DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150748

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

U.S. Department of Energy

Solar Energy

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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 copacity of 10,000 gallons hot and 10,000 gallons chilled.

17. KEY WORDS

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WILLIAM A. BROOKSBANK, JR.
Mgr, Solar Heating and Cooling Project Office

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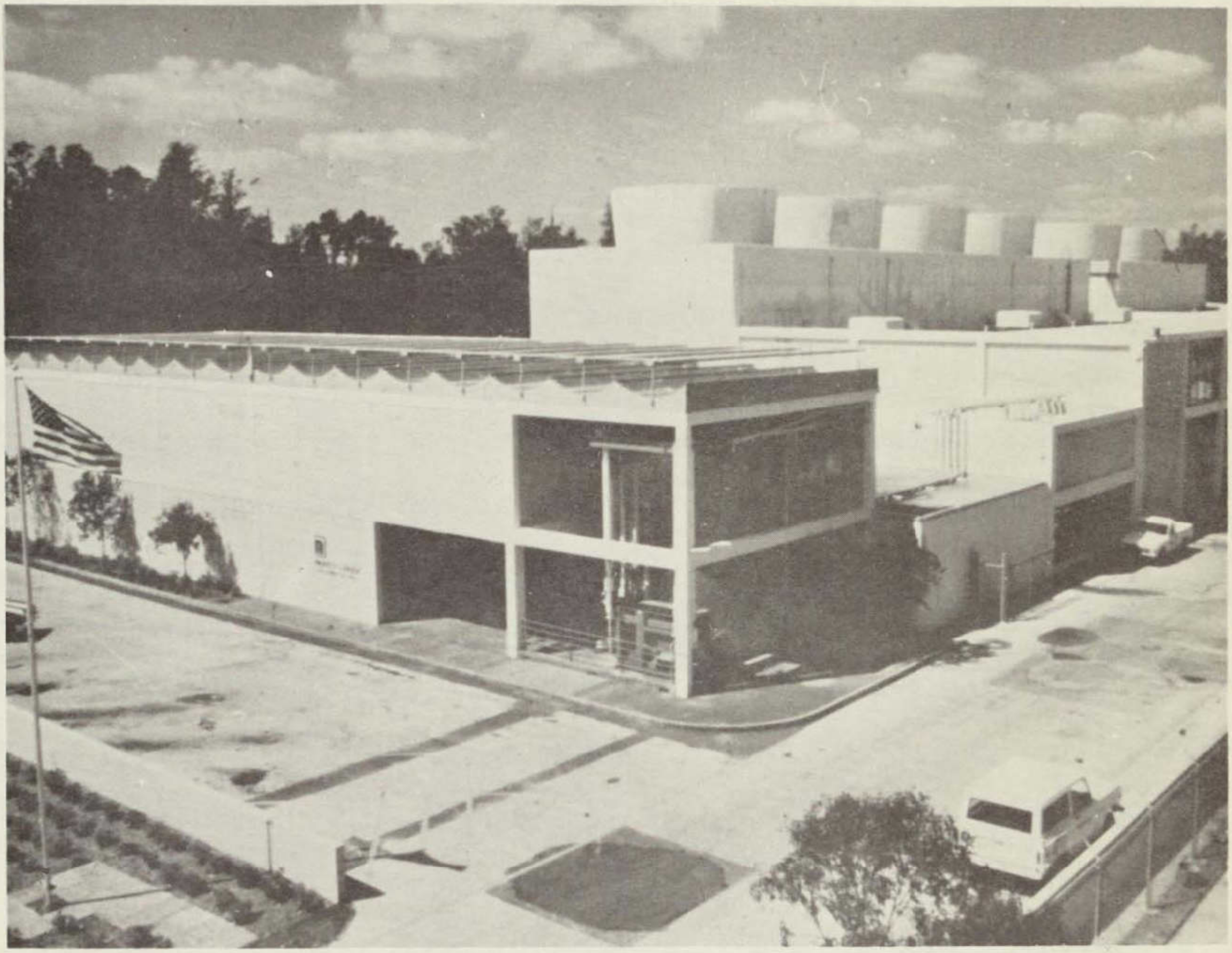
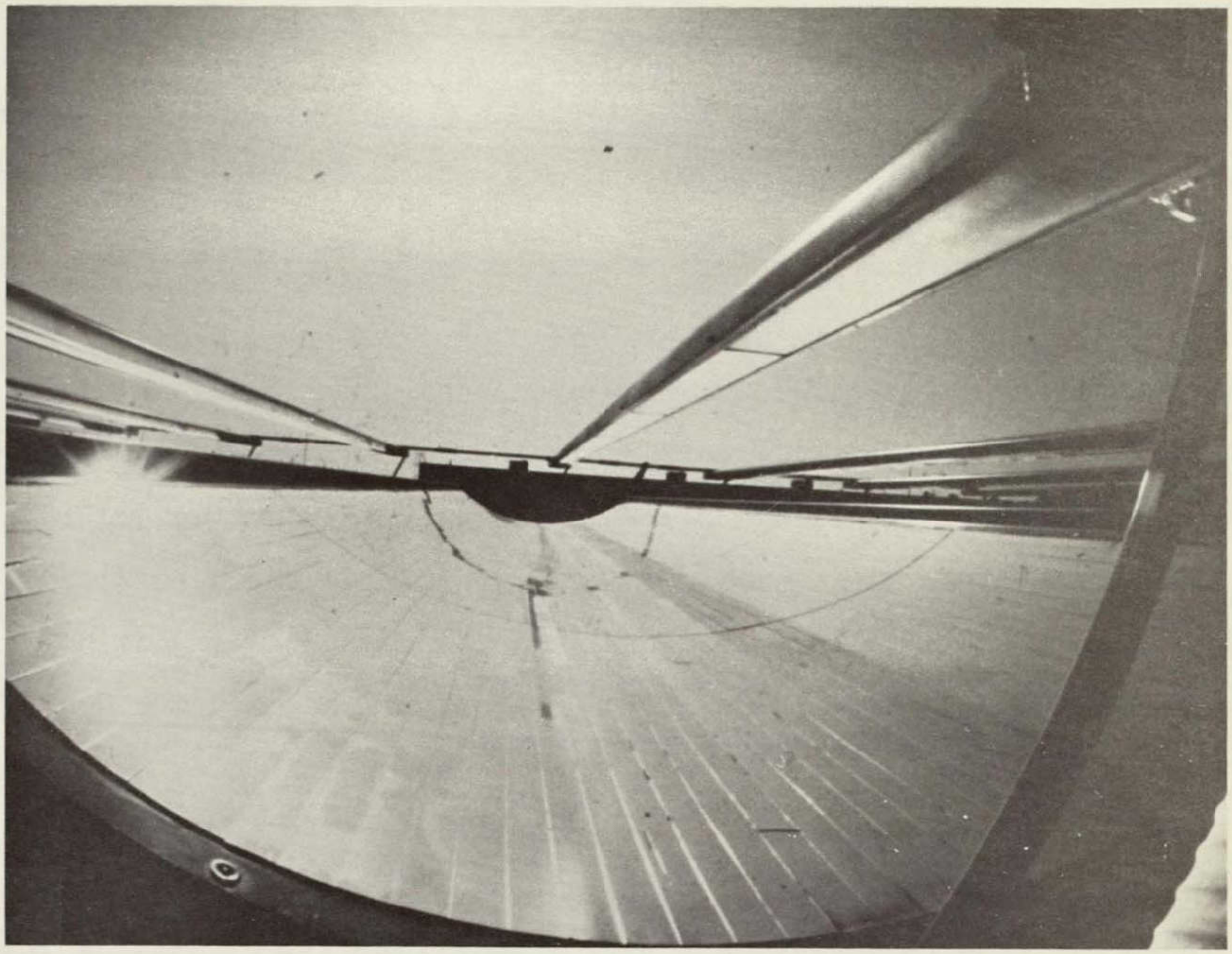
Reedy Creek Utilities Co., Inc.
WALT DISNEY WORLD



