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DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150748

DR. 549
MASTER

SOLAR HEATING AND COOLING SYSTEM FOR AN OFFICE BUILDING AT REEDY CREEK UTILITIES

Prepared by

Reedy Creek Utilities Company, Inc.
P. O. Box 40
Lake Buena Vista, Florida 32830

Under Contract DOE No. EX-76-C-01-2401

Monitored by

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

For the Department of Energy

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U.S. Department of Energy

Solar Energy

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15. SUPPLEMENTARY NOTES The Project Manager for this work was Don F. Seeley of Reedy Creek Utilities. Mr. Daniel E. Henry, Marshall Space Flight Center, Alabama, was the technical manager.			
16. ABSTRACT This final report describes in detail the solar energy system installed in a new two-story office building at the Reedy Creek Utilities Company, which provides utility service to Walt Disney World at Lake Buena Vista, Florida. The solar components were partly funded by the Department of Energy under Contract EX-76-C-01-2401, and the technical management was by NASA/George C. Marshall Space Flight Center. The solar energy system application is 100 percent heating, 80 percent cooling, and 100 percent hot water. The collector is a modular cylindrical concentrator type with an area of 3,840 square feet. The storage medium is water with a capacity of 10,000 gallons hot and 10,000 gallons chilled. <div style="text-align: center;">NOTICE MN ONLY PORTIONS OF THIS REPORT ARE ILLEGIBLE. It has been reproduced from the best available copy to permit the broadest possible availability.</div>			
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Solar Office Building
Reedy Creek Utilities Co., Inc.
WALT DISNEY WORLD

The Solar Powered Office Building at WALT DISNEY WORLD

I. INTRODUCTION

In November 1977, the utility company servicing WALT DISNEY WORLD put into operation a new two-story office building, specifically designed for a unique solar energy system. Solar energy powers air conditioning, space heating and potable hot water supply. The solar collectors are the roof

of the building. They are horizontal parabolic mirrored troughs which focus on tracking absorbers, moving in one dimension, and filled with water. There is dual storage, 10,000 gallons of hot water and 10,000 gallons of chilled water. The chiller is a commercially available 25-ton lithium bromide absorption unit and utilizes an existing cooling tower system as the heat sink. The building has 5,625 square feet of air conditioned space and the collector area of the roof is 3,840 square feet. There is no redundant nor auxiliary energy system for space heating or hot water. There is a connection to the utility company's chilled water distribution system as the alternate cooling mode. The building was built with the support of the Department of Energy of the United States as one of those selected in the November 1975 PON submissions for space heating and cooling of commercial buildings. The system is highly instrumented as part of the National Solar Data Program. Performance to date has been equal to or exceeded design criteria.

A mirrored roof panel with collector bars in focus. The flexible tube contains both supply and return lines.

Concept

AAI Corporation proposed that the roof be shaped in parabolic troughs to focus solar energy on collectors, or conversely that the normal roof be omitted from a building and that the collector panels serve as the weatherproofing. This would cut the cost of the actual building construction and make solar energy more economical. Florida, as the most southern

of the mainland states, uses four percent of its energy for space heating, 18 percent for air conditioning, the reverse of the average in the United States. The collectors as the roof, are most efficient when the sun is directly overhead which is when air conditioning demand is the greatest. With modification, parabolics could be angled or pitched on the roof of the building at other latitudes to optimize the collector angles. The system was designed to be of modular components that could be mass-produced. The solar system roof was integrated into the architecture of the building. The system was optimized for a weekly cycle, that is, collect solar energy seven days a week and normally use the office spaces on a five-day schedule. No redundant heating or hot water were to be provided, only solar, since there would be a sizable excess of energy collected during the heating season. There would be a redundant cooling system for long periods of cloud cover. An energy efficiency cycle of controlled building louvers is incorporated in the design and does increase efficiency to a degree but would be even more effective in more northern climates. A major purpose of the building was to showcase or demonstrate a solar system and, therefore, the building was specifically designed so that all major components would be clearly visible and that the mechanical features, piping, tanks, pumps, etc., would be color coded to facilitate understanding the temperatures in any given position, e.g., the hot water storage tank is red; cold water lines, blue; and warm water, pink.

II. SUMMARY OF PROJECT INFORMATION

Owner Builder: Reedy Creek Utilities Co., Inc.
Subsidiary of Walt Disney
Productions

Designer: Architectural - WED Enterprises,
Glendale, California
Mechanical - Sudtell Engineering,
Glendale, California
Solar System - AAI Corporation,
Baltimore, Maryland

Contractor: Buena Vista Construction Co.

DOE Technical Management: NASA Marshall Space Flight Center,
Alabama

Operational Date: November 1977

Building: Type - General Office Area -
5,625 square feet (522.58m²)
conditioned

Location: WALT DISNEY WORLD, P. O. Box 40,
Lake Buena Vista, Florida 32830

Latitude: 28.4°N

Climatic Data

Degree Days	Heating 733	Cooling 3226
Avg. Temp. (°F)	Winter 61.1 (16.17°C)	Summer 75.3 (24.05°C)
Avg. Insolation	Winter 1162.35 Btu/Ft/Day (315 Langleys/Day)	Summer 1752.75 Btu/Ft/Day (475 Langleys/Day)

Solar Energy System

Manufacturer: AAI Corporation, Baltimore, Maryland

Application: Heating - 100% Cooling - 80% Hot Water - 100%

Collector

Type: Modular cylindrical concentrator

Area: 3,840 square feet (356.75m²)

Storage

Type: Water

Capacity: 10,000 gallons hot (37,854 liters)

10,000 gallons chilled

III. SYSTEM SCHEMATIC DIAGRAM

IV. CONSTRUCTION

AAI Corporation designed and manufactured the solar components in Cockeysville, Maryland. The AAI parabolic roof panels are eight feet on the arch, seven and one-half feet on the cord, 32 feet long. They are a sandwich of aluminum, poly isocyanurate foam, aluminum, mastic and mirror. They are shipped with lifting eyes. They include stiffeners on which can be hung lighting, air ducts or sprinklers. They are oriented in an east-west line. The saddles which support the parabolic panels fit on top of the building wall, serve as the interface, provide appropriate structural tie, transmit lateral loads and provide joint sealing. Saddles were shipped in 30-foot lengths. The collector bar or receiver is made of a 36-foot long aluminum extrusion which serves as the structural backbone and weather cover. Inside is a grooved or mechanically selective aluminum plate which is the collector plate and is painted with black epoxy paint. Copper tubes are swaged to the collector plate, with a water white tempered low iron glass covering the plate. The 16 collector bars are each supported at their ends by rocker arms, and are connected horizontally by tie bars or struts forming a parallelogram. Tie bars are adjustable between collectors. The entire system is kept in focus by an electric eye sensor and an electric motor driving a screwjack activator which moves the absorbers in the north-south direction. The electronic control panel was also manufactured by AAI Corporation. Tanks and piping insulation were done by construction contractors on site. Walt Disney

World Co. used its affiliated company, Buena Vista Construction Co. as the general contractor and subcontracted the more critical parts of work. The building is a concrete frame, concrete block wall, heavily insulated office building with minimum windows. This design, plus the fact the roof is reflecting sunlight, makes it a low energy consumer. Construction proceeded with no problem in matching prebuilt solar panels and saddles to the building.

Construction Start Date - February 1977

Construction Complete Date- October 1977

Solar System Start-Up - October 1977

Solar Acceptance Test - March 1978

Demonstration Period Ends - March 1983

Roof panel being lifted in place.

Display piping for solar system.

Solar control console

V. MODES OF OPERATION

The system has five operating modes and one central control system.

- The first mode is the collection process through hot water storage. The collector focusing does not commence until there is sufficient light intensity on the photoelectric cells to make the expenditure of energy in moving the collector worthwhile. When that occurs, the collector bars are brought into focus over the parabolic trough mirrors. When the absorber plates in the collector bar reach a temperature 20°F higher than the temperature of the water at the bottom of the hot water storage tank, the circulating pump is activated. This loop is from hot water storage to collector and return.
- The second mode is space heating. When the building temperature falls below the setting of the thermostat a pump is activated to move hot water from the top of the storage tank into the air handler and return. There is no other system to heat the building.
- The third mode is for potable hot water. When a hot water tap is opened, domestic water flows through a heat exchanger in the side of the solar hot water storage tank to a wash basin. There is no other hot water heating system.

- The fourth mode is the production of chilled water. When the water at the bottom of the chilled water storage tank is above 45°F and when the water at the top of the hot water tank is above 180°F, hot water is circulated through the absorption chiller and condenser water from the cooling tower is cycled through the chiller. Water from the cold water storage tank is then cycled from the cold tank through the chiller and return. The chiller remains in operation until the bottom of the cold tank reaches 45°F or until the hot water tank goes below 165°F, whichever occurs first.
- The fifth mode is space cooling. This again is activated when the room temperature in the building gets warmer than the thermostat's setting, at which time chilled water is pumped from the bottom of the storage cold water tank to the air handler and return. When the bottom of the cold water storage tank exceeds 57°F and building temperature exceeds 80°F, the water produced from solar energy is stopped. The valve to permit auxiliary cooling by the flow of chilled water from the Central Energy Plant through the air handler is then opened.

VI. DESCRIPTION OF THE DATA ACQUISITION SYSTEM

In order to obtain information necessary for evaluation of the performance and operation of the solar heating system throughout the year, 45 sensors were installed within the system. These sensors were furnished by the government and installed at government expense in accordance with the document, "SHC-1006, August 4, 1976; Instrumentation Installation Guidelines for the National Solar Heating and Cooling Demonstration Program." In Table 1, each sensor is listed by a code designation and by the parameter measured. The number sequence in the code indicates the data groups in accordance with the following table:

<u>Number Sequence</u>	<u>Data Group</u>
001 to 099	climatological
100 to 199	collector
200 to 299	thermal storage
300 to 399	domestic hot water
400 to 499	space heating
500 to 599	space cooling
600 to 699	building/load

Each sensor provides data to a Site Data Acquisition Subsystem (SDAS) every five minutes around the clock. The SDAS digitizes the data and stores it on tape. Once a day the data is sent by telephone to an IBM facility in Huntsville, Alabama, where it is reduced. Monthly reports are prepared, one of which is sent to Reedy Creek Utilities Co., Inc.

The monitoring system will permit the government to determine the following kinds of information:

- Savings in conventional energy resulting from the use of solar energy for heating and/or cooling.
- Portion of the total heating and/or cooling load supplied by the solar energy.
- Efficiency of the system in converting solar radiation into useful thermal energy.
- Thermal performance and reliability of major subsystems or components over the demonstration period.

Table 1 describes each sensor in terms of its general location and the parameter that is being measured. The specific location of each sensor can be found on Figure No. 1.

Table 1

Instrumentation for Reedy Creek Utilities

Designation	Measurement
A. Temperature	
T001	Outdoor Ambient Temperature
T100	Collector Inlet Temperature
T150	Collector Outlet Temperature
T102	Collector Surface Temperature
T201	Hot Storage Tank Top Temperature
T202	Hot Storage Tank Middle Temperature
T203	Hot Storage Tank Bottom Temperature
T204	Cold Storage Tank Top Temperature
T205	Cold Storage Tank Middle Temperature
T206	Cold Storage Tank Bottom Temperature
T300	Domestic Hot Water Heat Exchanger Inlet Temperature
T350	Domestic Hot Water Heat Exchanger Outlet Temperature
T302	Domestic Water Supply Temperature
T402	Hot Load Supply Temperature
T452	Hot Load Return Temperature
T501	Arkla Condenser Water Inlet Temperature
T551	Arkla Condenser Water Outlet Temperature
T502	Arkla Generator Water Inlet Temperature
T552	Arkla Generator Water Outlet Temperature
T503	Arkla Chilled Water Outlet Temperature
T553	Arkla Chilled Water Inlet Temperature
T504	Chilled Water Supply Inlet Temperature
T554	Chilled Water Coil Outlet Temperature
T505	Chilled Water Tank Inlet Temperature from Cooling Coil
T555	Chilled Water Tank Outlet Temperature to Cooling Coil
T600	Return Air Temperature
B. Power	
EP101	Collector Pump Power (PHWA-4ZE)
EP102	Tracker Motor Power
EP401	Hot Water Supply Pump Power (PHWA-5ZE)
EP402	Internal Air Recirculating Fan Power (AH-6ZE)
EP403	Hot Water Coil Supply Pump Power (PHWA-ZE)
EP501	Arkla Chiller Operating Power (CH-10ZE)
EP502	Arkla Chilled Water Pump Power (CH-10ZE)
EP503	Condenser Water Pump Power (PCW-10ZE)
EP504	Chilled Water Coil Pump Power (PCHA-3ZE)

Table 1 (Continued)

Designation	Measurement
C. Flow	
W100	Collector Array Flow Rate
W300	Domestic Hot Water Solar Flow Rate
W301	Domestic Hot Water Supply Flow Rate
W401	Hot Water Coil Supply Flow Rate
W501	Arkla Condensing Water Flow Rate
W502	Arkla Hot Water Flow Rate
W503	Arkla Evaporator Water Flow Rate
W504	Chilled Water Supply Flow Rate
D. Insolation	
1001	Collector Plane Total Insolation
1002	Collector Plane Diffuse Insolation

T001 Outside Amb

REEDY CRFEK

Figure No. 1

VII. COSTS

PROJECT COSTS

	<u>Estimated Cost</u>	<u>Actual Cost</u>
Building	\$352, 000	\$369, 000
Solar Energy System	459, 662	654, 071
Instrumentation	12, 843	16, 361
Display Panel	9, 570	10, 000*
	<hr/>	<hr/>
Total Project Cost	\$834, 075	\$1, 049, 432*

DOE Funding to Date

Solar Energy System	\$373, 303
Instrumentation	12, 843
Display Panel	<u>9, 570</u>
	\$395, 716

The project as a prototype had the usual first-of-a-kind cost control problems. Panels which lend themselves to production line techniques, were hand-built. In addition, design was pointed at high quality, long life components and showcasing of all solar components for public visibility. Proposals for major cost reduction are described in Section IX.

* Final actual costs of display panel not yet know.

VIII. PERFORMANCE TO DATE

The first month of data collection was March 1978 and resulted in many adjustments in the data collection as well as the mechanical part of the solar system itself. The first month of reasonable data is for April 1978. Those results:

- Collector and hot water storage mode (167°F to 226°F actual):

Insolation, total incident	232 MBtu
Collected energy	68 MBtu
Efficiency total	29%
Efficiency during collector operation	37%

Electrical operating energy 1.8 MBtu

Storage losses from the tank 12.3 MBtu

Hot storage efficiency - 82%

Note: The 12.3 MBtu storage loss includes the energy used to heat the potable hot water for the building.

- Potable hot water mode:

Consumption is so small that installed meters were not accurate. Estimated demand was .4 MBtu for the month which was included as a hot water storage loss.

- Space heating mode:

With minor exception, the building was heated throughout a below normal temperature winter while equipment was being adjusted.

No heating demand was recorded after data collection was inaugurated.

No problem with 100% solar heating foreseen.

- Chilled water production mode:

Solar energy consumed	53 MBtu
Chilled water produced	8 MBtu
To cooling tower	38 MBtu
To atmosphere	12 MBtu
Overall indicated COP	.15

Note: Because of sensor problems in the data collection system, these figures are highly suspect. Control temperatures of supply hot water and produced chilled water have been changed to reduce cycling of chiller. Also, a condenser water supply problem has been corrected.

Latest COP's measured in field range from .4 to .7.

- Space cooling mode:

Solar energy consumed	53 MBtu
Total heat removed	7.6 MBtu
Solar energy chilling	5.4 MDtu
Auxiliary chilling	2.2 MBtu
Cold storage efficiency	93.4%

To date the National Solar Data System has been very beneficial to adjusting our facility mechanically and operationally.

Although accuracy of initial data above is suspect in several

instances, we are confident the present program of correcting deficiencies will produce a very accurate measuring of performance.

IX. RECOMMENDATIONS FOR CONCEPT DEVELOPMENT

Experience to date indicates that this concept has promise of acceptable performance. Costs to date are not acceptable. Walt Disney organizations and AAI Corporation separate and joint reviews indicate sizable savings possible, as follows:

- Use building industry technology in solar system fabrications, e.g.:
 - Replace aluminum foam panels with precast, prestressed lightweight concrete.
 - Use tilt up wall construction with saddles precast, or incorporate saddles in precast panel.
 - Cast units in local precast plants with mirrors added either as sagged glass sheets or pre-positioned strips placed much as tile work in residential construction.
- Develop foam-in-place for receiver insulation and simplify cover glass assembly. Possibly redesign receiver drive from rocker arm to an overhead track with roller supports, or use sleeve bearings in lieu of roller bearings or rocker arms.
- In building design:
 - Use solar panels as diaphragm for lateral loads.
 - Add windows on low solar sides to reduce lighting demand.
 - Install insulation and vapor barrier on exterior of building.

- In mechanical design:
 - Place solar and HVAC in center of building.
 - Eliminate showcasing features, e.g., place storage in most economical position.
- Use micro processor controller now available in lieu of conventional electronics.

System technical improvements for increased efficiency:

- Utilize low temperature Rankine driven chiller to improve COP. With storage available in this project, a three-ton chiller would satisfy the 15-ton maximum demand.
- Add a cycle to utilize night low temperatures to charge chilled storage. This is a small modification of existing air handler and appropriate control logic for chilled water loop.

X. CONCLUSIONS

The office building is an addition to an existing central energy plant of fairly sophisticated systems. The personnel who maintain the solar facility also maintain the jet engine co-generation system, chiller plant, high temperature hot water distribution system, high voltage electrical generation system, instrumentation and computer systems serving WALT DISNEY WORLD. They were already in the prototype business which makes maintenance of the facility relatively easy. Tuning and learning how to operate has been an interesting process and only now is coming to a satisfactory point. The longest learning experience has been the operation of the absorption chiller to minimize cycling losses, to de-bug the related condenser water system, and to realize the .6 design coefficient of performance of the chiller. Modification of the sun positioned sensor was necessary because of moisture and overheat problems.

