Solar Desalination Project – Phase III

14 October 2008
Cape Verde

To potential lender and other interested parties:

The purpose of this proposal is to obtain **22,300 ECV (276 USD)** to purchase materials to build, and inform interested people about, the third phase of a solar desalination project at the Technical School in Assomada, Cape Verde.

Introduction

With <200mm of rainfall, saltwater infiltrated wells and expensive oil-guzzling desalination plants as the main source of fresh water in Cape Verde, it is important to consider researching alternative sources of production. As an island country with endless supply of seawater and over 3000 hours of annual sunlight, Cape Verde is an ideal country for solar desalination.

The goal of the project is to design a high output, cost-effective solar still model using local materials. If a relatively cheap model, achieving a reasonable output, can be engineered, it could potentially create both, an industry of employment for Capeverdeans and, given the abundant supply of sun and saltwater, a reliable source of fresh water for the country.

Complete proposals, design plans and bill of materials can be found at www.peacecorps.org.cv/solar-project.

Project Analysis

This is the third phase of this solar desalination project, a project originally inspired by (now Returned) Peace Corps Volunteer Technical Engineer Nicholas Hanson, nfhanson@gmail.com:

Phase I - The first phase – designed by RPCV Nicholas Hanson – was a 0.82m^2 prototype model built and tested in December 2007. The completed system **produced 1.75L of distilled water per day and cost 16,000CVE (210 USD)**.

The output was believed to be low because of the distance the water had to rise to condense on the glass. Modifications were made in the second phase.

Phase II - The second phase – designed and constructed by RPCV Nicholas Hanson - consisted of an improved 1m^2 model redesigned to include three shelves of water (7cm deep) to decrease the height of condensation. Additionally, a solar water pre-heater (an enclosed 0.7m^2 box with 4m of zigzag plastic tubing) was constructed to preheat the saltwater before it entered the still. At the first test however, the hot water heater burst under pressure at the 90º elbow joints of the zigzag. The second phase was completed in July 2008. It **produced 2.5L of distilled water per day and cost 16,250 ECV (214 USD) (production/price not including the solar water heater)**.

Design improvements for the third phase include decreasing the depth of the water for faster evaporation time, repairing/modifying the solar water pre-heater and dripping the saltwater from the water heater through the still into a brine pool (original idea by Nicholas Hanson) to prevent corrosive salt build-up in the still.

Proposed Model Specifications - *Phase III*

Moving into phase three of the solar project legacy left behind by legendary RPCV Nicholas Hanson, the proposed model consists of a design using corrugated concrete panels as the main design modification – maintaining a short distance between the saltwater basin and glass and decreasing the depth of each water shelf (<2cm). The hot water heater will be modified to include a large circular tube layout, rather than the zigzag layout, in order to prevent high-pressure spots on the plastic tube. The prototype model will also be attached to the drain of the new still model to serve as a slower-distilling output reservoir (brine pool)(not included in design plans).

