EGYPTIAN RENEWABLE ENERGY FIELD TESTING PROJECT

RENEWABLE ENERGY RESOURCES
FIELD TESTING

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STATEMENT OF WORK FOR FIELD TEST # 4
SOLAR THERMAL INDUSTRIAL PROCESS HEAT
HELWAN TEXTILES
AUGUST 1986

DRAFT

Prepared for

Egyptian Electricity Authority
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Submitted to

Louis Berger International, Inc.
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STATEMENT OF WORK

APPENDICES

R582/3.dt

1.0 PROJECT DESCRIPTION

1.1 Background of the Renewable Energy Resources Field Testing Project

The Government of Egypt herein referred to as (GOE) and the U.S. Agency for International Development (USAID) have initiated a four year Renewable Energy Field Test project (REFT). The Egyptian Electricity Authority (EEA) and Louis Berger International, Inc. are leading a team of subcontractors in the REFT project activities that encompass solar industrial process heat, wind and photovoltaic system applications.

The specific objectives of the EEA/USAID project are twofold: (1) to demonstrate, analyze and evaluate the viability of commercially available renewable energy technologies in Egypt, and (2) to establish the infrastructure necessary to ensure that successful renewable technologies are available for widespread use in-country. Three tasks are planned:

(1) Field Tests - Assess selected renewable energy systems/applications which could be suitable for commercial use in Egypt; develop detailed engineering design hardware specifications and system performance requirements; prepare RFP (Request for Proposal) packages for procuring equipment; supervise the work of hardware contractors; and collect and evaluate data generated from the field tests.

(2) Supporting Analysis - Conduct technical, social, financial, economic, and market analyses of renewable energy systems related to the field tests. Develop a computerized Renewable Energy Information System (REIS).

(3) Training - Improve the skills of the EEA and the private sector in evaluating renewable energy technologies, applications, economics and markets, and provide technical assistance in systems design, installation, operation and maintenance.

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The field tests consist of eleven separate renewable energy system application demonstrations; five solar industrial process heat applications, three photovoltaic field test applications and three wind system applications. One solar industrial process heat field test is a demonstration of a solar heated hot water system to provide hot water for the textile finishing industry. The host client, Helwan Textiles, is near Heliopolis, Egypt.

1.2 Summary of Bidder Requirements

The tenderer shall submit a complete proposal for a turn-key job for the design, manufacture, supply, instrumentation, installation, testing and performance guarantee of a flat plate solar system, flash steam system, and steam condensate return system. The solar system shall include 3 hours insolation storage capacity, and a distribution system. The waste heat recovery system shall help supply heated process water to the bleach range. Nominal flowrates for these supportive systems are shown in Appendix -A-. The proposals shall include on-the-job, classroom and in your factory training programs, including training materials and manuals, for the assigned Egyptian engineers and technicians. The operation, maintenance, training, troubleshooting and repair shall be according to requirements specified in Section 6.0. The contractor shall support operation of the system for a period of two years after the system is accepted by the EEA/USAID. Each tenderer shall submit a set of qualification documents describing in detail the contractor's and subcontractor's relevant capabilities and experience on similar projects. EEA/USAID reserve for themselves the right to refer to any of the tenderer(s) customers to obtain independant information about the contractor and/or the performance of equipment to be supplied.

The offer shall be made on turn-key basis. The contractor shall define in detail all site preparation procedures. It is anticipated that required site preparation would be performed locally by the EEA according to the tenderer's specifications and drawings and under the supervision of his representatives.

Representative climatic conditions are shown in Appendix -B-. The presence of airborne sand in the atmosphere, occasional sand storms and high temperature in summer shall be taken into consideration in the design of the proposed equipment.

For each component offered, the tenderer shall state in his offer the exact type and model number. He shall also submit a complete set of catalogues and drawings for each hardware item offered detailing complete specifications. All hardware offered shall be commercially available and proven reliable in similar applications.

The tenderer shall include in his offer a preliminary design description; system layout drawing; functional schematic; system electrical circuit diagram including the performance monitoring instrumentation system; and typical daily power and load operating curves for the solar system and waste heat recovery system. Maintenance requirements and spare parts lists for each major equipment item shall be included. In addition, the proposal should include details of installation, design procedures and interface requirements. Electrical and other utility requirements shall be identified.

Packaging and shipping of all required hardware to Alexandria, Egypt, custom clearance and transportation to the Helwan Textile site shall be the responsibility of the contractor. EEA will assist with custom clearance and permits as required.

The bidder shall furnish and install at a minimum the following equipment, materials and services:

Hardware

1. Flat-Plate Solar Collectors
2. Solar Storage Tank
3. Solar Circulation Pumps
4. Hot Water Distribution Pumps
5. Solar Control System

6. Hot Water Distribution Control System
7. Solar Circulation Piping
8. Hot Water Distribution Piping
9. A Meteoroligical Station for Onsite Data Acquisition
10. Waste Heat Recovery Heat Exchanger
11. Waste Heat Recovery Instrumentation and Controls
12. Waste Heat Recovery Pressure Relief Valve
13. Waste Heat Recovery Piping
14. Waste Heat Recovery Storage Tank
15. Waste Heat Recovery System Pumps
16. Filter Screen
17. All Electrical Controls and Panels
18. All Equipment and Piping Insulation
19. All Mechanical Tie-Ins
20. All Electrical Interfaces
21. Approved User Manuals for Solar System
22. Approved User Manuals for Waste Heat Recovery System
23. Approved User Manuals for Filter Screen System
24. Required Operating and Maintenance Repair Tools, Meters, Spare Parts, etc.
25. An on-site data acquisition system for performance monitoring of the solar system, and waste heat recovery system.
26. All other miscellaneous items, support steel, pipehangers etc. necessary to provide a complete, ready for use, turn-key installation.

Services

1. System Design, Instrumentation, Procurement and Shipment
2. Installation and Operations Support for 2 years after acceptance
3. Acceptance Testing (30 days)
4. Training of Egyptian Engineers/Technicians (Classroom, in-factory and on-the-job in Operation, Maintenance, Data Acquisition, Troubleshooting and Repair)
5. Two-year guarantee on all parts

1.3 Description of the Application Site

This project will demonstrate the use of solar collectors in conjunction with a waste heat recovery system to provide hot water for the textile finishing industry.

1.3.1 Existing Operation

Steam presently is provided by Helwan Textile's steam back pressure turbine/electric generator. The electrical power required to operate the plant (3.5 mega watts) is obtained from process steam as a by-product. The initial boiler steam pressure is approximately 950 psig (67 Kg/cm^2) and 870°F (465°C). The back pressure, which depends on the plant requirement, is 85-115 psig (6-8 Kg/cm^2), while the finishing department steam pressure requirement is 50-57 psig (3.5 to 4.0 Kg/cm^2). The heavy plant steam requirements are in excess of the electrical power load. The excess plant steam requirement is provided by supplying additional high pressure steam through a reducing valve directly from the boiler, i.e.

Plant steam demand (average)	121,000 lb/hr (54.9 mTON/hr)
Exhaust steam available (average)	-90,500 lb/hr (41.0 mTON/hr)
Pressure Reduced Make-up	30,500 lb/hr (13.9 mTON/hr)

Washer operating temperatures range from 22°C (72°F) for the rinse washer to 50°C (122°F) for the low temperature washer and 82°C (180°F) to 90°C (194°F) for the high temperature washer.

The nominal low temperature washer is 70°C (158°F).
The nominal high temperature washer is 90°C (194°F).
The nominal rinse washer temperature is 30°C (86°F).

In order to establish thermal and mass continuity, the EEA/Helwan Textile engineers expect a 75% (9/12), 17% (2/12) and 8% (1/12) flow split between the high temperature washer (90°C), low temperature washer (70°C) and rinse washer temperature (30°C), respectively.

Average fabric production: 800 Kg/hr (1,764 lbs/hr)

Annual plant operating schedule: 24 hrs/day, 6 days/week, 52 weeks/yr, or 7488 hrs/yr

Note (x); x represents the model's stream number

(1) Total water flow 48 m^3/hr (211 gpm), or 48 m^3/hr x 35.31 ft^3/m^3 x 62.3053 lb/ft^3 = 105,648 lb/hr

The annual average ground water temperature is 22°C (72°F) and will be used for the process water inlet temperature.

(2) Process water flow to the high temperature washers

105,648 lb/hr * 9/12 = 79,236 lb/hr (36 m^3/hr)

(3) Process water flow to the low temperature washers

105,648 lb/hr * 2/12 = 17,608 lb/hr (8 m^3/hr)

(4) Process water flow to the rinse washer

105,648 lb/hr * 1/12 = 8,804 lb/hr (4 m^3/hr)

(10) (11), and (12) Process water absorbed by the fabric is equal to 50% of the weight of the fabric or 400 Kg/hr (882 lb/hr)

(9) Fabric processed per hour is 800 Kg/hr (1,764 lb/hr)

The specific heat (C_p) of cotton fabric is 0.319 Btu/lb°F (0.319 Kj/Kg°C).

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1.3.2 Proposed Operation

The Proposed Washer P&ID, (Process and Instrument Diagram in Appendix -D-) indicates the required controls for the proposed scenario conditions.

(40)-(33) Waste Heat Exchanger Approach Temperature is 16°F

The existing washer conditions provide only a washer temperature indicator and a manual steam and water blend station. The individual washer's water flow is not monitored. Since the water flow is not monitored and temperature is manually controlled, the mass and heat balance for the individual washer can vary significantly and be unnoticed.

To control the water flow for each washer, a rotameter, (visual flowmeter with globe valve) shall be provided.

To maintain washer temperature and effectively utilize the solar heated and waste heated process water, two temperature control valves per washer are required, i.e., one three-way (three-ported) blend valve for effective blending of hot and cold process water, and a steam control valve with sparge nozzle for mixing steam with the washer water. Using the washer's flow meter and globe valve, the washer water flow rate is maintained. A shared temperature signal from the washer water level can be used to activate the three-way blend valve and/or the steam sparge valve. Should the blend valve outlet temperature be less than the washer water temperature setpoint, the steam sparge valve will open allowing steam to sparge into the washers water level maintaining the washer's temperature.

The exit three way diverting valve's position is determined by the up stream washer temperature, i.e. if the upstream washer water temperature is higher than the selected temperature the valve diverts to the recovery system, conversely if the up stream temperature is lower than the selected temperature the valve diverts to the drain.

The sump pump moves the waste water to a filter screen where solids and lint are removed and the clear waste water drains to the storage tank.

The clean waste water is pumped to the waste heat exchanger. After passing through the waste heat exchanger, the waste water drains to the waste water treatment facility.

As the waste water passes through the tube side of the waste heat exchanger, process make-up water passes through the shell side, i.e. the waste water temperature decreases and the process make-up water temperature increases.

The solar system storage tank is a pressurized via the process water line pressure. The tank has a high temperature cut-off switch for the solar array circulation pump. EEA/Helwan Textile have requested a minimum of three hours solar insolation storage without solar IPH water delivery.

A constant speed pump circulates process water through the array. The circulation is controlled by the array's inlet and outlet process water temperature differential.

A constant speed pump blends solar heated process water with process water heated by the waste heat exchanger.

The solar heat process water's delivery system overrides, the waste heated process water delivery pressure, hence the waste heated process water flow decreases. However, the solar delivery system cannot provide the total flow required to maintain washer level, therefore the waste heated process water maintains the differential flow (40), i.e. difference between washer demand and solar heated process water. Conversely, the above scenario allows the differential flow (40) increase to increase as the solar flow decreases.

Should the textile bleach range not require process water for three hours, the solar storage tank shall be capable of storing three hours of solar insolution without exceeding the system design temperature.

2.0 FLAT PLATE SOLAR SYSTEM, AND WASTE HEAT RECOVERY SYSTEM DESIGN SPECIFICATION

2.1 Schedule for Design, Delivery and Installation

The Contractor's proposal shall include the dedicated time requirements for the design, manufacture, factory testing, procurement, and delivery of the complete system cost, insurance and freight (CIF) to Alexandria, Egypt. In no case shall the total time exceed 360 days from the date of contract award.

Within 14 days after contract award, the Contractor shall submit for EEA/USAID review a detailed project schedule for the design, manufacture, factory testing, installation, instrumentation, startup and acceptance testing of the proposed Solar Thermal IPH Project. The schedule shall include provision for a final design review and approval by EEA/USAID, or its designated representative, prior to start of manufacture and procurement. The schedule will be approved in writing (or an alternate recommended) by the contracting officer within 14 days of receipt in Cairo.

2.2 Design Review

The EEA/USAID or its authorized representative shall have the right to review drawings and specifications pertaining to the design of the system and individual components. The design review location shall be in the United States. The location to be determined by EEA/USAID or its authorized representative. Submission of the drawings and specifications for review and the completion of the review will be in accordance with the detailed project schedule (Section 2.1) submitted by the Contractor and approved by EEA/USAID. EEA/USAID shall have the right to require modifications to the design prior to final design approval for specified cause; namely: for minimum safety, prevention of harm to property or equipment, meeting of minimum standards, or interference with Helwan Textile's operations.

2.3 General Design Requirements

The Solar System, and Waste Heat Recovery System plant design shall conform to U.S. standard specifications and practice with all equipment suited and sized for efficient, safe and functional use. The system should be designed for a life of 15 years minimum. The power control system, including switches and circuit breakers and instrument controls, should provide for reasonable equipment protection against incorrect procedures for starting, stopping, and operating the equipment. Operating and maintenance personnel safety shall be an integral part of the system design. All proposed equipment shall be commercially available, and of demonstrated reliability. The use of protoype or one-of-a-kind hardware will not be allowed.

The required level of design detail shall include as a minimum:

- Justification for system sizing and design including all calculations and technical/operational assumptions
- Justification for component selection
- Component (product) literature where appropriate
- General piping layout drawing with valves and fittings
- General electrical schematics showing junction connections, grounding circuitry, voltage and current limits, etc.
- An installation diagram that includes the relative sizing and location of major pieces of equipment in relation to the facility

2.4 Technical Design Requirements

This section provides specification guidelines. The guidelines should assist the contractor in preparing the final specifications. Areas covered include:

- Solar System
  - Collectors
  - Pumps
  - Valves
  - Thermal Storage Tank
  - Controls
- Waste Heat Recovery System
  - Filter Screen
  - Heat Exchanger
  - Pumps
- Piping, Valves, and Piping Specialties
- Insulation
- Electrical
- Instrumentation
- Roof Water Proofing and Roof Drains in the Collector Area

2.4.1 Solar System

A. Collectors

Provide 4,000 square feet of flat plate collectors with an instantaneous efficiency curve not less than a first order y intercept of .71 and a slope of not more than .76. The proposed must include a computer model of the proposed system. Collector field output will be weighed heavily in proposed evaluation.