This solar prototype will meet its design criteria of 100% heating and hot water and over 80% chilling. The concept is worth pursuing in order to eventually obtain cost effectiveness.

ERDA CONTRACT NO. E(49-18)2401

INTERIM PERFORMANCE CRITERIA

CERTIFICATION

DEMONSTRATION CONTRACTOR Reedy Creek Utility Company

SYSTEM LOCATION Walt Disney World, Lake Buena Vista, Florida

SYSTEM TYPE AAI Corp. Modular Solar Roof

CERTIFIED BY

Don P. Seely
Authorized Rep.

DATE

2/15/77

Don P. Seely
4/24/78

INTERIM PERFORMANCE CRITERIA CERTIFICATION
INSTRUCTIONS

- I. Evaluate System for each IPC requirement listed on I.P.C. Certification Sheets. All Requirements are to be in accordance with MSFC Document No. 98M10001, dated February 28, 1975.
- II. Check each Requirement Status
 - Yes - Meets IPC Requirement
 - No - Does not meet IPC Requirement
 - N/A - Requirement not applicable
- III. List IPC Requirement Evaluation Method utilized
 - Analysis
 - Test
 - Inspection
 - Demonstration
 - Other
- IV. All IPC Requirements which are not met shall be defined and recorded.

SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENTS
		YES	NO	N/A		
H and HC System Performance	1.1	X			--	
• Heating Design Temperature	1.1.1	X			Analysis	
• Cooling Design Temperature	1.1.2	X			Analysis	
• Relative Humidity and Water Vapor Pressure	1.1.3	X			Analysis	
• Solar Contribution	1.1.4	X			Analysis	
• HW System/Subsystem Performance	1.2	X			Analysis	
• Draw and Temperature Design Output	1.2.1	X			Analysis	
• Non-tap Temperature Design Output	1.2.2			X		
• Solar Contribution	1.2.3	X			Analysis	
• Collector Performance	1.3				--	
• Collector Efficiency	1.3.1	X			Analysis & Test	
• Thermal Storage Performance	1.4	X			--	
• Storage Capacity and Rate	1.4.1	X			Analysis	
• Habitability of Occupied Spaces	1.5	X			--	
• Heat or Humidity Transfer Effects	1.5.1	X			Analysis	
• Energy Transport Efficiency	1.6	X			--	
• Thermal Losses and Electrical Power	1.6.1	X			Analysis	
• Control	1.7	X			--	

SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CON'T.

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENT
		YES	NO	N/A		
• Installation and Maintenance	1.7.1	X			Analysis	
• Manual Adjustment	1.7.2	X			Analysis	
• Inhabited Space Temperature Control	1.7.3	X			Analysis	
• Hot Water Temperature	1.7.4			X		No separate storage tank
• Auxiliary Energy	1.8	X			--	
• Design Heat Loads	1.8.1	X			Analysis	
• Design Cooling Loads	1.8.2	X			Analysis	
• Impairment of Operation	1.8.3	X			Analysis	
• System Design Conditions	2.1	X			--	
• Equipment Capabilities	2.1.1	X			Analysis	
• Noise or Erosion-Corrosion	2.1.2	X			Analysis & Inspection	
• Operating Conditions	2.1.3	X			Analysis	
• Fluid Flow in Collectors	2.1.4	X			Analysis	
• Entrapped Air	2.1.5	X			Analysis	
• Thermal Expansion of Fluids	2.1.6	X			Analysis	
• Pressure Drops	2.1.7	X			Analysis	
• Condensate Removal	2.1.8	X			Analysis	
• Mechanical Stresses	2.2	X			--	
• Vibration Stress Levels	2.2.1	X			Analysis	
• Vibration From Moving Parts	2.2.2	X			Analysis	
• Water Hammer	2.2.3	X			Analysis	

SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CON'T.

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENTS
		YES	NO	N/A		
• Vacuum Relief Protection	2.2.4	X			Analysis & Inspection	
• Thermal Changes	2.2.5	X			Analysis	
• Flexible Joints	2.2.6	X			Analysis	
• Leakage Prevention	2.3	X			Analysis	
• Pressure Test: Nonpotable Fluids	2.3.1	X			Test & Inspection	
• Pressure Test: Potable Water	2.3.2	X			Test & Inspection	
• Air Transport Systems	2.3.3	X			Analysis	
• Collector Adjustments	2.4	X			Analysis & Inspection	
• Orientation and Tilt	2.4.1	X			Analysis & Inspection	
• Mutual Shadowing	2.4.2	X			Analysis & Inspection	
• Subsystem Isolation	2.5	X			--	
• Shutdown in Multiunit Facilities	2.5.1	X			Review & Analysis	
• Heat Transfer Fluid Quality	2.6	X			--	
• Liquid Quality	2.6.1	X			Review & Inspection	
• Air Quality	2.6.2	X			Analysis & Inspection	
• Fluid Treatment	2.6.3	X			Analysis & Inspection	
• Freezing Protection	2.6.4	X			Analysis & Inspection	
• Piping Supports	2.7	X			--	
• Applicable Plumbing Standards	2.7.1	X			Analysis & Inspection	
• Excessive Pressure and Temperature Protection	2.8	X			Analysis & Inspection	
• Relief Valves and Vents	2.8.1	X			Analysis & Inspection	

SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA CONT.

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENTS
		YES	NO	N/A		
• Structural Design Basis	3.1	X			--	
• Service Loads	3.1.1	X			Analysis & Test	
• Failure Loads and Load Capacity	3.2	X			Analysis & Test	
• Ultimate Load Combinations	3.2.1	X			Analysis & Test	
• Ice Loads	3.2.2			X		
• Vehicular Loads	3.2.3			X		
• Load Capacity	3.2.4	X			Analysis	
• Damage Control	3.3	X			--	
• Resistance to Damage	3.3.1	X			Analysis	
• Cyclic Loads	3.4	X			Analysis	
• Deflection Limitations	3.4.1	X			Analysis	
• Cutting of Structural Elements	3.5	X			Analysis	
• Design Provisions	3.5.1	X			Analysis	
• Creep and Residual Deflection	3.6	X			--	
• Deflection Limitations	3.6.1	X			Analysis	
• Hail Resistance	3.7	X			--	
• Hail Size and Loading	3.7.1	X			Analysis	
• Constraint Loads	3.8	X			--	
• Foundation Settlement; Contraction and Expansion	3.8.1	X			Analysis	
• Ponding Conditions	3.9	X			--	
• Design Provisions	3.9.1	X			Analysis	

**SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CONT.**

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COM.
		YES	NO	N/A		
• Plumbing and Electrical Installation	4.1	X			--	
• Plumbing Codes and Standards	4.1.1	X			Analysis	
• Electrical Codes and Standards	4.1.2	X			Analysis	
• Fail-Safe Controls	4.2	X			--	
• System Failure Prevention	4.2.1	X			Analysis	
• Automatic Pressure Relief Valves	4.2.2	X			Analysis	
• Fire Safety	4.3	X			--	
• Applicable Fire Standards	4.3.1	X			Analysis	
• Penetrations Through Fire-Rated Assemblies	4.3.2	X			Analysis	
• Toxic and Flammable Fluids	4.4			X	--	
• Provision of Catch Basins	4.4.1			X	--	
• Detection of Toxic and Flammable Fluids	4.4.2			X	--	
• Safety Under Emergency Conditions	4.5	X			Analysis	
• Emergency Egress and Access	4.5.1	X			Analysis	
• Identification and Location of Controls	4.5.2	X			Analysis	
• Protection of Water and Circulated Air	4.6	X			--	
• Contamination by Materials	4.6.1	X			Analysis	

**SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CONT.**

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENTS
		YES	NO	N/A		
• Separation of Circulation Loops	4.6.2	X			Analysis	
• Backflow Prevention	4.6.3	X			Analysis & Inspection	
• Growth of Fungi	4.6.4	X			Analysis	
• Excessive Surface Temperatures	4.7	X			Analysis	
• Protection From Heated Components	4.7.1	X			Analysis	
• Effects of External Environment	5.1	X			--	
• Solar Degradation	5.1.1	X			Analysis, test & inspection	
• Soil Corrosion	5.1.2			X	--	
• Airborne Pollutants	5.1.3	X			Analysis & test	
• Dirt Retention on Cover Plate Surface	5.1.4	X			Analysis & test	
• Abrasive Wear	5.1.5	X			Analysis & test	
• Fluttering by Wind	5.1.6	X			Analysis & test	
• Temperature and Pressure Resistance	5.2	X			--	
• Thermal Degradation	5.2.1	X			Analysis & test	
• Deterioration of Heat Transfer Fluids	5.2.2	X			Analysis & test	
• Thermal Cycling Stresses	5.2.3	X			Analysis & test	
• Leakage	5.2.4	X			Analysis & test	
• Deterioration of Gaskets and Sealants	5.2.5	X			Analysis & test	
• Transmission Losses Due to Outgassing	5.2.6	X			Analysis & test	
• Chemical Compatibility of Components	5.3	X			Analysis & test	

**SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CONT.**

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENTS
		YES	NO	N/A		
• Materials/transfer fluid compatibility	5.3.1	X			Analysis & test	
• Corrosion of dissimilar materials	5.3.2	X			Analysis & test	
• Corrosion by leachable substances	5.3.3	X			Analysis & test	
• Effects of decomposition products	5.3.4	X			Analysis & test	
• Components involving moving parts	5.4	X			--	
• Wear and fatigue	5.4.1	X			Analysis & test	
• Accessibility for maintenance and servicing	6.1	X			--	
• Access for system maintenance	6.1.1	X			Analysis & test	
• Access for system monitoring	6.1.2	X			Analysis & test	
• Draining and filling of liquids	6.1.3	X			Analysis & test	
• Flushing of liquid subsystems	6.1.4	X			Analysis & test	
• Filters	6.1.5	X			Analysis & test	
• Water shutoff	6.1.6	X			Analysis	
• Installation, operation and maintenance manual	6.2	X			--	
• Installation instructions	6.2.1	X			} An installation, operation & maint. manual was prepared	
• Maintenance and operation instructions	6.2.2	X				
• Maintenance plan	6.2.3	X				
• Replacement parts	6.2.4	X				

SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CON'T.

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENTS
		YES	NO	N/A		
• Repair and service personnel	6.3	X			--	
• Servicing of H and HC systems	6.3.1	X			Analysis & review	
• Servicing of HW system	6.3.2	X			Analysis & review	
• Design	7.1	X			--	
• Design-Habitable Facilities	7.1.1	X			--	
• Esthetics	7.1.2	X			--	
• Materials	7.1.3	X			Review	
• Passive use of Solar Energy	7.1.4	X			Review	
• Adequate Space	7.2	X			--	
• Solar collector space requirements	7.2.1	X			Review	
• Storage	7.2.2	X			Review	
• Interface Between Facility & H and HC Systems	7.2.3	X			Review	
• Portability	7.2.4			X	--	
• Functioning of facility and site	7.3	X			--	
• Space use	7.3.1	X			Review	
• Shading	7.3.2	X			Review	
• Impact on environment	7.3.3	X			Review	
• View	7.3.4	X			Review	
• Compatibility with conventional systems	7.4	X			--	
• Utility compatibility	7.4.1	X			Review	

**SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CONT.**

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENTS
		YES	NO	N/A		
• Interference with mechanical operation	8.1	X				
• Blockage of solar components	8.1.1	X			Analysis	
• Shading of Collector	8.1.2	X			Analysis	
• Sensor Location	8.1.3	X			Analysis	
• Mechanical and electrical functioning of facility and site	8.2	X			--	
• Exhaust and venting	8.2.1	X			Analysis & review	
• Utilities	8.2.2	X			Analysis & review	
• Mechanical and electrical functioning of connections	8.3				--	
• Plumbing connection	8.3.1	X			Analysis & review	
• Electrical connections	8.3.2	X			Analysis & review	
• Lightning Protection	8.3.3	X			Analysis & review	
• Structural integrity of H, HC and HW systems	9.1	X			--	
• Movement in adjacent structures	9.1.1	X			Analysis	
• Structural integrity of facility	9.2	X			--	
• Loads	9.2.1	X			Analysis	
• Penetration of structural members	9.2.2	X			Analysis	
• Structural connections	9.3				--	
• Structural connections	9.3.1	X			Analysis	
• Brittle components	9.3.2	X			Analysis	
• Strength and Stiffness	9.3.3	X			Analysis	

**SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CONT.**

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD	COMMENTS
		YES	NO	N/A		
• Safety of facility and site	10.1	X			--	
• Fire	10.1.1	X			Analysis	
• Accidents	10.1.2	X			Analysis	
• Durability and reliability of H, HC and HW systems	11.1	X			--	
• Vegetation	11.1.1	X			Analysis	
• Durability and reliability of facilities and site	11.2	X			--	
• Chemical corrosion	11.2.1	X			Analysis	
• Heat and moisture	11.2.2	X			Analysis	
• Exterior penetrations	11.2.3	X			Analysis	
• Durability and reliability of connections	11.3	X			Analysis	
• Material Compatibility	11.3.1	X			Analysis	
• Maintainability of H, HC and HQ systems	12.1	X			--	
• Accessibility	12.1.1	X			Analysis & review	
• Misuse	12.1.2	X			Analysis & review	
• Permanent maintenance accessories	12.1.3	X			Analysis & review	
• Maintainability of facility and site	12.2	X			--	
• Accessibility	12.2.1	X			Analysis & review	
• Ice dams	12.2.2			X		
• Connections	12.3	X				
• Accessibility	12.3.1	X			Analysis & review	

SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CONT'D

IPC REQUIREMENT	IPC PARA.	MEETS IPC			EVALUATION METHOD
		YES	NO	N/A	
• Visual characteristics of facility and site	13.1	X			--
• Facility	13.1.1	X			Analysis & review
• Neighborhood	13.1.2	X			Analysis & review

APPENDIX B

SEQUENCE OF OPERATION

Sequence of Operation

The building solar heating and cooling is activated by three components in the HVAC system: The hot water circulating pump, the chilled water circulating pump and the CEP solenoid valve. These components must obey the following rules:

- The hot water circulating pump must be on whenever either of the two zones require heat.
- The chilled water circulating pump must be on whenever either zone requires cooling and if the solar chilled water supply is adequate to control the two zones.
- The CEP solenoid valve, which controls four pneumatic valves in the chilled water system, will be energized whenever the solar chilled water supply is inadequate to maintain the two zones cool and chilled water tank bottom temperature greater than 55°F.
- When the building is unoccupied no heating or cooling will be provided.
- The cooling water and heating water are not on at the same time except when one zone calls for heating while the other zone calls for cooling.

The accompanying block diagram illustrates the logic for implementing these rules. A number of decision sensors are required in the HVAC system to provide inputs to the logic.

The first of these is a differential pressure switch which indicates that the fan in the air handling unit is on. This fan is controlled by timers and is an indication of building occupancy. The remaining sensors are P/E switches associated with the zone temperature sensors. Six such P/E switches are required with three on each zone thermostat pneumatic output line. The heating signal, from each zone thermostat, consists of a P/E switch closure whenever the temperature in the zone is less than 70°F. The cooling signal, from each zone thermostat, consists of a switch closure whenever the temperature in the zone is greater than 78°F. The CEP signal, indicating that solar chilled water is insufficient to provide adequate cooling, is a third P/E switch closure whenever the temperature in the zone is greater than 80°F. The P/E switches should all be adjustable over the range of at least 60° to 80°F so that these setpoints can be changed to accommodate building comfort.

The block diagram indicates how the sensor signals are used to generate control signals for the three output components. No output signals are provided if the differential pressure switch on the fan does not indicate fan operation. The circulating pumps are on if either zone requires heating or cooling. If insufficient cooling capacity is available, as indicated by a zone temperature rise above 80°F, the CEP valve is activated if chilled water tank bottom is greater than 55°F. This condition is held for a minimum of 30 minutes. The CEP chilled water will reduce the zone temperature below

76°F. During this period the chilled water circulating pump will be off. At the end of 30 minutes the system will revert back to the solar mode. If the zone temperature again goes above 80°F, the 30 minute CEP water cycle will be repeated.

The HVAC components not mentioned above will all be operating independently of the solar system and are not included in this interface. This encompasses such things as the zone dampers, the fresh air mixing system, etc., and the controls for these components.

The control inputs, to the solar equipment cabinet, from the P/E switches, and the fan differential pressure are switch closures not tied to any other circuits. A wire pair from each of the seven inputs is connected to the solar equipment console. The outputs to the three controlled components is 115 volt 60 Hz power, capable of actuating motor starters or the CEP solenoid valve.