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 (522.58m^2) 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 ($356.75m^2$)

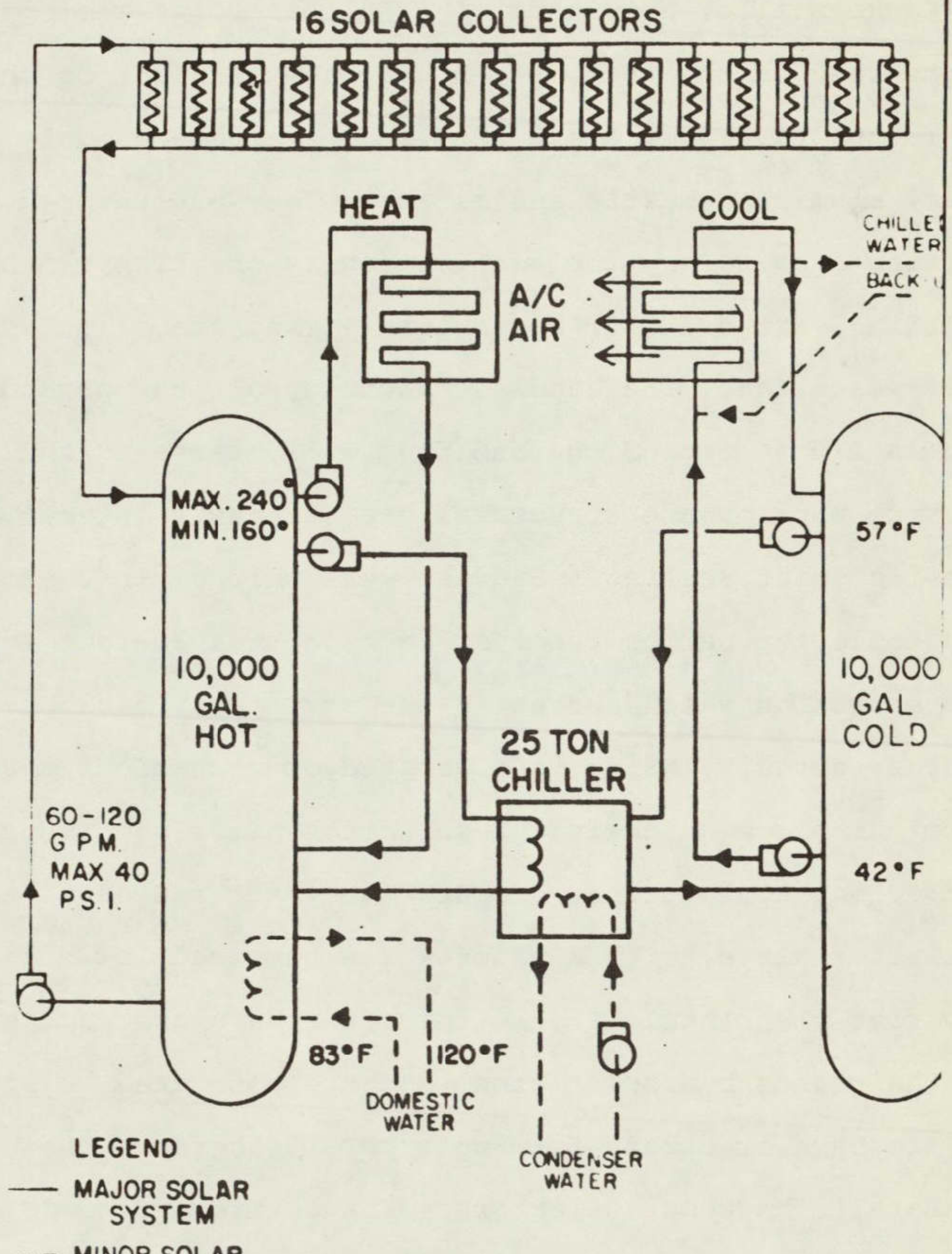
Storage

Type: Water

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

10,000 gallons chilled

III. SYSTEM SCHEMATIC DIAGRAM



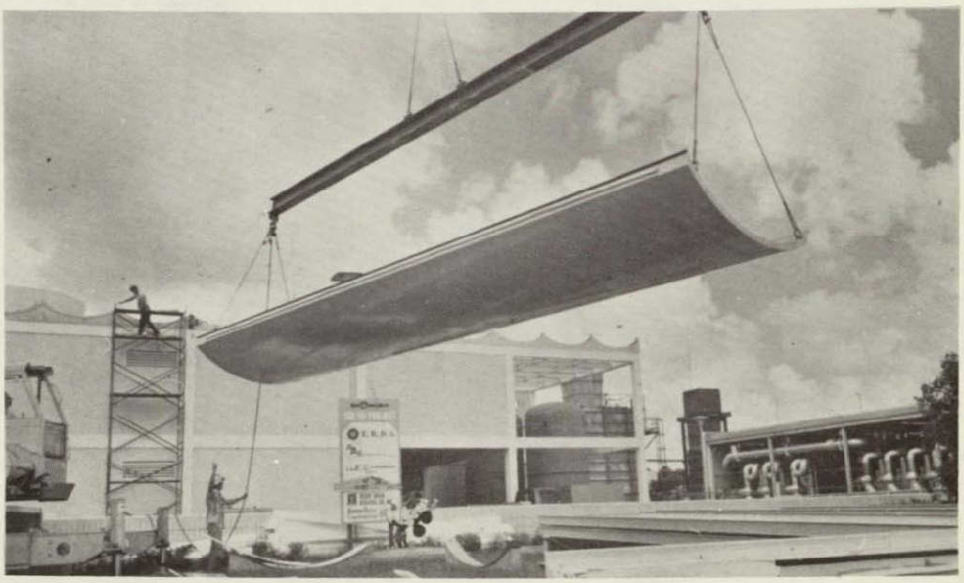
SCHEMATIC DIAGRAM

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

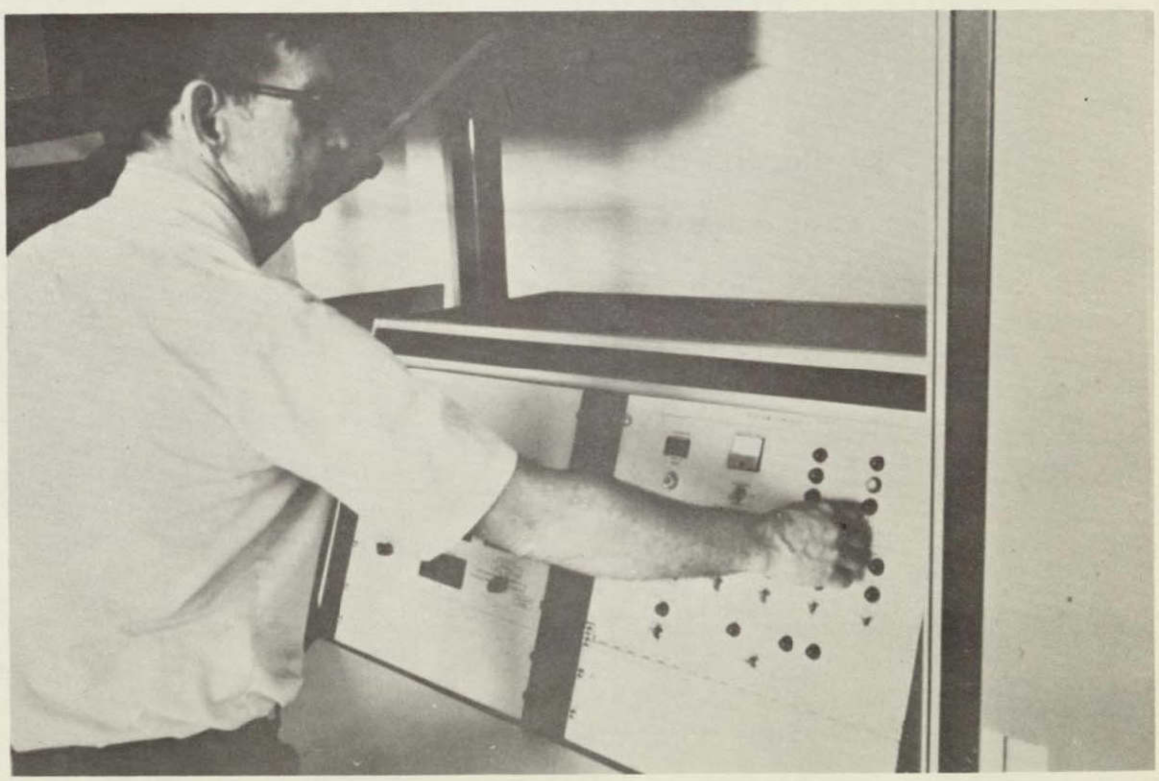
World Co. used its affiliated company, Buena Vista Construction Co. as the general contractor and subcontracted the more critical parts of work. The building is a concrete frame, concrete block wall, heavily insulated office building with minimum windows. This design, plus the fact the roof is reflecting 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:

Number Sequence	Data Group
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	
I001	Collector Plane Total Insolation
I002	Collector Plane Diffuse Insolation

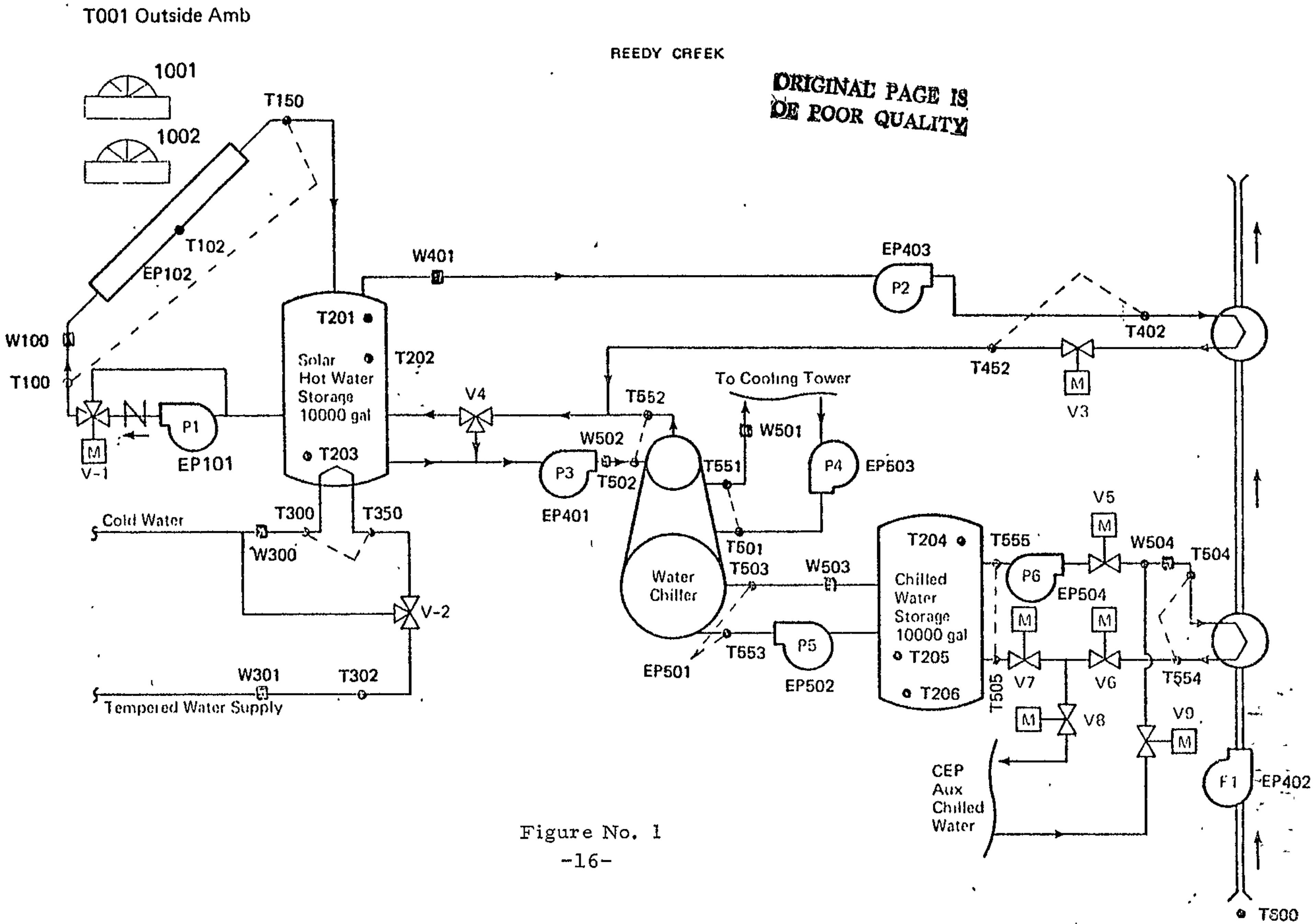

T001 Outside Amb
REEDY CREEK
1001
1002
T150
T102
EP102
W100
T100
V-1
M
P1
EP101
T201
Solar Hot Water Storage 10000 gal
T202
T203
W401
EP403
P2
T402
T452
V3
V4
T552
To Cooling Tower
W501
W502
T502
P3
EP401
T551
P4
EP503
T501
T503
Water Chiller
W503
T553
P5
EP502
EP501
Cold Water
W300
T300
T350
V-2
W301
T302
Tempered Water Supply
T204
Chilled Water Storage 10000 gal
T205
T206
T555
P6
EP504
V5
W504
T504
V7
V6
T554
T505
V8
V9
CEP Aux Chilled Water
F1
EP402
T500

Figure No. 1

VII. COSTS

PROJECT COSTS

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

DOE Funding to Date

Solar Energy System	$373,303
Instrumentation	12,843
Display Panel	9,570
	$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 MBtu
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.

APPENDIX A

INTERIM PERFORMANCE CRITERIA CERTIFICATION

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 L. Seely
Authorized Rep.

DATE 2/15/77

Don L. 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.

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SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA

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

SOLAR ENERGY SYSTEMS PERFORMANCE CRITERIA
CON'T.

IPC REQUIREMENT	IPC PARA.	MEETS IPC YES	MEETS IPC NO	MEETS IPC N/A	EVALUATION METHOD	COMMENTS
• 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 YES	MEETS IPC NO	MEETS IPC N/A	EVALUATION METHOD	COMMENTS
• 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 CON'T.