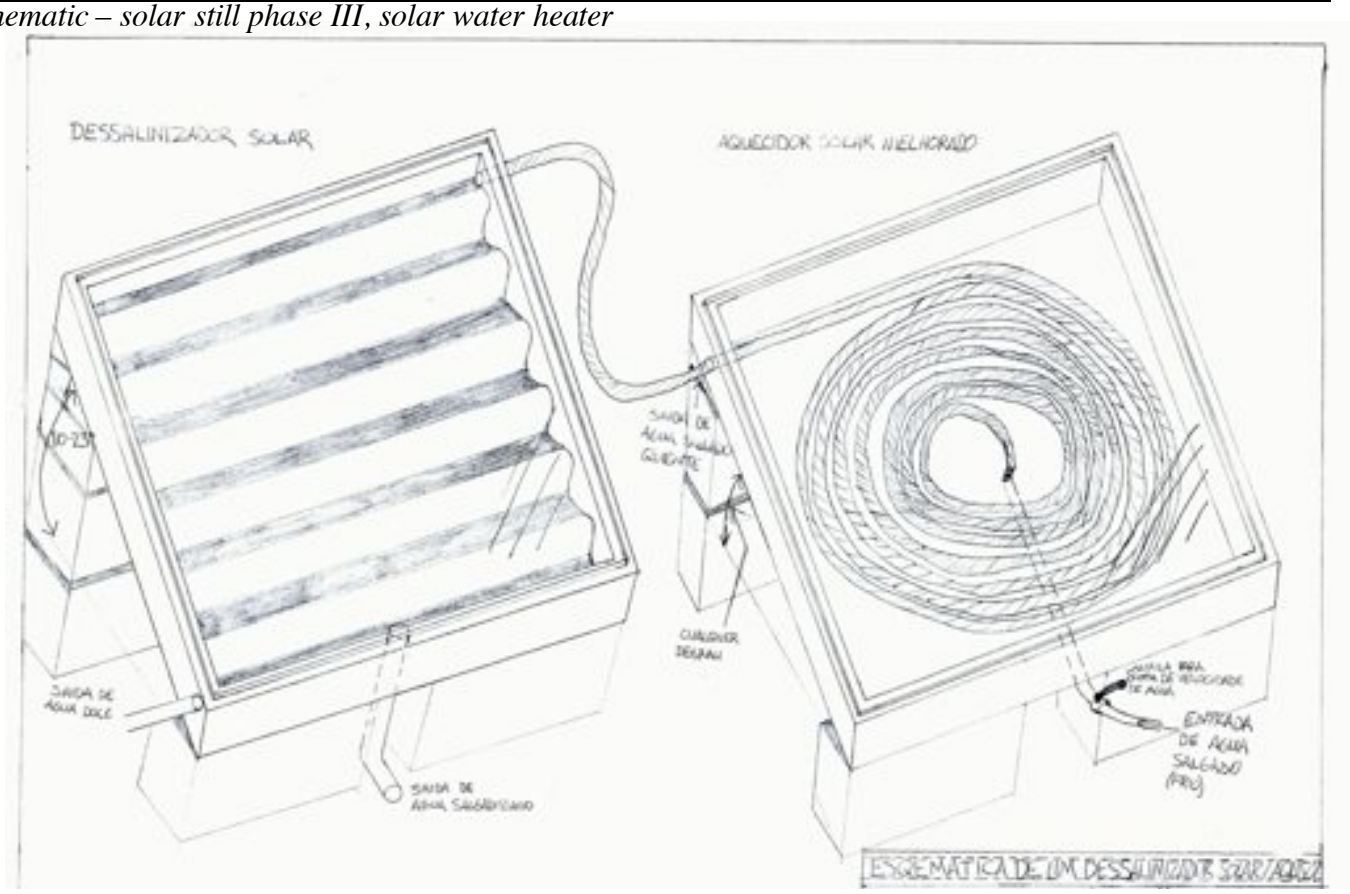
When activated, saltwater will drip through the solar hot water heater into the new still model. When the undistilled, very salty seawater, reaches the bottom undulation of the angled still, it will drain into the prototype basin – thus avoiding corrosive salt build-up, maintaining a closed system to avoid heat loss and, in theory, making it easier to remove the salt/residue of the seawater from the system.

Another design modification will be to add mirrored wings to each side of the model to reflect additional sunlight into the still (also not shown in the design plans). The wings will be made of glass painted black on the reverse side, creating a mirrored effect when sunlight hits the front side of the glass. The wings will be supported by string and hinged to the side of the concrete still. The string must be periodically adjusted as the sun moves in the sky. Tests will be performed to gauge the cost-effectiveness of the wings.