APPENDIX C

BUILDING DRAWINGS

SOLAR DISPLAY AND OFFICE BUILDING

LIST OF DRAWINGS
SOLAR DISPLAY AND OFFICE BUILDING

- A-1 - First and Second Floor Plans
- A-3 - Exterior Elevations
- A-4 - Building Sections
- A-6A - Ceiling Mechanical Lay-out
- A-7 - Wall's Sections and Miscellaneous Details
- E-223 - Solar Energy Equipment Plans, Details, Routing
- AC-301 - Air Conditioning Sections and Details
- M-101 - Site Plan, Legend, Schedule, General Notes
- M-201 - Partial Chiller Building Floor & Roof Plan, Sections, Details
- M-202 - Solar Energy Equipment Room Plans and Sections
- M-203 - Solar Energy Equipment Room Sections and Details
- M-204 - Schematic Flow Diagram

PROJECT DESIGNED FOR		PROJECT NO.		SHEET NO.		DATE	
Redy Creek Utilities Co., Inc.		FLORIDA		M-167-002			
PROJECT NAME		SHEET TITLE		DATE		REVISION	
CENTRAL ENERGY PLANT SOLAR DISPLAY AND OFFICE BUILDING ADDITION		FIRST & SECOND FLOOR PLANS					
DESIGNED BY		CHECKED BY		APPROVED BY			
WED INTERPRISES		FLORIDA					
SCALE		SHEET NO.		DATE			
1/2" = 1'-0"		M-167-002					
PROJECT NO.		SHEET TITLE		DATE			
M-167-002		FIRST & SECOND FLOOR PLANS					
DESIGNED BY		CHECKED BY		APPROVED BY			
WED INTERPRISES		FLORIDA					
SCALE		SHEET NO.		DATE			
1/2" = 1'-0"		M-167-002

SECOND FLOOR PLAN

FIRST FLOOR PLAN

ENCLOSED PORTION INDICATES SOLAR

		PROJECT REQUIRED FOR REEDY CREEK UTILITIES CO. INC.		PROJECT NO. M-167.002	
CENTRAL ENERGY PLANT ADDITION		FLORIDA MECHANICAL LAY-OUT		BILL DEWITT PROJECT MANAGER	
DATE: 10/1/80		SCALE: 1/4" = 1'-0"		DRAWN BY: J. L. STEVENSON	
CHECKED BY: J. L. STEVENSON		DATE: 10/1/80		PROJECT NO. M-167.002	
A-6A		C-6		1

PROJECT NO.	DATE	BY	CHECKED	APPROVED
100-100-100	10-1-76	W. J. DENNIS	W. J. DENNIS	W. J. DENNIS
PROJECT NAME	PROJECT ENGINEER	PROJECT OWNER	PROJECT ARCHITECT	PROJECT CONTRACTOR
SOLAR ENERGY EQUIPMENT	FLORIDA	REDDY CREEK UTILITIES CO., INC.	W. J. DENNIS	W. J. DENNIS
PLANS, DETAILS, ROUTING	DATE	BY	CHECKED	APPROVED
100-100-100	10-1-76	W. J. DENNIS	W. J. DENNIS	W. J. DENNIS
PROJECT NAME	PROJECT ENGINEER	PROJECT OWNER	PROJECT ARCHITECT	PROJECT CONTRACTOR
SOLAR ENERGY EQUIPMENT	FLORIDA	REDDY CREEK UTILITIES CO., INC.	W. J. DENNIS	W. J. DENNIS
PLANS, DETAILS, ROUTING	DATE	BY	CHECKED	APPROVED
100-100-100	10-1-76	W. J. DENNIS	W. J. DENNIS	W. J. DENNIS
PROJECT NAME	PROJECT ENGINEER	PROJECT OWNER	PROJECT ARCHITECT	PROJECT CONTRACTOR
SOLAR ENERGY EQUIPMENT	FLORIDA	REDDY CREEK UTILITIES CO., INC.	W. J. DENNIS	W. J. DENNIS
PLANS, DETAILS, ROUTING	DATE	BY	CHECKED	APPROVED
100-100-100	10-1-76	W. J. DENNIS	W. J. DENNIS	W. J. DENNIS

W. J. DENNIS & ASSOCIATES, INC.
CONSULTING ENGINEERS
1000 PINE STREET
SUITE 100
SAN FRANCISCO, CALIF. 94109
TELEPHONE (415) 398-1111
FAX (415) 398-1111

E-223

PUMP SCHEDULE															
SYMBOL	SERVICE	LOCATION	MANUFACTURER	MODEL	TYPE	WATER TEMP. °F	GPM	FT. HD.	MOTOR			NT.	DRAWING REF. NO.	REMARKS	
									HP	PH	VOLTS				
CH-126	CHILLED WATER CIRC.	ROOF	WORTHINGTON	C-1130	IN LINE	44	35	35	1	1750	450	3	60	M-201	
PH-126	COLLECTOR	EQUIP. RM.	WORTHINGTON	C-1130	END-SUCT.	225	120	60	3	1750	450	3	60	M-202	FRAME MOUNTED
PH-126	MED. TEMP. HOT WATER	EQUIP. RM.	WORTHINGTON	C-1130	↑	225	90	70	3	1750	450	3	60	M-202	" "
PH-126	CHILLED WATER	EQUIP. RM.	WORTHINGTON	C-1130		44	60	40	192	1750	450	3	60	M-202	" "
PH-102	COND. WATER	CHILLED WATER PLANT	WORTHINGTON	C-1130	END-SUCT.	95	90	120	5	350	450	3	60	M-201	" "
PH-102	MED. TEMP. HOT WATER	ROOF	BELL & GOSSETT	116-116	IN LINE	225	7	25	1/2	1750	115	1	60	M-201	MOUNT MADE IN HORIZONTAL POSITION

TANK SCHEDULE									
SERVICE	LOCATION	CONSTRUCTION	TYPE	TAPPING	MANHOLES	SUPPORTS	CAP IN GAL.	SIZE	REMARKS
T-1	HOT WATER	EQUIP. RM.	ASME 125PSI	VERTICAL	SEE SCHEDULE	18" FLG'D	4 BEAM	5000	18" DIA.
T-2	CHILLED WATER	EQUIP. RM.	ASME 125PSI	VERTICAL	SEE SCHEDULE	18" FLG'D	4 BEAM	10000	18" DIA.
T-3	HOT WATER	EQUIP. RM.	ASME 125PSI	HORIZONTAL	SEE SCHEDULE	NONE	BRACKET TO WALL	100	24" DIA.
T-4	CHILLED WATER	EQUIP. RM.	ASME 125PSI	HORIZONTAL	SEE SCHEDULE	NONE	BRACKET TO WALL	100	24" DIA.

HEAT EXCHANGER SCHEDULE									
SERVICE	LOCATION	MANUFACTURER	MODEL	TYPE	SIZE	NO. OF SYSTEM H ₂ O	SERVICE H ₂ O	REMARKS	
HE-126	DOMESTIC HOT WATER	ATG	TEW-47-A	UNITED	8" DIA.	4	100	100	100

CHILLER UNIT SCHEDULE									
SERVICE	LOCATION	MANUFACTURER	MODEL NO.	CAP. TONS	HOT WATER	CHILLED WATER	CONDENSER WATER	ELECTRICAL	REMARKS
CH-1026	EQUIP. RM.	ARL	WE-300	25	100	100	100	100	100

- LIST OF DRAWINGS
MECHANICAL
- M-101 SITE PLAN, LEGEND, SCHEDULES, GENERAL NOTES
 - M-201 PARTIAL CHILLER BLOCK PLAN & EQUIP. PLAN SECTIONS
 - M-202 SOLAR ENERGY EQUIPMENT ROOM PLANS & SECTIONS
 - M-203 SOLAR ENERGY EQUIP. RM. SECTIONS & DETAILS
 - M-204 FLOW DIAGRAM

LEGEND		
SYMBOL	ABBREV.	DESCRIPTION
CH	CH	DOMESTIC COLD WATER
ICH	ICH	INDUSTRIAL COLD WATER
CH	CH	CHILLED WATER SUPPLY
CHR	CHR	CHILLED WATER RETURN
TH	TH	TEMPERED WATER
MTS	MTS	MEDIUM TEMP. HOT WATER SUPPLY
MTR	MTR	MEDIUM TEMP. HOT WATER RETURN
HTS	HTS	HIGH TEMP. HOT WATER SUPPLY
HTR	HTR	HIGH TEMP. HOT WATER RETURN
EXIST	EXIST	EXISTING PIPING OR EQUIPMENT
ID	ID	INDIRECT DRAIN
CS	CS	CONDENSER WATER SUPPLY
CR	CR	CONDENSER WATER RETURN
A	A	COMPRESSED AIR
POC	POC	POINT OF CONNECTION
POP	POP	BOTTOM OF PIPE
2CS	2CS	DIRECTION OF FLOW
2CS	2CS	TYPICAL PIPE SIZE DESIGNATION
2CS	2CS	FLEXIBLE CONNECTION
1/2"	1/2"	CAP/PLUG
GV	GV	GATE VALVE
GLV	GLV	GLOBE VALVE
BV	BV	BUTTERFLY VALVE
CV	CV	CHECK VALVE
PV	PV	PLUG VALVE
PV	PV	PULL VALVE
PV	PV	NEEDLE VALVE
PV	PV	CONTROL VALVE
PV	PV	MOTOR OPERATED VALVE
PV	PV	PRESSURE REDUCING VALVE
PV	PV	3 WAY VALVE W/O OPERATOR
PV	PV	ANGLE VALVE
PV	PV	PRESSURE-TEMPERATURE RELIEF VALVES
PV	PV	FLOW MEASURING DEVICE
PV	PV	HOSE DRAIN VALVE
PV	PV	UNION (SCREWED)
PV	PV	MECHANICAL COUPLING
PV	PV	Y-TYPE STRAINER W/ GLOBE DRAIN VALVE
PV	PV	SHUT-OFF VALVE
PV	PV	REDUCER OR INCREASER (CONC)
PV	PV	REDUCER OR INCREASER (ECC)
PV	PV	PRESSURE GAUGE
PV	PV	ORIFICE FLG.
PV	PV	THERMOMETER
PV	PV	THERMOMETER WELL COUPLING ONLY - 3/4"
LOC	LOC	LIMIT OF CONTRACT
NC	NC	NORMALLY CLOSED
NO	NO	NORMALLY OPEN

AREAS INSIDE OF THIS SYMBOL ARE NON-SOLAR
ALL REMAINING IS SOLAR.

HENRY SUTTELL ENGINEERING, INC.
CONSULTING MECHANICAL ENGINEERS
1650 Flower Street
Glendale, California 91201 Phone: (818) 248-9106

PROJECT DESIGNED FOR
Reedy Creek Utilities Co., Inc.
FLORIDA
PROJECT NO. 100-100-100
SHEET NO. 100-100-100
DATE 10/1/77
BY H.S.
CHECKED BY H.S.
APPROVED BY H.S.
PROJECT NO. 100-100-100
SHEET NO. 100-100-100
DATE 10/1/77
BY H.S.
CHECKED BY H.S.
APPROVED BY H.S.

WED INTERPRISES
1650 Flower Street
Glendale, California 91201
Phone: (818) 248-9106

M-101
SITE PLAN, LEGEND, SCHEDULE, GEN'L. NOTES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

HENRY SUTELL ENGINEERING, INC.
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Phone: (818) 248-0100

M-201
F

NOTE:
ALL VERTICAL DROPS OR RISES SHALL
BE SUPPORTED AT THE TOP WITHIN 10'
OF DROP OR RISE WITH TRAP OR
SEPARATE HANGERS. ALL SUCH TRAPS
OR HANGERS SHALL BE ADEQUATELY
SWAY BRACED.

NOTE:
PIPE SUPPORT TRAPES SHALL BE
SIMILAR TO DETAIL ON SHEET 101
SECTION 1.

NOTE:
WHERE "D" DATA ARE USED TO
INDICATE PIPING TO TRAPES OR
OTHER SUPPORTS, INSULATION SHALL
BE PROVIDED TO COMPLETELY
ENGINEER THE PIPE AT THAT POINT.

NOTE:
SEE ELEC. DWG. FOR CONDUIT
PENETRATING WATER TIGHT
DECKED OFF PIPE. LOCATE VALVE
HANDLES & LEVERS TO CLEAR
CONDUIT.

PROJECT NO.	100-1007	DATE	11/18/83
PROJECT NAME	SOLAR DISPLAY OFFICE BUILDING	DESIGNED BY	WED ENTERPRISES
CLIENT	Reedy Creek Utilities Co., Inc.	FLORIDA	Bill Dennis
PROJECT LOCATION	SOLAR ENERGY EQUIP. RM.	PLANS & SECTIONS	Bill Dennis
PROJECT NO.	100-1007	DATE	11/18/83
PROJECT NAME	SOLAR DISPLAY OFFICE BUILDING	DESIGNED BY	WED ENTERPRISES
CLIENT	Reedy Creek Utilities Co., Inc.	FLORIDA	Bill Dennis
PROJECT LOCATION	SOLAR ENERGY EQUIP. RM.	PLANS & SECTIONS	Bill Dennis
PROJECT NO.	100-1007	DATE	11/18/83
PROJECT NAME	SOLAR DISPLAY OFFICE BUILDING	DESIGNED BY	WED ENTERPRISES
CLIENT	Reedy Creek Utilities Co., Inc.	FLORIDA	Bill Dennis
PROJECT LOCATION	SOLAR ENERGY EQUIP. RM.	PLANS & SECTIONS	Bill Dennis

HENRY SUOTELL ENGINEERING, INC.
CONSULTING MECHANICAL ENGINEERS
1880 Flower Street
Glendale, California 91201 Phone: (818) 248-0100

ELEV - HOT WATER STORAGE TANK

172 x 172 x 4 L
(TTR)

NOTE: SUPP

TANK LOCATION PLAN

ELEV

RETS ON 10' CC.

DEVELOPED SECTION

WME

UNITAL
CENTRAL
ADJUTANT

APPENDIX D

SOLAR COMPONENT DRAWINGS

LIST OF DRAWINGS

SOLAR COMPONENT DRAWINGS

AAI-57939-40001	-	General Layout MSR for Disney World
AAI-57939-40001 (Cont.)	-	General Layout MSR for Disney World
AAI-57939-40001 (Cont.)	-	General Layout MSR for Disney World
AAI-57939-40019 Sheet 1 of 1	-	Roof Panel
AAI-57939-40064 Sheet 1 of 2	-	Solar Receiver Supply and Return Pipe Installation
AAI-57939-40064 Sheet 1 of 2 (Cont.)	-	Solar Receiver Supply and Return Pipe Installation
AAI-57939-40064 Sheet 1 of 2 (Cont.)	-	Solar Receiver Supply and Return Pipe Installation
AAI-57939-40064 Sheet 2 of 2	-	Solar Receiver Supply and Return Pipe Installation
AAI-57939-40092 Sheet 1 of 1	-	Electrical Installation Solar - Disney World
AAI-57939-40092 Sheet 1 of 1 (Cont.)	-	Electrical Installation Solar - Disney World
AAI-57939-40099 Sheet 1 of 1	-	Piping & Control Diagram (Same as our M-204)
AAI-57939-40128 Sheet 1 of 2	-	Drive Mechanism Installation
AAI-57939-40128 Sheet 2 of 2	-	Drive Mechanism Installation
AAI-57939-40142 Sheet 1 of 3	-	Roof Panel Installation Assembly
AAI-57939-40142 Sheet 2 of 3	-	Roof Panel Installation Assembly
AAI-57939-40142 Sheet 3 of 3	-	Roof Panel Installation Assembly

Solar Component Drawings
(Continued)

AAI-57939-40143 - Receiver Installation
Sheet 1 of 1

AAI-57939-40144 - Receiver Assembly
Sheet 1 of 1

AAI-57607-40107 - Electrical Schematic Amplifier - Sun
Sheet 1 of 1 Follower

AAI-57607-1A1A2 - Overheat - Defocus and Pump Control
Sheet 1 of 1 Logic (Schematic)

AAI-57607-1A1A3 - Sun Tracker Control Logic (Schematic)
Sheet 1 of 1

General Layout/MSR for Disney World

- ① REVERSING STARTER AT MCC 2
 ② ARKLA POWER DISCONNECT
 ③ CONSOLE POWER, OUTLET NEAR CONSOLE LOCATION.
 ④ 115V 60 Hz 1 Ø CONTROL SIGNAL FROM ARKLA TO CONDENSER WATER PUMP STARTER, VOLTAGE NOT SUPPLIED BY STARTER CONTROL TRANSFORMER.
 ⑤ VOLTAGE SUPPLIED BY STARTER CONTROL TRANSFORMER.

