DOE/GO/10208--T1

WEST ANGELES COMMUNITY DEVELOPMENT CORPORATION

Final Technical Report

For Grant Number DE-FG36-97GO10208
U.S. Department of Energy
Oversight Provided by National Renewable Energy Laboratory
Project: ***Export Market Feasibility Planning and Research for the Solar Medical Autoclave***

Prepared by Grant D. Power, Principal Investigator
April 20, 1998

This report summarizes core findings from an investigation performed by the staff of West Angeles Community Development Corporation (CDC) regarding the feasibility of marketing the Solar Medical Autoclave ("autoclave") in South Africa. The investigation was completed during 1997, the period prescribed by the Grant Award made by the U.S. Department of Energy on January 1, 1997, and was monitored by the National Renewable Energy Laboratory.

Sales Potential in South Africa

This investigation was conducted on the premise that final sales of the autoclave are the ultimate benchmark of viability in export marketing, and that the utility of the autoclave must be determined primarily on the basis of its practical value and affordability to intended end users. Field interviews completed on site in South Africa by CDC staff member Paul Turner in Spring 1997 determined that the autoclave was most useful for discrete medical, agricultural research, and dental labs where procedures demand sterilization of equipment. The cost per unit of the autoclave diminished its likely utility in village health clinic settings.

Primary prospective customers appeared to be hospitals and major clinics in townships and other metropolitan areas, institutions at the heart of South Africa's current health care infrastructure that could purchase autoclaves in bulk on a replace-as-needed basis. However, these institutions reported no felt need for autoclaves that are solar powered, as they generally had ready access to reliable urban power grids and could not easily place and protect the autoclave outdoors. The autoclave seemed most useful for sterilization applications in remote areas, but prospective end users were in the city. The conclusion was reached that we needed to revisit the question of which end uses would be most relevant to solar water disinfection in remote areas.

DISCLAIMER

DISCLAIMER

Turning Toward Water Pasteurization Applications

We confirmed in subsequent interviews in South Africa a "Plan B" market research hypothesis that solar thermal water pasteurization, not sterilization, might be an appropriate application for prospective end users. Village clinic directors, health workers and NGO managers in South Africa all indicated that water disinfection in remote areas using off-grid clean power has real value to people living in remote areas, and fits into the policy framework of South Africa's Reconstruction and Development Plan for public health and energy infrastructure.

Our primary research results corroborated the more general findings of NREL's earlier report by Jay Birch et al., *The Potential for Solar Thermal Water Disinfection in Developing Countries*. (See "Executive Summary" attachment of a policy memorandum by the California Energy Commission.) We determined that there was a market opportunity in solar thermal water pasteurization, and that we should investigate the technical and manufacturing feasibility of using existing core solar thermal technologies and innovations in balance-of-system (BOS) components for water pasteurization applications. This was a turn in our planning and research toward finding alternatives to replace the autoclave with more promising alternative applications. But it did not violate our basic premise that the technology should follow what end users truly value, not vice-versa.

We turned to the California Manufacturing Technologies Center (CMTC) for engineering assistance, in consultation with the engineering department at Colorado State University, Fort Collins. CMTC performed design tests for BOS specifications suited to water pasteurization, including a flow-through device attached to a solar evacuated tube with five-gallon capacity. The results and recommendations were reported in a CMTC final report (attached). A key advantage of the new design (yet to be named) is that its intended use does not require as high a temperature threshold (for water disinfection) as the autoclave (for water sterilization).

As a result of the investigation, West Angeles CDC has developed a network of confirmed contacts in South Africa; collected strong evidence supporting an alternative (parallel) application of its core technology; and a created a new manufacturing design that matches the intended applications for water pasteurization. West Angeles CDC has applied for final feasibility and demonstration funding from the International Energy Fund of the California Energy Commission to complete a business, export marketing, technical manufacturing and finance plan. A likely primary partner for distribution of solar water pasteurization units inside South Africa is the South African Center for Essential Community Services (SACECS).

Finally, the solar water pasteurization technology proposed in this research program was presented as part of the overall agenda of the Gore-Mbeki Binational Commission (BNC) at their fifth consultation (report cover attached). We believe prospects for the success of this export project are favorable. Critical research gathered largely with the support of DOE has substantially improved prospects for success.

SOLAR WATER HEAT PURIFICATION PROJECT

Overview

The West Angeles Community Development Corporation (CDC) is seeking to demonstrate and commercialize a solar water heat purification system in partnership with community-based organizations in South Africa. The system utilizes solar evacuated tubes capable of heating water up to 200 degrees Fahrenheit, thereby eliminating many water-borne disease contaminants from the water. The demonstrations will be conducted at rural health care facilities and in communities where chronic water contamination exists.

I. Description

Project/Activity: West Angeles CDC Solar Water Heat Purification System Demonstration

Responsible Agency: U.S. DOE

II. Objectives

Relations to Commission Objectives

In relation to BNC objectives the project will help promote the installation and advancement of renewable energy technologies and practices in South Africa's health care sector. The objectives of the project are to: 1) Demonstrate the effectiveness of the Solar Water Heat Purification Systems in eliminating many water-borne diseases where actual water contamination exists in South Africa, 2) identify market opportunities and determine the breadth and depth of user interest in a Solar Water Heat Purification System, and 3) assess overall market and sales potential for Solar Water Heat Purification Systems.