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The collectors shall be flat plate construction with an extruded casing of aluminum suitably treated to insure reliable operation for the specified life of the plant. The glazing shall be low iron glass suitably mounted and sealed to maintain collector integrity.

The collector tubes cross sectional area shall be no smaller than 1/2" inside diameter and designed for 125 psig operating pressure.

The headers and collection tubes shall be constructed of copper and shall be joined together in such a manner as to insure proper collector operation for the system life without joint degradation between the headers and the tubes. The absorber plate shall be constructed of copper or aluminum sheet and shall be bonded to the absorber tubes in a manner conducive to effective heat transfer. Roll bond type absorbers will not be considered. Absorbers shall be finished with a selective coating having an absorptivity of .95 and emissivity of .10.

The minimum aperture area shall be 85% of the gross area. Row spacing shall be designed to prevent shading of adjacent rows. Mounting shall be parallel to the building column lines but shall not deviate more than +/-10 degrees from true south. Tilt angle shall be 45° from horizontal, field adjustable.

Sealing compounds, gaskets, and insulation shall be capable of withstanding stagnation temperatures without outgassing. Insulation shall be closed cell type.

The collector shall be designed and mounted in such manner as to provide adequate support during a 25 meters/second wind load.

The collector array shall be roof mounted on steel supports with walkways provided for easy maintenance access. See Appendix -E- for example.

The collectors shall be tested and rated in accordance with ASHRAE 93-77 and the ASHRAE first order efficiency equation shall be used as as a guideline for collector efficiency.

$$eff = F_R (\alpha\tau) - F_R U_L (T_i - T_a)/G_t$$

Within 30 days of contract award, the collector of the brand and model proposed shall be shipped to EEA for evaluation. This collector shall remain with EEA.

B. Pumps

Electrically (380 volts, 3 phase, 50 hertz) driven pumps shall be compatible with hot water service. Consideration should be made for stagnation temperatures which would be much higher than normal operating temperatures.

Two Circulation Pumps(s) (one active and one standby) shall be sized to provide the flow required at the heads imposed by the solar system. The circulation pump should be sized to meet the requirements of the collection system so as to circulate water through the collectors at a flow rate that produces optimuim efficiency. The pumps may be centrifugal or positive displacement type.

Distribution pumps, if used, should be sized for the flow requirements of the process load. The use of multiple pumps in parallel should be considered when throttling of one pump would bring flow below manufacturer's recommended minimum.

All pumps' design shall be seal-less or mechanical seal type to reduce maintenance and minimize solar water energy losses. All pumps shall be equipped with isolation valves, discharge check valve, inlet strainer with drain valve, pressure gauge (with isolation valves). Each pump shall be equipped with an appropriate sized recycle line with globe valve piped from the pump discharge to the pump suction.

C. Valves

Valves shall be constructed of materials compatible with hot water service. This should include body, shafts, seals, and valve mechanism. The correct style valve design should be chosen for each location in the hydraulic circuit. Each pump shall have isolation valves. A high performance butterfly valve (wafer) is recommended for this application. Straight-through swing check valves should be installed on all pump discharges and elsewhere as required. Vents, drains and gauge isolation values should be ball valves. Isolation valves for rows of collectors should be minimized, thus minimizing the number of safety valves. Valves or orifice plates or piping design may be used to balance flow through individual collector circuits. Control valves should be butterfly valves (wafer) with electrical or pneumatic actuation.

D. Thermal Storage Tanks

Solar collection water storage tank(s) shall be sized to provide three hours insolation energy without exceeding the design or process limitations.

The tank(s) shall be designed and fabricated to meet or exceed all applicable codes and standards. The tanks shall have all flanged connections required for proper installation, operation, and control.

Preference shall be given to ground level or below grade storage; overhead or roof-mounted tanks shall not be considered.

Pressurized storage is recommended.

Internal piping and/or baffles shall be provided for stratified storage.

Tank material shall be selected as appropriate for installation and service requirements (above/below grade).

Fiberglass or carbon steel tank with corrosion resistant interior coatings suitable for potable water shall be provided.

E. Controls

The control system shall be designed and constructed such that high system reliability in a harsh environment is attained. Simplicity should be a prime goal in the design of the control system. The system is to be assembled and tested prior to shipment.

The contractor shall design and install a control system for the solar collection system compatible with the operational requirements of section 1.0 of this Statement of Work.

Manually operated balance valves with local flow indicating meters shall be provided on each collector row.

The contractor shall provide a freeze protection scheme which minimizes parasitic energy consumption and loss of collected energy.

The circulation pumps shall be operated by an adjustable on/off differential temperature controller.

Locally mounted dial thermometers with thermal wells shall be installed at the inlet and outlet of each collector row, on the main solar heated return header to the storage tank and on the main outlet from the storage tank to the pump's suction as a minimum. Each thermometer shall be easily visible from the walkways.

All pump discharges shall have a dial pressure indicator.

2.4.2 Waste Heat Recovery System

A. Screen Filter

A standard factory assembled, motor driven, vibrating screen type apparatus shall be provided for all removal of solids and lint from the bleach range's waste water. Unit to be complete with motor, necessary screens, pans, water outlet and solids outlet all suitable for tank top mounting. Unit mounting height should not exceed 30 inches (762 mm).

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Unit operation shall utilize a screen which vibrates about its center moving solids across the screen to the periphery, where they are collected and discharged thru a solids outlet connection with waste water passing thru the screen for collection and discharge. Vibration to be accomplished by eccentric weights on the ends of the motor shaft. Weights to be adjustable in order to change vibration pattern. Unit to be spring loaded so as not to put any undue vibration on the mounting surface.

Capacity: Normal flow 250 GPM (1,000 l/min) , max. flow 300 GPM (1,200 l/m) for short durations.

Unit to be constructed of stainless steel.

Unit to be supplied with a Velocity Breaker, (anti-splash device) suitable for use on 4" (100 mm) influent line.

B. Waste Heat Exchanger

1. Type: Sectional, shell and tube design.
2. Material: Stainless steel shell and tubes.
3. Tube Diameter: 3/4 inch OD (75 mm).
4. Fluid Handling Criteria:
   a. Shell Side: 200 GPM (800 l/min) fresh water heated from 72°F (22°C) to 140°F (60°C) with maximum pressure drop of 10 psi (.7 Bar).
   b. Tubes: 211 GPM (844 l/min) waste water at average inlet temperature of 156°F (69°C).
5. Design unit such that:
   a. waste water flows in same relative tube in each section, from inlet to outlet, as though each relative tube is continous tube from inlet to outlet.

b. flow is 100 percent true counterflow.

6. Pressure Ratings (shell and tube sides):

a. Working Pressure: 100 psig (7 Bar).

b. Test Pressure: 150 psig (10 Bar).

C. Relief Valve:

1. ASME approved.
2. Fully compatible with application, suitably sized.
3. Set Point: 100 psi (7 Bar).

D. Backflush Assembly:

1. Type: Timed and automatic; controlled by one valve.
2. Design so that all other cleaning of internal surfaces of reclaimer tubes can be accomplised mechanically and chemically.
3. Accessories:
   a. Timer.
   b. Four-way solenoid valve with air filter.

E. Chemical Tank:

1. Capacity: Minimum 20 gallons (80 l).
2. Material: As recommended and selected by supplier for this application.
3. Provide suitable opening such that cleaning solution can be recirculated through reclaimer unit.

F. Control Panel:

1. Prewired, NEMA 12; material suitable for this service.
2. Include:
   a. all electric and pneumatic controls necessary for proper system operation in accordance with manufacturer's recommendations to achieve optimum system efficiency.

b. all necessary selector switches, push buttons, and indicating lights, flush mounted on face of panel with jumbo prelettered nameplates.

c. required connections for final hookup of pneumatic controls and electrical power.

G. Provide manufacturer's standard nameplate for each supplied item.

H. Waste Water Sump Pump(s)

The contractor shall furnish and install suspended wet pit stainless pump(s). Each pump shall have a capacity of 250 G.P.M. (1,000 l/mm) at 40 feet (15 m) total dynamic heat, for a temperature of 160°F (71°C), 1.0 specific gravity. The unit(s) shall be designed for a pit and shall be furnished with an above the cover dicharge terminating with a flanged connection. A steel cover plate (simplex with oval and manhole or duplex with ovals and manhole) shall be specified. The pump casing shall have an integrally cast discharge flange. The suction strainer shall be fabricated 304 stainless steel with steel bottom plate. The impeller shall be semi-open, and capable of passing solids. The impeller shall container a balancing ring and be cast in stainless steel, and be secured to shaft by taper fit, with key, castellated nut, washer and cotter pin. Column pipe shall be stainless steel with welded flanges machined for registered fit. The pump bearing shal be of babbitt graphite. Bearing housing shall be of stainless steel.

An intermediate bearing of the same materials as the pump bearing must be provided on pumps in excess of 6'-0" in length. Pump and bearing(s) shall be grease lubricated through separate lubricatation lines terminating at the cover plate. The motor support shall be of cast iron, machined to assure positive alignment of motor and pump shaft, fitted with a high thrust angular contact bearing with moisture-proof enclosure and grease seals. External impeller and shaft axial adjustment shall be provided. Pump operation shall be controlled by a mechanical alternator and float switch combination enclosure. Float rod shall be stainless steel. Float shall be stainless steel. Float stops shall be stainless steel. The flexible coupling between the motor and pump shafts shall be spacer type coupling.

Pumps shall be driven by a standard "C" face, vertical Mill & Chemical electric motor.

I. Waste Water Storage Tank

Corrosion allowances specified for various wetted parts shall be added to the calculated or minimum base metal thickness of shells, heads, nozzles, and manhole necks, covers, blind flanges and tubesheets. Corrosion allowances do not apply to carbon steel base materials protected by a metallic, rubber, glass or other protective coating or lining.

The minimum corroded thickness of non-removable trays, internal pipes and baffles shall be 1/8 inch.

Nominal material thicknesses may be indicated on a data sheet. Actual material thicknesses may be thicker than required by code, but in no case should they be thinner.

Skirts, if specified, shall be a minimum of 1/4 inch thick. Skirts shall be supplied with at least one 20 inch (500 mm) diameter sleeved opening for access and four 3 inch dia. pipe skirt vents equally spaced and located clear of the vessel/skirt crotch.

All vessels shall be provided with at least one ground lug bracket at least 1/4 inch (6 mm) thick, drilled and tapped for a 1/2 inch (12 mm) x 13 bolt. Ground lugs shall extend beyond insulation for access.

All vessels shall be equipped with a minimum of two lifting lugs.

Openings and Flanged Connections

- Flanged connections, facing, drilling and pressure/temperature ratings shall conform to ANSI Standard B16.5.

- Nozzle Bolt holes shall straddle the vessel natural centerline or its parallel.

- Nozzle necks shall be seamless pipe. Long welding neck flanges are permissable.

- Nozzles shall not project more than 1/2 inch beyond the inside of the shell or head of the vessel except where the nozzle is attached to an internal pipe. Vent nozzles, nozzles on lower heads, bottom nozzles on horizontal vessels and all nozzles on lined vessels shall be flush with the inside of the vessel.

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- o Unless noted otherwise, all screwed connections shall be 3000 lb. rated half couplings.

J. Bolting and Gaskets

- o Internal bolting may be square headed with heavy hex nuts. Internal bolts and nuts shall be of the same type alloy as internals, lining or cladding. Internal bolting shall be wired, pricked-punched, or otherwise locked in place.

- o Where flat gaskets are required, they shall be proportioned to fit inside the flange bolt holes in accordance with ANSI Stnadard B16.21.

- o Gaskets for ring type joints shall be of the oval type conforming with ANSI Standard B16.20.

- o Gaskets for raised face flanges shall have the outside diameter in accordance with ANSI Standard B16.5.

- o Unless otherwise noted, flanged nozzles shall have a nominal projection of 6" (150 mm).

K. If vessel supports are shown and not detailed on the Purchaser's drawing, the Supplier shall design and guarantee the supports. Internal supports shall be designed to prevent charing, wear vibration and concentrated stresses due to thermal movement and agitation.

L. Surfaces exposed to vessel contents, including vapors and condensate shall be free of gouges, pits, cracks or other surface defects.

M. Seams shall be full penetration, butt-welded construction. Backing straps shall not be used.

N. Supports shall be continuously welded to the vessel shell or the reinforcing pad.

O. Reinforcing pads, when required, shall be of the same materials as that of the vessel to which they are attached. Tapped tell-tale holes of 1/8" (3 mm) IPS shall be provided for all reinforcing pads as follows:

- One hole in all reinforcement pads around openings up to 12 inch (300 mm) nominal pipe size.

- Two holes in all pads around openings larger than 12 inch (300 mm) nominal pipe size.

- Where pads are split each section shall have a minimum of one tell-tale hole.

P. Tolerances

Fabrication dimensions shall be within the following tolerances:

Overall height	± 1/4" (6 mm)
Shell Diameter	± 1/4" (6 mm)
Anchor bolt circle radius & location	± 1/8" (3 mm)
Nozzle elevation/location	± 1/8" (3 mm)
Nozzle projection from center	± 1/8" (3 mm)
Coupled instrument nozzle locations	± 1/16" (1.5 mm)
Nozzle deviation from plumb	$\pm 1/2^{\circ}$
Manway deviation from plumb	$\pm 1^{\circ}$

Manway elevation/location	± 1/2"
Manway projection	± 1/2"
Base ring out of level	± 1/8"
Deviation from straight shell	±.01 in/ft. (2 mm)

Q. Waste Water Storage Tank Pump(s)

The contractor shall furnish and install pump(s) each capable of delivering 250 GPM (1,000 l/m) when operating at a total developed head of 40 (15 m). The pump shall be single stage, vertical split case design, in stainless steel construction. The pump internals shall be capable of being serviced without disturbing piping connections or motor.

The impeller shall be of the enclosed type, dynamically balanced and keyed to the shaft and secured with a suitable locknut.

Pump seal shall be a stuffing box with double externally flushed mechanical seal with ceramic seal ring and carbon seat.