CABLE LIST

CABLE NO.	TYPE	SIZE	QUANTITY	FROM	TO
1	P	2	14	E ARKLA	CH10-2E C CONSOLE
2	P	2	14	C CONSOLE	1A2 E ARKLA CH10-2E
3	P	2	14	C CONSOLE	1A2 E H.W. PUMP STARTER PHWA-52E
4	S	3	20	✓ C	1A3 E H.W. TANK TOP RTD 3A1RTD1
5	S	2	20	✓ C	1A3 E CONDENSER WATER PUMP 3A1S1
6	S	3	20	✓ C	1A3 E C.W. TANK TOP RTD 3A1RTD3
7	S	3	20	✓ C	1A3 E C.W. TANK BOTTOM RTD 3A1RTD4
8	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S2
9	P	2	14	C	1A2 E H.W. TANK TOP RTD 3A1S3
10	S	2	20	✓ C	1A3 E C.W. TANK TOP RTD 3A1S4
11	P	2	14	C	1A2 E C.W. TANK TOP RTD 3A1S5
12	P	2	14	C	1A2 E C.W. TANK BOTTOM RTD 3A1S6
13	P	2	14	C	1A2 E C.W. TANK BOTTOM RTD 3A1S7
14	P	2	14	C	1A2 E C.W. TANK BOTTOM RTD 3A1S8
15	P	2	14	C	1A2 E C.W. TANK BOTTOM RTD 3A1S9
16	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S10
17	P	2	14	C	1A2 E C.W. TANK TOP RTD 3A1S11
18	P	2	14	C	1A2 E C.W. TANK TOP RTD 3A1S12
19	P	2	14	C	1A2 E C.W. TANK TOP RTD 3A1S13
20	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD1
21	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD2
22	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD3
23	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD4
24	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD5
25	S	3	20	✓ C	1A3 E H.W. TANK TOP RTD 3A1RTD6
26	S	2	20	✓ C	1A3 E H.W. TANK TOP RTD 3A1RTD7
27	S	2	20	✓ C	1A3 E H.W. TANK TOP RTD 3A1RTD8
28	S	3	20	✓ C	1A3 E H.W. TANK TOP RTD 3A1RTD9
29	S	2	20	✓ C	1A3 E H.W. TANK TOP RTD 3A1RTD10
30	P	2	14	C	1A2 E H.W. TANK TOP RTD 3A1RTD11
31	S	3	20	✓ C	1A3 E H.W. TANK TOP RTD 3A1RTD12
32	S	3	20	✓ C	1A3 E H.W. TANK TOP RTD 3A1RTD13
33	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S14
34	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S15
35	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S16
36	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S17
37	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S18
38	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S19
39	S	2	20	✓ C	1A3 D H.W. TANK TOP RTD 3A1S20
40	S	5	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD14
41	S	5	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD15
42	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD16
43	P	4	14	M	CONSOLE 3Ø POWER MCC 2
44	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD17
45	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD18
46	S	3	20	✓ C	1A3 R H.W. TANK TOP RTD 3A1RTD19
47	P	2	14	C	1A2 R H.W. TANK TOP RTD 3A1RTD20
48	P	2	14	C	1A2 R H.W. TANK TOP RTD 3A1RTD21
49	P	4	12	C	1A2 M 2Ø/120V 3Ø PWR SOURCE MCC 2
50	P	2	14	C	1A2 M 115V 1 Ø PWR SOURCE MCC 2
51	P	2	14	C	1A2 M 115V 1 Ø PWR SOURCE MCC 2
52	P	4	14	C	CONSOLE 1A2 M COLLECTOR AREA MCC 2

WIRE TYPE
 * PER MIL-W-16878 TYPE E
 ALL OTHER SIGNAL WIRES PER MIL-W-16878 TYPE B

LOCATION CODE
 E = EQUIPMENT AREA
 C = CONSOLE
 R = ROOF COLLECTOR AREA
 D = SECOND FLOOR BUXTS.
 M = MCC 2 (SEE REEDY CREEK UTILITY DWG E-501)

SECTION D-D
SCALE: 1/4
(COLLAR THROWN ROTATED FROM ACTUAL POSITION)

SECTION A-A
SCALE: 1/4

NOTES:

1. ITEMS 5 & 14 MUST BE MACHINED PER DWS. NO. 57939-40130-10 AND DWS. NO. 57939-40128-10 RESPECTIVELY, PRIOR TO ASSEMBLY HERE.
2. ITEM NOS. 5 AND 14 MUST BE ASSEMBLED PRIOR TO INSTALLATION OF SCREW JACK OR CHANNEL ASSY. 95 LBS. TO 1100 LBS. INDEX MARKS ON TORQUE TUBE ENDS (ALREADY INSTALLED) WITH INDEX MARKS ON DRIVE ARMS. THIS WILL INSURE PROPER ALIGNMENT OF SHOULDER SCREW HOLES. INDEX MARKS ON EAST END OF TORQUE TUBE MUST BE LOCATED PRIOR TO PLACEMENT OF ITEM 14 SINCE CAULK RATE ON ITEM 14 HIDES MARKS WHEN ASSEMBLED. APPLY CAULK AS NOTED IN SECTION A-A.
3. INSTALL TEMPORARY TOOLING STRUT (ITEM 17) TO ALIGN THE DRIVE ARMS IN THE VERTICAL POSITION. TOOLING STRUT SHOULD REMAIN IN PLACE UNTIL REEVE INSTALLATION (57939-40128) IS COMPLETE. ITEMS 17, 18, 19, 20 ARE FOR INSTALLATION ALIGNMENT ONLY. THEY MUST BE REMOVED PRIOR TO OPERATION OF SYSTEM.
4. AFTER DRAGSTAY (ITEM 1) AND DRIVE ARMS (ITEMS 5 AND 14) HAVE BEEN INSTALLED, THE CHANNEL ASSY. (ITEM 9) CAN BE ASSEMBLED. BE SURE THAT MATING SURFACES OF TORQUE BAR AND THE CHANNEL COLLAR ARE THOROUGHLY CLEANED,

- DEGREASED AND DRYED, APPLY A LIGHT COAT OF SILICON CARBIDE GRIT (CRYSTALINE) SIZE 800 FOUNDATIONS TO THROU HOLES PRIOR TO ASSY. ITEM 9. COVER ENTIRE AREA OF CONTACT. SEE NOTES 5/7.
5. TIGHTEN THE BOLTS ON THE DRAGSTAY END OF ITEM 9 PRIOR TO TIGHTENING THE BOLTS ON THE TORQUE BAR END.
6. APPLY TORQUE FOR 8-7/8 DIA. ANCHOR BOLTS: 230 FT. LBS.
7. ASSEMBLY TORQUE FOR 8-7/8 L9 TORQUE BAR BOLTS: 280 FT. LBS.
8. ASSEMBLY TORQUE FOR 4-5/8 DIA. CHANNEL ASSY. BOLTS: 280 FT. LBS.

VIEW C-C

NOTES:

1. THIS DRAWING SHOULD BE USED IN CONJUNCTION W/AST REPORT NO. ER-9008 "SOLAR SYSTEM ASSEMBLY AND INSTALLATION INSTRUCTIONS" DATED APRIL 1, 1977.
2. PANEL SUPPORT INSTALLATION PER DWG. NO. 57939-4006B MUST BE COMPLETE PRIOR TO ASSEMBLY OF THE ROOF PANELS. ALL WELDING & PAINTING MUST BE FINISHED. THE TORQUE TUBE MUST BE INSTALLED PRIOR TO ASSY. OF THE 9TH ROOF PANEL.
3. INSULATION (ITEM 25) OF THE PANEL SUPPORTS MUST BE DONE PRIOR TO ASSEMBLY OF THE ROOF PANELS. IT IS ALSO RECOMMENDED THAT THE END CLOSURE ANGLES (ITEMS 5 & 9) BE INSTALLED BEFORE THE ROOF PANELS. ITEMS 5 & 9 SHOULD BE ATTACHED TO THE CONCRETE BEAM USING PRE-DRILLED HOLES. ANY AVAILABLE 1/4" SCREWS AND ANCHORS CAN BE USED FOR THIS PURPOSE.
4. INSTALLATION OF THE ROOF PANELS MUST BEGIN AT THE SOUTH END OF THE BLDG. PART NO. 57939-40019-30 (ITEM 2) MUST BE INSTALLED 1ST. SUCCEEDING PANELS (ITEM 1) ARE THEN LOWERED INTO PLACE WORKING FROM SOUTH TO NORTH. ALL PANELS MUST BE HANDLED WITH A STRONGBACK WITH CABLES OF VARYING LENGTH SEE (ER 9008 FIGURES 12, 13 & 14). AFTER EACH PANEL IS PROPERLY POSITIONED AND ALIGNED 7 HOLES SHOULD BE DRILLED IN THE PANEL SUPPORTS AT EACH END, THRU THE 1/4" DIA. HOLES IN THE PANELS. A 3/4" DRILL (.709 DIA) SHOULD BE USED FOR THIS PURPOSE. SELF TAPPING SCREWS WITH 1" STAINLESS WASHERS (ITEMS 27 & 28) SHOULD BE INSTALLED IN THESE HOLES TO MAINTAIN CONTACT BETWEEN ROOF PANEL AND RUBBER SEAL. EACH PANEL SHOULD THEN BE DRILLED 32 PLCS. (2 HOLES ON EACH CORNER) FOR SHOULDER SCREWS (ITEMS 31, 22, 25, & 26) THESE HOLES MUST BE MATCHED DRILLED THRU EXISTING HOLES IN THE VERTICAL 1/4" PLATES IN THE PANEL SUPPORTS USING SPACERS (ITEM 31) AS DRILL BUSHINGS. THESE SPACERS WILL REMAIN IN PLACE AS THE NEXT PANEL IS ASSEMBLED.

(NOTES CONTINUED ON SHEET 2)

QTY	DESCRIPTION	QTY	DESCRIPTION
34	3/4" DIA. SCREWS	10	1/4" DIA. SCREWS
32	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
31	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
30	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
29	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
28	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
27	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
26	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
25	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
24	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
23	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
22	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
21	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
20	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
19	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
18	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
17	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
16	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
15	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
14	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
13	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
12	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
11	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
10	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
9	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
8	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
7	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
6	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
5	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
4	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
3	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
2	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS
1	1/4" DIA. SCREWS	10	1/4" DIA. SCREWS

DETAIL C
TYPICAL PANEL CONNECTION
17 PLACES
SCALE: 1/1

DETAIL B
CONNECTION NORTH END
OF BUILDING
SCALE: 1/1

DETAIL A
CONNECTION SOUTH END
OF BUILDING
SCALE: 1/1

NOTES: (CONT'D. FROM SHEET 1)

5. ATTACH UPPER ANGLES (ITEMS 6, 7, 8) TO INSULATION OF ROOF PANEL. THESE ANGLES MUST BE FASTENED TO THE INSULATION ONLY OF THE PANEL USING 8/16" UNF SCREWS THRU THE PREDRILLED HOLES IN THE ANGLES. MATCH DRILL A .50 DIA HOLE IN PANEL SKIN ONLY FOR UNF SCREWS. INSTALL END CLOSURES (ITEMS 31 & 32) WELD ALONG EACH END AND ATTACH BOTTOM COSE TO ANGLE WITH SELF TAPPING SCREWS AND WASHERS (ITEMS 32 & 33) ON 1FT. CENTER. CAULK JOINTS INDICATED, FILL THE END JOINTS WITH INSULATION, AND CLOSE OFF THE ANGLE USING PANELS (ITEMS 10 THRU 13) AND BRIDGING (ITEM 14 THRU 16). CLOSURE PANELS AND BRIDGING SHOULD BE ATTACHED USING SHORT METAL SCREWS OF ANY CONSUMABLE SIZE AS REQUIRED.
6. ITEMS 31 & 32: NYLON ROLLED WASHER & SEAL NYLON CORD OF AMERICA, 3/4" SOUTH CHINA AVE. S. PLAINFIELD, N.J. 07060
7. ITEM 33: CARBON-STEEL-ALUMINUM COATED STEEL - 093-307 CR. LAMBERT, MO.
8. ITEM 34: THERMAFIBER PACKING WOOL 2.0 LB. DENSITY AVE. WT. PER BAG 30 LBS. UNITED STATES GYPSUM IN. SOUTH WACKER DRIVE CHICAGO, ILL. 60606
9. ITEM 35: SHOULDER SCREW, HIGH GRADE ALLOY STEEL END PLATED FOR CO. 2-3254 TYPE I.
10. ITEMS 37, 38, 39 & 40: CONSTRUCTION FASTENERS WYOMISING, MO. 19610

N

- NOTES:**
1. THIS DWG. SHOULD BE USED IN CONJUNCTION WITH AAI REPORT NO. RE 9008, "SOLAR SYSTEM ASSEMBLY AND INSTALLATION INSTRUCTIONS," DATED APRIL, 1977.
 2. TOOLING STEUT (57939-40126) SHOULD BE IN PLACE TO INSURE PROPER ALIGNMENT OF RECEIVERS.
 3. TIE BARS, ITEM 5 & RECEIVERS, ITEM 9, SHOULD BE ASSEMBLED AT GROUND LEVEL. BE SURE THAT THE BRACKETS FOR THE RECEIVER SUPPORTS ARE ON THE SOUTH SIDE OF THE RECEIVERS. ALSO THE SHORT END OF THE TIE BARS MUST BE TOWARD THE CENTER (LINE, ITEM 5). THIS MEANS THAT THERE WILL BE (7) RECEIVERS WITH THE SHORT END OF THE TIE BAR FACING NORTH & (7) WITH THE SHORT ENDS FACING SOUTH. TIE BARS, ITEM 5, GO ON THE END RECEIVERS & SHOULD HAVE THEIR LONG END TOWARD THE CENTER.
 4. ATTACH RECEIVER SUPPORT, ITEM 1, (12) PLACES, TO STUDS ON PANEL SUPPORTS ALREADY IN PLACE.
 5. INSTALL LINE, ITEM 3.
 6. NEXT INSTALL RECEIVER-TIE BAR ASSEMBLIES (SEE NOTE 2, ABOVE) ALTERNATING FROM NORTH TO SOUTH SIDE OF CENTER TO BALANCE LOADS. PIPING CONNECTION ON RECEIVER MUST BE ON WEST SIDE OF BLDG.
 7. USE TURNBUCKLE CONNECTIONS TO ADJUST ALL RECEIVER SUPPORTS (ITEM 1) TO THE VERTICAL POSITION.
 8. WHEN INSTALLATION IS COMPLETE, BE CERTAIN THAT SECURANCE IS PROPERLY INSTALLED, THEN REMOVE TOOLING STEUT.

A - A

C - C

A - A

NO.	QTY.	DESCRIPTION	REVISION
1	1	RECEIVER SUPPORT	1
2	1	RECEIVER-TIE BAR ASSEMBLY	1
3	1	TURNBUCKLE CONNECTION	1
4	1	PIPE RACK SUPPORT	1
5	1	LINE TIE BAR	1
6	1	PIPE BAR ASSY.	1
7	1	PIPE BAR ASSY.	1
8	1	PIPE BAR ASSY.	1
9	1	PIPE BAR ASSY.	1
10	1	PIPE BAR ASSY.	1
11	1	PIPE BAR ASSY.	1
12	1	PIPE BAR ASSY.	1
13	1	PIPE BAR ASSY.	1
14	1	PIPE BAR ASSY.	1
15	1	PIPE BAR ASSY.	1
16	1	PIPE BAR ASSY.	1
17	1	PIPE BAR ASSY.	1
18	1	PIPE BAR ASSY.	1
19	1	PIPE BAR ASSY.	1
20	1	PIPE BAR ASSY.	1

21	8	10-32 UNF-284-1-6		SCREW ALTIMETER
20	8	10-32 UNF-284-1-6	M387938-07	SCREW ALTIMETER
19	8	10-32 UNF-284-1-6	M387938-07	SCREW ALTIMETER
18	10	10-32 UNF-1-6	M387938-07	SCREW ALTIMETER
17	10	10-32 UNF-1-6	M387938-07	SCREW ALTIMETER
16	10	10-32 UNF-1-6	M387938-07	SCREW ALTIMETER
15	20	10-32 UNF-1-6	M387938-07	SCREW ALTIMETER
14	20	10-32 UNF-1-6	M387938-07	SCREW ALTIMETER
13	20	10-32 UNF-1-6	M387938-07	SCREW ALTIMETER
12	1	37789-40085-1-0		SCREW ALTIMETER
11	8	-40188-1		SCREW ALTIMETER
10	8	-40188-1		SCREW ALTIMETER
9	10	-40188-1		SCREW ALTIMETER
8	10	-40188-1		SCREW ALTIMETER
7	1	-40188-1		SCREW ALTIMETER
6	7	-40084-1		SCREW ALTIMETER
5	1	-40084-1		SCREW ALTIMETER
4	2	-40084-1		SCREW ALTIMETER
3	1	-40084-1		SCREW ALTIMETER
2	8	-40084-1		SCREW ALTIMETER
1	2	37789-40085-1-0		SCREW ALTIMETER

APPENDIX E

INSTRUMENTATION PROGRAM AND COMPONENTS LIST

REVISIONS

CHK	ENGRG NOTICE	LTR	DESCRIPTION	DATE	APPROVED
	66333RH	-	RELEASE	5/26/77	RED
R	66348 GR	A	COMPLETE REVISION TO MOD II SDAS REQUIREMENTS & RE-NUMBER PAGES 17 TO 30.	11/21/77	VG/WE
R	66348NT	B	REV PAGE 5-CORRECT PHONE NO. REV PAGE 7-COL. 7. REV PAGE 8-COL 9. REV PAGE 13-COL 7, DEFINITION. REV PAGE 14-COL 9 DEFINITION. REV PAGE 16-ADD NOTE 5. REV PAGE 24-CHANGE TEMP & DIFF TEMP QUANTITIES. REV PAGES 23 TO 30-CHANGE TDs TO Ts, REDEFINE "A" CHANS, ADD "T" CORR & SCALE FACTORS, AND ADD CORR VALUES TO IOO1 & IOO2.	1/26/8	
R	66348ZV	C	Rev page 8 col 9. Rev page 16 add notes 6 & 7. Rev pages 25 thru 29. Change T coefficients for Meas. No. T300, T555, & T553. Rev channel 7 delete T300 add spare. Rev channel 34 change scale factor. Rev channel 48 delete spare add T300. Delete pages 30 & 31.	3/23/8	HE/VJ

CONTR NO. NASS-32036		INTERNATIONAL BUSINESS MACHINES CORP.	
PREPARATION J. DWIGGINS		FEDERAL SYSTEMS DIVISION	
DSGN CHK		HUNTSVILLE, ALABAMA 35807	
DWG CHK		TITLE	
DSGN APPROVAL E. VAN		INSTRUMENTATION PROGRAM-	
12		REEDY CREEK UTILITIES-DISNEY WORLD	
SIZE A	CODE IDENT NO. 20234	DWG NO. IP 7933707	
SCALE	WT	SHEET 1 of 29	

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK UTILITIES
IP 7933707

5/26/77
REV _____

INTRODUCTION

THIS DOCUMENT DEFINES AND CONTROLS THE MEASURING REQUIREMENTS AND INSTRUMENTATION SYSTEM APPLICATIONS FOR A SOLAR HEATING AND COOLING OPERATIONAL SITE.