What the Program Will Accomplish in South Africa

This project establishes new and improved technology that will enhance the delivery of essential community needs - clean drinking water and sanitation, effective wastewater treatment, and safe and efficient healthcare facilities. Provides essential safeguards to protect public health, strengthen community infrastructure and a foundation for economic growth.

How We Will Know Whether or Not It Has Succeeded

South African partners, SACECS and Independent Development Trust will perform their own independent assessments of the system and gauge the efficiency and effectiveness of the system to treat contaminated water at acceptable levels.

III. Status

The conclusion from our earlier investigation into the potential market feasibility of the solar medical autoclave revealed that use of the solar evacuated tubes to purify water for safe drinking was more suitable than for medical sterilization. Dr. William Duff, Professor of Mechanical Engineering at Colorado State University, was called upon to begin work on devising a system utilizing evacuated tube technology that would purify water for safe drinking. Two designs of the Solar Water Heat System have been established and will be ready for demonstration in the next three months. The first design is best suited for water treatment at small water processing facilities in small rural and mountainous communities. The system eliminates deadly pathogens such as giardia and cryptosperidium. The second design is most appropriate for small community or village use because it employs a single tube and requires water to be manually fed into the system. This design also heats water to a temperature where deadly pathogens and water-borne bacteria are eliminated.

Phase I calls for the units to be fabricated and tested at Colorado State University. Phase II will involve testing of live pathogens. Our intention is have representatives from the South African Center for Essential Community Services (SACECS) and Independent Development Trust in attendance during phase II testing in Colorado. These two organizations have been identified as potential partners for demonstration exercises in South Africa.

The California Manufacturing Technology Center (CMTC), a non-profit organization that provides single point access to advanced technology and training for small to medium size companies throughout California, has been contracted to surmise material costs and design specifications.

West Angeles CDC has secured funding from the California Energy Commission in the amount of $125,000 for demonstration and commercialization activities in California. West Angeles CDC plans to seek additional support from DOE to conduct the demonstrations. West Angeles CDC conducted market feasibility research with an initial $50,000 grant from DOE.

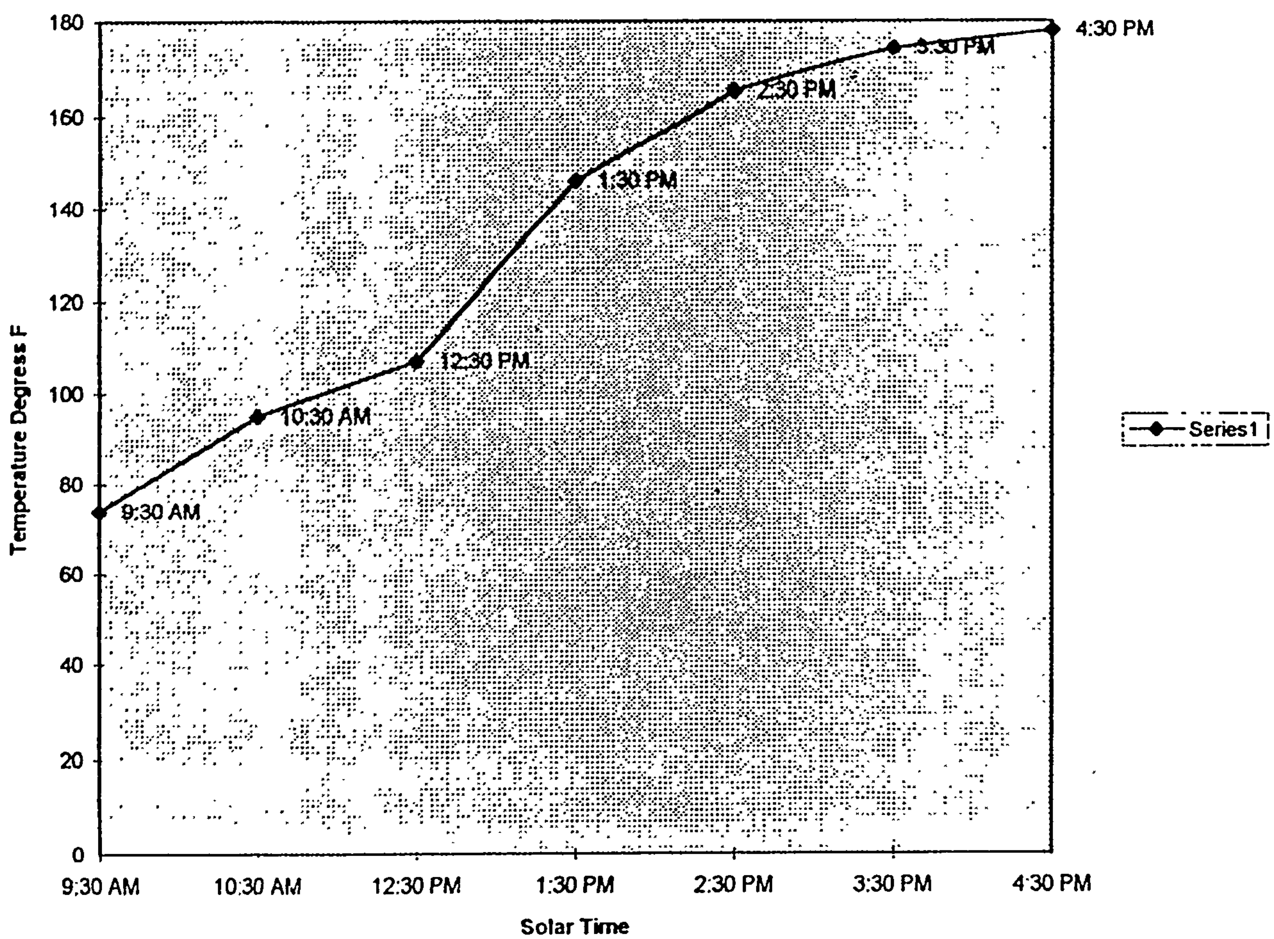
Single Tube Pasturization System (5 gallons-5 sq.ft absorber area with stainless steel reflector)
Time of Test: October 24, 1996
Huntington Beach, California

