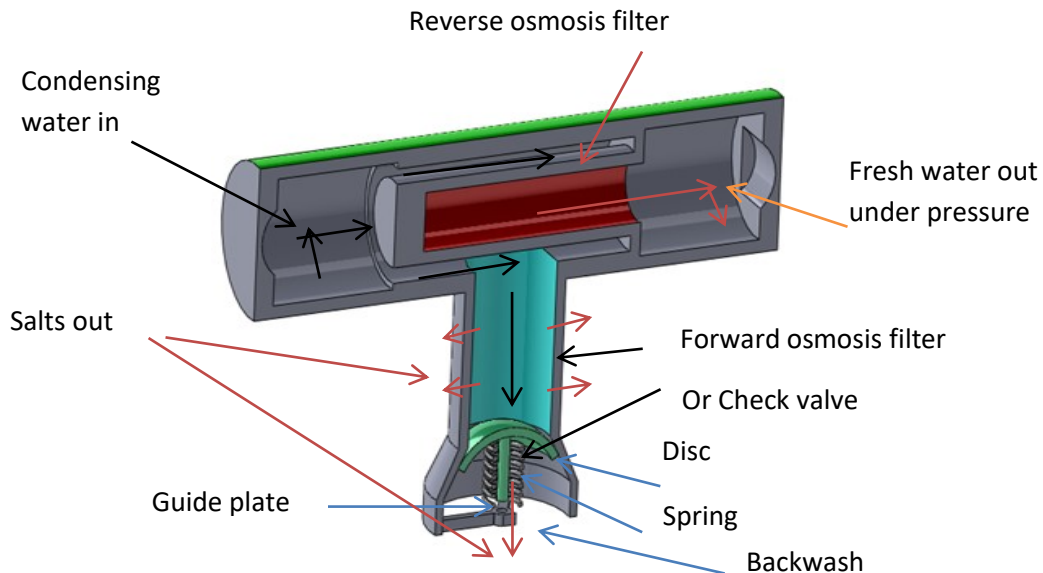


Renewably powered desalination station



1.3 The filtering processor for desalination with near- zero liquid discharge

The processor has an inlet with a reverse osmosis filter and a forward osmosis filter and check / pressure relief valve, as an out pumping assembly pressurize the condensing water through reverse osmosis filter to produce fresh water, some of the salts would flow out through the forward osmosis filter without discharging the condensing water, some of salts would build up around the filters as fouling, as a result the process pressure would increase through reverse osmosis filtering, so the relief valve is designed to release overpressure fluid at a set pressure in the filtering process and backwash salt buildup with discharging few liquid, a spring in the relief valve is biased between the disc and a guide plate for the set pressure unlike the conventional desalinations constantly release pressurized liquid, the brine and waste lots of fluid energy.