THE SECTIONS OF THIS DOCUMENT ARE DESCRIBED AS FOLLOWS:

1. PREAMBLE SECTION -- CONTAINS DESCRIPTIONS, EXPLANATIONS, INSTRUCTIONS AND DIAGRAMS NECESSARY TO UNDERSTAND THIS DOCUMENT AND THE APPLICATION OF THE DATA COLLECTION SYSTEM TO A SPECIFIC SITE.
2. INSTRUMENTATION COMPONENTS SECTION -- LISTS ALL HARDWARE ELEMENTS OF THE DATA COLLECTION EQUIPMENT NOT SUBSEQUENTLY LISTED IN THE MEASUREMENTS SECTION.
3. MEASUREMENTS SECTION -- LISTS ALL MEASUREMENTS WHICH ORIGINATE IN A SOLAR HEATING AND COOLING OPERATIONAL SITE WITH APPROPRIATE INFORMATION FOR EACH MEASUREMENT.

INSTRUMENTATION PROGRAM AND COMPONENTS LIST

REEDY CREEK UTILITIES
IP7933707

03/23/78
REV C

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IP 7933707

5/26/77
REV

PREAMBLE SECTION

INSTRUMENTATION PROGRAM AND COMPONENTS LIST: REEDY CREEK UTILITIES
IP 7933707

1/26/78
REV B

OPERATIONAL SITE IDENTIFICATION

1. SITE NAME: REEDY CREEK UTILITIES--DISNEY WORLD
2. PON: 2126
3. SITE NUMBER: 0018
4. SITE SDAS TELEPHONE NUMBER: 305-824-3534
5. SITE ADAS COMPUTER ADDRESS: 062
6. SITE ADDRESS: CENTRAL ENERGY PLANT OFFICE BLDG.
7. LOCATION: LAKE BUENA VISTA, FLA.
8. SYSTEM DESIGNER: AAI CORP. BALTIMORE, MD.
9. SYSTEM TYPE: SOLAR HEATING AND COOLING
10. FLUID MEDIA: WATER

INSTRUMENTATION PROGRAM AND COMPONENTS LIST:

REEDY CREEK UTILITIES

IP 7933707

11/7/77REV AASSOCIATED DOCUMENTS

1. SOLAR HEATING AND COOLING INSTRUMENTATION INSTALLATION GUIDELINES, OCTOBER 1, 1977.
2. ☐ SITE DATA ACQUISITION SUBSYSTEM PERFORMANCE SPECIFICATION, MAY 14, 1976, IBM NO. 7932905.
☒ SITE DATA ACQUISITION SUBSYSTEM MODEL II, PERFORMANCE SPECIFICATION, 7934354.
☐ SITE DATA ACQUISITION PERFORMANCE SPECIFICATION. ACUREX MODEL.
3. CENTRAL DATA PROCESSING SOFTWARE PERFORMANCE SPECIFICATION, JULY 28, 1976, IBM NO. 7933251.
4. THERMAL DATA REQUIREMENTS AND PERFORMANCE EVALUATION PROCEDURES FOR THE NATIONAL SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM, AUGUST, 1976 (NBSIR-76-1137).
5. JUNCTION BOX PERFORMANCE SPECIFICATION, OCTOBER 26, 1976, IBM NO. 7933446.
6. ON SITE MONITOR (OSM) OPERATION MANUAL, OCTOBER 17, 1977, IBM NO. 7934365.

MEASUREMENTS LEGEND

THE LEGEND FOR THE DATA LISTED IN THE MEASUREMENTS SECTION OF THIS DOCUMENT IS AS FOLLOWS:

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6	COLUMN 7
LINE	MEAS NUMBER OSM CODE	MEASUREMENT NAME	CHANNEL #	ASYN	# WIRES	OPERATING RANGE SENSOR OUTPUT SDAS GAIN ACTUAL OPER RANGE

INSTRUMENTATION PROGRAM AND COMPONENTS LIST:

REEDY CREEK UTILITIES

IP 7933707

03/23/78

REV C

MEASUREMENTS LEGEND (CONTINUED)

COLUMN 8	COLUMN 9	COLUMN 10	COLUMN 11
MICROBRD TYPE MICROBRD P/H SENSOR EXCIT	TEMP SERIAL # SCALE FACTOR UNITS CDPS SCALE FACTOR, (A0,A1,A2,A3)	SENSOR TYPE SENSOR MANUFACT SENSOR P/H WELL P/H	NOTES SERIAL # CROSS SECTION AREA

THE COLUMN HEADINGS ARE DEFINED ON THE FOLLOWING SHEETS.

INSTRUMENTATION PROGRAM AND COMPONENTS LIST REEDY CREEK UTILITIES
IP 7933707

11/7/77
REV A

COLUMN 1. LINE NUMBER

THIS COLUMN IS USED FOR AUTOMATIC PRINTOUT DATA CONTROL AND LINE IDENTIFICATION.

COLUMN 2. (MULTIPLE DATA SETS)

THIS COLUMN CONTAINS TWO DATA SETS AS DEFINED BELOW:

MEAS NUMBER. THE FIRST LINE OF THIS COLUMN LISTS EACH MEASUREMENT WHICH IS IDENTIFIED BY A UNIQUE ALPHANUMERIC CODE CONSISTING OF TEN CHARACTERS AS FOLLOWS:

FIELD NO.	1	2	3	4
MEASUREMENT NO.	XY	001	-	0001

AN ASTERISK (*) FOLLOWING THE MEASUREMENT NUMBER DENOTES A CHANGE FROM THE PREVIOUS RELEASE.

OSM CODE. THE SECOND LINE OF THIS COLUMN LISTS THE ON SITE MONITOR SWITCH SETTING TO DISPLAY ENGINEERING UNIT DATA. THIS IS TO BE USED WITH ASSOCIATED DOCUMENT 6 AND THE GENERAL NOTES ON PAGE 1.6 OF THIS DOCUMENT.

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INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK UTILITIES

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A. FIELD NO. 1 - PARAMETER TYPE

CODE	PARAMETER	UNITS	ABB
D D	WIND DIRECTION SWITCH	DEGREES - AZIMUTH DEGREES - ON/OFF	DEG DEG
EP	ELECTRICAL POWER	KILOWATTS	KW
F F	FLOWRATE (NATURAL GAS) FLOWRATE (FUEL OIL)	FEET ³ /MINUTE GAL/MINUTE	SCFM GPM
I	SOLAR FLUX	BTU PER FOOT ² X HOUR	BTU/FT ² - HR
RH	HUMIDITY	PERCENT	PER
SP	SPARE	N/A	N/A
T	TEMPERATURE	DEGREES FAHRENHEIT	DEG F
TD	DIFFERENTIAL TEMPERATURE	DEGREES FAHRENHEIT	DEG F/DT
W W	FLOWRATE (LIQUID) FLOWRATE (AIR)	GALLONS PER MINUTE, CUBIC FEET PER MINUTE	GPM CFM
V	WIND SPEED	MILES PER HOUR	MPH
PD	DIFFERENTIAL PRESSURE	POUNDS PER SQ. INCH	PSI

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B. FIELD NO. 2 - PARAMETER SEQUENCE

A NUMERIC GROUPING WHICH DESIGNATES THE SEQUENTIAL NUMBER OF A MEASUREMENT WITHIN EACH SUBSYSTEM. THE SEQUENTIAL NUMBER OF EACH MEASUREMENT CONFORMS TO THE PATTERN ESTABLISHED IN FIGURE 3-1 OF SHC-1006. SEQUENTIAL NUMBER ALLOCATIONS ARE AS FOLLOWS:

<u>NUMERIC SEQUENCE</u>	<u>SUBSYSTEM</u>
001-099	CLIMATOLOGICAL
100-199	COLLECTOR
200-299	THERMAL STORAGE
300-399	DOMESTIC HOT WATER
400-499	SPACE HEATING
500-599	SPACE COOLING
600-699	BUILDING/LOAD

C. FIELD NO. 3 - SEPARATOR

FOR NUMERIC CLARITY.

D. FIELD NO. 4 - SITE IDENTIFIER

A NUMERIC GROUPING WHICH DESIGNATES THE SITE IN WHICH THE MEASUREMENT IS LOCATED.

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COLUMN 3. MEASUREMENT NAME

THIS COLUMN LISTS THE MEASUREMENT NAME USED TO DESCRIBE THE DATA SOURCE.

COLUMN 4. CHANNEL NUMBER

THIS COLUMN DEFINES THE SDAS CHANNEL ASSIGNED TO EACH MEASUREMENT. CHANNEL 1 IS RESERVED FOR AN SDAS INTERNAL CALIBRATION OFFSET MEASUREMENT.

COLUMN 5. ASYN

THIS COLUMN DEFINES EACH MEASUREMENT WHICH IS ASYNCHRONOUSLY SAMPLED AND IS INDICATED BY THE LETTER "A". THESE MEASUREMENTS ARE SAMPLED EACH 32 SECONDS WITH THE AVERAGED VALUE PER 5 MINUTES MAINTAINED FOR TRANSMISSION. SYNCHRONOUSLY SAMPLED MEASUREMENTS ARE READ ONCE PER 5 MINUTES AND ARE IDENTIFIED BY THE " - " SYMBOL.

COLUMN 6. NUMBER WIRES

THIS COLUMN DEFINES THE NUMBER OF WIRES PER CHANNEL USED IN THE SDAS. EITHER 3 WIRE OR 2 WIRE OR ALL 3 WIRE CHANNELS ARE AVAILABLE VIA A PRE-DEFINED CONFIGURATION.

COLUMN 7. (MULTIPLE DATA SETS)

THIS COLUMN CONTAINS FOUR DATA SETS AS DEFINED BELOW:

OPERATING RANGE - THE FIRST LINE OF THIS COLUMN DESCRIBES THE OPERATING RANGE OF THE PARAMETER IN ENGINEERING UNITS.

SENSOR OUTPUT RANGE - THE SECOND LINE OF THIS COLUMN DESCRIBES THE OUTPUT RANGE IN VOLTS OF THE SENSOR.

SDAS GAIN - THE THIRD LINE OF THIS COLUMN DESCRIBES THE SDAS GAIN SELECTED FOR EACH CHANNEL.

ACTUAL OPER RANGE - THE FOURTH LINE OF THIS COLUMN IS APPLICABLE TO ABSOLUTE TEMPERATURES ONLY(AFTER CORRECTION COEFFICIENTS ARE APPLIED.)

COLUMN 8: (MULTIPLE DATA SETS)

THIS COLUMN CONTAINS THREE DATA SETS AS DEFINED BELOW:

MICROBRD TYPE - THE FIRST LINE OF THIS COLUMN DESCRIBES THE TYPE OF MICROBOARD USED FOR SIGNAL CONDITIONING OF THE EMPLOYED SDAS CHANNEL.

MICROBRD P/N - THE SECOND LINE OF THIS COLUMN DESCRIBES THE PART NUMBER OF THE MICROBOARD USED FOR SIGNAL CONDITIONING OF THE EMPLOYED SDAS CHANNEL. A NON-DEFINED MICROBOARD P/N INDICATES THAT THIS CHANNEL SHARES A MICROBOARD WITH ANOTHER CHANNEL WHICH WILL DEFINE THE P/N.

SENSOR EXCIT - THE THIRD LINE OF THIS COLUMN DESCRIBES THE EXCITATION REQUIREMENTS FOR EACH SENSOR, IF REQUIRED.

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COLUMN 9. (MULTIPLE DATA SETS)

THIS COLUMN CONTAINS THREE DATA SETS AS DEFINED BELOW:

TEMP SERIAL # - THE FIRST LINE OF THIS COLUMN DESCRIBES THE TEMPERATURE PROBE SERIAL NUMBER (IF AVAILABLE).

SCALE FACTOR UNITS - THE SECOND LINE OF THIS COLUMN DESCRIBES THE ENGINEERING UNITS MAINTAINED IN THE CDPS FOR EACH MEASUREMENT.

CDPS SCALE FACTOR -- THE THIRD AND FOURTH LINES OF THIS COLUMN DESCRIBE THE NUMERIC SCALE FACTOR(S) USED IN THE CENTRAL DATA PROCESSING SYSTEM (CDPS) TO CONVERT EACH MEASUREMENT TO ENGINEERING UNITS.

COLUMN 10. (MULTIPLE DATA SETS)

THIS COLUMN CONTAINS FOUR DATA SETS AS DEFINED BELOW:

SENSOR TYPE - THE FIRST LINE OF THIS COLUMN LISTS THE TYPE (NAME) OF THE EMPLOYED SENSOR.

SENSOR MANUFACT - THE SECOND LINE OF THIS COLUMN LISTS THE SENSOR MANUFACTURER.

SENSOR P/N - THE THIRD LINE OF THIS COLUMN LISTS THE PART NUMBER OF THE SENSOR.

WELL P/N - THE FOURTH LINE OF THIS COLUMN DESCRIBES THE PART NUMBER OF A THERMAL WELL IF REQUIRED FOR THE DEFINED SENSOR.

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COLUMN 11. (MULTIPLE DATA SETS)

NOTES - THE FIRST LINE OF THIS COLUMN DEFINES ANY INFORMATION REQUIRED TO SUPPORT CLARIFICATION OF THE MEASUREMENT.

SERIAL # - THE SECOND LINE OF THIS COLUMN DEFINES AN ITEM UNIQUE SERIAL NUMBER MARKED BY THE MANUFACTURER.

CROSS SECTION AREA - THE THIRD LINE OF THIS COLUMN DEFINES THE CROSS SECTIONAL AREA OF A DUCT IN SQUARE FEET.

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GENERAL NOTES

NOTE 1 - DATA NOT CURRENTLY DEFINED.

NOTE 2 --ENGINEERING UNIT VALUES MUST BE CALCULATED USING COUNTS & SCALE FACTORS.

NOTE 3 - LIQUID FLOW WITHIN $\pm 5\%$ OF DISPLAYED VALUE.

NOTE 4 - INSULATION WITHIN ± 5 BTU OF DISPLAYED VALUE.

NOTE 5 - POWER MEASUREMENT RANGE VALUES & SCALE FACTORS ARE HALVED DUE TO FOUR TURNS THRU TRANSDUCERS.

NOTE 6 - POWER MEASUREMENT RANGE VALUES & SCALE FACTORS ARE REDUCED DUE TO MULTIPLE TURNS THRU TRANSDUCERS.

NOTE 7 - VALUES APPEAR ON ATTACHED PAGES AT THE REAR OR END OF THESE LISTINGS.

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INSTRUMENTATION PROGRAM AND COMPONENTS LIST

DATA COLLECTION SYSTEM

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INSTRUMENTATION COMPONENTS SECTION

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REV A

<u>EQUIPMENT NAME</u>	<u>PART NUMBER</u>	<u>SERIAL NUMBER</u>
-----------------------	--------------------	----------------------

JUNCTION BOX	#1 <u>7933657</u>	#1 _____
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CABLES (J-BOX TO SDAS)	#2 _____	
------------------------	----------	--

NO. 1	<u>7933654</u>	
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NO. 2	<u>7933653-1</u>	
-------	------------------	--

NO. 3	<u>7933653-2</u>	
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NO. 4	<u>7933653-3</u>	
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NO. 5	_____	
-------	-------	--

NO. 6	_____	
-------	-------	--

NO. 7	_____	
-------	-------	--

SDAS	<u>7934400-2</u>	_____
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IBM DRAWING NUMBER	<u>7933707</u>	
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MEASUREMENTS SECTION

18M07

INSTRUMENTATION PROGRAM AND COMPONENTS LIST:

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REV B

MEASUREMENT SUMMARY

<u>PARAMETER</u>	<u>NUMBER</u>
WIND DIRECTION	--
ELECTRICAL POWER	9
FLOWRATE (NATURAL GAS)	--
SOLAR FLUX	2
HUMIDITY	--
SPARE	(2)
TEMPERATURE	26
DIFFERENTIAL TEMPERATURE	--
FLOWRATE (LIQUID/AIR)	8
WIND SPEED	--
TOTAL	45

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REPORT BY CHANNEL ASSIGNMENT

LINE	MEAS NUMBER	MEASUREMENT NAME	C H A N N E L	#	OPERATING RANGE	MICROPRO TYPE	TEMP SERIAL #	SCALE FACTOR UNITS	SENSOR TYPE	NOTES
1	USM CODE	NAME	4	N	ACTUAL OPER RANGE	SENSOR EXCIT	(A0, A1, A2, A3)		SENSOR MANUFACT	SERIAL #
1	T402 -0018	SPACE HEATING	02	- 3	30-230 DEGF	BRIDGE	0013		PRT	
2		SUPPLY TEMP			0-100 MV	7932988	DEGF/BIT		NINCO	
3	0202				50		+3222837E-05		S53P40236	
4							+1947638E-07		F203010	
5							+0004392E-09			
6							+0001628E-13			
7	T452 -0018	SPACE HEATING	03	- 3	30-230 DEGF	BRIDGE	0006		PRT	
8		RETURN TEMP			0-100 MV	7932988	DEGF/BIT		NINCO	
9	0302				50		+1263187E-05		S53P40236	
10							+1939427E-07		F203010	
11							+0004335E-09			
12							+0001598E-13			
13	T350 -0018	DIRTY OIL OUTLET	04	- 3	30-230 DEGF	BRIDGE	0007		PRT	
14		TEMP			0-100 MV	7932988	DEGF/BIT		NINCO	
15	0402				50		+3222639E-05		S53P40236	
16							+1952005E-07		F203010	
17							+0004406E-09			
18							+0001645E-13			
19	T521 -0018	APKLA CONDENSER	05	- 3	30-160 DEGF	BRIDGE	0003		PRT	
20		WATER OUTLET			0-100 MV	7932988	DEGF/BIT		NINCO	
21	0501				50		+3367169E-05		S53P40236	
22							+1289937E-07		F203015	
23							+0002046E-09			
24							+0004931E-14			
25	EP101-0018	COLLECTOR PUMP	06	A 3	0-4 KW	STRAIGHT	0003		WAIT XDCP	
26		POWER			0-100 MV	7932985	KW/BIT		CHILD SEMITRONICS	
27	NOTE 2				50		0		PC5-6	
28							+0039100E-07			
29	SPO02-0018	*SPARE	07	- 3	N/A	SHORT	N/A		N/A	
30					N/A	7932939	N/A		N/A	
31					50					
32										
33										
34										
35	T501 -0018	APKLA CONDENSER	08	- 3	30-160 DEGF	BRIDGE	0014		PRT	
36		WATER INLET TEMP			0-100 MV	7932990	DEGF/BIT		NINCO	
37	0801				50		+3181548E-05		S53P40236	
38							+1253401E-07		F203015	
39							+0002146E-09			
40							+0005122E-14			