Conditions: Clear

Time	Temp. of Water	Volume of Water	Collected Energy Btu	Solar Radiation Btu	Effeciency
9:30 AM	74	5 gallons	190 Btu/sq.ft	876.75 Btu	92%
10:30 AM	95	5 gallons	190 Btu/sq.ft	501 Btu	52.70%
12:30 PM	107	5 gallons	190 Btu/sq.ft	1127.25 Btu	90%
1:30 PM	146	5 gallons	250 Btu/sq.ft	501 Btu	40%
2:30 PM	165	5 gallons	250 Btu/sq.ft	793.25 Btu	72%
3:30 PM	174	5 gallons	190 Btu/sq.ft	375 Btu	46%
4:30 PM	178	5 gallons	190 Btu/sq.ft	167 Btu	20%

Total Btu: 4,341.75

Temperature vs. Time



Sun Utility Network, Inc. 626 Wilshire Blvd., #711 L.A., CA 90017 T*(213) 614-8667 F* (213) 623-2041
Email: info@sunutility.com * Website: sunutility.com

Executive Summary

This study originated within the New Technologies Task at the National Renewable Energy Laboratory, with goal to determine the potential for solar thermal water disinfection in developing countries. The objectives are to: a) characterize the developing world disinfection needs and market; b) identify competing technologies, both traditional and emerging; c) analyze and characterize solar thermal pasteurization; d) compare technologies on cost-effectiveness and appropriateness; and e) identify research opportunities. Natural consequences of the study beyond these objectives include a broad knowledge of water disinfection problems and technologies, introduction of solar thermal pasteurization technologies to a broad audience, and general identification of disinfection opportunities for renewable technologies.

Water pathogens include bacteria, viruses, protozoa, and worms. Bacteria and viruses are readily treated with chemicals and ultraviolet (UV) light, whereas protozoan cysts and worm eggs are not. The water disinfection needs are staggering, with of order billions of affected people. Demographic data for the developing countries are sparse. The water disinfection market is complex and relevant stratification variables include: size (urban, village, dispersed single family); water supply type (deep well, shallow well, surface water); existing water supply treatment; water pathogens (protozoa and worms vary); water turbidity (clean well water to "dirty" river water); water use (several to several hundred liters per day per person); hygiene and washing practices; availability of electricity; local labor cost; income and discretionary funds; access to technical infrastructure for supply and repair; education (with implications for operation and maintenance of complex technologies); and awareness of the fecal-oral cycle of water-borne disease (affecting motivation to invest in and maintain water treatment). Access to infrastructure for supplies and maintenance is crucial to appropriate technology choice. Six market segments are identified that have varying water load and penetration potential. The market includes urban dwellers already boiling water from un-safe distribution systems (best market), peri-urban population, villages with public tap, health clinics and other institutions, and dispersed single family units (uncertain market, hard to reach).

Methods appropriate for smaller scale markets in the developing world include chlorination, oxidant generation from electrolysis, slow sand filtration, household filtration, ultraviolet irradiance (UV, sunlight and lamps), boiling, batch solar pasteurization, and flow-through solar pasteurization. Batch chlorination is inexpensive, easy to use and moderately effective (cyst/egg/turbidity problems); need for fresh chemicals is troublesome. In large volumes, chlorine dosing has the same characteristics, including complex operation and maintenance needs. Electrolysis units have higher first cost and high maintenance needs, but treat high volumes of water and do not have supply problems. Slow sand filters are effective, but are high in labor and (in some cases) sand supply cost. Household filtration units are moderately effective (problems with bacteria and especially viruses), but require consistent maintenance are prone to failure from cracking. Batch UV sunlight methods are emerging, which are very low cost and easy to use, but are small scale, moderately effective, and need further study. UV lamp techniques are low cost and moderately simple. However, cyst/egg/turbidity problems require filtering and the device requires access to infrastructure for maintenance. Water boiling is common and effective, but is extremely costly and laborious. Batch solar pasteurization is effective, has no appreciable maintenance, but is low volume due to high energy input requirements. Flow-through solar thermal products using heat exchanger to recover pasteurization energy are available, but are relatively costly. They are very effective and easy to use with low maintenance. A small-scale, inexpensive solar pasteurizer is not available. Polymer thin film systems have potential to reduce water treatment cost by over a factor of five.

All techniques examined have strengths and weaknesses and will have some market share. Solar thermal pasteurization is very simple to use with very low maintenance, and appears well-suited for remote areas where access for maintenance and supplies is very poor. Solar products might have market share on single family urban scale if more convenient "on-demand" home filtering and UV systems cannot be better adapted to this market. Current solar thermal products for larger scale do not compare favorably on costs compared to several alternatives. Program research in polymer components and systems is an opportunity reasonable to pursue as part a wider suite of polymer applications once polymer durability issues are resolved.