A replaceable shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal or packing.

The bearing frame assembly of the pump shall be fitted with regreasable ball bearings equivalent to electric motor bearing standards for quiet operation.

The pump and motor shall be mounted on a common baseplate of heavy structural steel design with securely welded cross members and open grouting area. A flexible coupler, capable of absorbing torsional vibration, shall be equipped with a suitable coupling guard as required.

The pump shall be factory tested, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. A set of installation instructions shall be included with the pump at the time of shipment.

2.4.3 Piping, Valves, and Piping Specialties

A. Piping systems shall be designed and installed to include all control and isolation valving, traps, strainers, unions, anchors, guides, hangers, supports, instrumentation ports, and insulation as required for a completed system. All systems shall be hydrostatically tested at 1.5 times the design pressure. All water systems shall be disinfected and flushed prior to use.

B. Piping material for the solar collection system array shall be seamless, drawn type K hard temper copper with wrought or cast copper fittings. Solder joint shall be made with 95-5 (tin-antimony) solder. Main headers may be galvanized steel.

C. Piping material for other systems (heat recovery, solar circulation headers and distribution) shall be galvanized carbon steel, stainless steel, threaded or flanged as required. Tubing may be considered in lieu of piping to decrease system mass and overnight heat loss.

D. All pipe systems shall have a maximum velocity of 7 ft/sec (2 meters/second) with the minimum inside diameter for optimal balance between parasitic power requirements and system heat loss.

E. Valves shall be specified as required for a complete, safe operation. Ball valves shall be full bore, bronze body. p Waffer valves shall have carbon steel disc in carbon steel body. Swing-check valves shall be bronze construction with bronze disc.

F. Anchors, guides and expansion joints shall be provided as required for proper restraint and alignment. No rubber hoses shall be used. Flexible joints shall be stainless steel braided hose.

G. Hangers and supports shall be selected or designed to carry the loads with ample safety margin, provide for expansion and vibration, and give suitable support without contributing to piping stress. All supports, guides and anchors shall be thermally isolated from the piping system.

H. Unions shall be provided at control valves, specialty items, and equipment to allow easy disassembly for removal and maintenance. In general, unions should be 300-pound, malleable iron, screwed, with ground iron to brass seats. Dielectric unions shall be used between dissimilar metals.

I. Steam traps shall be provided as required and shall be inverted bucket traps with thermic vents, internal strainers, and orifices designed for the maximum pressure of the steam main. Each trap shall be followed by a check valve and equipped with unions for easy removal.

J. Strainers shall be provided in the suction inlet to all pumps, and shall be basket or "Y" type with drain valve.

K. Safety relief valves and automatic air relief valves shall be incorporated in the solar system design as required for a continuous, safe operation.

L. Provide a reduced pressure backflow preventor at all plant water tie-ins to prevent cross-contamination of water systems.

M. All piping shall be identified in English and Arabic based on the American National Standards Institute, Standard No. A13.1-1956.

2.4.4 Insulation

A. Piping

All piping serving the solar collection system shall be insulated with form-fitted, heavy-density fiberglass. All piping shall have an embossed aluminum jacket. Fittings shall have a PVC (poly vinyl chloride) form fitted cover. No duct tape shall be used.

The insulation product shall not support combustion. It shall have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 (ASTM E84 or UL 723 or English System equivalent). Insulation protection saddles shall be used at each hanger location. "Blocking" (multiple layers of insulation) shall be employed on all insulated piping 2-1/2" diameter or larger. Unions shall not be insulated.

Insulation thicknesses shall be selected to provide an overall heat loss equal to or less than 0.16 W/m^2 °C (0.10 BTUH/ft^2 °F). In no case shall the piping insulation thickness be less than 25.4 mm (1 inch).

B. Equipment

All above-grade thermal storage tanks and heat recovery equipment shall be insulated with heavy-density unfaced industrial fiberglass board conforming to equipment contours and banded in place. A field-applied mastic and/or aluminum cover surface finish will be required. Outdoor equipment will require a metal covering.

Insulation thicknesses shall be selected to provide an overall heat loss equal to or less than 0.06 W/m^2 °C (0.10 BTUH/ft^2 °F). In no case shall insulation thickness be less than 1".

The insulation product shall not support combustion. It shall have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 (ASTM E84 or UL 723).

Below-grade thermal storage tanks shall be insulated, as appropriate for the site conditions, using a hydrophobic material compatible with the equipment material (chemically inert).

2.4.5 Electrical

A. The contractor shall provide all electrical design, specifications materials, tools and construction labor to complete a ready to operate electrical system (380 volts/3 phase/50 hertz.

B. All electrical work shall conform with the requirements and recommendations of the NEMA (National Electrical Manufacturer's Association) local codes and all applicable government codes.

C. The contractor shall provide all necessary raceways, offsets, fittings, and boxes and adjust all fixtures and equipment and provide all supporting materials required for a planned, coordinated and neat installation.

D. The Contractor shall commission and check for correct operation of all electrical devices.

E. Rigid conduit shall be galvanized, zinc metalized or aluminum.

F. Flexible conduit shall be used for final connections to motors.

2.4.6 Instrumentation

A. The contractor shall provide all instrumentation design, specifications, materials, tools, and construction labor to complete a ready to operate instrumented solar IPH system.

B. All instrumentation work shall conform to the requirements and recommendations of the Joint Industrial Counsel (JIC), American Society of Instrumentation, local codes, and all applicable government codes.

C. The contractor shall design, purchase and install all panels and instruments and provide all electrical and electronic interconnections between the various components

3.0 INSTALLATION

3.1 Equipment Shipment

Packing, insurance, freight and related charges to deliver all equipment items to the plant site is the responsibility of the Contractor. EEA will assist the contractor in obtaining custom clearance.

The supplier shall send shipping documents, bill of lading, inspection certificates and other related documents to EEA one month prior to the receipt of the equipment at Alexandria.

All equipment shall be packaged or boxed in clearly numbered cartons or boxes. A Box Contents List (BCL) shall be delivered to the USAID contracting officer with a copy to EEA prior to the delivery of any equipment at Alexandria. This is in addition to Bill of Lading documents. The BCL shall identify the contents of each box by box number. Box numbers shall be grouped by subsystem. For example, solar arrays and related hardware are number series 200, flash steam system 300, and so forth. Prior to shipment, the tenderer should define in writing such equipment transport and receipt controls in similar detail as that provided above.

3.2 Plan and Schedule for Construction

The schedule for design, delivery and installation submitted in accordance with Section 2.1 shall include the number and skill level of laborers which will be employed; the duration of the work; and the plans for accomodations for both the labor force and the Contractor's personnel.

Within two weeks of receiving EEA/USAID approval of the final design the Contractor shall submit a "Plan and Schedule for Construction" to the USAID Contracting Officer for approval. The Contracting Officer will approve the Plan/Schedule, or recommend changes required for approval within two weeks of receipt in Cairo.

The EEA/USAID reserves the right to periodically inspect all phases of the work in progress or after completion of the whole or any part thereof to insure that the work is performed in compliance with the terms of the contract. If EEA/USAID determines that the work is not performed in accordance with the specifications, they reserve the right to require that the work be corrected or replaced if acceptable corrections cannot be made. Any part of the work that is redone shall be at the Contractor's expense. All work related records shall be available at all times for examination by the EEA/USAID Contracting Officer. The Contractor shall provide all necessary facilities for such inspection during contractor's regular working hours. It should be clearly understood, except as otherwise provided, that such progress inspection shall not constitute acceptance by the Contracting Officer of any part of the work, but will be for the purpose of coordination and assistance in interpretation of specifications and technical requirements.

Within one month of system acceptance (see Section 7.0), the Contractor shall furnish a complete set of "as built" drawings incorporating all changes and corrections to the original system design incurred in the system installation. The "as builts" shall be modified original tracings. Changes and corrections so entered shall be indicated by a lettered circle, and noted as "As-Built" in the revision. In the case where no revisions or correction to an individual drawing were necessary, the notation "As-Built-No-Changes" shall be made directly below the revision block. Where several manufacturers' brands, types or clases of items listed have been used in the project, the specific areas where each item was used shall be designated. Designations shall be keyed to the area and space designations on the contract drawings. Information shall be furnished, typewritten, for the listed materials. Copies of the "As-Built" drawings shall be given to the Contracting Officer.

3.3 Site Planning and Construction

The Contractor is encouraged to use local Egyptian labor and in-country fabrication of subsystems whenever possible. Low-cost fabrication techniques should be emphasized. The proposal shall discuss the extent to which the proposed system can be constructed and installed by local labor using local materials should the system be replicated elsewhere in Egypt. The contractor shall indicate where this approach has been taken with this or similar equipment in other developing countries.

4.0 OPERATION AND MAINTENANCE

4.1 Schedule of Energy Production

The Contractor shall include in the proposal an "Energy Production Plan and Schedule". This document shall contain, but is not necessarily limited to, average daily energy supply and demand projections for twelve months of solar thermal collection and waste heat recovery systems. A complete description of how these projections were computed, including descriptions of any computer models used, is required. Input parameters to any model shall be shown. Planned scheduled outages during the upcoming year and planned changes in equipment, control mode, or operating characteristics significantly impacting the energy production of the system shall be given, if applicable.

4.2 Guarantee/Spare Parts Requirements

The contractor shall provide at least a 2 year guarantee on all parts from the time of EEA/USAID system acceptance. An option for a 5-year guarantee shall be included as a separately costed option. The contractor shall separately cost an itemized list of spare parts that should be purchased by EEA/USAID and made available to insure trouble-free operation for five years. Any specialized, custom manufactured tools or equipment required for operation and maintenance of the system shall be specified and provided by the contractor as part of the original contract (scope of supply).

4.3 Operations Support

The contractor is required to provide technical support of the operation of the system for a period of 2-years after system acceptance by EEA/USAID. The contractor's proposal shall describe the level of support offered, the procedures for management and control of the technical support and related support issues such as availability of spare parts, anticipated response time to a request for support, etc. This technical support shall be costed as a separate cost item in the contractor's cost proposal.

5.0 PERFORMANCE MONITORING

5.1 Field Test Data Acquisition System

The contractor shall provide an on-site data acquisition system (ODAS) for monitoring the performance of hardware installed for this field test. This requirement is in addition to any other requirement for system control instrumentation and instrumentation necessary for routine test and maintenance checks.

The ODAS will comply with the specifications listed in Appendix -C- of this statement-of-work and will monitor, as a minimum, the data parameters listed in Appendix -C-. The contractor will provide output ports and transducers to sample and measure each data parameter as specified in Appendix -C- and to insure compatibility with the data storage system proposed. The contractor will also provide a separate meteorological station to monitor data parameters as specified in Appendix -C-. The meteorological station will have its own data recording system that is compatible with the ODAS. If an exception must be taken to any of these requirements, the contractor will clearly note the exception and explain why the exception should be acceptable to the EEA/USAID.

5.2 ODAS Installation and Training

The contractor will install the ODAS at the same time that the field test hardware is being installed. Training for Egyptian engineers and technicians in the installation and operation of the ODAS will be included in the on-the-job training program described in Section 6.0 of this statement-of-work.

The ODAS instrumentation and installation shall be a separate item in the cost proposal for this field test. The EEA/USAID reserves the right to replace or modify the proposed ODAS during contract negotiation if required to maximize compatibility with other data collection, analysis and storage requirements of the REFT Project.

5.3 Log Sheets/Maintenance Records

The contractor shall develop, as part of the proposal, a log sheet of pertinent data that should be manually recorded on each major subsystem to document operations and maintenance history. The recommended frequency for maintenance of each item shall be stated. These logs/records should comply with the specifications outlined in Section 8.0.

6.0 TRAINING REQUIREMENTS

The following training program and materials are required from the contractor for this project. These training programs fall into three general areas: classroom training in Cairo, in-factory training in the U.S. and on-the-job training at Helwan, Egypt. Training sessions and materials vary in content and presentation from informal "one-on-one" type instruction to more formal group "lectures and workshops". The sections below describe the training requirements. All training and materials will be written and conducted in English. All emergency startup and shut-down procedures must be provided in both English and Arabic.

6.1 Operator Training Program

Formal classroom training will be given in Cairo for EEA and engineering, operating, and maintenance staff in the design of the Solar IPH and Waste Heat Recovery Systems. This training is anticipated to be for 20 hours (5 days, 4 hours per day) and intended to provide the EEA and Helwan Textile staff with an understanding of the engineering parameters, design process, and decisions which resulted in the final design of the system. This training will be conducted at the start of the installation work and is not intended to require separate dedicated travel to Cairo.

As part of this proposal, the Contractor shall develop a syllabus that briefly summarizes topics and content of the classroom design training program.

6.2 Maintenance Training Program

Formal classroom training will be given in Cairo for selected EEA and Helwan Textile engineering, operating and maintenance staff in the operation, maintenance and repair of the system and individual components. The training is anticipated to be for 20 hours (5 days, 4 hours per day). The training will utilize the actual working drawings for this project to cover such topics as installation procedures, specifications, contruction schedule and labor requirements. This training is intended to familiarize EEA and Helwan Textile staff with the details of the installation as well as the project management aspects of the project. System installation will begin as soon as possible following this training and the operator training program (Section 6.1).

The Contractor is required to operate the Solar Thermal IPH and Waste Heat Recovery Systems for a period of 30 days after the system is designated as operational by the EEA/USAID. During this time period the contractor shall provide an on-the-job training program in the operation, maintenance and repair of the system and equipment components. The training program shall consist of a minimum of 20 hours of on-site formal classroom training and 140 hours of on-the-job (OJT) field training. As part of the proposal the contractor shall develop a syllabus for the on-site training program that briefly summarizes the topics, operating and maintenance procedures which will be taught.

It is assumed that the OJT field training will consist of selected EEA and Helwan Textile personnel accompanying the contractor personnel during normal daily operational tasks. The contractor shall briefly describe, as part of this proposal, the itinerary of the Solar Thermal IPH and Waste Heat Recovery operating personnel over an average day. The itinerary should take into account the demonstration nature of this field test, i.e., the Egyptian engineer must understand the function and operation of any specialized equipment and instrumentation.