IPC REQUIREMENT	IPC PARA.	MEETS IPC YES	NO	N/A	EVALUATION METHOD
• 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			Analsyis
• 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

IPC REQUIREMENT	IPC PARA.	MEETS IPC YES	NO	N/A	EVALUATION METHOD	COMMENT
• 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	

IPC REQUIREMENT	IPC PARA.	MEETS IPC YES	MEETS IPC NO	MEETS IPC N/A	EVALUATION METHOD	COMMENTS
• 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	

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

IPC REQUIREMENT	IPC PARA.	MEETS IPC YES	NO	N/A	EVALUATION METHOD	COMMENTS
• 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	

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

IPC REQUIREMENT	IPC PARA.	MEETS IPC YES	NO	N/A	EVALUATION METHOD	COMMENTS
• 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	

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

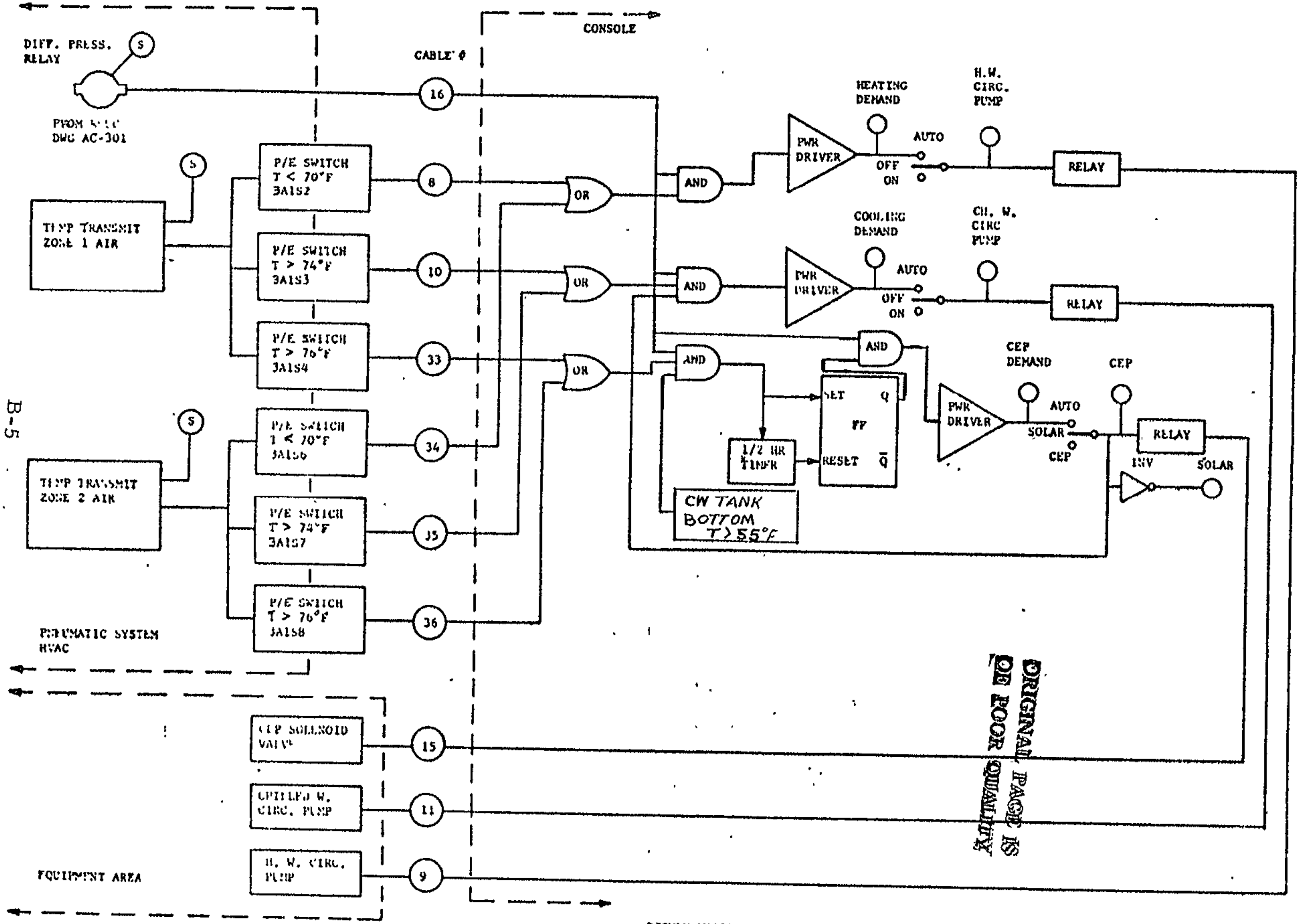
The first of these is a differential pressure switch which indicates that the fan in the air handling unit is on. This fan is controlled by timers and is an indication of building occupancy. The remaining sensors are P/E switches associated with the zone temperature sensors. Six such P/E switches are 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.



DISNEY WORLD - HVAC INTER..CE & CONTROL

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

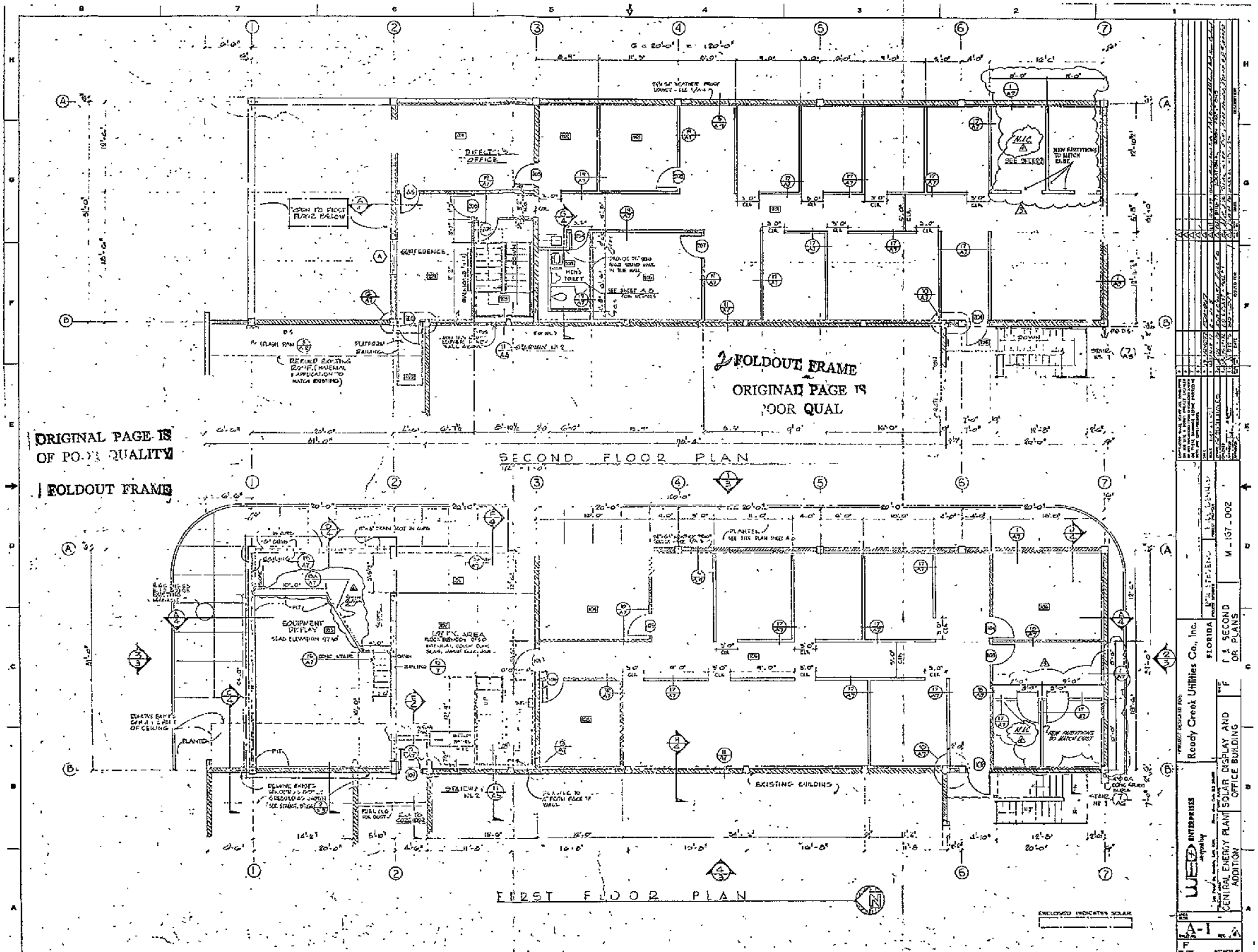
M-101 - Site Plan, Legend, Schedule, General Notes