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REPORT BY CHANNEL ASSIGNMENT

LINE	MEAS NUMBER	MEASUREMENT NAME	CHANNEL	SENSOR TYPE	OPERATING RANGE		MICROHARD TYPE	TEMP SERIAL #	SCALE FACTOR	UNITS	SENSOR TYPE	SENSOR MANUFACT	NOTES
					SENSOR OUTPUT RANGE	SENSOR GAIN							
LINE	DSM CODE	NAME	CHANNEL	SENSOR TYPE	ACTUAL OPER RANGE		SENSOR P/N	EXCIT	(A0,A1,A2,A3)		WELL P/N	CROSS SECTION AREA	
1	EP102-0018	TRACKER MOTOR	09	A	3	0-4	KW	STRAIGHT			WATT XDCR		
2		POWER				0-100	MV	7932985			0110 SEMITRONICS		
3	NOTE 2					50					PCS-A		
4													
5	T001-0018	OUTDOOR AMBIENT	10	-	3	-20-120	DEGF	BRIDGE			PRT		
6		TEMP				0-100	MV	7932986			MINCO		
7	1000					50					S53P85236		
8						-10.247 / +119.42					N/A		
9													
10													
11	T100-0018	COLLECTOR INLET	11	-	3	30-450	DEGF	BRIDGE			PRT		
12		TEMP				0-100	MV	7932987			MINCO		
13	1103					50					S53P40736		
14						+31.953 / +455.54					F203015		
15													
16													
17	T150-0018	COLLECTOR APPRAY	12	-	3	30-450	DEGF	BRIDGE			PRT		
18		OUTLET TEMP				0-100	MV	7932987			MINCO		
19	1203					50					S53P40236		
20						+31.637 / +449.09					F203015		
21													
22													
23	T102-0018	COLLECTOR SURFA	13	-	3	30-450	DEGF	BRIDGE			PRT		
24		CE TEMP				0-100	MV	7932987			MINCO		
25	1303					50					S34A736		
26						+31.999 / +449.55					DC96-380		
27													
28													
29	T201-0018	HW STORAGE TANK	14	-	3	30-450	DEGF	BRIDGE			PRT		
30		TOP TEMP				0-100	MV	7932987			MINCO		
31	1403					50					S53P180236		
32						+31.999 / +449.55					F2030154		
33													
34													
35	T202-0018	HW STORAGE TANK	15	-	3	30-450	DEGF	BRIDGE			PRT		
36		MIDDLE TEMP				0-100	MV	7932987			MINCO		
37	1503					50					S53P180236		
38						+31.999 / +449.55					F2030154		
39													
40													

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REPORT BY CHANNEL ASSIGNMENT

LINE	MEAS NUMBER	MEASUREMENT NAME	C H A N N E L	A S S I G N M E N T	OPERATING RANGE SENSOR OUTPUT RANGE SDAS GAIN ACTUAL OPER RANGE	MICROBRD TYPE MICROBRD P/N SENSOR EXCIT	TEMP SERIAL # SCALE FACTOR UNITS CPDS SCALE FACTORS (A1, A2, A3)	SENSOR TYPE SENSOR MANUFACT SENSOR P/N WELL P/N	NOTES SERIAL # CROSS SECTION AREA
1 2 3 4	W100 -0010 1666	COLLECTOR APPRAY FLOW RATE	16	- 3	0-197.1 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/RTT 0. +1247817E-05 SOCT	FLOW METER RAMAPO MKV-3-W01	S/N-4337
5 6 7 8	W300 -0019 1771	DHW SOLAR FLOW RATE	17	- 3	0-9.90 GPM 0-30 MV 50	STRAIGHT 7932985 +5 VDC	GPM/RTT 0. +5648390E-07 SOCT	FLOW METER RAMAPO MKV-1-J01	S/N-4215
9 10 11 12	W301 -0010 1871	DHW SUPPLY FLOW RATE	18	- 3	0-9.93 GPM 0-30 MV 50	STRAIGHT 7932985 +5 VDC	GPM/RTT 0. +5608452E-07 SOCT	FLOW METER RAMAPO MKV-1-J01	S/N-4230
13 14 15 16	1001 -0010 1922	COLLECTOR PLANE TOT INSOLAT	19	A 3	0/362.06 BTU/FT2-HR 0-12 MV 50	CAPACITOR 7934363	B/F2-H/PIT 0. 2:9529899	PIPERNOM FPPLEY PSP	15350F3
17 18 19 20 21 22	1554 -0010 2000	CHILL H2O COIL OUTLET TEMP	20	- 3	-20/120 DEGF 0-100 MV 50 -18.049 /+121.01	BRIDGE 7932986	0010 DEGF/RTT -1804971E-05 +1334917E-07 +0002330E-09 +0006066E-14	PRT MINCO S53P40236 F203U10	
23 24 25 26 27 28	1504 -0010 2100	CHILLED WATER SUPPLY IN TMP	21	- 3	-20-120 DEGF 0-100 MV 50 -18.101 /+120.85	BRIDGE 7932986	0016 DEGF/RTT -1810160E-05 +1333899E-07 +0002325E-09 +0006103E-14	PRT MINCO S53P40236 F203U10	
29 30 31 32 33 34	1206 -0010 2200	CW STORAGE TANK BOTTOM TEMP	22	- 3	-20-120 DEGF 0-100 MV 50 -19.027 /+119.85	BRIDGE 7932986	DEGF/RTT -1902760E-05 +1333191E-07 +0002326E-09 +0006066E-14	PRT MINCO S53P180236 F203U154	
35 36 37 38 39 40	1302 -0010 2302	DHW SUPPLY TEMP	23	- 3	30-230 DEGF 0-100 MV 50 +32.451 /+235.55	BRIDGE 7932986	0011 DEGF/RTT +3245118E-05 +1934359E-07 +0004337E-09 +0001590E-13	PRT MINCO S53P40236 F203U10	

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REPORT BY CHANNEL ASSIGNMENT

L	MEAS NUMBER	MEASUREMENT	C	A	M	OPERATING RANGE	MICROBRO TYPE	TEMP SERIAL #	SENSOR TYPE	NOTES
H			A	S	I	SENSOR OUTPUT RANGE	MICROBRO P/N	SCALE FACTOR UNITS	SENSOR MANUFACT	
E	ISH CODE	NAME	N	Y	R	SDAS GAIN	SENSOR EXCIT	CPDS SCALE FACTORS	SENSOR P/N	SERIAL #
			#	N	F	ACTUAL OPER RANGE		(A0,A1,A2,A3)	WELL P/N	CROSS SECTION AREA
1	LP504-0018	CHILLED WATER	24	A	3	0-4 KW	STRAIGHT		WATT XDCR	
2		COIL PUMP PHP				0-100 MV	7932985	KW/BIT	OHIO SEMITECHNICS	
3	NOTE 2					50		0.	PC5-6	
4								+0039100E-07		
5	W502-0018	APKLA HW	25	-	3	0-120.3 GPM	STRAIGHT		FLOW METER	
6		FLOW RATE				0-10 MV	7932985	GPM/BIT	RAMAPO	S/N-4314
7	2563					50	+5 VDC	0.	HKV-2-1/2W01	
8								+1108851E-05 SQCT		
9	W503-0018	APKLA EVAPOR	26	-	3	0-105.26 GPM	STRAIGHT		FLOW METER	
10		WATER FLW RTE				0-10 MV	7932985	GPM/BIT	RAMAPO	S/N-4340
11	2666					50	+5 VDC	0.	HKV-3-W01	
12								+1929635E-05 SQCT		
13	SPO01-0018	SPARE	27	-	3	N/A	SHORT		N/A	
14						N/A	7932985	N/A	N/A	
15						50		N/A		
16										
17										
18										
19	1502-0018	APKLA GEN WATER	28	-	3	30-230 DEGF	BRIDGE	0117	PRT	
20		INLET TEMP				0-100 MV	7932988	DEGF/BIT	MINCO	
21	2802					50		+319908E-05	S57P40236	
22						+32.000 /+234.60		+1932930E-07	F203010	
23								+0004307E-09		
24								+0001554E-13		
25	1502-0018	APKLA GEN WATER	29	-	3	30-230 DEGF	BRIDGE	0012	PRT	
26		OUTLET TEMP				0-100 MV	7932988	DEGF/BIT	MINCO	
27	2902					50		+3150315E-05	S53P40236	
28						+31.533 /+234.62		+1939477E-07	F203010	
29								+0004307E-09		
30								+0001570E-13		
31	LP401-0018	HW SUPPLY PUMP	30	A	3	0-4 KW	STRAIGHT		WATT XDCR	
32		POWER				0-100 MV	7932985	KW/BIT	OHIO SEMITECHNICS	
33	NOTE 2					50		0.	PC5-6	
34								+0039100E-07		
35	1503-0018	APKLA CHILLED	31	-	3	30-160 DEGF	BRIDGE	0018	PRT	
36		WATER OUT TMP				0-100 MV	7932990	DEGF/BIT	MINCO	
37	3101					50		+3063262E-05	S57P40236	
38						+30.632 /+159.63		+1239067E-07	F203015	
39								+0002291E-09		
40								+0005269E-14		

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+0004307E-09
+0003604E-14

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REPORT BY CHANNEL ASSIGNMENT

LINE NO.	CHAS. NO.	MEASUREMENT NAME	C	#	OPERATING RANGE	SENSOR OUTPUT RANGE	MICROPROCESSOR TYPE	TEMP. SERIAL #	SCALE FACTOR UNITS	SENSOR TYPE	NOTES
1	2	3	4	5	6	7	8	9	10	11	12
1	2	3	4	5	6	7	8	9	10	11	12
1	1003	0018	*	12	- 4	30.100 DEGR	BRIDGE	DEGR/RTT		RTT	
2						0-100	7932990			RTT	
3	3201					50		+3218054E-05		S532180236	
4								+1231077E-07		F2030156	
5						+32.100 /+161.42		+0002058E-07			
6								+0005168E-14			
7	1004	0018	*	33	A	3	07.00.97 RTU/F12-HP	CAPACITOR		BYRONOM	
8						0-10	7934363	0/F12-H/RTT		FOOLEY	1527383
9	3524					50		0.		930	
10								3.1003417			
11	0001	0018	*	34	-	3	07.00.97 GPM	STRAIGHT		FLOW METER	
12						0-15	7932335	GPM/RTT		PANAPH	6502
13	NOTE 2					50	+5 VDC	0		MRV-1-1/4J01	
14								+7923670	SQRT		
15	0001	0018	*	35	-	3	07.00.97 GPM	STRAIGHT		FLOW METER	
16						0-10	7932985	GPM/RTT		PANAPH	574-46.24
17	3205					50	+5 VDC	0		MRV-3-W01	
18								+1475047E-05	SQRT		
19	0004	0018	*	36	-	3	07.00.97 GPM	STRAIGHT		FLOW METER	
20						0-10	7932985	GPM/RTT		PANAPH	574-46.24
21	NOTE 2					50	+5 VDC	0		MRV-2-1/4W01	
22								+5529530E-05	SQRT		
23	1005	0018	*	37	-	3	30-950 DEGR	BRIDGE		RTT	
24						0-100	7932997	DEGR/RTT		RTT	
25	3733					50		+3190974E-05		S532180236	
26								+3015571E-07		F2030156	
27						+311.000 /+440.55		+1231077E-07			
28								+0001600E-08			
29								+0001170E-12			
30	1006	0018	*	38	-	3	07.00.97 DEGR	BRIDGE		RTT	
31						0-100	7932985	DEGR/RTT		RTT	
32						50		+1902760E-05		S532180236	
33								+1333101E-07		F2030156	
34						+10.000 /+110.00		+0002058E-07			
35								+0005168E-14			
36	1007	0018	*	39	-	3	07.00.97 DEGR	BRIDGE		RTT	
37						0-100	7932985	DEGR/RTT		RTT	
38	3500					50		+1902760E-05		S532180236	
39								+1333101E-07		F2030156	
40						+10.000 /+110.00		+0002058E-07			
41								+0005168E-14			

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK IP7933707

03/23/78

PFV: C

PAGE:

REPORT BY CHANNEL ASSIGNMENT

L I N E	MEAS NUMBER	MEASUREMENT NAME	C H A N N E L	A S S I G N M E N T	OPERATING RANGE SENSOR OUTPUT RANGE SDAS GAIN ACTUAL OPER RANGE	MICROBRD TYPE MICROBRD P/N SENSOR EXCIT	TEMP SERIAL # SCALE FACTOR UNITS CPDS SCALE FACTORS (A0,A1,A2,A3)	SENSOR TYPE SENSOR MANUFACT SENSOR P/N WELL P/N	NOTES SERIAL # CROSS SECTION AREA
1 2 3 4 5 6	1505 -0018 4030	CHILLED WAT TK OUTLET TEMP	40	- 3	-20/120 DEGF 0-100 MV 50 -19.063 /+119.79	BRIDGE 7932986	0019 DEGF/BIT -1906364E-05 +1332947E-07 +0002325E-09 +0006075E-14	PRT MINCO S57-P40236 F203U15	
7 8 9 10 11 12	1555 -0018 4100	*CHILLED WATER TANK RETURN TEMP	41	- 3	-20/120 DEGF 0-100 MV 50 -18.878 /+119.80	BRIDGE 7932986	DEGF/BIT -1887849E-05 +1331262E-07 +0002319E-09 +0005899E-14	PRT MINCO S53P40236 F203U15	
13 14 15 16 17 18	1600 -0018 4201	RETURN AIR TEMP	42	- 3	30-160 DEGF 0-100 MV 50 +32.270 /+159.84	BRIDGE 7932990	0004 DEGF/BIT +3227312E-05 +1225723E-07 +0002038E-09 +0004923E-14	PRT MINCO S53P45236 F132	
19 20 21 22	EP402-0018 4344	INTERNAL AIR RECIR FAN PWR	43	A 3	0-8 KW 0-100 MV 50	STRAIGHT 7932985	KW/BIT 0. +0078201E-07	WATT XDCR OHIO SEMITRONICS PC5-15	
23 24 25 26	EP403-0018 4440	HW COIL SUPPLY PUMP POWER	44	A 3	0-50 KW 0-50 MV 50	STRAIGHT 7932985	KW/BIT 0. +0009765E-07	WATT XDCR OHIO SEMITRONICS PC5-1	
27 28 29 30	EP501-0018 4540	APPLA CHILLER OPERATING PWR	45	A 3	0-50 KW 0-50 MV 50	STRAIGHT 7932985	KW/BIT 0. +0009765E-07	WATT XDCR OHIO SEMITRONICS PC5-1	
31 32 33 34	EP502-0018 NOTE 2	APPLA CHILLED WATER PMP PWR	46	A 3	0-4 KW 0-100 MV 50	STRAIGHT 7932985	KW/BIT 0. +0009100E-07	WATT XDCR OHIO SEMITRONICS PC5-6	
35 36 37 38	EP503-0018 4744	CONDENSER WATER PUMP POWER	47	A 3	0-8 KW 0-100 MV 50	STRAIGHT 7932985	KW/BIT 0. +0073201E-07	WATT XDCR OHIO SEMITRONICS PC5-15	

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK IP7933707

03/23/78

REV: C

PAGE: 1

REPORT BY CHANNEL ASSIGNMENT

L N E	HEAD NUMBER USP CODE	MEASUREMENT NAME	C H N	A S Y N	# W R E	OPERATING RANGE	MICROHOLD TYPE	TEMP SERIAL #	SENSOR TYPE	NOTES
						SENSOR OUTPUT RANGE	MICROHOLD P/N	SCALE FACTOR UNITS	SENSOR MANUFACT	
1 2 3 4 5 6	1500 -0018	*OCH HST WAT HX INLET TEMP	48	- 3	30/160	DEGF	BRIDGE			PRT MINCO 557-P40736 F203010
						0-100 50 +31.547 /+159.71	7932990	DEGF/RT +3154754E-05 +1231245E-07 +2002060E-09 +0004990E-14		

E-30

APPENDIX F

SOLAR ACCEPTANCE TEST

DISNEY WORLD SOLAR PROJECT

ACCEPTANCE TEST

Contract E(49-18)2401

Solar Office Building

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I. SOLAR SYSTEM ACCEPTANCE TEST

A. Subsystem Test

1. Collector/Storage Tank Energy Transport System

a. Integrity of Installation

- o Purpose: To determine if all fluid loop components have been included and properly installed per the complete Disney World Mechanical Specification.
- o Method: Visually compare installation and component manuals with D/W drawings and design specification.
- o Results:
 - 2/24/78 - Relocated bypass to bottom of check valve on solar system piping.
 - 2/24/78 - Relocated two RTD's in chilled water system at IBM's direction.
 - 3/08/78 - Changed out flow meter in hot water line to air handler at IBM's direction.
 - 3/14/78 - All other piping was properly installed as per drawings and specifications.

b. Leak Test

- o Purpose: To determine if any water leaks exist in loop when pressured to 150 psi.
- o Method: Pressurize loop only to 150 psi for four (4) hours. Must not leak.
- o Results: Complete - No leaks

c. Calibration of Pressure Gages & Thermometers

- o Purpose: To insure that all gages and thermometers are indicating properly.
- o Method: Calibrate gages (must be within ± 2 psi and thermometers within $\pm 2^\circ\text{F}$) utilizing pressure and temperature standard or ice water and hot water bath.
- o Results: Complete - All gages and thermometers tagged and dated.

d. Functional Tests

(1) Tank (T-1) Isolation Valves

- o Purpose: To determine if valves isolate tank from collector circuits with no leaks.
- o Method: Close isolation valves, depressurize all loops interconnected with tank, and pressurize tank to 150 psi for four (4) hours thru tank air drain. Tank must not leak.
- o Results: Complete - No leaks

(2) Drain Valves

- o Purpose: To determine if valves will properly drain system.
- o Results: Complete - The system was flushed, filled, and drained before the hydrotest.