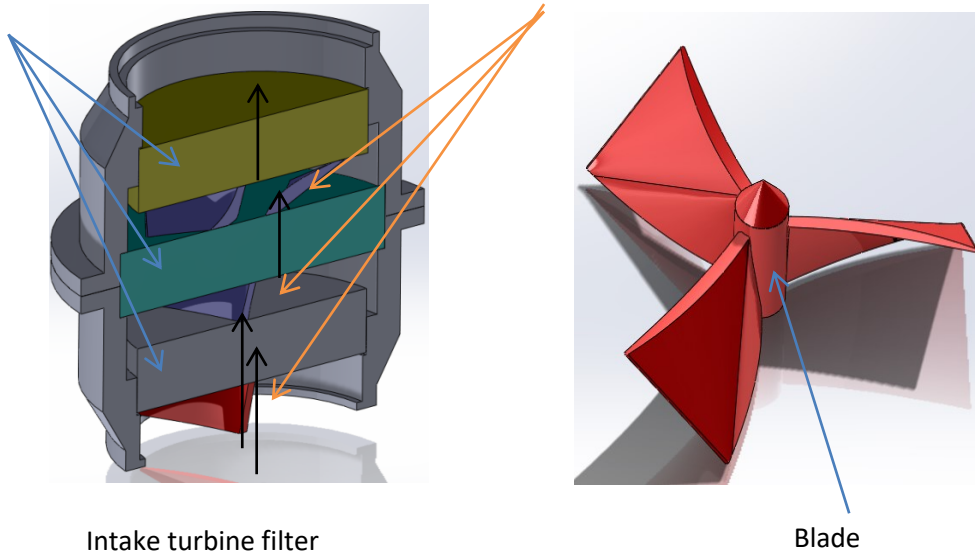


1.4 The filtering processor for Intake pretreatment

The filter has three filter layers and three magnetic blades among them to clean up any buildup on the surfaces of the filter layers and prolong the life of filter, so the magnetic also can soften the water and reduce further fouling on the reverse osmosis filter and prolong the life of reverse osmosis filter.

Filter layers with various filtering sizes

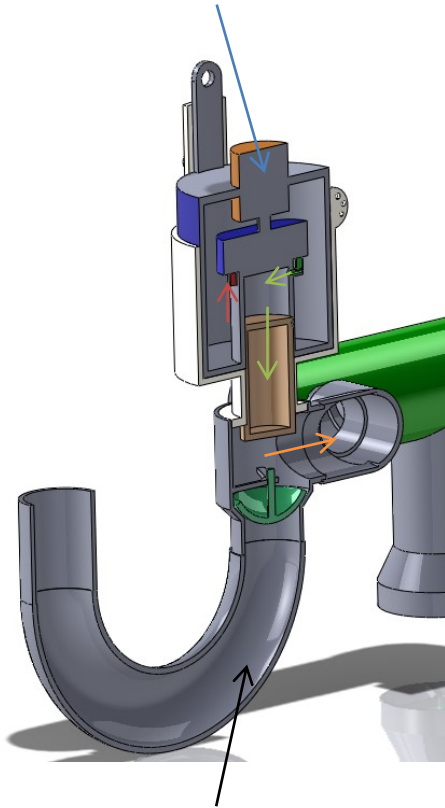
Blades



1.5 The pumping assembly for the desalination filtering processor

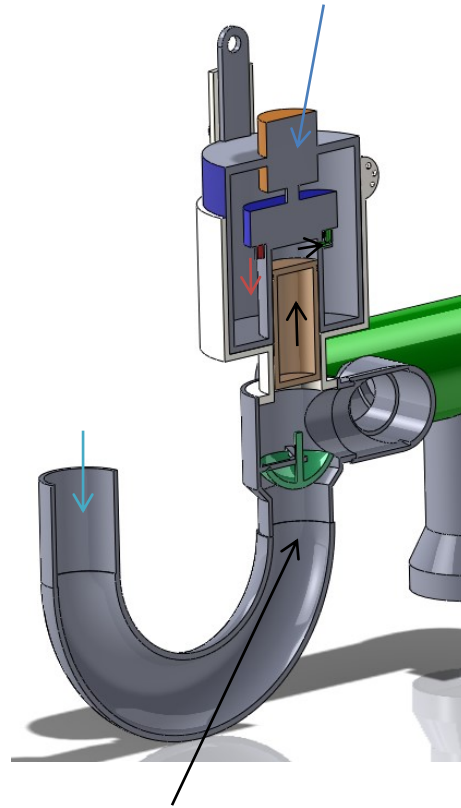
The assembly is based on a push/pull pumping mechanism and has a cylinder assembly with an electrical gear pump (or wave energy not shown) to control a piston in the cylinder assembly filled with hydraulic fluid through an inlet port /outlet port, and check valve. As the assembly pumps in hydraulic fluid from the outlet port to the inlet port and move the piston up as a pulling action and suck in condensing water from the water collector with the check valve at an open position and pumps out hydraulic fluid from the inlet port to the outlet port to move the piston down as a pushing action to pressurize condensing water with the check valve at a closed position and the pump is controlled with a control box, the piston positions also can be powered by wave energy between the height of the wave.