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



SECOND FLOOR PLAN
FIRST FLOOR PLAN
DIRECTOR'S OFFICE
CONFERENCE
MEN'S TOILET
OPEN TO FIRST FLOOR BELOW
EQUIPMENT DISPLAY
LOBBY AREA
STAIRWAY NO 2
STAIR NO 1
EXISTING BUILDING
PLANTER
PLATFORM RAILING
N.I.C.
NEW PARTITIONS TO MATCH EXIST
ENCLOSED INDICATES SCALE
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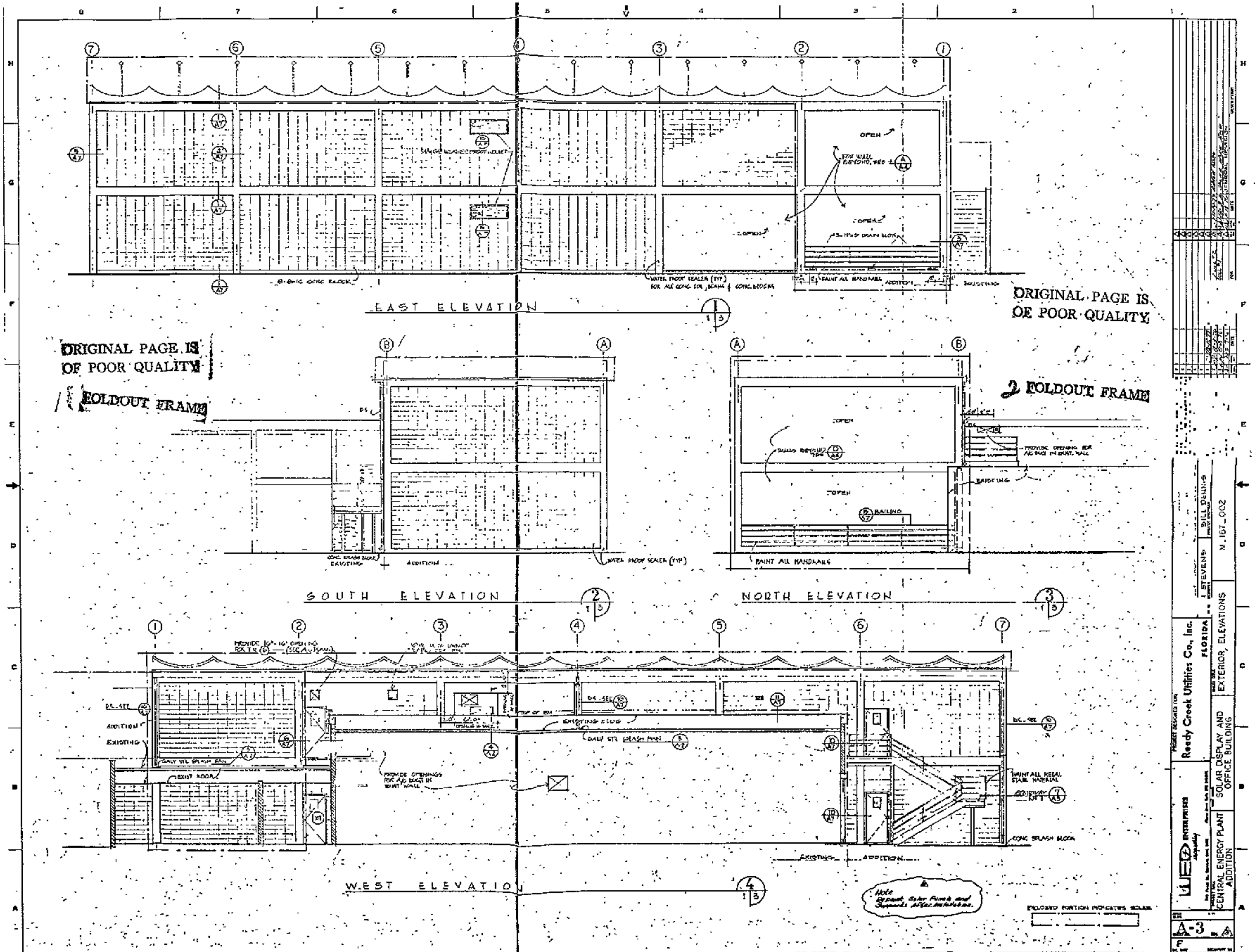
Reedy Creek Utilities Co., Inc.
FLORIDA
CENTRAL ENERGY PLANT SOLAR DISPLAY AND OFFICE BUILDING ADDITION
1st & SECOND FLOOR PLANS
M-137-002
A-1
WED ENTERPRISES