Solar thermal devices have the advantage of low maintenance. However, there are two caveats on maintenance: scaling and freeze damage. Scaling is a natural consequence of heating hard water, especially with metallic collector passageways (Burch 1989 and Vliet 1996). The problem will be more severe for pasteurization than for SDHW, due to the relatively higher temperatures. Periodic flushing with acidic solutions may be needed to remove scale. There is limited evidence that polymer-based collector passageways will not scale as badly due to crystalline mismatch (Burch 1989). Metallic collectors should not be used in climates where freezing might occur even as infrequently as only once a decade. Freezing may be less of a problem for more flexible materials such as polybutylene piping or thin films.

4.4.3.1 Batch solar thermal devices

One weakness with any batch device is the inability to effectively reclaim the pasteurization energy. These devices are lower in first cost and higher in cost/volume than flow-through systems of similar area.

1. Family Sol-Saver

The Family Sol-Saver is shown in Figure 4.4.3.1-1. It is a batch solar thermal system, manufactured by Safe Water Systems/Grand Solar, Inc. It is an integral-collector storage (ICS) design, holding about 15 liters (4 gal.) of water. The system consists of interconnected black polybutylene tubes, which are covered by a xxx glazing. Polypropylene is also used [check what is where]. There is no control valve. A thermo-chromic indicator indicates when the water has been safely pasteurized, which requires repeated observation. The water is drained from the system. It is claimed that several mid-day hours of sunshine is sufficient, implying the process may be done twice per day.

Cost
The unit is projected to cost about $60 FOB. Aside from possible scale removal in hard water areas, there is essentially no maintenance on the system. No maintenance costs were assumed.

Appropriateness
First cost is low, and cost/volume is moderately low. The unit has appropriate low levels of maintenance. There are no supplies necessary.

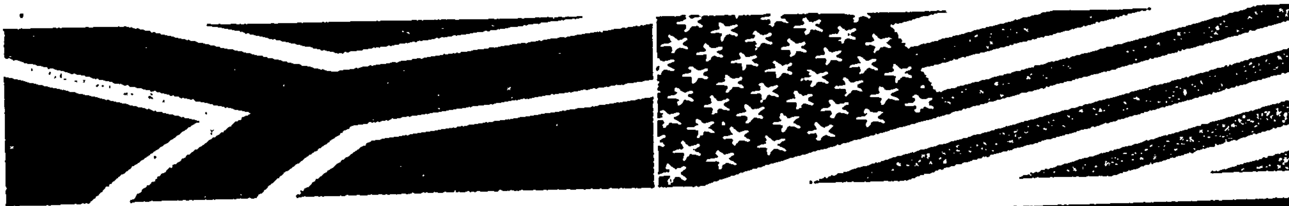
Stagnation temperatures of a single glazed solar collector system is shown in Figure 4.4.3.1-2, as a function of the ratio of the effective loss coefficient and the product of transmission and absorptivity. The operating temperature of the Family Sol Saver can be expected to be toward the lower end of the non-selective scale, about 140C (280F). The continuous high temperature limit of polypropylene is 90C (194F), and polybutylene is about 93 C (199F), from (Kutscher, 1984). Thus, it would appear that the system should not be subjected to dry stagnation, to avoid materials breakdown. The unit may be used in climates with occasional freezing, as polybutylene piping can withstand limited freeze-thaw cycling when filled with water (Farrington, 1987). The unit should probably not be used in climates with frequent hard freezing, due to uncertainty in repeated polybutylene piping freezing (Burch 1995).

2. SUN Evacuated tube disinfector

A batch solar disinfector manufactured by SUN, Inc. is shown in Figure 4.4.3.1-3. The application utilizes the evacuated tube technology of NEG, and incorporates a 5 gallon storage tank within the evacuated tube. This is the same tube used in the SUN family integral-collector-storage system certified by the Solar Rating and Certification Corporation for US SDHW (SRCC 1996). There have been speculations about how to increase the throughput of these tubes by using a back reflector (specular or diffuse), but no back-reflector is supplied with this unit (cost of the mounting is said to be the issue) (Hamasaki, private communication 1997). The unit produces 5 gallons per day. The throughput could be dramatically increased by use of a heat exchanger, converting to a flow-through device.

Cost.
The unit costs about $110 FOB. Maintenance should be minimal, excepting for scale in hard water areas.

Appropriateness.



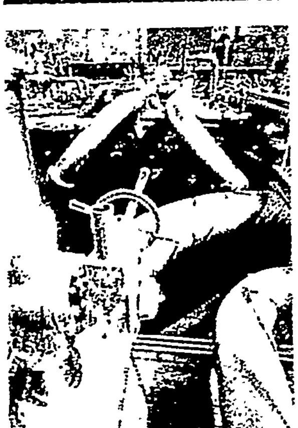
GORE - MBEKI BINATIONAL COMMISSION

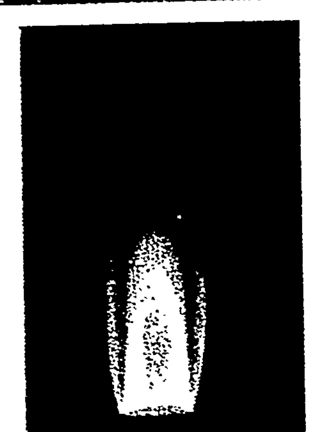
U.S. - South Africa Sustainable Energy Committee

February 26, 1998

DRAFT

PROGRESS REPORT V





CALIFORNIA TRADE AND COMMERCE AGENCY

Pete Wilson
Governor

Lee Grissom
Agency Secretary

April 22, 1998

Mr. Grant Power
West Angeles CDC
3045 S. Crenshaw Boulevard
Los Angeles, CA 909016

Dear Mr. Power:

Having learned about your proposed Solar Water Pasteurization Project for South Africa, I believe that the State of California offers several services through the California Trade and Commerce Agency's International Trade and Investment Division that may be of assistance in both the planning and implementation phases of your project.