Electrical pump pumps out and pressures the inlet water



The check valve at a closed position

Electrical pump pumps in and sucks in condensing water



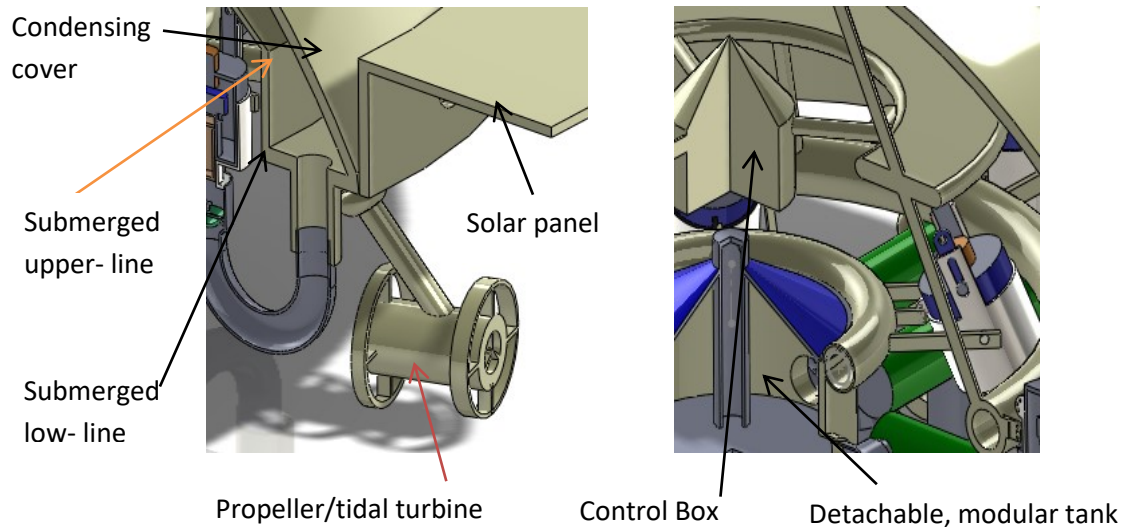
The check valve at an open position

1.6 Deplorability, movability and modularibility

The station includes the condensing cover, propeller/ tidal turbines and control box and detachable tank to provide unique deplorability and movability and modularibility those features greatly reduce the cost of construction and operation and eliminate the brine disposal issue , the control box has a power battery and wireless communication device and driver controller to provide unique deplorability and movability under GPS , the propeller/ tidal turbine can be used for both generating power as a tidal turbine at static conditions and for moving the station around as a propeller, while the condensing cover can be deployable to any open surface of saline water, the station can be deplorable and movable between open

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water sites and onshore sites , the modular, detachable tanks can be connected to a city waterline, water towers or pumping stations.



2. Technical feasibility

The station includes three breakthrough technologies (1) thermal process with a vacuum distilling processor and spray evaporation processor, which fully harness solar radiations by minimizing reflected radiation (2) the near-zero liquid discharge processor is to filter saline water through the reverse osmosis filter, forward osmosis filter and pressure release valve to prevent the filters from fouling by backwashing buildup on the filters (3) the pull/pushing pumping assembly is to pressurize the fluid for filtering process and powered by electrical power or wave power

2.1 Thermal processor

Thermal processes includes the proven vacuum distilling processor and spray evaporation processor , if the pressure in chamber 14.696 (psi) is reduced to 3.888 (psi), the boiling temperature would reduce from 100 c to 67c, so the difference would greatly reduce thermal energy and produce more condensing water with much less energy in comparison with the conventional distilling process or solar still, the distilling processor is a first step to desalinate or purify the process water , some of solar energy as light, heat or other rays would

hit on the saline water and reflect back in the conventional solar thermal desalination process, the spray evaporation processor is designed to enhance the thermal process by capturing reflected solar radiation by spraying saline water, so the heater plate is made out of dark metal and is designed to capture the reflect energy, increasing convection and conduction processes with the heater plate, the inlet pumping assembly with the spray nozzle is to accelerate the thermal process by spraying the saline water with mechanical energy. Finally the condensing cover is not only simple, robust and deplorable, but also cheap without seal ring or moving part or infrastructure, it can be made out of the polycarbonate plastic, polyethylene or glass, so injection process for the plastics can be used to product performed cover or sheet with a strong cover frame.