EAST ELEVATION
SOUTH ELEVATION
NORTH ELEVATION
WEST ELEVATION
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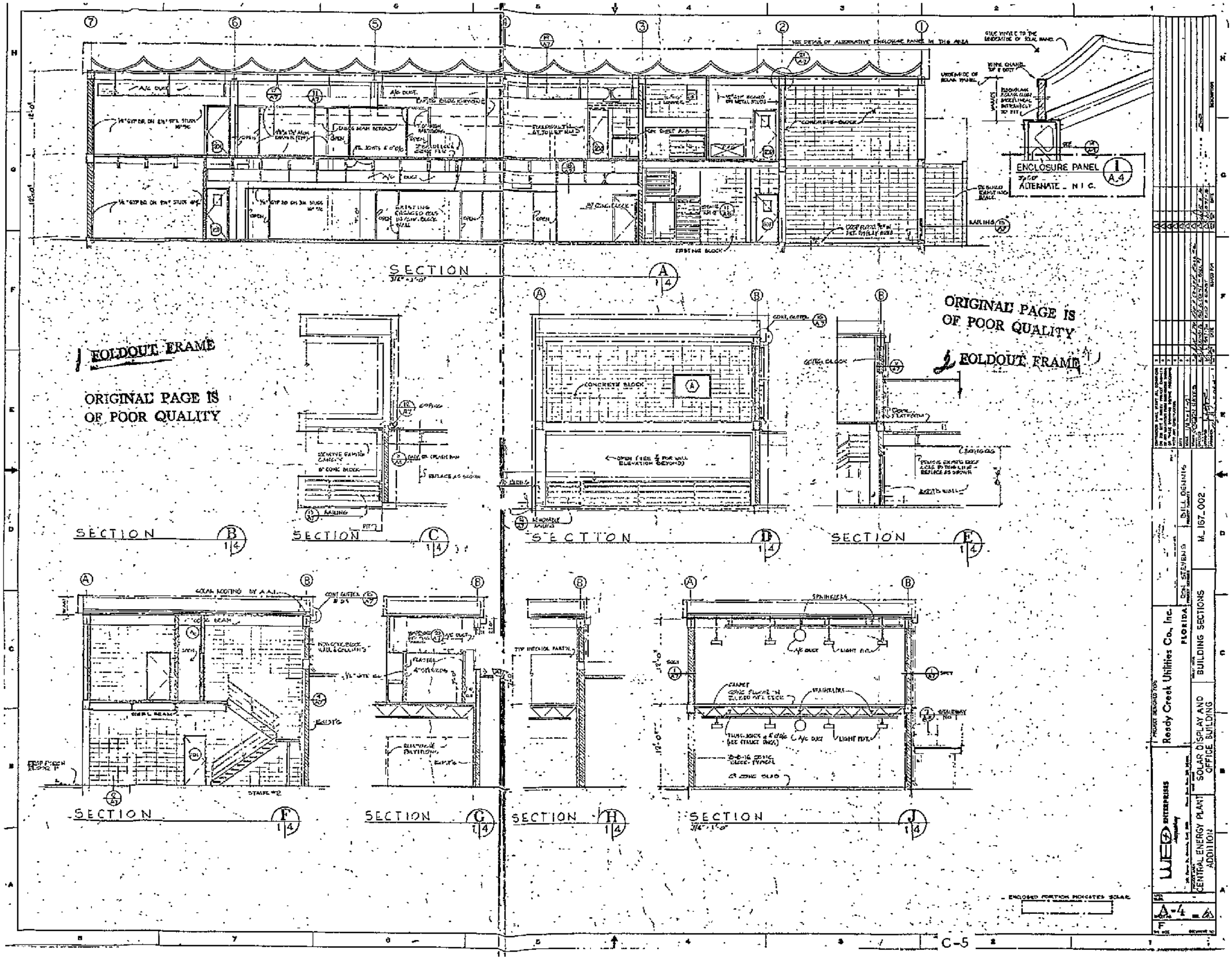
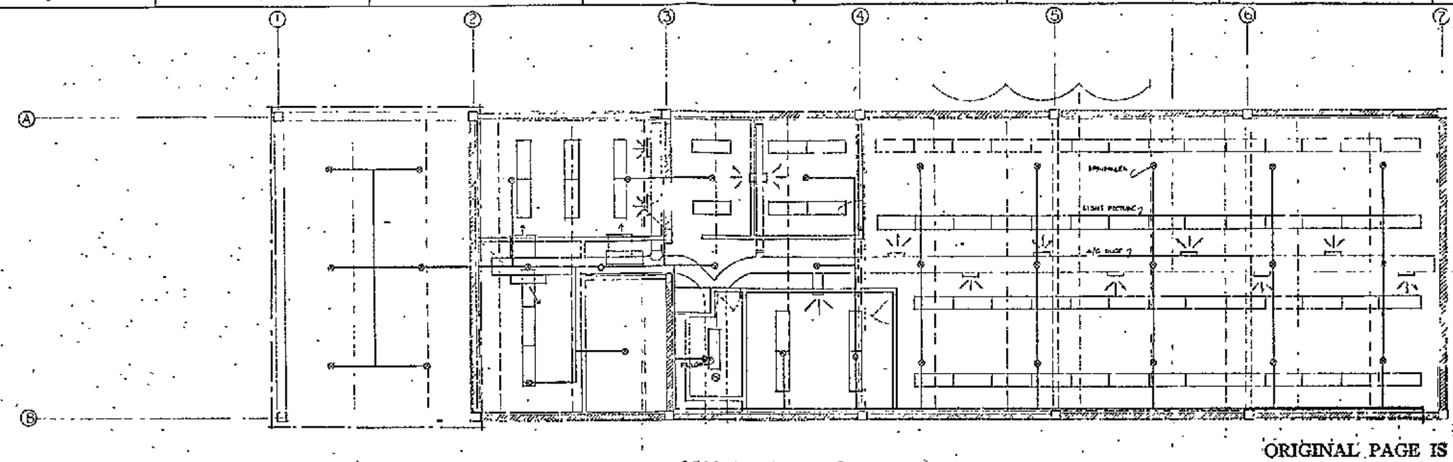
OPEN
EXISTING
ADDITION
PAINT ALL HANDRAILS
WATER PROOF SEALER (TYP)
CONC SPLASH BLOCK
PAINT ALL METAL STAIR MATERIAL
Reedy Creek Utilities Co., Inc.
FLORIDA
SOLAR DISPLAY AND OFFICE BUILDING
EXTERIOR ELEVATIONS
CENTRAL ENERGY PLANT ADDITION
STEVENS
BILL DENNIS
A-3


SECTION A 1/4
ENCLOSURE PANEL 1 A.4
ALTERNATE - N.I.C.
SECTION B 1/4
SECTION C 1/4
SECTION D 1/4
SECTION E 1/4
SECTION F 1/4
SECTION G 1/4
SECTION H 1/4
SECTION J 1/4
Reedy Creek Utilities Co., Inc.
FLORIDA
BUILDING SECTIONS
SOLAR DISPLAY AND OFFICE BUILDING
CENTRAL ENERGY PLANT ADDITION
M_167_002
A-4



SECOND FLOOR PLAN

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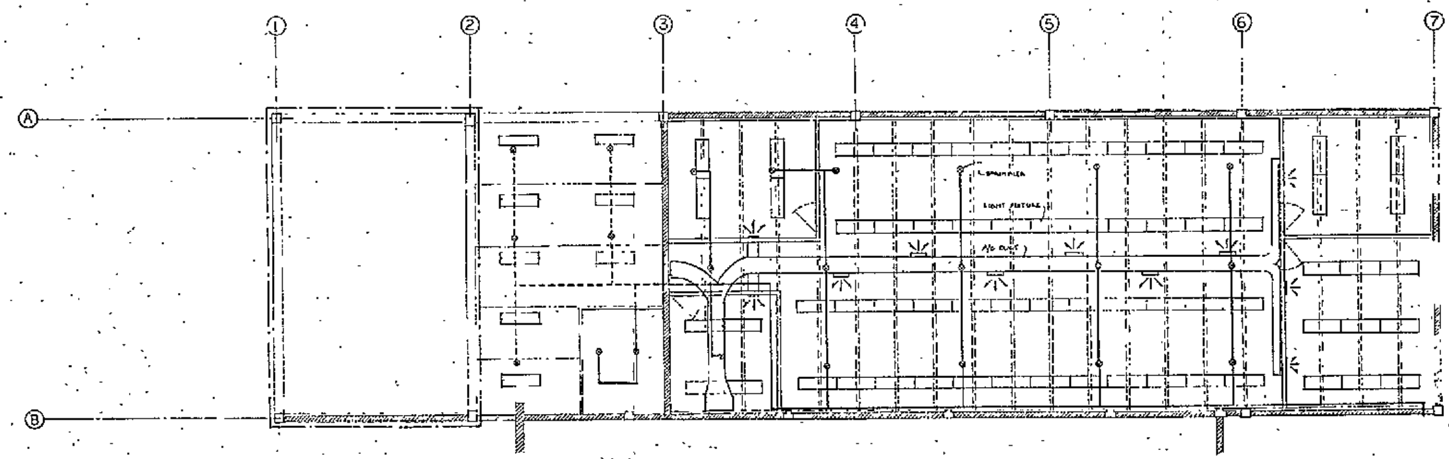