Throughout the project, our California Office of Trade and Investment in Johannesburg, South Africa could assist you in planning your overseas trade mission to determine feasibility and market development opportunities for your solar water pasteurization units. In the implementation and export phase, your product may qualify for export finance assistance through our California Export Finance Office in Los Angeles which offers working capital loan guarantees for qualified companies and products. I have attached contact information for both of these offices. We look forward to working with you as the project develops.

Sincerely,

BRIAN BUGSCH
Trade Policy Analyst

Attachment

International Trade and Investment

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95814-3520
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received
4-28-98 cg

SACECS

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Braamfontein, 2017

28 APRIL 1998

Ms Lula Ballton
Executive Director
West Angeles Community Development Corp.
3045 Crenshaw Boulevard
Los Angeles,
CA 90016 USA

Dear Ms Ballton,

On behalf of the South African Centre for Essential Community Services (SACECS). I am writing to let you know of our interest in partnering with West Angeles CDC in connection with your solar water purification technology project.

As you already are aware SACECS major objective is to demonstrate energy related technologies that would impact on peoples' lives. We believe that your intended project will serve the water and healthcare needs of remote rural communities in South Africa, help protect the environment through lower energy pollution and also provide an economically viable alternative to conventional heating sources.

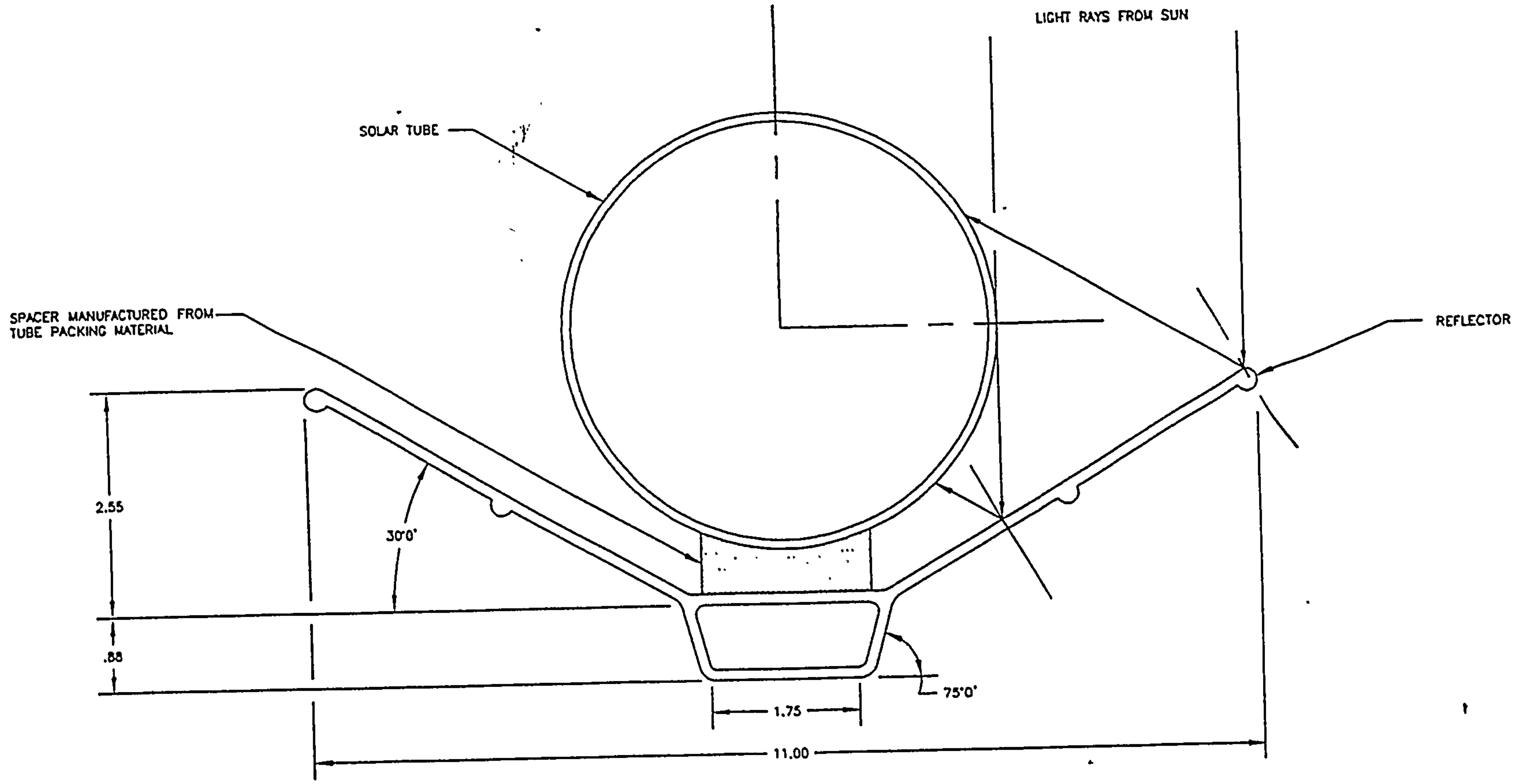
Since the economic programme of our government currently is focusing on stimulating growth and meeting the needs of poor community, the opportunity to engage in growth sector such as renewable energy to meet the growing demand for clean drinking water is appealing to us.