6.3 In-Factory Training Program

The Contractor is required to provide and/or coordinate in-factory training on the operation, maintenance and repair of the Solar Thermal IPH and Waste Heat Recovery systems and major equipment components. This training is anticipated to take place at the respective manufacturer's facilities for the following components: solar array, flash steam tanks and condensate return systems. The training should be both classroom and "hands-on". The total number of training days is not expected to exceed 20 days covering all subsystems. All expenses for the visiting engineers are the responsibility of EEA/USAID. As part of this proposal, the contractor shall develop a syllabus for the in-factory training and suggested itinerary for the program.

7.0 SYSTEM ACCEPTANCE TEST CRITERIA

The Contractor shall include in his proposal a proposed Acceptance Test Procedure for "Point of Manufacture Testing" and "Field Acceptance Test" of the system and specific components. At a minimum it shall include the following:

7.1 Point of Manufacture Testing (PMT)

The Contractor shall detail in his proposal the procedures to be followed for the point of manufacture testing of the major equipment items. At a minimum this shall include: solar collectors, pumps, and controls. EEA and USAID or their authorized representative shall have the right to attend and witness component and system performance testing at the manufacturer's plant prior to shipment. EEA and USAID representatives attending the tests shall have the right to require measures and procedures necessary to ensure that tests comply with contractors proposed testing procedure specifications (Institute of Electrical and Electronic Engineering, American Society of Mechanical Engineers, etc.). PMT data and acceptance test certificates shall be assembled into usable formats to constitute baseline acceptance test data for the equipment. The signed (manufacturer) and countersigned (EEA and USAID and/or representative) acceptance test certificates shall be considered part and parcel of the necessary shipping documents.

7.2 Field Acceptance Testing

The Contractor's proposal shall provide, in detail, performance guarantees and evaluation procedures for the system and its major components. These shall include, as a minimum, the following:

- A solar array performance guarantee expressed, in part, as a curve guaranteeing the average daily output of the array as a function of the average daily insolation.

- Operating efficiency as a function of load over a sustained running time.

- Control system full operational performance.

EEA and USAID and/or their authorized representatives shall participate in a 30-day acceptance test conducted by the contractor at the site. The contractor shall submit in the proposal the guaranteed solar array output. The EEA/USAID, or its designated representative, will measure solar array operating conditions at a number of insolation levels throughout the 30-day acceptance test period. Calibrated pyranometers, curve tracers, and temperature measurement instrumentation will be used.

8.0 OPERATION AND MAINTENANCE MANUALS

The contractor shall provide manual(s) prepared to the minimum content listed below. The manual is to be used for operation, maintenance, repair and logistic support for the Solar and Waste Heat Recovery Systems. All manuals shall be delivered to EEA/USAID for review at least 30 days prior to the arrival of equipment at the site. All manuals shall be in English. Manual(s) will be revised as needed and a final set submitted no later than 30 days after the completion of the 30-day acceptance testing period. The minimum requirements for the manual(s) shall include chapters on the folowing subjects:

8.1 System Description

This chapter shall include but not be limited to the following:

- a full page composite illustration of the Plant equipment and layout
- an illustration(s) calling out the major assemblies
- a basic description of the type of equipment and its purpose
- a function block diagram
- tables listing equipment supplied and equipment required but not supplied, if any
- tables of technical, environmental and physical characteristics, as appropriate

8.2 System Installation

This chapter shall include:

- information on unpacking and proper location of equipment
- interconnections and initial pre-operational adjustments
- details of structure, cables and foundation requirements (as applicable)

- operating ranges (voltage, current for each equipment item and system)

8.3 System Operation

This chapter shall include:

- step-by-step procedures for starting, operating and stopping the equipment

- meter readings and/or results expected from properly adjusted and operated equipment

- tables and illustrations calling out all operational controls and indicators and their functions (all references to controls and indicators throughout the manual shall follow these designations)

- means for setting array tilt angle

8.4 Principals (or Theory) of Operation

This chapter shall include:

- a functional description of the equipment, based on a block diagram

- for complex mechanical features, a complete explanation, using block diagrams, exploded views of cutaway drawings

- major assemblies broken into individual circuits, accompanied by complete circuit analysis keyed to simplified schematic

- brief description of conventional circuits

- detailed descriptions of complex and novel circuits

- typical daily power, load, and state of charge curves for each component

8.5 Maintenance (Preventive/Corrective)

This chapter shall include:

- a maintenance schedule for all equipment including adjustments and procedures

- list of recommended test equipment

- lubrication data

- information that permits a technician to locate trouble and to make replacements, repairs or adjustments to the equipment

- for complex equipment or where the procedure is not obvious, an outline of disassembly and reassembly procedures

- details of special test procedures

- complete adjustment and maintenance information for relays and other electro-mechanical devices

- list of tools required for maintenance

8.6 Parts List

The parts list shall consist of a tabulation of descriptive data on all electrical components and repairable/replaceable commercial or vendor mechanical components in the equipment. All parts shall be sufficiently described to implement reorder/replacement. The parts list shall contain at least the following information:

(a) Reference designation

(b) Name and description of part

(c) True Manufacturer's code and part number (and list manufacturer's codes and addresses)

(d) Quantity

8.7 Drawings

In addition to drawings previously specified, the following shall be included:

(a) Schematic diagrams of individual major components, printed wiring boards and, where applicable, the certified equipment drawings

(b) Logic diagrams

(c) Interconnection diagrams

(d) Cabling diagrams

(e) Wiring diagrams

9.0 SPECIAL PROVISIONS

9.1 Site Access and Local Labor

Employees and representatives of the Contractor and personnel conducting business with the Contractor relating to the Contract, will be granted a revocable permit to enter the Helwan Textile plant for the purpose of installation, operation, and/or maintenance of the facilities and equipment under this Contract. Access to and movement within this area is subject to restrictions and provisions of the security instruction in effect.

It is the Contractor's responsibility to maintain satisfactory labor relations with his employees. Representatives of the Contracting Officer will not participate in labor relations matters unless disputes develop that interfere with the proper performance of the contract, at which time the representative may endeavor to assist in settling the difficulty. The Contractor is encouraged to hire local labor whenever possible.

9.2 Protection of the Environment and Personnel

During all operations, all EEA and local environmental and labor requirements shall be rigorously observed. The EEA will retain the right to suspend any operation judged to present an imminent threat to the environment or personnel, or a violation of applicable labor laws and regulations or natural resources management agreements, after giving notice to the contractor.

9.3 Public Release of Information

There shall be no public release of information or photographs concerning the aspects of this Contract or other documents resulting from this Contract without prior written approval of the EEA.

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9.4 Pre-Award Survey

The EEA/USAID may make a pre-award survey of the facilities of any apparently successful bidder to determine whether or not such bidder is adequately qualified to perform the requirements of any Contract that may be awarded on the basis of this specification. Investigation may be conducted to determine that the Contractor does regularly engage in the performance of work of the type covered by the specification and has a satisfactory record of performance in this field. The bidder is required to submit information, as well as any other related material, requested by EEA/USAID audit agencies during the course of the preaward survey.

9.5 Minimum Proposal Requirements

The contractor is required to submit as part of the proposal the following:

9.5.1 Organization Chart. Show the organization for accomplishing and managing the project. Explain briefly the responsibilities of each element shown on the organizational chart. Identify key personnel by name in each element and submit their curriculum vitae (resumes). Show the lines of authority within the organization. If important portions of the project are to be subcontracted (e.g., design of the system), identify the subcontracted function, the subcontractor(s), the subcontractor(s) key personnel, and which elements of the organization will manage the subcontract(s).

9.5.2 Key Personnel and Resumes. Provide resumes of key personnel, including those of the subcontractor(s). Be explicit in identifying past training and experience of each individual which qualifies him/her for the position to be held in the organization.

9.5.3 Staffing Plan. Indicate the type and approximate number of skilled personnel required in each element of the organization chart. State whether or not the required personnel are available within the organization. If not, comment on the availability of needed skilled personnel within the labor force and outline a schedule and plan for recruitment and/or training.

9.5.4 Related Experience. For each of the categories of experience below, list and describe projects or contracts which have provided your firm or that of your proposed subcontractor with related, qualifying experience. The descriptions should include: (1) dates during which the work was accomplished; (2) the scope and price of the total project or contract; (3) statement of what portion of the total project or contract was accomplished by your firm, i.e., an explicit description of the responsibilities or role of your firm; (4) financing arrangements; (5) references; (6) approximate payment for your service; (7) number of similar projects, location and contact person.

9.5.5 Construction Projects. List and discuss projects or contracts providing experience in the construction of facilities, particularly those using Solar IPH/Waste Heat Systems.

9.5.6 Operation and Maintenance of Solar IPH/Waste Systems. List and discuss projects or contracts providing experience in the operation and/or maintenance of Solar IPH/Waste Systems.

For each of the items listed, state which of the following functions were the responsibility of your firm; (a) start-up of facilities; (b) operation of facilities; (c) routine maintenance; (d) periodic overhaul of facilities. Also state, what type of facilities were included; (e) solar thermal systems; (f) controls; (g) electrical switchgear and protection equipment; (h) other. If "other" is listed, please identify or explain.

9.6 Post-Award Site Visit

Upon contract award, winning contractor personnel are expected to inspect the Heliopolis site to satisfy themselves as to all general and local conditions that may affect the design and installation of the Solar IPH/Waste Heat Systems. EEA/USAID, and/or authorized representative personnel, will be available at that time for detailed discussions prior to initiation by the contractor of detailed system design.

9.7 Summary of Deliverables

9.7.1 Contract Documentation Schedule

	ACTIVITY	WEEKS AFTER CONTRACT AWARD*
(a)	Project Schedule	2
(b)	EEA/USAID Approval of Project Schedule	5
(c)	Detailed Design Complete	16
(d)	EEA/USAID Design Review Complete (Authorization to proceed)	20
(e)	Written Results of Component/Subsystem In-Factory Testing	Within 2 weeks of test completion
(f)	System Operations and Maintenance Manuals	Within 4 weeks of system acceptance
(g)	Unscheduled Maintenance Reports	As required to document unscheduled maintenance throughout the 2-year support period

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9.7.2 Contract Hardware Installation Schedule

(a) Site Preparation Complete, Hardware Delivered (D) to Site .... Day 0 (D)

(b) Construction Completed, Solar Thermal IPH, and Waste Heat Recovery Interconnected with the Existing Facility .... D + 120 working days

(c) System Acceptance Test Complete .... D + 150 working days

(d) Final System Drawings and System Operations and Maintenance Manual Submitted ...... D + 180 working days

* In this schedule, one week is allowed for transmittal and receipt of documents mailed from either the United States or Cairo.

Appendix -A-

Existing and Proposed Flow Diagrams

A.1 Existing Flow Diagram

Appendix-A.1, Existing Flow Diagram, details process streams evaluated in this field test. The mass flow, operating temperature, operating pressure, enthalpy, and resulting energy demand are shown in the "Helwan 04 output existing conditions". Stream number 5, the bleach line steam consumption for the existing conditions is:

(x) = x stream number

(5) 16,083,848 Btu/hr

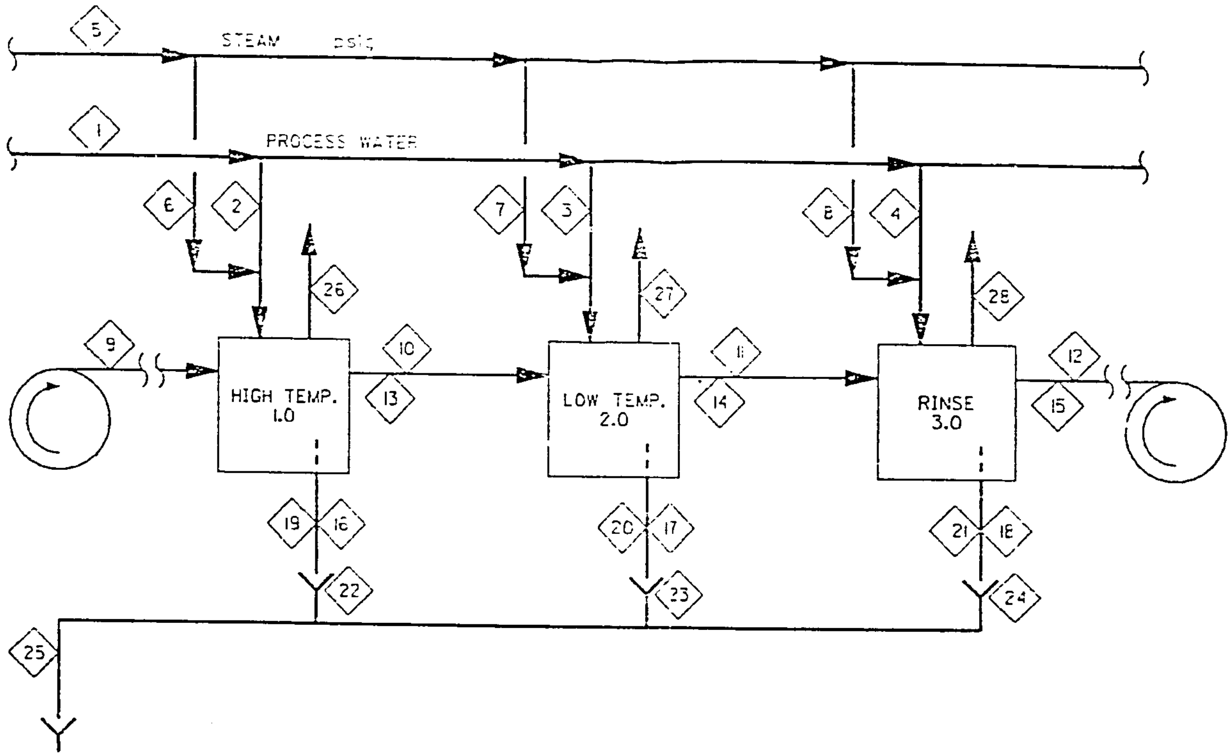
Steam conditions at the finishing department are:

(5) 298°F and 65 psia

Saturation enthalpy is:

(5) 1,179 Btu/lb

Page A-3 describes the streams.