(3) Collector Pump & By-pass (PHWA-4ZE)

- o Purpose: To determine if main throttle valve and by-pass has been properly adjusted with respect to pump and collector flow and electrical load on pump.
- o Method: Utilize pump FMD and collector FMD to determine pump 50/collector 3.125 flows, measure resistance of circuit 11 feet and measure ampere draw by pump motor amps. Compare with published pump data.
- o Results: Complete - 4.5 Amp

(4) Flow Distribution in Collector Array

- o Purpose: To determine if circuit setters in the fluid loop have been properly adjusted to provide for equal ± 1 gpm through each collector.
- o Method: Utilizing portable manometer type flow meter, measure the flow in each collector.
- o Result: Complete - Equal pressure at both ends.

(5) Collector Air Elimination Devices

- o Purpose: To determine if air elimination devices will function properly.
- o Method: Per operation instructions; open air elimination devices and bleed air.
- o Results: Complete

2. Hot Water Storage Tank (T-1)/Compression Tank (T-3)

a. Integrity of Installation

- o Purpose: To determine if all fluid loop components have been included and properly installed per the completed mechanical specification.
- o Method: Visually compare installation and component manuals with drawings and design specifications.
- o Results: Complete - The system has been installed to the drawings and specifications.

b. Leak Test

- o Purpose: To determine if any water leaks exist in loop when pressurized to 150 psi.
- o Method: Pressurize loop only to 150 psi for four (4) hours. Must not leak.
- o Results: Complete - No leaks

c. Calibration of Pressure Gages & Thermometers

- o Purpose: To insure that all gages and thermometers are indicating properly.
- o Method: Calibrate gages (must be within ± 2 psi and thermometers within $\pm 2^\circ\text{F}$) utilizing pressure and temperature standard.
- o Results: Complete - All gages and thermometers calibrated, tagged, and dated.

d. Functional Test

(1) Compression Tank Pressure Regulating Valves

- o Purpose: To determine if the air and water pressure regulating valves are set for 40 $\pm$ 2 psi and are operating properly.
- o Method: Install hydraulic-type pressure gage on tank. By alternating closing off air and water and draining tank of air/water, both valves can be checked by noting pressure on gage and noting water level in sight gage.
- o Result: Complete - There has been a problem in balancing the air regulator, water regulator, and the Clayton dump valve. As of 3/13/78, the system is working properly.

3. Solar Collectors

a. Installation Integrity of Components

(1) Receiver Position - Completed

The receiver position should be checked with the drive arm in its vertical position. The drive arm can be oriented properly by using the temporary tooling strut as shown in Figure 1A. Each receiver support can then be checked with a level to see that the receivers are also in the vertical position and that the parallelogram is properly aligned.

(2) Screwjack Stroke - Completed

The screwjack drives the receiver array through the drive arm. The limit switches mounted on the screwjack motor should be set to insure proper travel of the drive arm. The travel for the arm should be 48° north of vertical and 42° south of vertical to provide a total stroke of 90° . This arm rotation will correspond to a screwjack stroke of $39\frac{1}{2}$ ". The proper travel is shown in the following sketch.

Fig. 1-A

Fig. 1

b. Receiver Focus - Completed

In order to achieve the maximum system performance, it is important to insure that the receivers are adjusted properly with regard to the reflector focal point. This focal point varies in position, size and density depending on the sun angle. The proper receiver adjustment, then, is the position at which the total absorbed heat over the complete operating stroke for the entire receiver array is at a maximum.

This can best be checked by noting the illuminated area on the underside of each of the receivers at various times of the day. If some or all of the units show a tendency for this illuminated area to favor one side or the other of the target (receiver glass) over the period of a full day's travel, then there is a need for further adjustment. If the amount of drift of the illuminated area from one side to the other is roughly equal and the losses on each side are about the same for each receiver at all sun angles, then the receivers can be considered properly focused.

c. Torsion Bar - Completed

The torsion bar counterbalance for the receiver array relies on a friction clamp to transmit torque from the torsion bar to the channel assembly. To insure that this friction clamp is not slipping, the following check should be made. With the drive arm in the vertical position, an index mark should be placed on the torsion bar and a matching mark on the friction clamp collar. The receiver array should then be run to the north stop, 48° off the vertical. If the index marks are still in line, then the torsion bar is working properly.

d. Sun Sensor - Completed

In order to move the receiver array into the maximum focal point as the sun's angles change, the sun sensor is located on Receiver No. 1. The sensor is tied to the control console and has been adjusted with a separate written procedure.

This can best be checked by noting the illuminated area on the underside of each of the receivers at various times of the day. If the illuminated area favors one or the other, over a period of two full day's travel, then there is a need to recalibrate with the written procedure. When the amount of drift of the illuminated area from one side to the other is roughly equal and the losses on each side are about the same, the receivers can be considered properly focused.

4. Solar Hot Water Transport System
For Space Heating

a. Integrity of Installation

- o Purpose: To determine if all fluid loop components have been included and properly installed per the mechanical specification.
- o Method: Visually compare installation and component manuals with drawings and design specifications.
- o Results: Complete - The system is in agreement with the specifications and drawings.

b. Leak Test

- o Purpose: To determine if any water leaks exist in loop when pressurized to 150 psi.
- o Method: Pressurize loop only to 150 psi for four (4) hours. Must not leak.
- o Results: Complete - No Leaks

c. Calibration of Pressure Gages & Thermometers

- o Purpose: To insure that all gages and thermometers are indicating properly.
- o Method: Calibrate gages (must be within +2 psi and thermometers within +2°F) utilizing pressure and temperature standard.
- o Results: Complete - All gages and thermometers have been calibrated, tagged, and dated.

d. Functional Test

(1) Space Heating Pump (PHWA-6ZE)

- o Purpose: To determine if pump is performing per specification and is properly throttled
- o Method: Manually start pump and open hot water coil control valve. Note the flow from the FMD, the circuit resistance from the pressure gages and measure the ampere draw by pump motor.
- o Results: Complete 7 GPM and 4.6 Amps at 110V.

(2) Manual Air Vent

- o Purpose: To determine if this vent removes air from circuit.
- o Method: With pump stopped, open valve until water flows from vent, then close. With pump running, check hot-water coil for gurgling noise.
- o Results: Complete

5. Solar Hot Water Transport System
For Space Cooling

a. Integrity of Installation

- o Purpose: To determine if all fluid loop components have been included and properly installed per the completed mechanical specification.
- o Method: Visually compare installation and component manuals with drawings and design specifications.
- o Results: Complete - The system is in agreement with the drawings, specifications, and manuals.

b. Leak Test

- o Purpose: To determine if any water leaks exist in loop when pressurized to 150 psi.
- o Method: Pressurize loop only to 150 psi for four (4) hours. Must not leak.
- o Results: Complete - No Leaks

c. Calibration of Pressure Gages & Thermometers

- o Purpose: To insure that all gages and thermometers are indicating properly.
- o Method: Calibrate gages (must be within ± 2 psi and thermometers within $\pm 2^{\circ}\text{F}$) utilizing pressure and temperature standard.
- o Results: Complete - All gages and thermometers have been calibrated, tagged, and dated.

6. Collector Fluid Flow Control System

a. Integrity of Installation

- o Purpose: To determine if all control circuit components have been included and properly installed per the completed mechanical specification.
- o Method: Visually compare installation and component manuals with drawings and design specifications.
- o Results: The system is in agreement with the drawings and specifications.

b. Calibration of Thermometers

- o Purpose: To insure that all thermometers are indicating properly.
- o Method: Calibrate thermometers within $+2^{\circ}\text{F}$ utilizing pressure and temperature standard.
- o Results: Complete - All gages and thermometers have been calibrated, tagged, and dated.

B. System Operational Test

1. Collector Flow Control System

- o Purpose: To determine if system (Operation of collection pump - PHWA-4ZE) is functioning properly with regard to the following operating modes:
 - Pump Start-up: Pump starts when the collector surface temperature is $20 \pm 2^\circ\text{F}$ above temperature of tank bottom.
 - If collector pump can maintain a Δt of $0.5^\circ \pm 2^\circ\text{F}$ or more, pumping continues.
 - If not, pump shuts down and repeats start-up procedure.
- o Method: Record collector surface temperatures, tank bottom temperatures and collector Δt during pump operation.
- o Results: Complete - There are four (4) surface temperatures taken and any two (2) will start the pump with a Δt of $20^\circ \pm 2^\circ\text{F}$ above the temperature of the tank bottom.

2. Hot Water Compression Tank (T3)

- o Purpose: To determine if the compression tank is operating properly with respect to the expansion and contraction of the water in the hot water fluid loop.
- o Method: Install pressure gage on tank and observe compression tank controls during periods when loop fluid is expanding or contracting.
 - Tank pressure should remain at 40 +2 psi.
 - Water level in tank as seen through sight gage should be maintained at a level prescribed in pressure-level controller manual.
- o Results: Complete - There has been a problem in balancing the air regulator, water regulator, and the Clayton dump valve. As of 3/13/78, the system is working properly.

3. Solar Hot Water Transport System
For Space Heating

- o Purpose: To determine if the pump is properly interconnected with HVAC system.
- o Method: Increase temperature setting of space thermostat until pump starts.
- o Results: Complete

4. Solar Hot Water Transport System For Space Cooling

- o Purpose: To determine if throttle valve and by-pass have been properly adjusted with respect to flow to chiller (CH-10ZE).
- o Method (for back pressure relief valve): Drain chilled water tank (T-2) sufficiently so that chiller will start when the necessary hot water is available from hot water storage. With the pump/chiller running, open and close the chiller throttle valve and record the flow and the pump electrical data and compare with operating data in Arkla manual.
- o Results: Complete - It was not necessary to drain any of the chilled water since the temperature was high enough to let the unit start. 90 GPM
4.5 Amps

II. HVAC

A. Subsystem Testing (Functional Testing)

1. Space Heating

a. Pump (PHWA-6ZE) & Hot Water Circuit

- o Purpose: To determine if the pump has the proper direction of rotation and supplies the required GPM to the heating coil.
- o Method: Visually check to see if the rotation is the same as shown on the pump casing. The GPM will be checked with a flow meter.
- o Results: Complete - 7 GPM

b. Air Handling Equipment (AH-6ZE)

- o Purpose: To determine if the air handling equipment will supply heating to the office space.
- o Method: Place thermostat at a temperature that requires heating. Visually check inlet and outlet damper for each zone to be sure the cooling dampers are closed and the heating and return air dampers are open. The economy cycle should not be operating.
- o Results: Complete - One damper indicator was reversed, so the damper was readjusted.

c. Controls

- o Purpose: To determine if the air heating controls function properly.
- o Method: Check modulating control valve by changing thermostat setting. Check inlet water and outlet water temperatures and hot deck setting to be sure valve is functioning properly.
- o Results: Complete - We tried several different hot deck temperatures, but ended up back at 100°F, where Honeywell had set it.

2. Space Cooling

a. Arkla Chiller (CH-10ZE)

- o Purpose: To determine if the Arkla functions properly.
- o Method: The unit should be placed in operation at the direction of a factory representative.
- o Results: Complete - January 7, 1978

b. Condenser Water Circuit

(1) Pump (PCW-10ZE)

- o Purpose: To determine pump direction and GPM.
- o Method: Visually check rotation. Check GPM with flow meter.
- o Results: Complete - 90 GPM

(2) Controls

- o Purpose: To determine if the controls will limit the condenser water temperature a minimum of 70°F.
- o Method: Operate the condenser water system and Arkla when the cooling tower water is less than 70°F. Visually check mixing valve and thermometers in the system.
- o Results: Complete

c. Chiller Pump (PCH-10ZE) and Circuit to T-2 Tank

- o Purpose: To determine pump direction, GPM and operation of valves and control in piping to Tank T-2.
- o Method: Visually check pump direction. Use meter to check GPM. Check location of valves and controls with drawings and operate each to be sure the seats are clean.
- o Results: Complete - 90 GPM
Throttled to 60 GPM, the motor average was high - 3.1 Amps. The name plate indicates it should be 2.6 Amps. The motor was returned to the manufacturer and tested. The motor test proved satisfactory and is in warranty at 3.1 Amps.

d. Chilled Water Tank (T-2)

- o Purpose: To determine if the piping to Tank T-2 has any water leaks. Tank T-2 was hydrotested before installation.
- o Method: Pressurize loop only to 150 psi for four (4) hours. Must not leak.
- o Results: Complete - No Leaks

e. Chilled Water Pump (PCHA-3ZE) and Circuit to Air Handler (AH-6ZE)

- o Purpose: To determine if the pump has the proper direction of rotation and supplies the required GPM to the cooling coil.
- o Method: Visually check pump rotation as shown on the pump casing. Check the GPM flow with a flow meter.
- o Results: Complete - 35 GPM

f. Air Handler (AH-6ZE)

- o Purpose: To determine if the air handling equipment will supply cooling to the office space.
- o Method: Place thermostat at a temperature that requires cooling. Visually check inlet and outlet dampers for each zone to be sure the heating dampers are closed and the cooling and return air dampers are open. The economy cycle may operate if conditions are proper.
- o Results: Complete - The economy cycle had to be redesigned and altered before it would operate as required by the specifications.

g. Controls

- o Purpose: To determine if the air cooling controls function properly.
- o Method: Check modulating control valve by changing thermostat setting. Check inlet and outlet temperatures and cold deck setting to be sure valve is functioning properly.
- o Results: Complete

B. System Operational Testing

1. Space Heating System

- o Purpose: To determine if the heating system functions properly.
- o Method: Set all controls in automatic and adjust thermostat to require heating. Observe temperature in space and thermostat setting to be sure they become equal.
- o Results: Complete

2. Space Cooling System

- o Purpose: To determine if the cooling system functions properly.
- o Method: Set all controls in automatic and adjust thermostat to require cooling. Observe temperature in space and thermostat setting to be sure they become equal.
- o Results: Complete

III. DOMESTIC HOT WATER SYSTEM

- o Purpose: To determine if the automatic temperature control on the domestic hot water is functioning properly.
- o Method: Determine water temperature in bottom of hot water storage tank. Check setting on automatic control. Open water faucet and measure outlet temperature.
- o Results: Complete - 120°F

APPENDIX G

OPERATION AND MAINTENANCE MANUAL

OPERATION AND MAINTENANCE MANUAL

REEDY CREEK UTILITIES CO., INC.

CEP SOLAR BUILDING

April 1978

OPERATION AND MAINTENANCE MANUAL

REEDY CREEK UTILITIES CO., INC.

CEP SOLAR BUILDING

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Operation and Maintenance Manual (Continued)

Reedy Creek Utilities Co., Inc.

CEP Solar Building

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CAUTION

- o The operating angular stroke of the receivers must not exceed 48° north of vertical or 42° south of vertical.
- o Damage to receivers will occur if absorber temperature goes above 320°F (overheat) or, with water in the system, below 32°F.
- o Walking on the reflective surface of the roof without proper padding may cause cracked mirrors.
- o If the system is shut down or the water flow to the collectors is interrupted, the receivers must be kept out of focus to prevent overheating.
- o The system should be operated in automatic or off position. The manual position is for calibration only and by-passes the built-in safeties.

I. Operating Instructions

A. Initial Adjustments

1. Receiver Focus

The receiver position should be checked with the drive arm in its vertical position. The drive arm can be oriented properly by using the temporary tooling strut as shown in Figure 1. Each receiver support can then be checked with a level to see that the receivers are also in the vertical position and that the parallelogram is properly aligned. This procedure is designed to provide a preliminary alignment of the receivers.

A turnbuckle type adjustment screw is located in the tie bar between each receiver as shown in Figure 1. The screw can be rotated to increase or decrease the tie bar length and hence the receiver spacing. The nominal distance between tie bar sections is three inches as shown in the figure. An adjustment travel of ±two inches has been provided. It is important that the distance between tie bars not be allowed to exceed five inches. Adjustment beyond the five inch dimension will cause a decrease in the tie bar strength and a possible failure of that point. Adjustment to the receivers should begin at the building mid-point and continue outward to the north and south ends of the building. This is done because adjustment of the inner receivers also moves all outer units on that side of center. After the adjustment has been completed, the outer splice tube is slipped over the turnbuckle to lock it in place. The locking screw then

fastens the splice tube to the turnbuckle screw.

In order to achieve the maximum system performance it is important to insure that the receivers are adjusted properly with regard to the reflector focal point. This focal point varies in position, size, and density depending on the sun angle. The proper receiver adjustment, then, is the position at which the total absorbed heat over the complete operating stroke for the entire receiver array is at a maximum.

This can best be checked by noting the illuminated area on the underside of each of the receivers at various times of the day. If some or all of the units show a tendency for this illuminated area to favor one side or the other of the target (receiver glass) over the period of a full day's travel, then there is a need for further adjustment. If the amount of drift of the illuminated area from one side to the other is roughly equal and the losses on each side are about the same for each receiver at all sun angles, then the receivers can be considered properly focused.

2. Screw Jack

The screw jack drives the receiver array through the drive arm. The limit switches mounted on the screw jack motor should be set to insure proper travel of the drive arm. The travel for the arm should be 48° north of vertical and 42° south of vertical to provide a total stroke of 90° . This arm rotation will correspond to a screw jack stroke of $39\frac{1}{2}"$. The proper travel is shown in the sketch below. Be sure to use the manufacturer's recommended procedure for adjustment of the limit switches.