For this reasons we look forward to exploring ways in which we can work together and consequently improve on the quality of life of our people. In particular, SACECS could assist in site selection, institutional capacity development, project management, operation and maintenance of the system in end user communities of South Africa.

Thank you again for contacting us regarding this opportunity.

Yours faithfully
Cynthia Motau (Ms)
National Director
SACECS

ZONE	LTR	DESCRIPTION	DATE	APP.



DESIGN LAYOUT

NOTES : UNLESS OTHERWISE SPECIFIED

1. REFLECTOR TO BE EXTRUDED PLASTIC WITH ALL WALL THICKNESS .125 INCHES.
2. THIS DRAWING IS FOR DESIGN PURPOSES ONLY.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION	ITEM NO

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
• TOLERANCES •
DECIMALS ANGULAR
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DO NOT SCALE DRAWING

TREATMENT

FINISH

SIMILAR TO | ACT WT | CALC WT

CONTRACT NO.

ENGINEER: A. DOMASZEWICZ — DATE: 1/26/98

CHECK

DESIGN: M. CONWAY — 1/26/98

DESIGN ACTIVITY

CUSTOMER

CALIFORNIA MANUFACTURING TECHNOLOGY CENTER

TITLE: REFLECTOR DESIGN CONCEPT

SIZE: A | CAGE CODE | DWG. NO. SUN0005

SCALE 1:2 | RELEASE DATE | SHEET

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ADDITIONAL APPROVALS	DATE		QTY REQD PER ASSY		APPLICATION	

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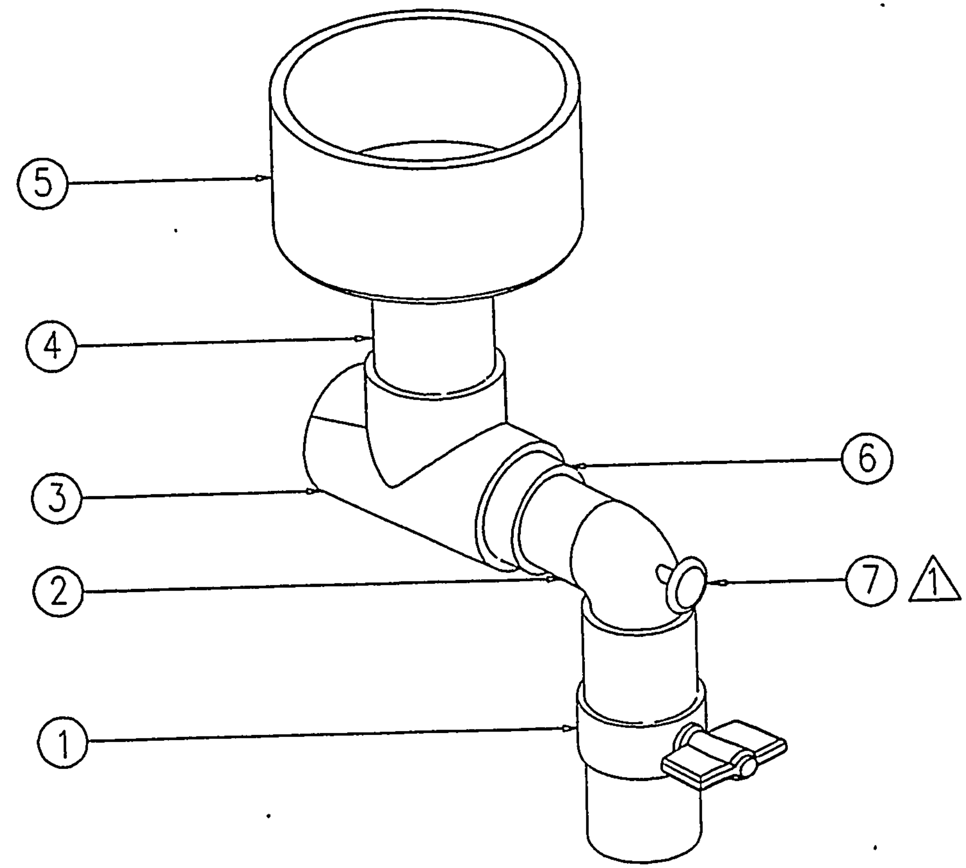

NOTES : UNLESS OTHERWISE SPECIFIED

⚠1 DRILL THROUGH ITEM ② AND BOND IN ITEM ⑦ WITH TWO PART EPOXY ADHESIVE.