FIRST FLOOR PLAN

ENCLOSED PORTION INDICATES SOLAR

WED ENTERPRISES

PROJECT DESIGNED FOR:
REEDY CREEK UTILITIES CO INC.
FLORIDA

RON STEVENS

BILL BENTLEY

CENTRAL ENERGY PLANT ADDITION

SOLAR DISPLAY AND OFFICE BUILDING

CEILING MECHANICAL LAY_OUT

M.167.002

A-6A

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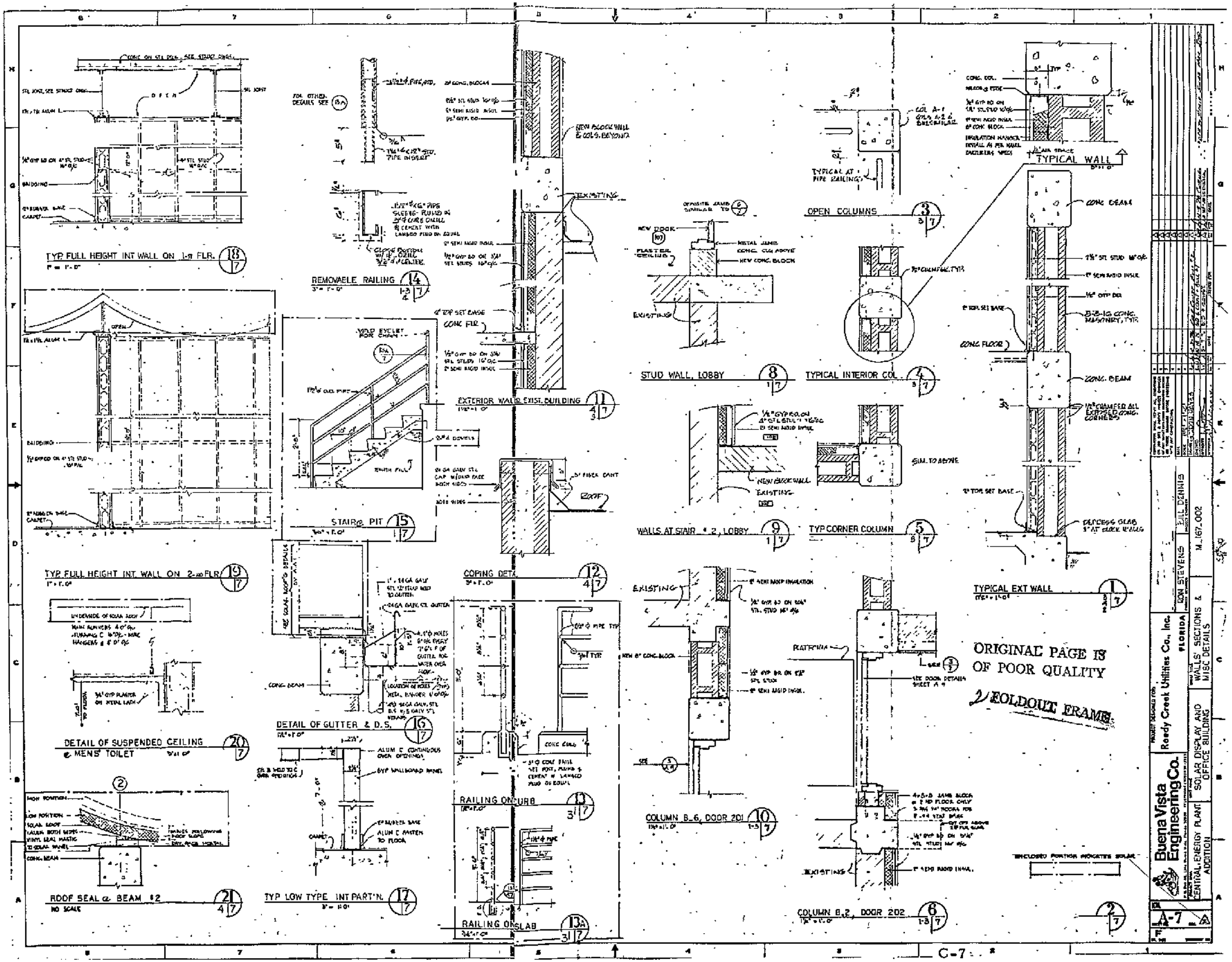