LOCKWOOD GREENE
Planners/Engineers/Architects/Managers

SHEET TITLE: BLOCK DIAGRAM EXISTING CONDITION

JOB NAME: U.S. AID HELWAN TEXTILE

JOB NO. B4208.02 | DATE 6-25-86 | SCALE NONE | DWG. NO. M-011

PLOTTED ON 6/25/86

LAST EXITED: 6/25/86

Stream Number	Stream Name
1	Process Water Total, In
2	High Temp Washer Process Washer, A
3	Low Temp Washer Process Water , A
4	Rinse Washer, Process Water, A
5	Steam total, In
6	High Temp Washer Steam, A
7	Low Temp Washer Steam, A
8	Rinse Washer Steam, A
9	Temp Washer Fabric, In
10	High Temp Washer Fabric, A
11	Low Temp Washer Fabric, A
12	Rinse Temp Washer Fabric, Out
13	High Temp Process Water With Fabric, A
14	Low Temp Process Water With Fabric, A
15	Rinse Water With Fabric, Out
16	High Temp Washer Process Water, B
17	Low Temp Washer Process Water, B
18	Rinse Washer Process Water, B
19	High Temp Washer Condensate, B
20	Low Temp Washer Condensate, B
21	Rinse Washer Condensate, B
22	High Temp Washer Waste Water, B
23	Low Temp Washer Waste Water, B
24	Rinse Washer Waste Water, B
25	Waste Water Total, Out
26	High Temp Washer Heat Loss, Out
27	Low Temp Washer Heat Loss, Out
28	Rinse Washer Heat Loss, Out

HELWAN 04-OUT PUT EXISTING CONDITIONS

07/09/86 03:29 PM

STREAM NUMBER	1	2	3	4	5	6	7
DESCRIPTION	PROCESS WATER TOTAL IN	HIGH TEMP PROCESS WATER A	LOW TEMP PROCESS WATER A	RINSE WASHER PROCESS WATER A	STEAM TOTAL IN	HIGH TEMP WASHER STEAM A	LOW TEMP WASHER STEAM A
T (DEG F)	72	72	72	72	298	298	298
PRESSURE (PSIA)	14.7	14.7	14.7	14.7	65.0	65.0	65.0
MASS (LB/HR)	105,648	79,236	17,608	8,804	13,641	11,833	1,637
H (BTU/LB)	40	40	40	40	1,179	1,179	1,179
Q (BTU/HR)	4,225,908	3,169,431	70[illegible],318	352,159	16,083,843	13,952,410	1,929,906

HELWAN 04-OUT PUT EXISTING CONDITIONS

07/09/86

STREAM NUMBER	8	9	10	11	12	13	14
DESCRIPTION	RINSE WASHER STEAM A	TEMP WASHER FABRIC IN	HIGH TEMP WASHER FABRIC A	LOW TEMP WASHER FABRIC A	RINSE TEMP WASHER FABRIC OUT	HIGH TEMP WATER W/FABRIC A	LOW TEMP WATER W/FABRIC A
T (DEG F)	298	80	194	158	86	194	158
PRESSURE (PSIA)	65.0	14.7	14.7	14.7	14.7	14.7	14.7
MASS (LB/HR)	171	1,764	1,764	1,764	(1,764)	882	882
H (BTU/LB)	1,179	15	52	40	17	162	126
Q (BTU/HR)	201,532	27,095	91,446	71,124	(30,482)	142,884	111,132

HELWAN 04-OUT PUT EXISTING CONDITIONS

07/09/86

STREAM NUMBER	15	16	17	18	19	20	21
DESCRIPTION	RINSE WATER W/FABRIC OUT	HIGH TEMP PROCESS WATER B	LOW TEMP PROCESS WATER B	RINSE PROCESS WATER B	HIGH TEMP CONDENSATE B	LOW TEMP CONDENSATE B	RINSE CONDENSATE B
T (DEG F)	86	194	158	86	194	158	86
PRESSURE (PSIA)	14.7	14.7	14.7	14.7	14.7	14.7	14.7
MASS (LB/HR)	(882)	78,354	17,608	8,804	11,833	1,637	171
H (BTU/LB)	54	162	126	54	162	126	54
Q (BTU/HR)	(47,628)	12,693,312	2,218,602	475,415	1,916,962	206,232	9,230

ELWAN 04-OUT PUT EXISTING CONDITIONS

07/09/86

STREAM NUMBER	22	23	24	25	26	27	28
DESCRIPTION	HIGH TEMP WASTE WATER 8	LOW TEMP WASTE WATER 8	RINCE WASTE WATER 5	WASTE WATER TOTAL OUT	HIGH TEMP HEAT LOSS OUT	LOW TEMP HEAT LOSS OUT	RINSE HEAT LOSS OUT
T (DEG F)	194	156	86	180	194	156	86
ESSURE (PSIA)	14.7	14.7	14.7	14.7	14.7	14.7	14.7
ASS (LB/HR)	90,187	19,245	8,975	(118,406)	0	0	0
H (BTU/LB)	162	126	54	148	162	126	54
Q (BTU/HR)	14,610,274	2,424,834	484,644	(17,519,752)	(2,304,333)	(261,464)	(173,193)

60

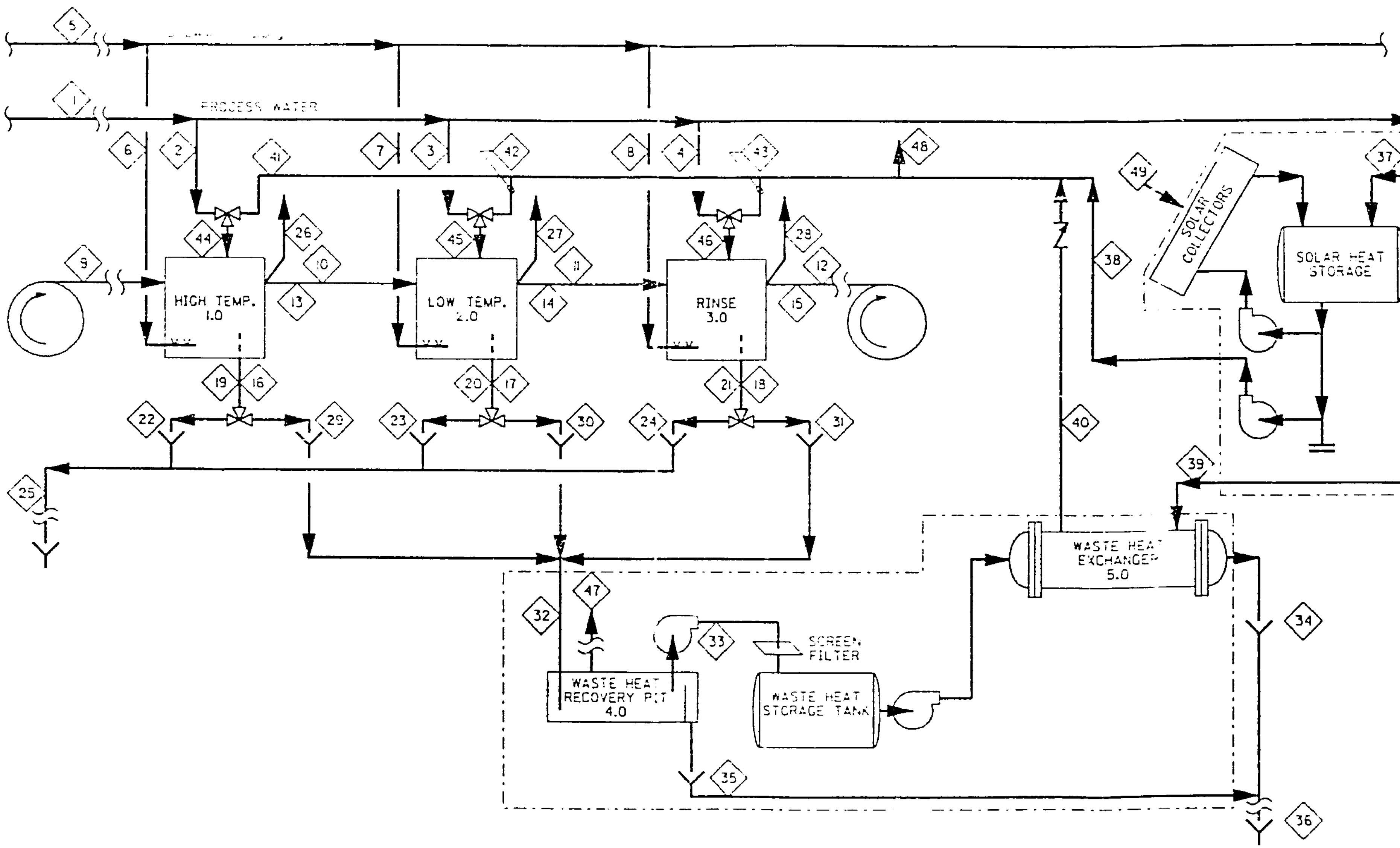
A.2 Proposed Flow Diagram

Appendix A.2, Proposed Flow Diagrams, indicates the operating conditions after installation of the waste heat recovery system and the solar system.

Pages A-9 and A-10 describe the streams.

Heat and Mass balances for individual equipment and for the overall plant can be accomplished in order to determine the parameters needed for appropriate equipment selections.

If an alternate system is proposed in addition to the base design, the Contractor shall revise the flow diagram and tabulations for submittal.



PLOTTED ON 7/15/86

LOCKWOOD GREENE
Planners/Engineers/Architects/Managers
Spartanburg, South Carolina

SHEET TITLE: BLOCK DIAGRAM PROPOSED CONDITION	JOB NAME: U.S. AID HELWAN TEXTILES	JOB NO. 84208.02	DATE 7-9-86	REV NO.
		SCALE NONE	DWG. NO. M-14	

LAST EXITED: 7/ 9/86 OSA7:[100,150]8420802M.014

Proposed Flow Diagram Symbol Key

Stream Number	Stream Name
1	Process Water Total, In
2	High Temp Washer Process Washer, A
3	Low Temp Washer Process Water, A
4	Rinse Washer, Process Water, A
5	Steam Total, In
6	High Temp Washer Steam, A
7	Low Temp Washer Steam, A
8	Rinse Washer Steam, In
9	High Temp Washer Fabric, In
10	Low Temp Washer Fabric, A
11	Rinse Washer Fabric, A
12	Rinse Washer Fabric, Out
13	High Temp Process Water With Fabric, A
14	Low Temp Process Water With Fabric, A
15	Rinse Water With Fabric, Out
16	High Temp Washer Process Water, B
17	Low Temp Washer Process Water, B
18	Rinse Washer Process Water, B
19	High Temp Washer Condensate, B
20	Low Temp Washer Condensate, B
21	Rinse Washer Condensate, B
22	High Temp Washer Waste Water, B
23	Low Temp Washer Waste Water, B
24	Rinse Washer Waste Water, B
25	Waste Water Total, Out
26	High Temp Washer Heat Loss, Out
27	Low Temp Washer Heat Loss, Out

28 Rinse Washer Heat Loss, Out
29 High Temp Washer Waste Water, C
30 Low Temp Washer Waste Water, C
31 Rinse Washer Waste Water, C
32 PIT Waste Water, A
33 Waste Heat Exchanger Waste Water, A
34 Waste Heat Exchanger Waste Water, B
35 PIT Waste Water, B
36 PIT Waste Water Total, Out
37 Solar Storage Tank Process Water, A
38 Solar Storage Tank Process Water, B
39 Waste Heat Exchanger Process Water, A
40 Waste Heat Exchanger Process Water, B
41 High Temp Washer IPH Water, A
42 Low Temp Washer IPH Water, A
43 Rinse Washer IPH Water, A
44 High Temp Washer Blended Water, A
45 Low Temp Washer Blended Water, A
46 Rinse Washer Blended Water, A
47 Pit Waste Water Heat Losses, Out
48 Industrial Process Heated Water, A
49 Solar Insolation, In

Appendix -B-

Insolation Data: Cairo, Egypt

FIELD TEST NO. 3
HELWAN TEXTILES
Helwan, Egypt

Annual Heating Degree Days (base = 65) = 689HDD
Annual Cooling Degree Days (base = 65) = 3089CDD

Summer	97°F (36°C) Dry Bulb
	74°F (23°C) Wet Bulb
	25°F (14°C) Mean Daily Range
	6 Knots NNW Prevailing Wind
Winter	46°F (8°C)
	6 Knots SSW Prevailing Wind

Average Annual Ground Temperature = 72°F (22°C)

Building size, orientation, location of existing utilities (boilers, etc.), and feasible location for solar collection array (roof only) should be determined by the contractor at the job site.

The Solar radiation for Cairo, Egypt, follows and should be used in solar energy design calculations. These data were supplied by the Egyptian Electricity Authority Project Management Team. Both metric and English units are provided.

A Summation of the Daily Total Solar Radiation Received on Surfaces of Various Orientations in cal/cm^2

Month	Normal	Horiz.	South	North	East	West
Jan.	720	360	485	44	215	215
Feb.	752	435	440	49	250	250
March	796	523	350	56	273	273
April	830	600	226	65	275	275
May	863	650	150	105	288	288
June	864	662	115	130	295	295
July	858	650	130	116	288	288
Aug.	828	610	190	80	285	285
Sep.	790	546	293	59	270	270
Oct.	714	438	385	51	240	240
Nov.	672	361	452	45	216	216
Dec.	660	330	466	42	202	202
Annual	779	514	306	70	258	258

Data Supplied by EEA

CAIRO, EGYPT

DAILY TOTAL SOLAR RADIATION

BTU/FT2

Month	Normal	Horiz.	South	North	East	West
JAN	2657	1328	1790	162	793	793
FEB	2775	1605	1624	181	923	923
MAR	2937	1930	1292	207	1007	1007
APR	3063	2214	834	240	1015	1015
MAY	3184	2399	554	391	1063	1063
JUN	3188	2443	424	480	1089	1089
JUL	3166	2399	480	428	1063	1063
AUG	3055	2251	701	295	1052	1052
SEP	2915	2015	1081	218	996	996
OCT	2635	1616	1421	188	886	886
NOV	2480	1332	1668	166	797	797
DEC	2435	1218	1720	155	745	745
ANNUAL	2875	1897	1130	260	952	952

Conversion from SI to English
by LGE

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Appendix -C-

Field Test Data Acquisition System

SPECIFICATIONS FOR A

FIELD TEST ONSITE DATA ACQUISTION SYSTEM (ODAS)

The Renewable Energy Field Test instrumentation system will be used to monitor IPH, PV and wind energy system installation at urban and remote desert locations in Egypt. These energy systems include main power sources (solar collectors, PV arrays and wind turbines) as well as ancillary subsystems depending on specific field test applications. These subsystems include the solar array, solar storage, solar circuilation, solar distribution, meteorologicl data and a variety of waste heat characteristics.