2. BOND ITEMS ①, ②, ③, ④, AND ⑤ WITH PVC CEMENT.

3. DRILL ITEM ⑤ AT CENTER TO ACCEPT ITEM ④.

4. PAINT ASSEMBLY FLAT BLACK ON OUTSIDE. DO NOT PAINT THERMOMETER ITEM ⑦ OR VALVE HANDLE.

PART NO.	DESCRIPTION	QTY. REQ.
1	1/2" PVC BALL VALVE	1
2	1" PVC ELBOW	1
3	1-1/2" PVC TEE	1
4	1" PVC SCH 40 PIPE	1
5	4" PVC CAP (DRILLED)	1
6	1-1/2" TO 1" ADAPTER	1
7	THERMOMETER	1

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL/SPECIFICATION	ITEM NO
			FILLER/DISPENSER	PVC	

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
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DECIMALS ANGULAR
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DO NOT SCALE DRAWING

		Date
CONTRACT NO		
ENGINEER	A. DOMASZEWICZ	2/12/98
CHECK		
DESIGN	M. CONWAY	2/12/98
DESIGN ACTIVITY		
CUSTOMER		

TREATMENT

FINISH

SIMILAR TO | ACT WT | CALC WT

CALIFORNIA MANUFACTURING TECHNOLOGY CENTER

TITLE: FILLER/DISPENSER–SOLAR TUBE SUB-ASSEMBLY DRAWING

SIZE	CAGE CODE	DWG NO
A		SUN0004

SCALE: NONE | RELEASE DATE | SHEET

WEIGHTS

STRESS

MATERIALS & PROCESS

MANUFACTURING ENGRG.

QUALITY ASSURANCE

ADDITIONAL APPROVALS | DATE | PART DASH NO. | NEXT | FINAL | QTY REQD PER ASSY | NEXT ASSY | USED ON | APPLICATION

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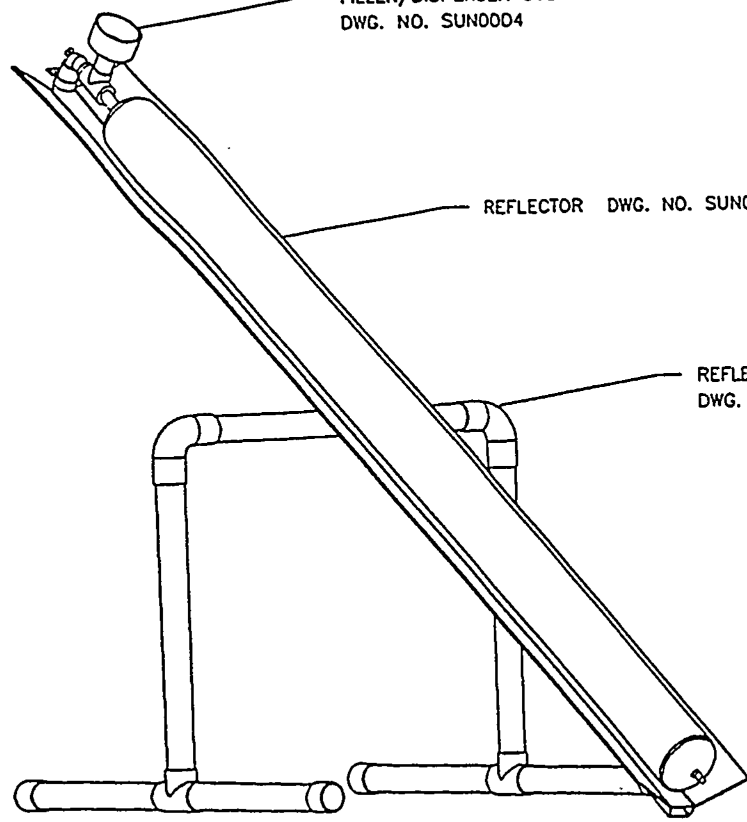

NOTES : UNLESS OTHERWISE SPECIFIED

1. THIS DRAWING IS FOR DESIGN PURPOSES ONLY.
2. SEE DWG. NO. SUN0006 FOR REFLECTOR TO STAND AND SOLAR TUBE TO REFLECTOR ATTACH POINTS.

PARTS LIST

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DO NOT SCALE DRAWING

CONTRACT NO.	
ENGINEER: A. DOMASZEWICZ	DATE: 1/26/98
CHECK	
DESIGN: M. CONWAY	1/26/98
DESIGN ACTIVITY	
CUSTOMER	

CALIFORNIA MANUFACTURING TECHNOLOGY CENTER

TITLE: WATER PASTEURIZATION SYSTEM ASSEMBLY DRAWING

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Proposal for Field Trials of the Solar Water Purification System

SUMMARY

The primary objective of this project are to:

- identify and correct any design problems in the technology, and ensure its compatibility with the end user preferences and requirements in South African rural communities and health clinics,
- evaluate and document the field performance of the system and its effectiveness in limiting the occurrence of waterborne biological contaminants in the drinking water, for provincial health agencies, NGOs and other markets in South Africa,
- determine appropriate marketing action steps delivery systems for (1) community placement and acceptance of the system, (2) the necessary end-user education to assure sanitary and exclusive use of disinfected water for drinking, and (3) relevant community education in public hygiene and sanitary practices;.and ,
- determine the content and delivery systems for technical training of maintenance personnel, and local management systems for community ownership and operation of the system to ensure its ongoing functioning.

We anticipate that sucess in the above goals of the project in South Africa will assist in the successful transition of solar water purification systems to markets in other African countries in particular, and to developing countries in general. We are requesting funding support for a one (1) year demonstration program.