FIGURE 2

3. Controls - Sun Sensor

In order to move the receiver array into the maximum focal point as the sun's angles change, the sun sensor is located on Receiver No. 1. The sensor is tied to the control console and has been adjusted with a separate written procedure.

This can best be checked by noting the illuminated area on the underside of each of the receivers at various times of the day. If the illuminated area favors one or the other, over a period of two full day's travel, then there is a need to recalibrate with the written procedure. When the amount of drift of the illuminated area from one side to the other is roughly equal and the losses on each side are about the same, the receivers can be considered properly focused.

4. Circuit Setters

In order to perform a hydronic system balance there is a circuit setter valve in the return from each receiver. Lack of balance of the system could starve the receivers farthest from the pump. Air trapped in any one receiver could cause inadequate flow to that receiver. It is, therefore, necessary that the pressure drop be checked at each receiver. In order to check this flow, an accurate pressure differential gage must be used. The actual value reading on the meter is not of major significance, but the same reading should be read at each receiver. If additional information is required, see Circuit Setter Valve Balance Procedures, HS-CS-671, Bell & Gossett, ITT.

II. Calibration

Prior to installation, the platinum resistance thermometers (PRT's, also referred to as RTD's) have been checked for R_0 (resistance at zero degrees celsius) of 100 ± 0.1 ohms and at sufficient other temperatures to show they follow the Callendar-van Deusen temperature/resistance curve for .00392 platinum from 0°C to at least 130°C (266°F). In addition, the resistance bridge amplifiers have been calibrated using precision resistors in place of PRT's, and these resistances are within $\pm .01\%$ of nominal at 0°F , 32°F , 100°F , 212°F , 300°F , and 350°F . The readout linearizers have also been calibrated to compensate for the non-linear Callendar-van Deusen equation to reduce the readout error from a maximum of $+3.06^\circ\text{F}$ to a maximum of $\pm 0.2^\circ\text{F}$. Procedures for performing these calibrations are included in the handbook. With no additional system calibration or adjustments, all temperature readings should be within $\pm 1^\circ\text{F}$ of the true temperature. The error can be reduced to less than 0.3°F by immersing the temperature sensors at the ends of their wire runs in an insulated container of melting crushed ice made from low mineral content water, and adjusting the balance pot on the appropriate bridge amp circuit for zero volts out of the bridge amp, or a 32.00°F reading on the temperature readout. An alternate procedure yielding even greater readout accuracy is to immerse the PRT and a precision thermometer in a stirred fluid near 32.00°F and adjust the balance pot for equal readings; immerse them in a stirred fluid near 212°F and adjust the scale pot for action foot.

equal readings, and repeat the cold and hot immersion and adjustments until no adjustment is necessary, remembering that the PRT must be connected to its normal wire, and several minutes should be allowed between immersion in the stirred fluid and any adjustment.

The above and the delta T calibrations should be made on a periodic (six months or one year) basis, and if either the bridge power supply or the op amp power supply is replaced or reset to a voltage differing from that at calibration by more than 0.1%.

A. Sun Sensor

Insert extender card between sun follower amplifier and its socket. The extender card has three amber and four red LED indicators for three light levels and two N errors and two S errors. The bottom amber and two red lights are for the center photosensor.

Put the test panel meter switch in "Test Jack" position. Connect the upper meter to TP8 and ground, and the lower meter to the junction at R40, C11, and R46 and ground. The top meter reads the inner sensors amplitude difference, and the bottom reads the negative of the sum of the voltage magnitudes. Put the collectors in focus by nulling the top meter. Start with all pots fully C.W. (all LEDs should be off). Note the sum voltage. Refocus the collectors about one foot north. Adjust R51 if necessary to keep the top meter positive from focus to one foot north. Run the sensor south. TP8 shall go thru zero

at focus and go negative for at least one foot south of focus. Stop south travel when the bottom meter shows $-1.4V$. Turn R49 CCW until the light level light just appears. Return sensor to near focus. When the top meter shows $+ \text{ or } -.13 \pm .02V$, turn R64 CCW until red error light just comes on. Run sensor north and south until level light goes out in each direction. Top meter shall always be positive when north of focus and negative when south of focus. Let the sensor automatically center from extremes of light level enable.

Move top meter to TP1 and bottom meter to TP2. Start with sensor six inches north of focus. Run sensor to north limit, adjusting R1 if necessary to keep TP1 at least $+0.3V$. Verify that TP1 is $-0.3V$ or more from six inches south to the south limit. Put sensor just north of focus so that TP1 is $+0.15 \pm .2V$. Turn R18 CCW until red light just appears. Move sensor south (TP1 thru null) and north red light shall go out, then south red light shall appear when TP1 is $-.15 \pm .2V$. Put bar about six inches north of focus. Turn R28 CCW until amber light just comes on. Move to six inches south of focus and turn R35 CCW until its amber light just appears.

Wait for a cloud shadow to cover roof. All amber lights should go out. Turn R49, R28, or R35 CW as necessary to put amber lights out. TP2 monitors south level for information only.

Defocus bar to north and south limits in turn and verify automatic return to focus and proper tracking.

FIGURE 3

III. Systems Tests

A. Collector

1. Turn On and Focus

On a bright, sunny day, manually operate the collector pump with the collector out of focus to cool the collector to near 0 delta T (or negative). Operate the collector pump switch to "Automatic", and place the collector focus switch in "Automatic". Verify that the collector moves into focus. Monitor the four surface temperatures and the hot water tank bottom temperature. When the second surface temperature reaches $20 \pm 2^\circ\text{F}$ greater than the tank bottom, the collector command will light and the collector pump indicator will light and the collector pump shall start. Operate the collector pump switch to "Off" and the pump shall stop and the pump light extinguish. Return the pump switch to "Automatic" to restore the "On" condition.

2. Turn Off

After allowing the collector pump to operate until reasonably static conditions are reached, and focus corrections have been noted, and observing that the collectors stay in focus and do not get lost or run to a stop when clouds obscure the sun, operate the collector focus switch to "Manual" and move the collectors completely out of focus, observing delta T. When delta T decreases to $1 \pm .5^\circ\text{F}$, the collector pump command light and collector pump light shall extinguish and the collector pump shall turn off. Repeat the turn on - off cycle and verify turn off cannot occur less than five

minutes after turn on.

3. Overheat

Return the collector focus switch to "Automatic" and observe the system during the turn on cycle. After the turn on transients have passed, place the collector pump switch in the "Off" position and monitor the four surface temperatures. When any surface temperature reaches $250 \pm 5^{\circ}\text{F}$, the overheat light shall appear, the collector south travel light will come on, and the collector shall move south until the limit is reached and indicated by the appearance of the south limit light and extinguishing of the south travel light.

Return the collector pump switch to "Automatic". When the hottest collector surface is less than 245°F , press the overheat reset switch and watch the system return to normal operation.

In turn, disconnect the surface temperature PRT hot leads at the rear of the cabinet and connect a 200 ohms pot in place of it. Reset overheat, observe the simulated surface temperature as the pot is slowly increased from 100 ohms. When the simulated temperature reaches $250 \pm 5^{\circ}\text{F}$, the overheat light shall appear and the collector shall start to defocus. Reduce the simulated temperature below 245°F and press overheat reset to restore operating conditions. Disconnect the pot and reconnect the PRT leads. NOTE: The momentary open circuit will produce "Overheat", so the reset must be pressed after each time the circuit is open. Repeat for other three surface temperatures.

Perform this type test for the H.W. tank top thermometer circuit, noting overheat at a simulated $245 \pm 5^{\circ}\text{F}$ and reset capability below 240°F .

Verify that reset is inoperative when the simulated temperature remains above the switch point value for surface or tank.

B. Chiller Control

1. Set Up

Replace the H.W. tank top PRT, and the C.W. tank top and bottom PRT's with 200 ohms potentiometers at the terminal strips in the back of the cabinet. Disconnect the output of the Arkla control relay and substitute a 115V 60Hz bulb for its load. Set H.W. tank top temperature to 165°F , C.W. tank top to 52°F , and C.W. tank bottom to 40°F . Ground the condenser flow switch input.

2. Switch Test

Verify that the H.W. pump and light are off with the H.W. pump switch in any position except "On", and are on in that position. Leave in "Automatic" position.

Repeat above for the Arkla switch and the C.W. pump switch.

3. Logic Test

Set C.W. tank bottom to 50°F and H.W. tank top to 180°F . Increase C.W. tank top temperature slowly from 52°F . Temperature at which H.W. pump, Arkla, and C.W. pump and their lights come on shall be $57 \pm 3^{\circ}\text{F}$. Reduce C.W. tank

top to 52°F, and reduce C.W. tank bottom temperature. The three lights, two pumps, and simulated Arkla shall turn off at C.W. tank bottom at 45 $\pm$ 3°F.

Set H.W. tank top to 165°F, C.W. tank top to 60°F, and C.W. tank bottom to 50°F. Increase H.W. tank top until H.W. pump, C.W. pump, and Arkla lights come on. Temperature must be 175 $\pm$ 3°F. Slowly reduce H.W. tank top and note turn off temperature which must be 170 $\pm$ 3°F, and must also be 5 $\pm$ 2°F less than the previously noted turn on temperature.

Remove ground from condenser motor flow switch input, set H.W. tank top to 180°F, C.W. tank top to 50°F, and C.W. tank bottom to 50°F. Increase C.W. tank top temperature to 60°F. The H.W. pump, C.W. pump, and Arkla lights shall come on for 7 $\pm$ 2 seconds, then go out.

C. Heating - Cooling Control

1. Set Up

Replace the C.W. tank bottom PRT with a 200 ohms pot as previously used. Set the C.W. tank bottom temperature to 55°F.

2. Switch Tests

Disconnect the active wire to the "Fan On" PE switch. The heating demand, cooling demand, and the CEP demand lights shall be out and shall remain out as each of the two area PE switch inputs ($T < 70$, $T > 74$, and $T > 76$) are shorted in turn. The corresponding pumps and CEP lights shall be lit only when its ON-OFF-AUTO switch is ON, and the function shall

also only then be active. Leave all switches in the AUTO position.

3. Logic Tests

Simulate a "Fan On" signal, or reconnect the "Fan On" switch if it is actuated. Disconnect the active leads of all six temperature PE switches. In turn, simulate closure of each 70°F and 74°F PE switch by shorting terminals on the back of the rack. Note that the proper heating or cooling demand light illuminates, and that the proper pump and pump light come on except when ON-OFF-AUTO switch is in OFF. Simulate closure of the area one >76°F PE switch. Slowly increase the simulated C.W. tank bottom temperature until the CEP demand light comes on. Record the time, the temperature shall be 60 $\pm$ 3°F. With the AUTO-SOLAR-CEP switch in AUTO, the CEP light shall also come on and the solar extinguish. Remove the simulated closure on the area one >76°F PE switch. The lights shall revert to SOLAR ON, CEP OFF, only after 30 $\pm$ 2 minutes have elapsed since turn on. Simulate activator of area 2 >76°F PE switch and note action identical to the above for area one. Reconnect all switches and PRT's in their normal configuration. Remove dummy loads and reconnect Arkla, EP's, etc.

IV. Variations

If desired, a dummy load such as a light bulb may be used in place of any motor starter, EP switch, solenoid valve, etc., so long as the nature of the interface is not altered. Similarly, input signals from PE switches, flow switches, etc., may be simulated at will by open or closed circuit conditions corresponding to the actual condition being simulated.

The temperature at which an action takes place (e.g., $250 \pm 5^{\circ}\text{F}$) is usually selectable over a wide range, and central numbers are tentative. If desired, these can be set to any reasonable exact integral number during the course of this test, or during a repeat thereof, or the central number can be reset using the comparator calibration socket on the back panel.

V. Miscellaneous

Some additional controls, indicators, and interlocks are included as a convenience or for abnormal condition protection. Tests of these follow.

A. Condenser Water Pump Control

This switch provides a test means of the pump. Verify the pump will not run when "Off", runs when "On", and is controlled by the Arkla unit when "Automatic".

B. North Limit

Manually run the collectors north until the north travel light goes off and the north limit light comes on. Verify the screw jack motor is stopped.

C. Collector Position Indicator

Convenient indicator of collector position, with near 0 being north and near 80 to 100 being the south travel limit, a variable setting.

D. Flowmeter

The flowmeter itself is factory calibrated and delivers, from its accompanying electronics, +1V per 100 GPM. The front panel meter reads from 0 to 199.9 GPM.

E. Operating Mechanism

The screw jack and associated drive linkage should operate smoothly over the entire 90° stroke. Proper operation of the limit switches should be checked by insuring that the end stop positions of the drive arm are as described earlier

in section A.2. When the screw jack motor is stopped there should be no drift in the receiver position.

The receiver focus should be checked for all receiver positions as discussed in section A.1.

The torsion bar counterbalance for the receiver array relies on a friction clamp to transmit torque from the torsion bar to the channel assembly. To insure that this friction clamp is not slipping, the following check should be made. With the drive arm in the vertical position, an index mark should be placed on the torsion bar and a matching mark on the friction clamp collar. The receiver array should then be run to the north stop, 48° off the vertical. If the index marks are still in line, then the torsion bar is working properly.

VI. Maintenance

A. Periodic Maintenance

1. Operating Mechanism

a. Screw Jack

The screw jack should be lubricated once a year. The grease fitting is located on the underside of the housing. If for any reason the motor housing is opened, a new bead of caulk must be applied to provide a weather seal for the motor.

b. Receivers

The glass covers on the underside of the receivers should be checked periodically to see that they are clean and also to insure that no residue has accumulated on the inside of the glass. It is not anticipated that cleaning of the receiver glass will be necessary, but an occasional inspection will prevent a deterioration of efficiency due to residue accumulation.

Each receiver is equipped with an air bleed valve at the highest point in the line. This valve is located on the east end of each receiver inside the end plate. If air accumulation in the absorber is suspected, the following procedure should be used. Remove the end plate on the east (loop) end of the receiver (four screws hold this plate on). Unfold the flex line and open the bleed valve until the trapped air has been released. The flex line is provided to prevent water from getting inside the receiver while bleeding the line. Replace the hose and the end plate. The end plate must be

caulked in place to provide a weather-tight seal.

The receiver focus should be checked periodically. This procedure is described in section I.A.1 of this report.

2. Reflectors - Roof Panels

All exposed external edges of the laminated roof panel sandwich should be protected from exposure to the weather. Each end of each roof panel should be checked to insure that it is properly caulked and painted to prevent any deterioration of the adhesive bond between the foam core and the aluminum skins.

Cleaning of the reflector surface is not usually necessary. During extended dry spells or exceptionally dusty or dirty conditions it may be necessary to hose off the roof mirrors to afford maximum performance of the collectors.

When walking on the mirrored surface for maintenance or inspection of the system it is recommended that foam padding be used to prevent the mirrors from cracking. The polystyrene bead board packing material that was used for shipment of the roof panels works very well for this purpose. A block of the polystyrene four or five inches thick can be layed on the mirrors or taped directly to the feet of anyone wishing to walk out on the roof.

3. Controls

It is necessary that the control calibration procedure (Page 7) be used for recalibration periodically (six months or one year as required). The control cabinet

should be checked for surface corrosion and deterioration every six months. Several RTD weather caps should be checked for moisture and deterioration in the thermowell.

4. Piping - Flow Rates (Circuit Setters)

The insulated cover on the circuit setters should be removed yearly to check for leaks. At the same time, the pressure drop through each circuit setter should be checked using the procedure on Page G-10.

B. Repair and Replacement Instructions

1. General

Any repair work on the system should be done only in accordance with the manufacturer's recommended procedure for the particular item in question. AAI's report No. ER-9008, "Solar System Assembly and Installation Instructions" can be used as a guide for repair of the basic operating mechanism and roof assembly. Any questions regarding items not covered or not clearly defined either here or in the above mentioned installation instructions should be directed to AAI Corporation's solar engineering department.

2. Operating Mechanism

If it becomes necessary to disassemble any portion of the drive mechanism (including tie bars and receivers), two things must always be considered beforehand. First, if the water flow is stopped, the receivers must not be allowed to remain in the focus position for more than a minute or so. Provisions must be made to run water through the receivers or

to keep the receivers out of focus during the repair period. Secondly, it must be remembered that the drive mechanism is in a "spring loaded" condition at all positions other than the vertical due to deflection of the torsion bar. Disassembly should be attempted only after these items have been given proper attention.

If work must be done on one particular receiver, it can be disconnected and repaired on the building roof, or on the ground if extensive repair is required, without disrupting the rest of the system. Receivers should be removed one at a time only and the drive arm should remain in the vertical position while the receiver is out. This must be done because of the increased length of the unsupported tie bar and the possibility of buckling if a compression load is applied. Four 3/8" bolts hold the receiver to the tie bar. Two 1" diameter pivot pins connect the receiver to the receiver supports. The flex line on the west end is the only other connection point for the receiver. By laying 2 x 10's across the peaks of the roof panel near each end, the receiver can be layed on its back, with the water lines still connected, to replace glass or for other minor repairs. To remove the receiver to the ground, the flex lines must be disconnected and plugged to allow water flow thru the rest of the system. The approximate weight of one receiver is 320 lb.

If the screw jack is to be disconnected, the receiver array must be held in position by another means. The temporary tooling strut supplied by AAI can be used for this

purpose. The tooling strut will lock the drive arm in the vertical position. The receivers will not be in focus in this position during the fall and winter months (Sept. 21 thru March 21). During the spring and summer, however, this is a focus position and the tooling strut, therefore, should be used only if water is running in the system.

FIGURE 4

NOTE: For installation see
dwg 57939-40128

FIGURE 5

FIGURE 6

Tie bar and receiver assemblies
as seen from west side

FIGURE 7