The on-site data acquisiton must be a stand-alone system. Failure of the system must not affect the performance of the field test system that is being monitored. The ODAS must have an on-site data storage system that is non-volatile and capable of easy physical removal and transport to another location for data removal and long-term storage. One form of the non-volatile storage system must be microchip/ EPROM or CMOSRAM - Type system that can be "milked" on site easily and without danger of a loss of data.

The ODAS must be a microprocessor based data logger with programmable input channels and output formats both analog and digital. The user must have control over sampling frequency and output period for each channel. The capability to multiplex some of the channels is also required. Primary design objectives for the OSDA system should be reliability, simplicity, small size, low power and the ability to operate in environmental extremes as specified (especially high temperature, and sand/dust). The unit must be capable of stand-alone battery operation for a period of at least one month, preferably for two months.

The following minimum specifications are required for the ODAS. If an exception must be taken to one or more of these requirements, tne exception shall be noted and a clear explanation given as to why the bidder believes that the exception should be acceptable to the purchaser.

System Power Requirements

- o Capable of operation using self-contained batteries
- o Capability of the use of an external power source to allow continued data collection while changing batteries is desirable
- o Capable of transient protection from spurious electricl charges or lightning.

Environmental Specifications

- o Ambient Temperature: -5° C to +55° C
- o Relative Humidity: 0 to 95 percent non-condensing
- o Impervious to airborne sand/dust.

Analog Inputs

- o Number of channels: At least 12 channels
- o Voltage Measurement Types: Differential or single-ended
- o Accuracy of Measurements: at least ± 0.5 percent

- Range and Resolution: Selectable for any input channel from microvolts to several volts full scale

- Sample Rates: At least once per second for each channel

- Multiplex Capability: at least four channels

Pulse Inputs

- Number of Pulse Counter Channels: at least 4 channels

- Analog and Digital Control Outputs: a total of three resettable channels each is desired with a range of 0 to +/- 5 volts with a 0.5 volt resolution

- Multiplex Capability: at least three channels

Output Signal Interface

- Memory: Capable of storing at least 3000 data points per day for a period of two months

- Display: A visual display of instantaneous stored data is required on-site for data verification before data removal

- Per'pheral Interface: Downloading of data at the site should be by physical removal of the data storage device or simple, reliable data downloading to a non-volaile storage device. Storage data files shall be IBM-PC compatible on floppy disc either directly from the data logger or through a simple, fast, reformatting techique.

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FIELD TEST PERFORMANCE DATA REQUIREMENTS

Field Test #3 Solar Industrial Process Heat General Poultry

OSDA	Parameter	Channel Type	Output Interval
T-1	Make-up Water to Solar Storage Tank - Temperature	A	10 min
F-2	Solar Collector Inlet - Flowrate	P	10 min
T-3	Solar Collector Inlet - Temperature	A	10 min
T-4	Solar Collector Outlet - Temperature	A	10 min
T-5	Solar Storage Tank Temperature	A	10 min
F-6	Solar Heated Water to Washers - Flowrate	P	10 min
T-6	Solar Heated Water to Washers - Temperature	A	10 min
F-7	Heated Process Water from Waste Heat Exchanger - Flowrate	P	10 min
T-8	Heated Process Water from Waste Heat Exchanger - Temperature	A	10 min
F-9	Waste Water to Heat Exchanger - Flowrate	P	10 min
T-10	Waste Water to Heat Exchanger - Temperature	A	10 min

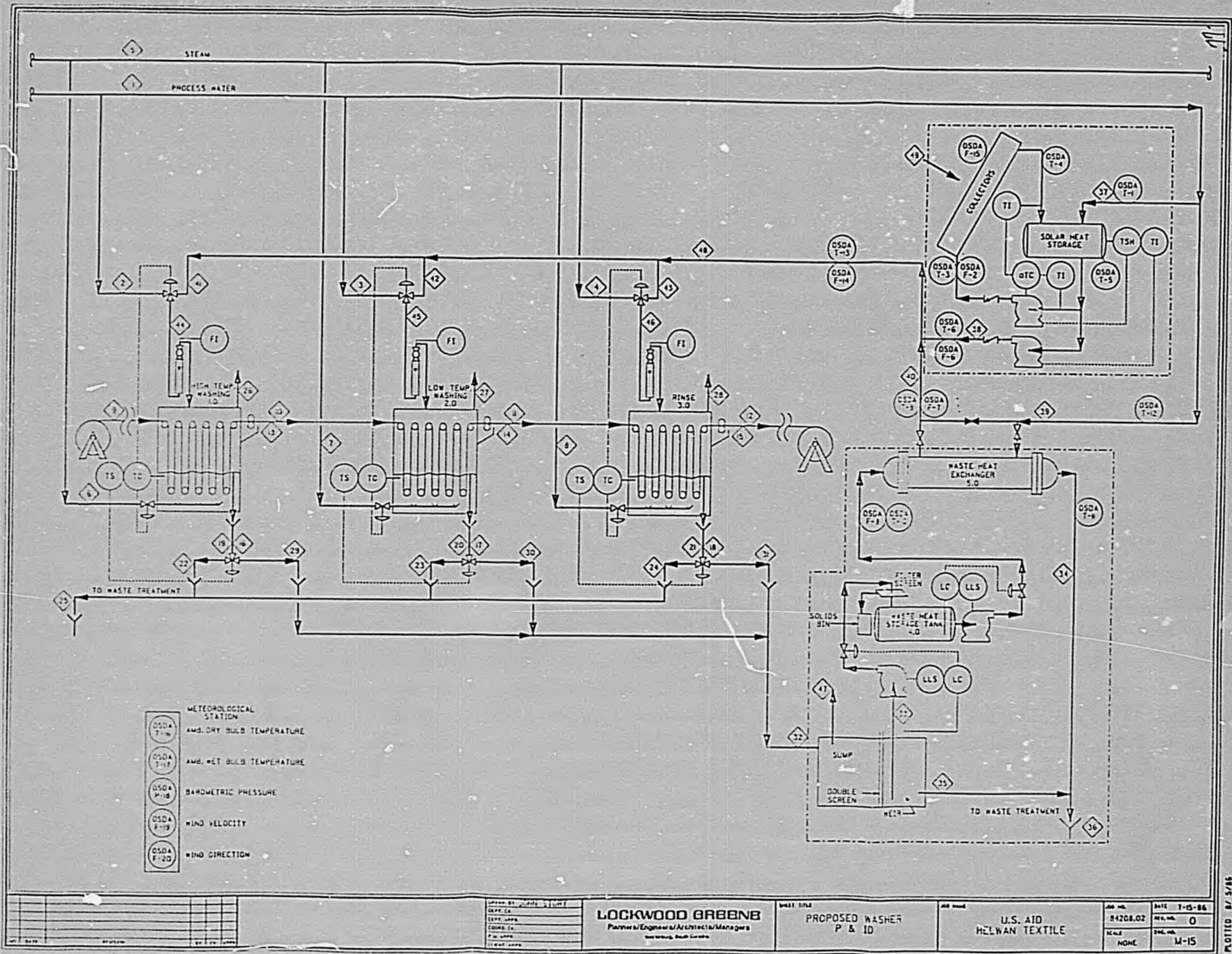
T-11	Waste Water from Waste Heat Exchanger - Temperature	A	10 min
T-12	Process Water to Waste Heat Exchanger Temperature	A	10 min
T-13	Heated Process Water to Washers - Temperature	A	10 min
F-14	Heated Process Water to Washers - Flowrate	A	10 min
F-15	Plane of Array Insolation	P	10 min
T-16	AMB DRY BULB Temperature	A	10 min
T-17	AMB WET BULB Temperature	A	10 min
P-18	Barometeric Pressure	A	10 min
F-19	Wind Velocity	P	10 min
F-20	Wind Direction	A	10 min

Appendix -D-

implified Process and Instrument Diagram

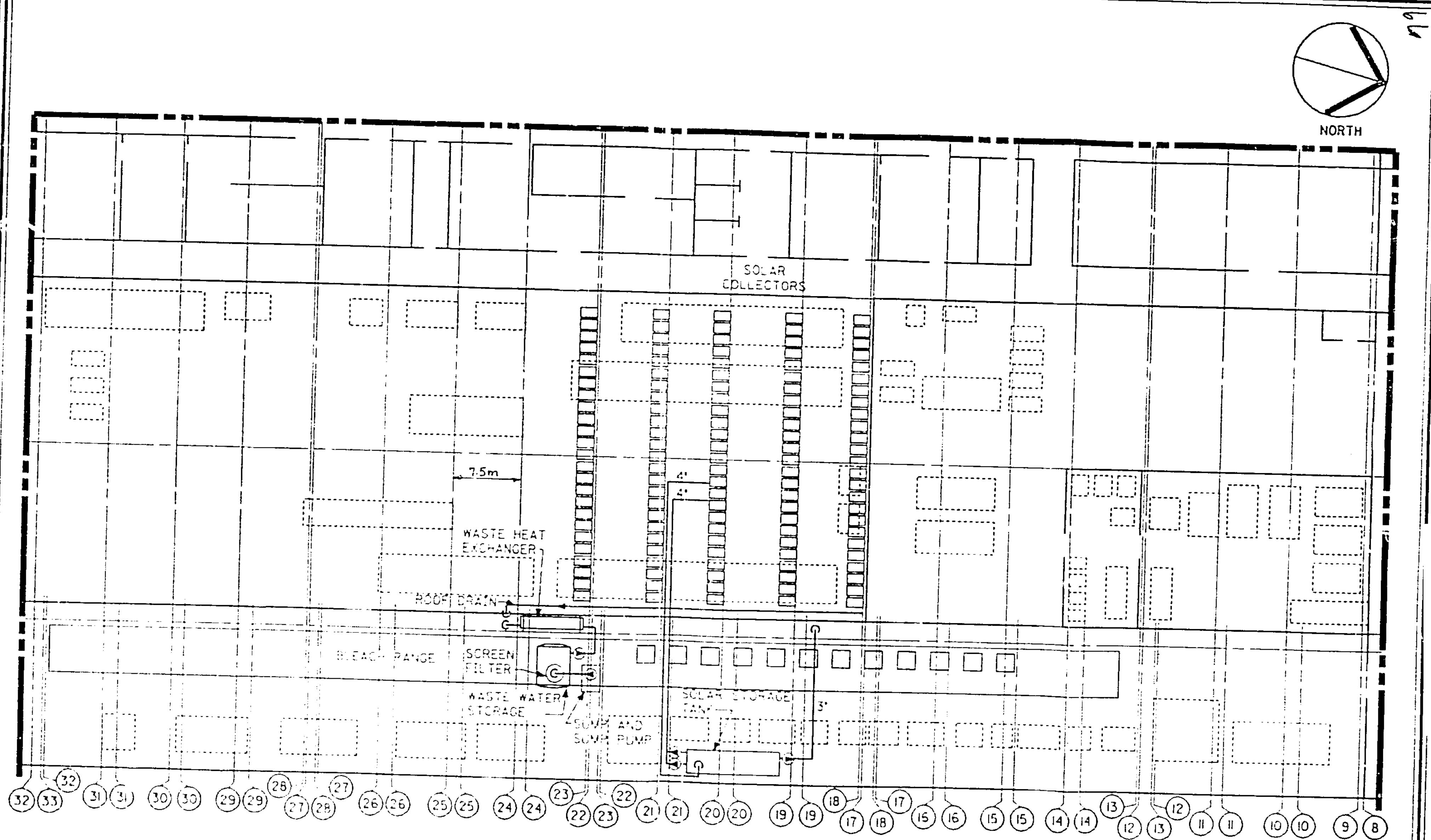
Appendix -E-

Plant Layout


STEAM
PROCESS WATER
HIGH TEMP. WASHING 1.0
LOW TEMP. WASHING 2.0
RINSE 3.0
COLLECTORS
SOLAR HEAT STORAGE
WASTE HEAT EXCHANGER 5.0
FILTER SCREEN
SOLIDS BIN
WASTE HEAT STORAGE TANK 4.0
SUMP
DOUBLE SCREEN
WEIR
TO WASTE TREATMENT
TO WASTE TREATMENT
METEOROLOGICAL STATION
OSDA T-16 AMB. DRY BULB TEMPERATURE
OSDA T-17 AMB. WET BULB TEMPERATURE
OSDA P-18 BAROMETRIC PRESSURE
OSDA F-19 WIND VELOCITY
OSDA F-20 WIND DIRECTION
LOCKWOOD GREENE
Planners/Engineers/Architects/Managers
PROPOSED WASHER P & ID
U.S. AID HELWAN TEXTILE
84208.02
7-15-86
0
NONE
M-15
PLOTTED 8/ 5/86