BACKROUND

Polluted and poisonous water is believed to cause 25-30 million deaths each year, about 60% of them children under five. Untreated and reused water in many developing countries carries a multitude of germs, causing about 80% of their diseases. Typhus, cholera, and dysentery are associated with contaminated water, which causes severe diarrhea, and cause 24,000 childhood deaths each day. In addition to the fatal consequences of polluted water are the many diseases that cause severe losses in productivity, economic instability, and poor quality of life.

To combat the devastating effect of contaminated water in Southern Africa, West Angeles CDC has joined with SUN Utility Network and Colorado State University to develop a community scale solar water purification system capable of heating water at temperatures high enough to kill many water borne diseases. The system utilizes solar evacuated tubes provided through SUN Utility Network. West Angeles CDC has entered into a license agreement with SUN Utility Network for marketing and manufacturing of the solar water purification system in Africa.

In January 1997, The US Department of Energy (DOE) partnered with West Angeles CDC in its endeavor to perform market feasibility research and development for the Solar Medical Autoclave (portable solar thermal sterilizer) in Southern Africa in conjunction with the sustainable energy effort of the US-South Africa Binational Commission (BNC). The Autoclave is a heat compression chamber connected to solar evacuated tubes to generate steam for sterilization of medical equipment, bandages, and surgical instruments. The Autoclave was considered to be a lead application of the solar evacuated tubes. However, our research revealed that greater emphasis should be placed on the demand for the use of the solar evacuated tube technology in a system to provide safe, clean drinking water, rather than for sterilization. Thus, A system utilizing solar evacuated tube technology to disinfect contaminated water has been developed for use in a village or rural health care setting.

We are requesting funding to conduct extensive field tests of the technology, to identify and implement any changes needed in the design as a result of the tests, to evaluate and document the performance of the technology for market development, and to develop and test community education and technology management systems to ensure a long term and successful impact of the technology on community health.

THE SITUATION IN SOUTH AFRICA

Millions of South Africans do not have access to safe drinking water. In economically deprived areas, waterborne diseases lead to illness and sometimes even death, especially in children. The unavailability or excessive cost of fuel prevents many families from boiling their water for disinfection before drinking. The Lawrence Berkeley National Laboratory (LBNL), WaterHealth International, Inc., Natural Resources Defense Council, SACES, and the US Information Service are involved in demonstrating a device called UV Waterworks, which uses ultraviolet light to disable bacteria, viruses, and protozoa. It requires 40 watts of electricity to disinfect the daily water needs of approximately 1,000 people, therefore it is not an off-grid application.

Approximately 20% of South Africa's rural population is not expected to have access to the centralized power provided by the utility grid for at least another 20 years. The government has elected to shoulder the costs of electrifying 2,000 clinics and 16,800 schools serving this population through photovoltaics. Renewable Energy for South Africa, or REFSA, was established to implement a renewable energy-based, rural electrification program. With its emphasis on photovoltaics, REFSA has the potential to facilitate the provision of electricity to 10 million rural South Africans.

ESKOM, the South African national utility has embarked on an ambitious program to electrify 16,000 primary health care units and schools in rural South Africa. Approximately 4,000 will be powered with PV panels.

FIELD TEST OPERATION AND INSTITUTIONAL RESPONSIBILITIES

The field tests will last 12 months. Two rural health clinics at the provincial level will participate. Feedback on the solar water purification system frm
Random checks on bacterial content will be performed. An evaluation of the community education systems and community management systems for the solar water purification system wil be conducted at each site. A primary focs will be the level of contamination in the inlet and outlet water

THE ROLE OF SUN UTILITY NETWORK

SUN Utility Network, Inc. (SUN) is an international solar energy systems and environmental management company. SUN specializes in comprehensive solar utility hot water service applications for utilities' demand side managment and integrated resource planning programs. In addition, SUN has capabilities to develop other solar energy systems in the area of air conditioning, desalination, food processing and dehydration, home water distillation, and water purification. West Angeles CDC has retained SUN Utility Network, Inc. as consultants on marketing and technical design.

THE ROLE OF WEST ANGELES CDC:

THE ROLE OF THE INDEPENDENT DEVELOPMENT TRUST: IDT will identify suitable sites.

THE ROLE OF SACES: The South African Center for Essential Community Services (SACES) will oversee the field tests in the country. SACES staff have an extensive history and experience in rural development in South Africa and are aware of local NGO contacts that have long-term ties to local communities. SACES will give local direction to the field tests. It will conduct quality tests of water, interface with the community for placement, assist in the installation of the solar water purification system in the community, communicate user feedback for desired design changes to West Angeles CDC, develop and implement information and management systems in collaboration with the other participating institutions (West Angeles CDC, IDT, Colorado State University) for community education and management and maintenance of the solar water purification system in the field.

In Summary, West Angeles CDC will work with SUN Utility, Colorado State University, The Independent Development Trust and South African Center for Essential Community Services to:

(a) design a six week test of the solar water purfication system;

(b) carry out field tests including identification of clinics, and collection of technical data on water quality, implementation of any needed design changes, and social data on introduction and management of the solar water purification system technology and community education;

(c) analyze and evaluate the resulting data;

(d) identify and recommend design modification to the solar water purification system and test those modifications in subsequent phases of the field;

(e) participate in stakeholders conference in South Africa;

(f) test and document media and methods for community placement and acceptance of the solar water purification, and management systems for its continued successful operation and routine maintenance;

(g) develop and evaluate media methods for community education/training in public health and hygiene issues related to safe drinking water; and

(h) facilitate the transfer of the technology to appropriate South African small business and institutions concerned with public health.

BUDGET