2.2 System filtering processors

This system filtering processor has the intake turbine, the near-zero liquid discharge filter processor and the out filter, the intake turbine filter not only filters out solid particles, soften the saline water, but also remove any buildup on the each layer surface and move solid particles radially with centrifugal forces and prolong the filters, the near-zero liquid discharge filter processor is designed to combine the reverse osmosis, forward osmosis filter and pressure release valve as one unit to handle any water for desalination or purification after thermal distilling without brine disposal at the lowest cost and energy consumption, the forward osmosis filter and pressure release valve are redundant to remove salt and backwash fouling from filters and reduce the maintenance cost process. Even the reverse osmosis, forward osmosis filter and release valve are based on conventional processes, but the combination are so novel and powerful solution for any desalination or for purification process, and has the forward osmosis filter and check / pressure relief valve, finally the out pumping assembly pressurize the condensing water through reverse osmosis filter to produce fresh water, then the pressure for reverse osmosis process reduces below the set pressure unlike the conventional desalination constantly release pressurized liquid, the brine and waste fluid energy.

2.3 The pull/pushing pumping assembly

The pull/pushing pumping assembly includes the outlet pumping assembly and intake pumping assembly, the assembly can be powered by the DC (12 or 25 V) electricity through renewable energy or direct wave power (not shown), the electrical gear pump is a proven product powered by electrical power from renewable energy through solar panel or tidal turbine for 24/7, the pump assembly can generate pressure up to 1200 psi to move the piston and pressurize process water for the reverse osmosis filtering and forward osmosis filtering, the pumping assembly is not only simple and robust, but also cheap to make with PVC, the operation timing is controlled by the control box for desired flow rate.

3 Impact

3.1 Performance

The proposal provides disruptive innovations, the best performance with the lowest cost ever among all existing desalination processes to resolve three most challenges in desalination and water purification industries (1) high energy consumption in the process (2) high construction cost, and high operation cost (3) brine disposal.

3.1.1 Efficiency The station or farm has the highest efficiency over all existing processes, due to the vacuum distilling process and spray evaporation process with higher 30% efficiency in comparison with the conventional solar thermal process, it has not only eliminated the intake pipeline, pump station, output pipeline and pump station to consume energy, but also uses the pull/push pumping assemblies, which consume the least power over any existing pumping method like centrifugal pumping system, moreover the pull/push pumping assemblies are only powered by renewable energy directly or indirectly and run for 24/7.

3.1.2 Versatile The station or farm is designed to handle all saline water desalination on the list or dirty water purification through the vacuum distilling / spraying evaporation and the self-clean filter process regardless of the salt or dirty contents, they can be deplorable to

any sites , seawaters, brackish water of brine or dirty water , so no other processor in the world is so versatile to handle all kind of fluids with the simple and robust structures, the simple station can be directly powered by the solar energy and wave energy without electricity and the control box , finally they can be used to collect spill oil or transfer the water tanks between stations and onshore facilities with the mobility under GPS guide.

3.1.2 The Lowest production cost

(A) The station has no infrastructures or facility with reduction of 25 to 40% cost

(B) High scalability is based on the modular design for a single part, single station or single farm, they are all scalable. The pumping assembly, control boxes, propellers/ tidal turbines are based on a few basic sizes, so the tooling, fixtures, inventory can be reduced greatly.

(C) Economics of scale Instead of a station or farms, this station includes multiple covers, floater, the cost as well as LCOW would be reduced as the number of part produced increase from one to 24 or 48 or 100. As an example 10000 GPD can be made with multiple 1000 GPD, 5000 GPD stations.

(D) Synergy cost. Every station shares a control box and pumping assembly, filter processor , every tidal turbine shares the same

3.13 The Lowest O & M cost and LCOE.

(A) Lower operation cost, there are no brine disposal costs or energy cost, and the only cost would be membrane replacement and delivery cost, which the conventional desalination plants also have , as a result, the cost would much less at 30% .

(B) No energy cost for operation of the station or farms