Appendix -E-

Plant Layout



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			SCALE None	DWG. NO. M-17

PLOTTED ON 7/16/86

LOCKWOOD GREENE

ARCHITECTS-ENGINEERS

NEW YORK - SPARTANBURG - ATLANTA - DALLAS

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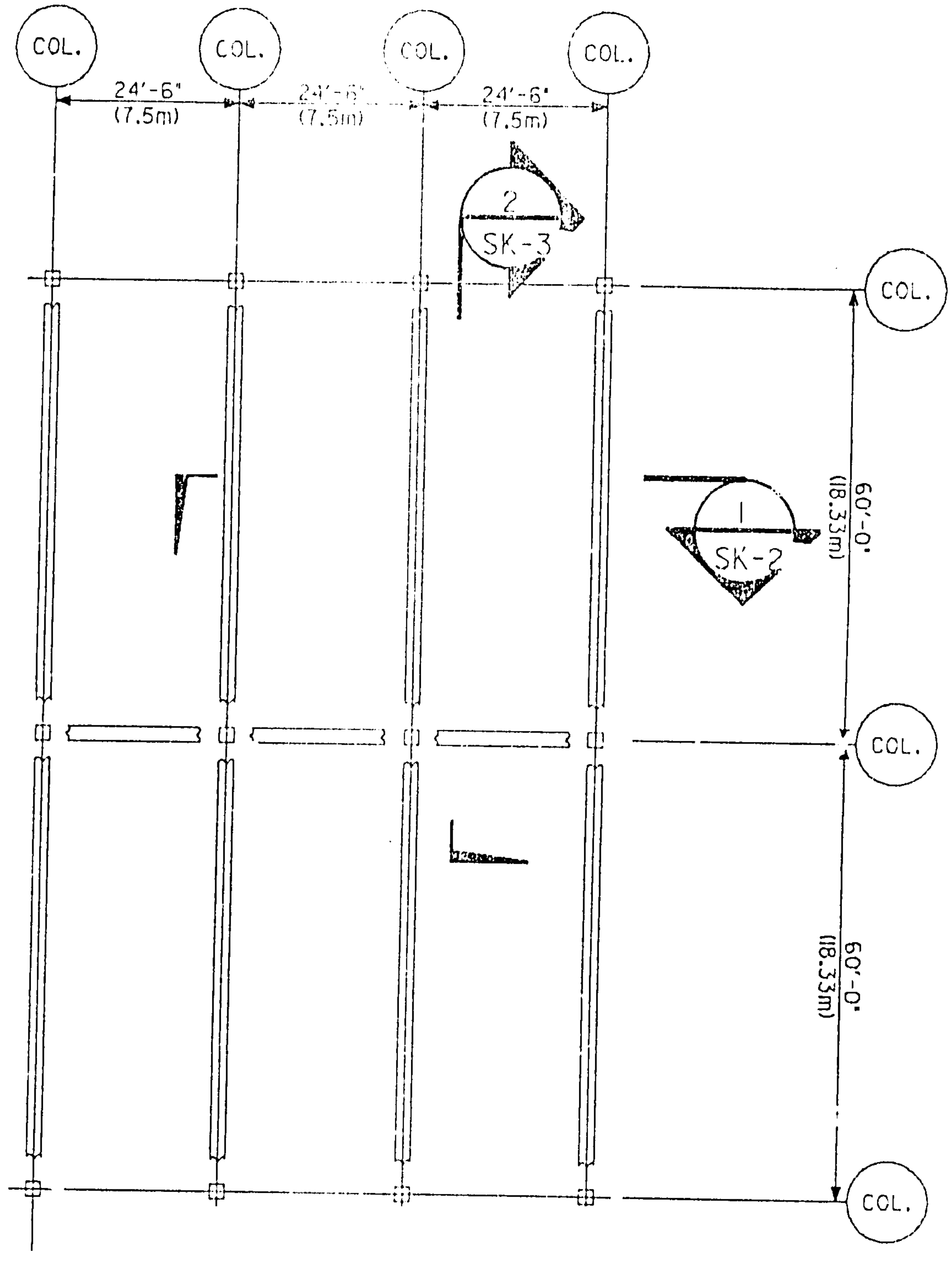

SCALE: 3/64"=1'-0"

3/64" = 1'-0" scale 4 0 4 8 12 16 20 feet

sheet title	job name	job no.	dwg. no.
	U.S. AID HELWAN TEXTILE	84208.03	SK-1
		date 7-17-85	

USA7:[100,150]84208O2M.006
PLOTTED 8/ 4/86

LOCKWOOD GREENE
ARCHITECTS-ENGINEERS
NEW YORK - SPARTANBURG - ATLANTA - DALLAS

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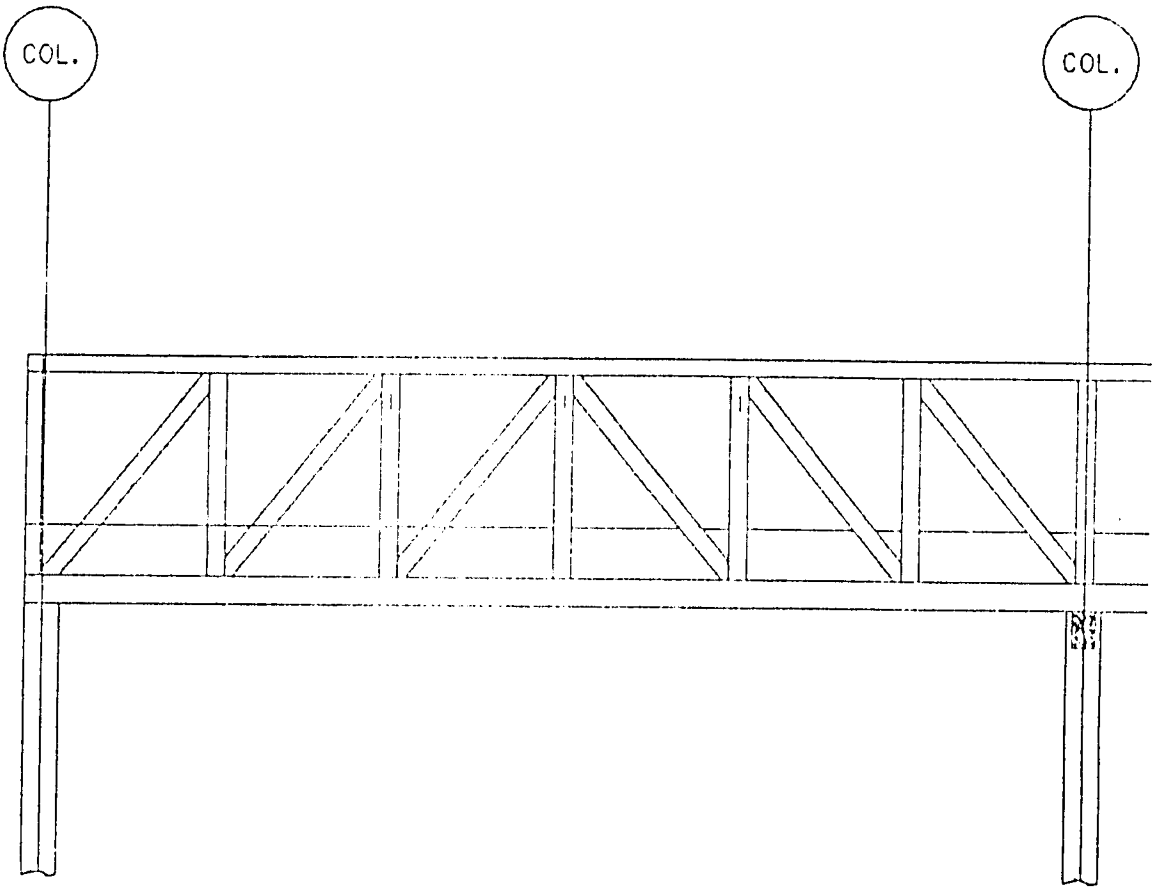


SECTION 2 SK-1 / SK-3

SCALE: 3/32"=1'-0"

3/32" = 1'-0"

2 0 2 4 6 8 10 12 14

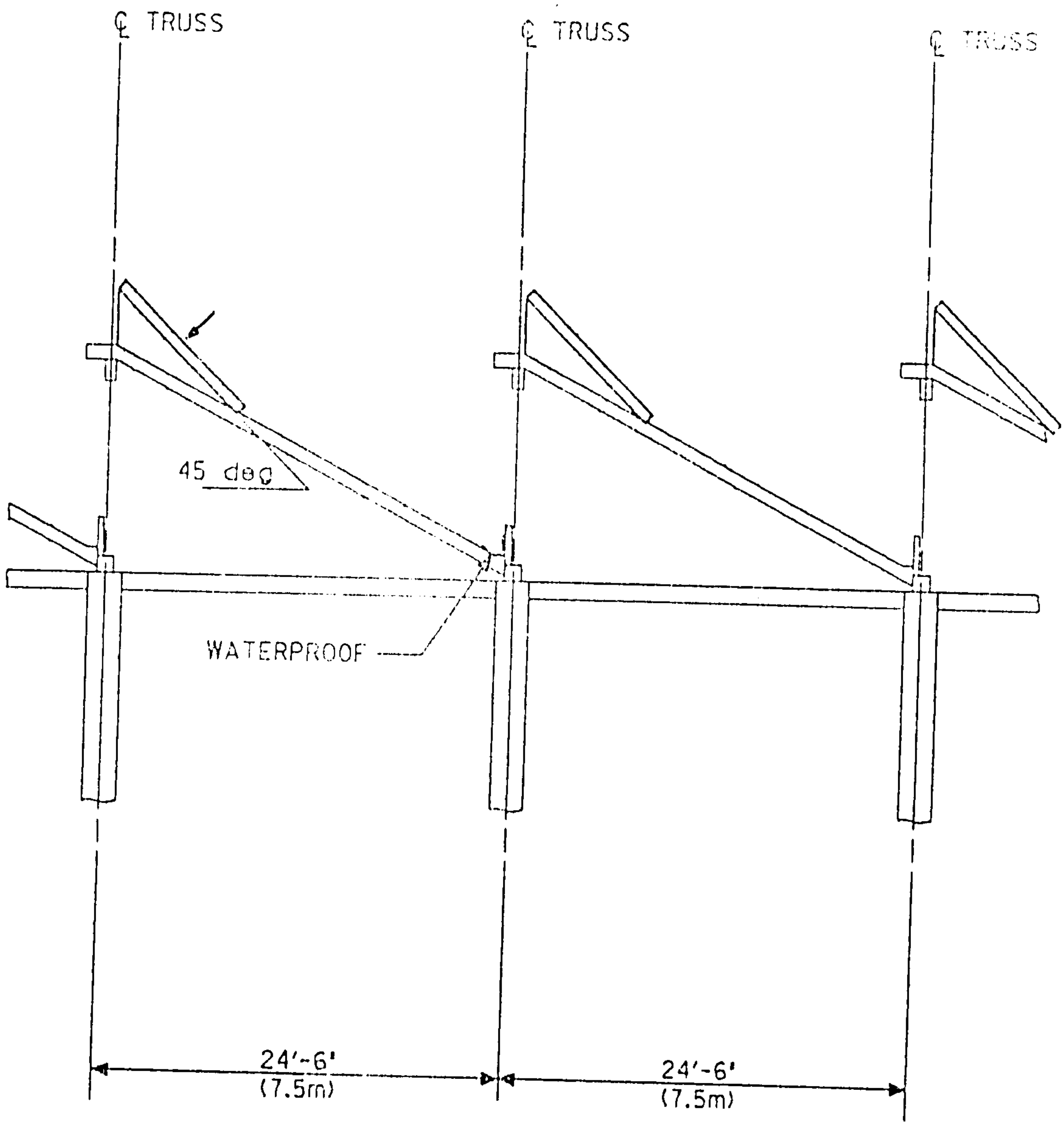
scale feet

sheet title	job name	job no.	drwg. no.
E-4	U.S. AID HELWAN TEXTILE	84208.03 date 7-17-85	SK-2

QSA7:[100,150]84208 02M.006
PLOTTED 8/ 4/86

LOCKWOOD GREENE
ARCHITECTS-ENGINEERS
NEW YORK - SPARTANBURG - ATLANTA - DALLAS

no	date	REVISION	by	chk	appr



SECTION

SCALE: 3/32"=1'-0"

1 / SK-2 SK-1

3/32" = 1'-0"

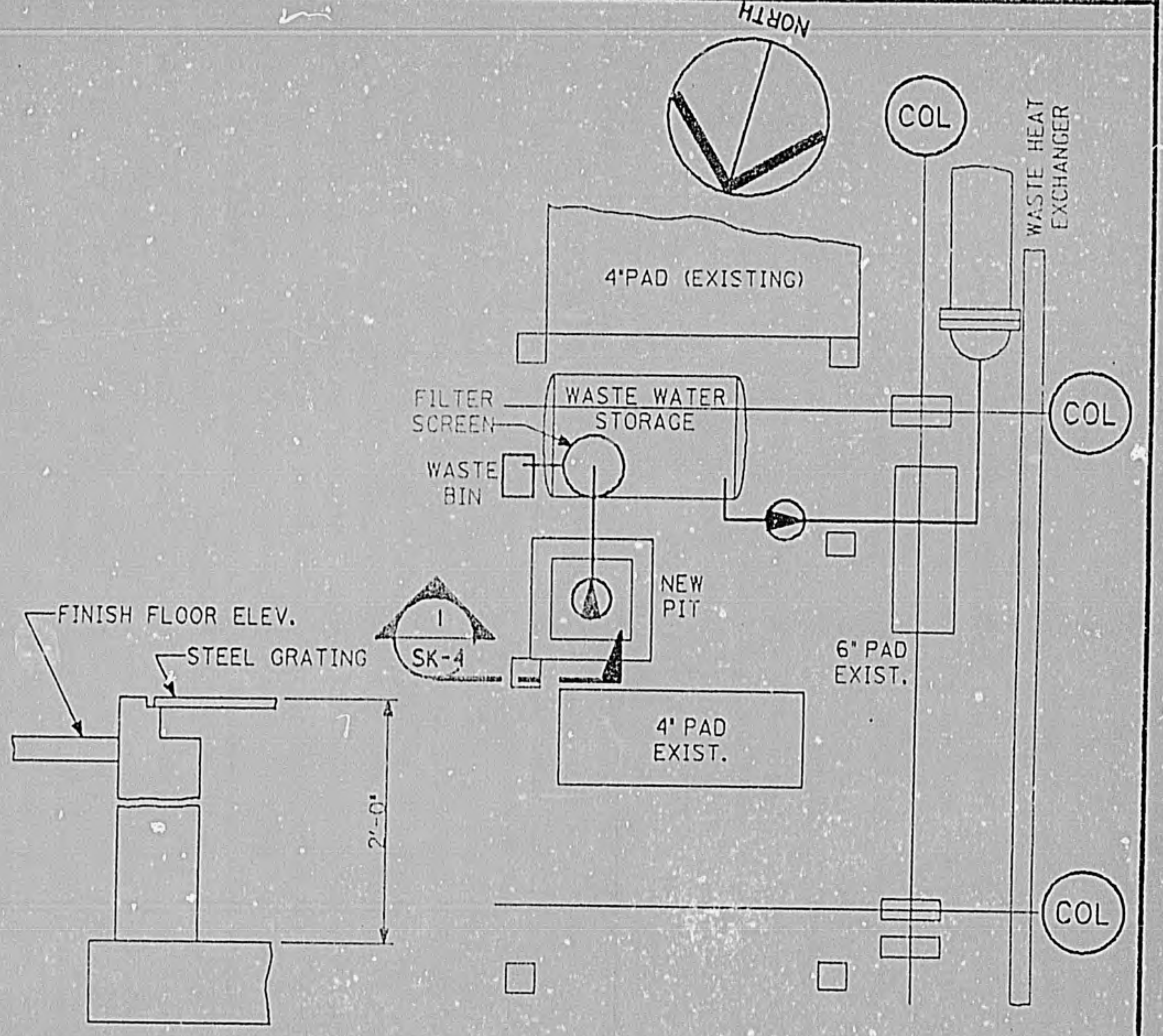
2 0 2 4 6 8 10 12 14
scale feet

sheet title	job name	job no.	dwg. no
existing E-5	U.S. AID HELWAN TEXTILE	84208.03	SK-3
		date 7-17-85	