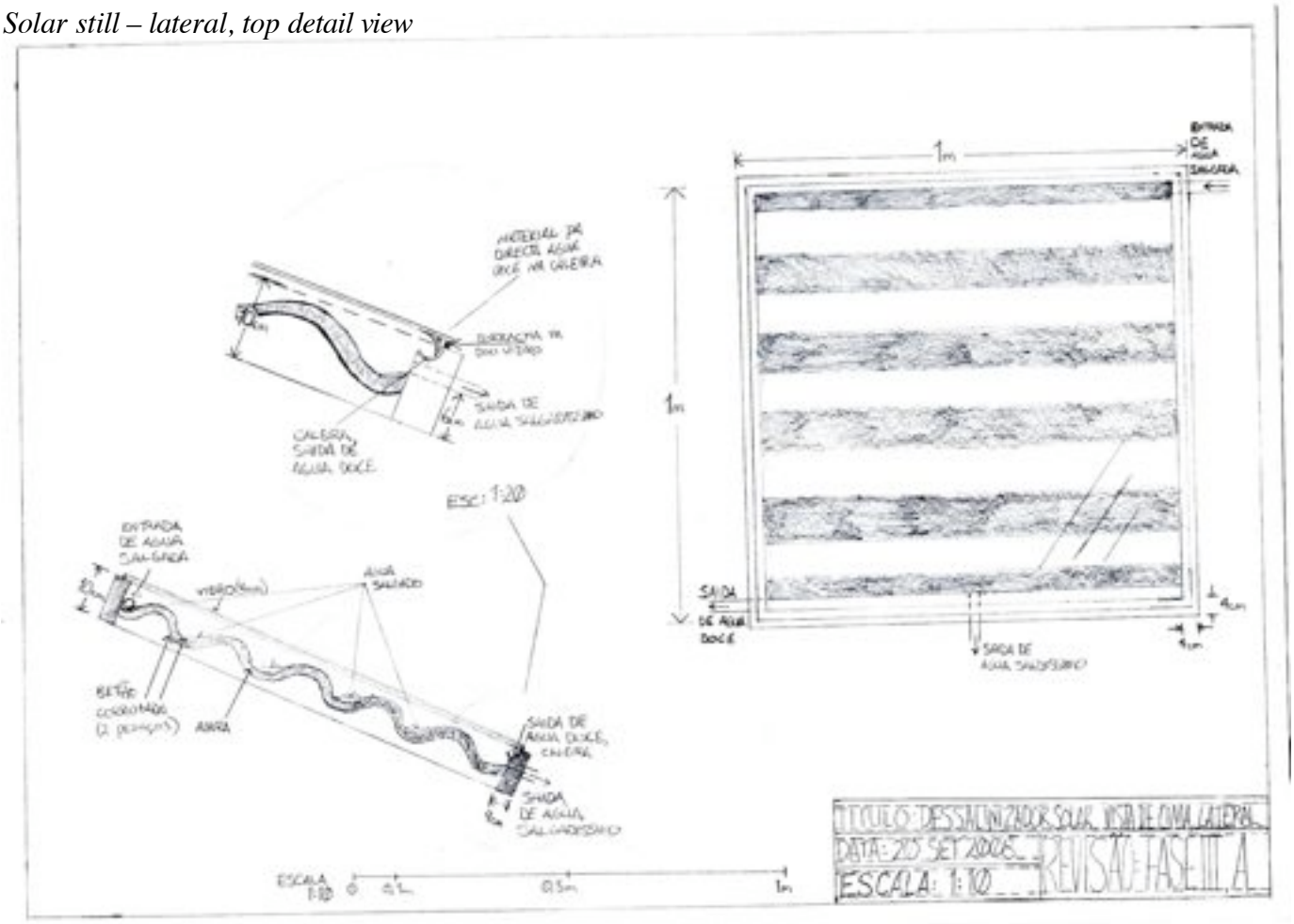
Note: Construction of the still, as was the first two phases, will be performed with the Civil Construction students at the Grau Duque Henri Technical School in Assomada, Cape Verde.

