**Four Fish**

The first objective of this Project is to obtain from Nature something vital for us, freshwater, not through an industrial process (hidden and harmful), but respecting the natural cycles of the seasons and swells. The second goal, not less important, is to make explicit, through the design and sensations it promotes, the respect toward Nature.

Man is both dependent from and part of Nature, but need to rediscover that. Needs to remind its naturalness beyond its rationality. When man reaches the natural rationality it achieves environmental consciousness.

From a distance, people can see four large fish jumping from the water, moving their tails, emitting noises and reflecting the sun. At the same time, they can see people walking underneath. This encourages them to go there too.

Tail:

Water is collected from the sea and pretreated in a filter located in the basement of the pillar, removing sand and other solid particles in suspension. The wave hits the board and lift it up making the piston work to send pressure into a hyperbaric camera, which receives and regulates the pressure sending it to the hose with accuracy.

People hear the waves hitting the tail while a pump noise is issued. Tail moves up and down in the rhythm of swell.

Body:

Solar panels, with slowly annual rotation movements, follows the sun. The energy is used to heat a metal board extended along the body, against which the seawater is squirted by pressure through many holes in the hose, evaporating. The water vapour meets another board right above, this one cool enough (by cooling water from the sea) to condense it. Desalinated water runs by soft inclination along the acrylic tube.

Visitors can hear the water evaporating while they see the steam all over the tube.

Head:Desalinated water falls in a big tank with water from past cycles.Observers can see the level of the pure water obtained so far, and day by day, can realize the increase. It´s also possible to see sea ground by the glass tank working like a giant swimming goggles.

People feel emotions and experience different sensations by interacting with Nature forces, rhythms and cycles, all respectfully synthesized by the design and system of the four fish.They perceive their vital product been made. The tour stimulates them to come back to the city with new practices and ideas. Goal achieved.

**Estimated production of pressure, energy and destiled water**

To obtain the expected energy supplied by sea waves one can compute the wave energy flux per unit of wave-crest length, denoted by P (in kilowatts per meter) and given by the the equation P = 0.5\*T\*H²^2, where H is the significant wave height (in meters) and T is the wave time period (in seconds) between each wave crest. NDBC's (National Data Buoy Center data gives H=0.6 and T=4.2, therefore P=0.76 kilowatts per meter. Assuming that the tail of the fish will float in 10 meters of wave-crest length one obtains approximately 7 kW of energy per second, therefore giving 7\*10^4 Joules every 10 seconds. With this energy it is possible to lift 700 liters of sea water by a 10 meters of elevation, sufficient to keep all the system working.

The computation of the energy necessary to evaporate part (say 0.2% of it) of the 100 litres given by the water hose to the hot plate is given by E=m\*c\*dT + m\*cl, where m is the mass of water (0.2 Kg), c is the specific heat capacity of water (c = 4184 J/Kg C), dT is the temperature difference (dT = 80 degree Celsius - from 20 C to 100 C) and cl is the latent heat of water (2256 KJ-Kg), demanding a power of about 40 KW to complete the evaporation. A solar plate generates about 100 W per meter square, so at least 400 square meters of solar plate is needed to produce 0.2 litre of potable water in 10 seconds.

Considering six hour of solar panel prodution per day, the four fish could generate more than 50.000 liters of fresh water a mouth.

Notice that this computation does not take in account the dissipation of the hot plate's energy to the environment and the friction on the water hose. It will also be necessary to have a periodic cleaning of the hot plates in order to remove the accumulated salt. For desalinated water to be drinkable is required reconditioning water to replenish salts as well as add chlorine.

Estimated energy supplied by sea waves per year: 64.000 kW-h.

Estimated solar plate energy production per year: 87.000 kW-h.

**Dimension and materials:**

Each fish has around 400m² of solar panels, divided in 8 boards with 3,5m X 14m.

Those panels are supported by a metal beam composed by a tube in the top, slowly arched, while the bottom flange is flat. Both parts are joined by structural vertical tubes. The beam is 30m long.

The pillars, two by fish (one in the tail one in the head), are made of reinforced concrete. The head pillar has 8m in its biggest elliptical diameter and it is surrounded by the fresh water tank, made of acrylic.

The board receiving the impact of the waves are 10m long and 1,5m high, and they are made of a light and resistant plastic, curved like a boat hull to receive and transmit wave power.

**Environmental impact:**

Faunal flow is little obstructed, since the installation is focused right on top of the existing water break. Each fish is supported by to pillars that anchor it on the ocean floor, one on each side of the water break. The deck floor is located above the water break in order to minimize shadows on the ocean.

Regarding the return of unprocessed water to the sea, it is emphasized that each squirt transforms around 2% into desalinated water, and the rest returns to the sea with a salt concentration not so different from the original. Furthermore, the rate of transformation, spaced in the wave rhythm allows this drawback to be gradual, so the ocean can receive it with no impact. That´s one escencial poin of this project, to produce water and energy in a scale and rythm without residue.

The biggest impact is during the construction work. Increased turbidity can harm wildlife (planktonic and nektonic) as well as pillars fixing process will affect the benthic fauna in a timely manner, leading to temporary alteration of their habitat and reducing the number of its individuals. But after deployment, it is expected that the seabed of the influence area will be recolonised by the benthic community.

The impact on the landscape was assessed as positive, since it adhered to the pier heights as well as harmonizing with mountains north of Malibu.

Environmental awareness and man's connection with nature are the main points of the project. Its spaces can also be used for environmental education.