OSA7:[100,150]8420802...06
PLOTTED 8/ 4/86

LOCKWOOD GREENE
ARCHITECTS-ENGINEERS
NEW YORK - SPARTANBURG - ATLANTA - DALLAS

no	date	REVISION	by	ck.	appr



SECTION
SCALE: 1/2"=1'-0"

1 SK-4
SK-4

PARTIAL SLAB PLAN
SCALE: 1/8"=1'-0"

sheet title	job name	job no.	dwg. no
	U.S. AID HELWAN TEXTILE	84208.03 date 7-7-85	SK-4

OSA7:[100,150]84208O2M.006
PLOTTED 8/ 4/86

83

Appendix -F-

FCHART-4R Results

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******************************
** FCHART-4R VERSION 2.00 **
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PROJECT: HELWAN TEXTILE
COMMENT: APPLICATION REVIEW/CONCEPTUAL DESIGN

DATE: 7/21/86
FILE NAME: helwan05

THERMAL DATA

GENERAL INFORMATION:

1 SYSTEM TYPE (1-5) 1 = DHW-1TANK 4 = DHW-PREHEAT-LOADSIDE HX 2 = DHW-2TANK 5 = CONSTANT TEMP-COLLECTOR ONLY 3 = PROCESS HEAT	2.00
2 ECONOMICS (1=YES; 2=NO, 3=ECONOMIC ONLY)	2.00
3 COLLECTOR AREA OPTIMIZATION (1=YES; 2=NO)	2.00
4 CITY NUMBER	262.00

COLLECTOR AND COLLECTOR HX:

11 COLLECTOR AREA	4000.00 SQFT
12 FR-UL PRODUCT	0.72 BTU/SQFT-HR-F
13 FR-TAU-ALPHA PRODUCT	0.76
14 INCIDENT ANGLE MODIFIER CONSTANT	0.17
15 COLLECTOR TILT ANGLE	45.00 DEGREES
16 COLLECTOR AZIMUTH (SOUTH=0, EAST=-90, WEST=+90)	0.00 DEGREES
17 COLLECTOR HX EFFECTIVENESS	1.00
18 COLLECTOR LOOP FLOW RATE	14.70 LB/HR-SQFT
19 COLLECTOR-STORAGE LOOP FLOW RATE	14.70 LB/HR-SQFT
20 SPECIFIC HEAT OF COLLECTOR FLUID	1.00 BTU/LB-F
21 SPECIFIC HEAT OF SOLAR TANK FLUID	1.00 BTU/LB-F
22 UA OF COLLECTOR INLET PIPE	0.50 BTU/HR-F
23 UA OF COLLECTOR OUTLET PIPE	0.50 BTU/HR-F
24 GROUND REFLECTANCE	0.20
25 COLLECTOR TEST FLOW RATE	33.74 LB/HR-SQFT

SOLAR STORAGE TANK:

31 SOLAR STORAGE CAPACITY	1.50 GAL/SQFT
32 SOLAR TANK HEIGHT-DIAMETER RATIO	2.00
33 SOLAR TANK U-VALUE	0.10 BTU/HR-SQFT-F
34 SOLAR TANK ENVIRONMENT TEMPERATURE	70.00 DEG F

AUXILIARY STORAGE TANK:

41 AUX TANK OVERALL UA	0.00 BTU/HR-F
42 AUX TANK ENVIRONMENT TEMPERATURE	0.00 DEG F

DHW LOAD INFORMATION:

51 WATER HEATER USAGE	10572.00 GAL/DAY
52 WATER HEATER SET TEMPERATURE	140.00 DEG F
53 WATER SUPPLY TEMPERATURE (-1000 SETS TO GND TEMP)	-1000.00 DEG F

PROJECT: HELWAN TEXTILE
COMMENT: APPLICATION REVIEW/CONCEPTUAL DESIGN   DATE: 7/21/86
FILE NAME: helwan05

ENVIRONMENTAL DATA AND THERMAL PERFORMANCE

ENVIRONMENTAL DATA

CAIRO , EG
TILT ANGLE = 45.00   LATITUDE = 30.08
AZIMUTH ANGLE = 0.00

	HORIZONTAL SOLAR RAD	TILTED SOLAR RAD	AMBIENT AIR TEMPERATURE	WATER SUPPLY TEMPERATURE
	BTU/SQFT-DAY	BTU/SQFT-DAY	DEG F	DEG F
JAN	1329.	2122.	57.	58.
FEB	1606.	2180.	59.	56.
MAR	1931.	2174.	64.	58.
APR	2215.	2050.	70.	65.
MAY	2400.	1931.	77.	73.
JUN	2444.	1839.	82.	81.
JUL	2400.	1862.	82.	87.
AUG	2252.	1964.	83.	89.
SEP	2016.	2099.	79.	86.
OCT	1617.	2037.	75.	80.
NOV	1333.	2006.	67.	71.
DEC	1218.	2020.	60.	64.

THERMAL PERFORMANCE   SPECIFIED COLLECTOR AREA = 4000.00 SQFT

SOLAR FRACTION		INCIDENT SOLAR	COLLECTOR OUTPUT	SOLAR SYS OUTPUT	TANK LOSS	LOAD	TANK TEMP	TEMP OUT
	%	*	*	*	*	*	DEG F	DEG F
JAN	61.7	263.11	140.23	138.83	1.48	224.99	108	108
FEB	61.5	244.19	128.89	127.59	1.31	207.42	108	108
MAR	61.4	269.62	138.52	137.03	1.48	223.08	109	109
APR	61.7	245.95	124.43	122.86	1.54	199.22	111	111
MAY	61.2	239.41	114.25	112.51	1.70	183.71	114	114
JUN	63.3	220.72	100.65	98.80	1.83	156.09	118	118
JUL	68.4	230.94	101.71	99.60	2.10	145.71	123	123
AUG	76.3	243.58	109.60	107.23	2.34	140.52	128	128
SEP	79.9	251.86	116.54	114.08	2.34	142.86	129	129
OCT	73.9	252.60	123.50	121.38	2.16	164.30	124	124
NOV	67.3	240.68	123.92	122.14	1.80	181.49	118	118
DEC	62.5	250.51	132.22	130.63	1.60	209.14	111	111
YR	65.8	2953.15	1454.47	1432.68	21.69	2178.53		

* UNITS = MMBTU   ANNUAL OPERATING HOURS = 2741

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F.1 FCHART-4R is a computer program that simulates the performance of several types of solar hot water and process heat systems. It is intended for use by engineers, architects, solar energy consultants, energy analysts, and others who need accurate information about the thermal and economic performance of the types of solar energy systems included. Features include optimization of collector area and a comprehensive economic analysis which was developed at the National Bureau of Standards.

F.2 Types of systems that can be simulated using FCHART-4R include liquid based active solar hot water and process heat systems. System types include systems that have either one or two storage tanks and may optionally have a collector heat exchanger.

F.3 The thermal performance report generated by FCHART-4R calculates the monthly average values for solar fraction, solar energy incident on the collectors, solar energy collected, tank losses, load, average tank temperature, and average temperature delivered from the solar storage tank. The program also calculates annual results.

F.4 The economic report generated by FCHART-4R calculates the discounted life cycle cost of the solar, auxiliary, and reference systems. Also included are the net savings, internal rate of return, discounted payback time, and annual simple and discounted cash flow for the solar energy system relative to the reference system. Economics will be addressed in a separate document; therefore, the FCHART-4R economics report will not be used.

A. Input Data Descriptions

Helwan Spinning and Weaving Company
Heliopolis, Egypt

B. General Information

1. System Type = 2.

1.1 Two-Tank System (FCHART-4R only)

1.2 This type of system includes a collector with an optional heat exchanger, a solar storage tank, and a separate auxiliary tank. In this system, water flows between the solar storage tank and the collector, where it is heated. Makeup water is supplied to the solar tank. When there is a hot water demand, the solar tank provides its output to the auxiliary tank where the hot water load is supplied from the auxiliary tank. If the temperature from the solar tank is lower than the thermostat setting on the auxiliary tank, auxiliary energy is added to bring it to the set temperature.

2. Economics (Yes=1, No=2, Economic Only =3)

Enter a one (1) to perform a thermal and economic analysis, a two (2) for thermal analysis only, and three (3) for economic analysis only. If either collector area optimization (#3) or range of areas-fractions (#136) options are chosen, a one (#1) must be entered, as these options require economic data.

3. Collector Area Optimization (Yes=1, No=2)

Enter a one (#1) to perform collector area optimization or a two (#2) for the area specified in data item 11. The optimal collector area is the collector area which results in the greatest net savings over the analysis period. When optimization is selected, the economic data items must be specified.

4. City Number = 262.

CAIRO, EGYPT

LATITUDE = 30.08

	AMBIENT TEMP (DEG F)	DEGREE DAYS (DEG F-DAY)	HORIZONTAL SOLAR RAD. (BTU/SQFT-DAY)	GROUND WATER TEMP (DEG F)
JAN	57.0	148.0	1329.0	57.7
FEB	59.0	115.0	1606.0	56.0
MAR	63.5	97.0	1931.0	58.4
APR	70.0	63.0	2215.0	64.7
MAY	76.5	23.0	2400.0	72.8
JUN	81.5	1.0	2444.0	81.0
JUL	82.0	0.0	2400.0	86.7
AUG	82.5	0.0	2252.0	88.6
SEP	79.0	1.0	2016.0	86.0
OCT	74.5	22.0	1617.0	79.9
NOV	67.0	81.0	1333.0	71.4
DEC	59.5	138.0	1218.0	63.5

C. Collector and Collector HX

11. Collector Area = 4,000

Enter the total collector area. If optimization is selected, this value is ignored. (1.0 square foot is the minimum value accepted by FCHART).

12. FR-UL Product = 0.72 Btu/hr. sf. F

Enter the slope of the straight line collector efficiency curve as determined by the ASHRAE 93-77 Collector Method. (Value is for flat U.S. solar collector).

13. FR-TAU-ALPHA Product = 0.76

Enter the y-intercept of the straight line collector efficiency curve as determined by the ASHRAE 93-77 Collector Test Method. (Value is ror U.S. solar collector).

14. Incident Angle Modifier Constant = 0.17

Enter the value which is experimentally determined by the ASHRAE 93-77 Collector Test Method. (Value is for U. S. solar collectors.)

15. Collector Tilt Angle = 45 degees, Base Run

Enter the number of degrees (from horizontal) that the collector is tilted.

16. Collector Azimuth Angle (South Ø, East=-9Ø, West=+9Ø)

Enter the direction of the collector relative to South, which is defined as zero. Any azimuth between -18Ø and +18Ø is acceptable.

17. Collector HX Effectiveness = 1.

Enter a value of one (1) when there is no collector heat exchanger. When there is a collector heat exchanger, enter a value between zero and one. Typical values are 0.7 with correctly sized heat exchanger and 1 for no heat exchanger.

18. Collector Loop Flow Rate = 14.70 lb/hr sq ft

The flow rate per unit of collector area between the collector array and the collector heat exchanger or tank (depending on whether there is a collector heat exchanger or not).

Fluid flow per square foot (SF) of collector area. Define as 1.0 gpm/34 SF.

8.33 lb/gal of water

The collector loop flow rate becomes

	1/34	gpm/SF
*	8.33	lb/gal
*	60	minutes/hour
	14.70	lb/hr sf

Collector-Storage Loop Flow Rate = 14.70 lb/hr

The flow rate per unit of collector area between the collector heat exchanger and the tank if there is a collector heat exchanger. If there is no heat exchanger, value is ignored.

20. Specific Heat of Collector Fluid = 1.0 Btu/lb.F

Enter the value for the specific heat of the collector fluid. The value for water is one (1) when using English units.

21. Specific Heat of Tank Fluid = 1.0 Btu/lb.F

Enter the value for the specific heat of the tank fluid. The value for water is one (1) when using English units.

22. UA of Collector Inlet Pipe = 0.5 Btu/hr.F

The overall heat loss coefficient U of the inlet pipe multiplied by the surface area A of the pipe.

23. UA of Collector Outlet Pipe = 0.5 BTU/HR.F

The overall heat loss coefficient U of the outlet pipe multiplied by the surface area A of the pipe.

24. Ground Reflectance = 0.2

Enter the reflectance of the horizontal surface in front of the collector. A value of 0.2 is typical except for conditions of snow or water surroundings, or other reflective surfaces.

25. Collector Test Flow Rate = 33.74 LB/HR.SF

The flow rate per unit of collector area through the collector during the ASHRAE 93-77 collector efficiency test. (Value is for U.S. solar collector)

D. Solar Storage Tank

31. Solar Storage Capacity = 1.5 gal/SF

Enter the tank storage capacity per unit collector area. Typical values are 1.2 to 2.0 gal/sq ft (English units).

32. Solar Tank Height - Diameter Ratio = 2.

Enter ratio of the tank height to tank diameter.

33. Solar Tank U-Value = 0.10 BTUH/SF.F

Enter the overall heat loss coefficient of the Solar Storage Tank.

34. Solar Tank Environment Temperature = 70 degrees F

Enter the temperature to which tank losses occur. 70 degrees F is the mean annual ambient temperature for Cairo, Egypt.

41. Aux Tank Overall UA = <u>0</u>.

Enter the overall heat loss coefficient U times surface area A of auxiliary tank. This is the tank heat loss per degree of temperature difference between tank fluid temperature and environment. Tank temperature is assumed to be equal to the hot water set temperature.

42. Aux Tank Environment Temperature = <u>0</u>.

Enter the temperature to which tank losses occur.

51. Process Load Information, Stream (38), Helwan 05 - Output Proposed Condition

(6 days/7 day week)*(11,416 lb/hr)*(9 hrs/day)/(8.33 lb/gal) =

Water Heater Usage = <u>10,572</u> gal/day

52. Water Heater Set Temperature = 140 degrees F

Enter the desired supply temperature of heated water. This temperature is used to calculate the total water heating load.

53. Water Main Temperature = <u>-1000</u>.

Enter the temperature of the cold water supplied to the water heating system (DHW). If a value of -1000 is used, temperature will be set equal to monthly ground water temperature (which is in the weather data file).