Design plans

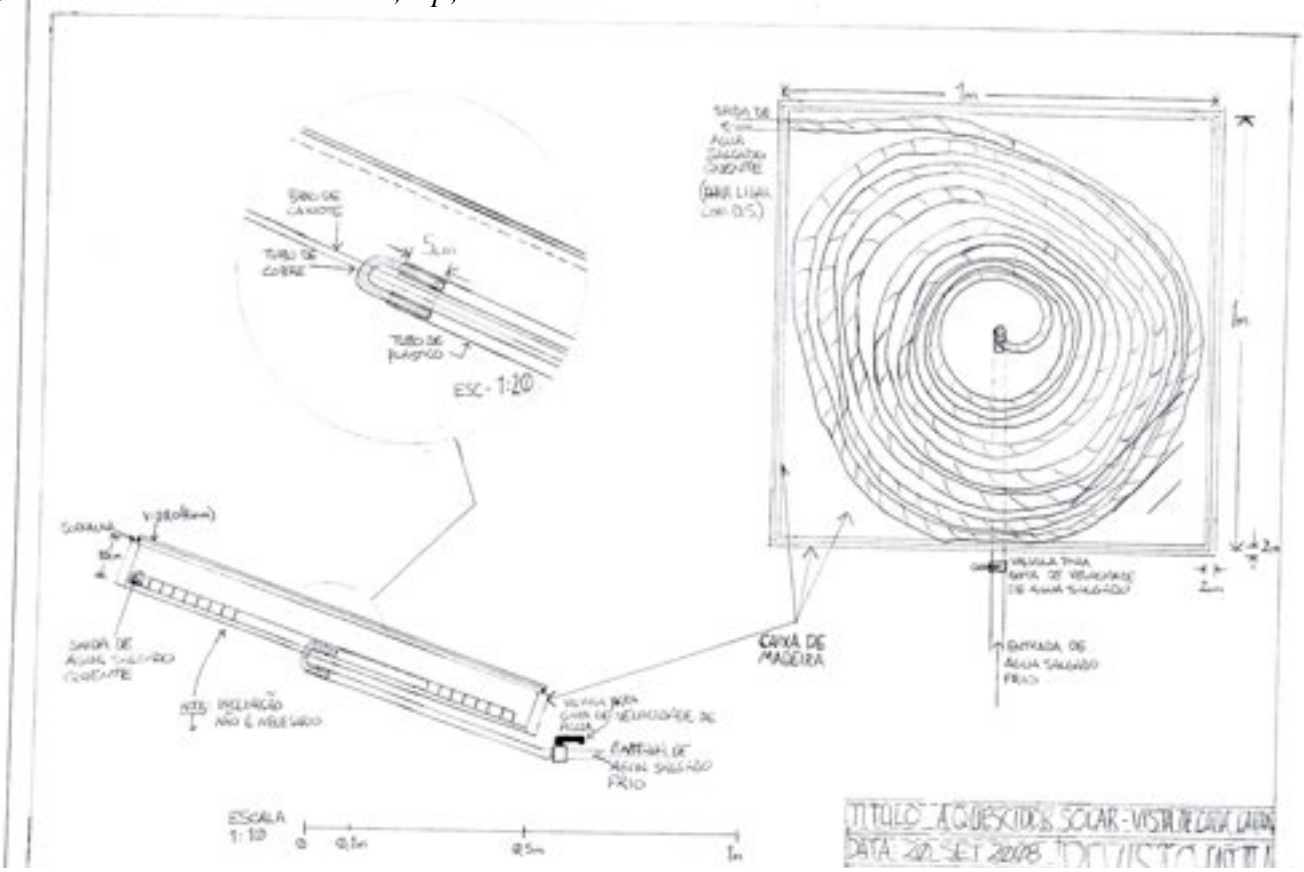
Schematic – solar still phase III, solar water heater



Solar still – lateral, top detail view



Solar hot water heater – lateral, top, detail view



Budget / Bill of Materials

Solar Still, Phase III Model

1 USD =	81	CVE

Item #	Description	Price	Quantity	Total
1	5m wood 2x4 (formwork)	400	6	2400
2	$1m^2$ wire mesh (reinforcement)	400	1	400
3	1m plastic tube (trough)	50	2	100
4	Input/output	600	1	600
5	$1m^2$ corrugated concrete form	1400	2	2800
6	50kg bag of concrete	800	1	800
7	sand, rock	0	0	0
8	Black paint (5L bucket, only large avail)	3500	1	3500
9	Sawdust (insulation)	0	0	0
10	4mm glass ($1m^2$)	1400	1	1400
	Total			12000 CVE = $148.15 USD

Solar Hot Water Heater, Phase III Model

Item #	Description	Price	Quantity	Total
1	50m 160psi 0,75cm plastic tube	50	50	2500
2	8m wood pieces to clamp tube ring	200	8	1600
3	Drip Valve	600	1	600
4	Connection to tank, still	600	2	1200
	Total			5900 CVE = $72.84 USD

Further modifications, mirrored wings, connection to prototype

Item #	Description	Price	Quantity	Total
1	4mm glass ($1m^2$)	1400	2	2800
2	black paint (same as above)	0	0	0
3	string	0	0	0
4	Glass hinge?	400	4	1600
	Total			4400 CVE = $54.32 USD

Grand total **22300 CVE = $275.31 USD**

References

1. Basic Manuel of Construction: Illustrated Guide to Construct our Habitat (in Portuguese), Leon Lopes, First Edition 2001, p337-8

2. http://greenpowerscience.com/SOLARHOTWATER.html -
Clean energy projects video series hosted by Dan Rojas, posted on YouTube

3. http://www.appropedia.org/Understanding_Solar_Stills -
Extremely thorough solar still report published by Horace McCracken, Joel Gordes of VITA.org

Request

To build the solar still and water heater, **22.300 ECV (276 USD)** will be required to purchase materials.

Brian Newhouse
bri.newhouse@gmail.com
PCV Cape Verde, 2007-present