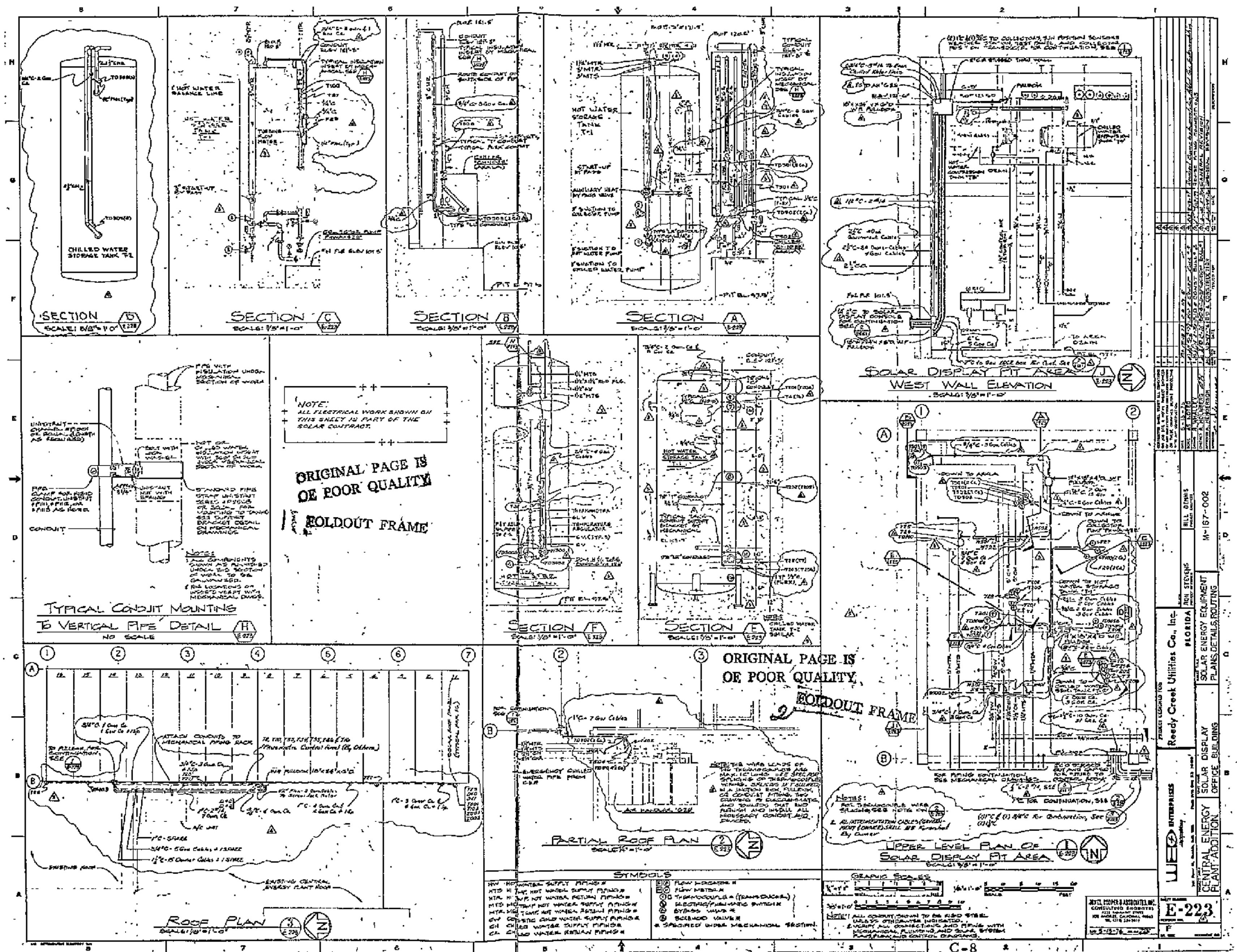

SECTION D
CHILLED WATER STORAGE TANK T-2
SECTION C
SECTION B
SECTION A
HOT WATER STORAGE TANK T-1
SOLAR DISPLAY PIT AREA
WEST WALL ELEVATION
TYPICAL CONDUIT MOUNTING TO VERTICAL PIPE DETAIL
NO SCALE
NOTE: ALL ELECTRICAL WORK SHOWN ON THIS SHEET IS PART OF THE SOLAR CONTRACT.
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SECTION F
SECTION E
ROOF PLAN
PARTIAL ROOF PLAN
UPPER LEVEL PLAN OF SOLAR DISPLAY PIT AREA
SYMBOLS
GRAPHIC SCALES
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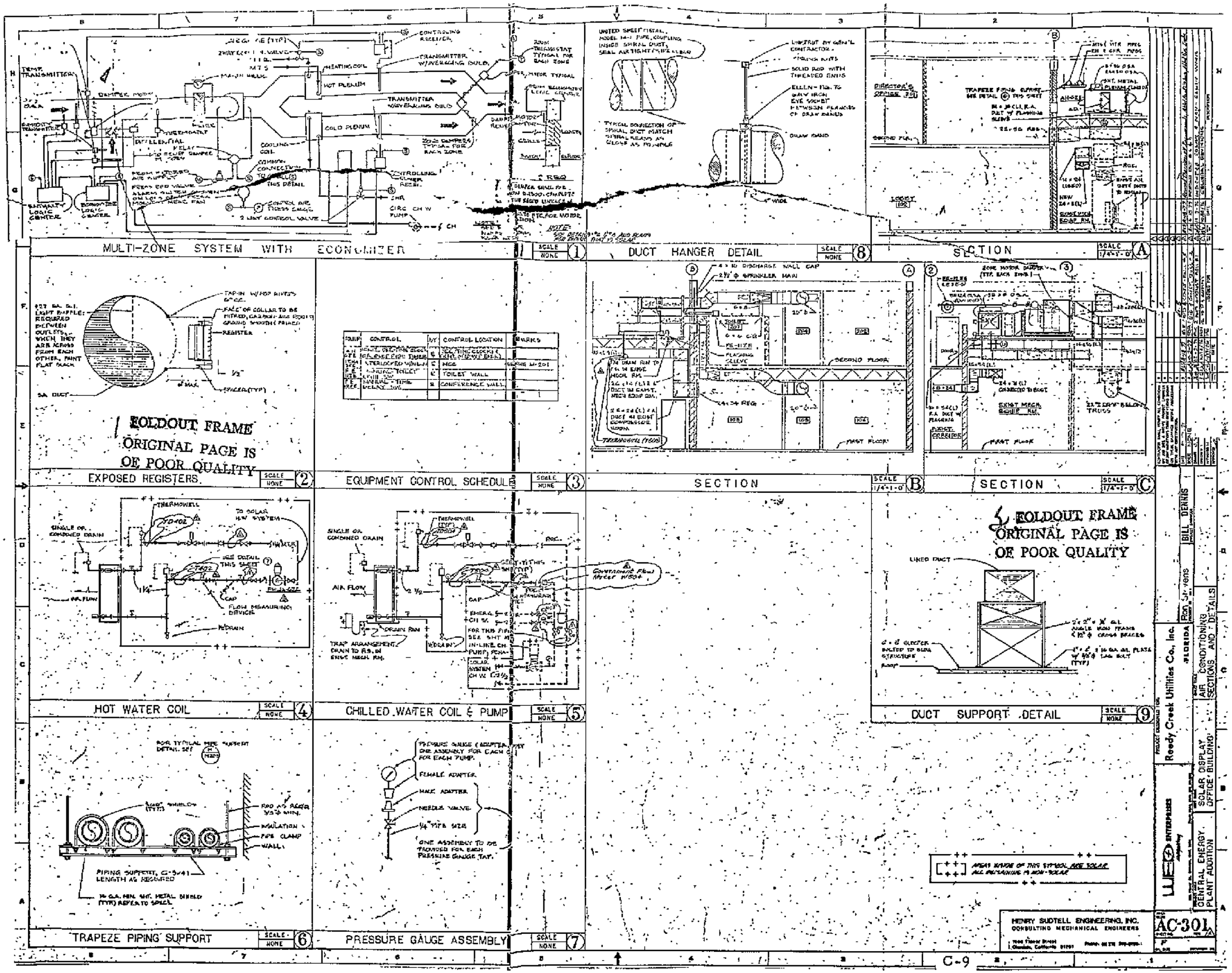
Reedy Creek Utilities Co., Inc.
FLORIDA
RON STEVENS
BILL DENNIS
M-167-002
WED ENTERPRISES
CENTRAL ENERGY PLANT ADDITION
SOLAR DISPLAY OFFICE BUILDING
SOLAR ENERGY EQUIPMENT PLANS, DETAILS, ROUTING
E-223
F



MULTI-ZONE SYSTEM WITH ECONOMIZER
SCALE NONE 1
DUCT HANGER DETAIL
SCALE NONE 8
SECTION
SCALE 1/4"=1'-0" A
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EXPOSED REGISTERS
SCALE NONE 2
EQUIPMENT CONTROL SCHEDULE
SCALE NONE 3
SECTION
SCALE 1/4"=1'-0" B
SECTION
SCALE 1/4"=1'-0" C
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HOT WATER COIL
SCALE NONE 4
CHILLED WATER COIL & PUMP
SCALE NONE 5
DUCT SUPPORT DETAIL
SCALE NONE 9
TRAPEZE PIPING SUPPORT
SCALE NONE 6
PRESSURE GAUGE ASSEMBLY
SCALE NONE 7
HENRY SUDTELL ENGINEERING, INC.
CONSULTING MECHANICAL ENGINEERS
Reedy Creek Utilities Co., Inc.
FLORIDA
BILL DENNIS
Ron Stevens
AIR CONDITIONING
SECTIONS AND DETAILS
SOLAR DISPLAY
OFFICE BUILDING
CENTRAL ENERGY
PLANT ADDITION
WED ENTERPRISES
AC-301
C-9

PUMP SCHEDULE

SYMBOL	SERVICE	LOCATION	MANUFACTURER	MODEL	TYPE	WATER TEMP °F	GPM	FT HD	MOTOR HP	MOTOR RPM	MOTOR VOLT	MOTOR Φ	MOTOR HZ	WT.	DRAWING REF. NO.	REMARKS
[illegible]	CHILLED WATER CIRC	ROOF	WORTHINGTON	[illegible]	IN LINE	44	55	35'	1	1750	460	3	60		M-201	
[illegible]	COLLECTOR	EQUIP RM.	WORTHINGTON	[illegible]	END-SUCT	225	120	60'	3	1750	460	3	60		M-202	FRAME MOUNTED
[illegible]	MED TEMP HOT WATER	EQUIP RM	WORTHINGTON	[illegible]		225	80	70	3	1750	460	3	60		M-202	"
[illegible]	CHILLED WATER	EQUIP RM	WORTHINGTON	[illegible]		44	60	40	1½	1750	460	3	60		M-202	"
[illegible]	COND WATER	CHILLED WATER PLANT	WORTHINGTON	[illegible]	[illegible]	95	40	120	5	[illegible]	460	3	60		M-201	"
[illegible]	MED TEMP HOT WATER	ROOF	BELL & GOSSETT	[illegible]	[illegible]	225	7	26	[illegible]	[illegible]	115	1	60		M-201	MOUNT PUMP IN HORIZONTAL POSITION

TANK SCHEDULE

SYMBOL	SERVICE	LOCATION	CONSTRUCTION	TYPE	TAPPINGS	MANHOLES	SUPPORTS	CAP IN GAL.	SIZE	REMARKS
T-1	HOT WATER STORAGE	EQUIP RM.	ASME 125 PSI	VERTICAL	SEE SCHEDULE	18" FLG'D	H-BEAM	[illegible]	[illegible]	PROVIDE DAVIT WITH MANHOLE
T-2	CHILLED WATER STOR.	EQUIP RM.	ASME 125 PSI	VERTICAL	SEE SCHEDULE	18" FLG'D	H-BEAM	[illegible]	[illegible]	PROVIDE DAVIT WITH MANHOLE
T-3	HOT WATER COMP TANK	EQUIP RM.	ASME 125 PSI	HORIZONTAL	SEE DET'L ON M-201	NONE	BRACKET TO WALL & SUSPENDED	100	[illegible]	
T-4	CHILLED WATER COMP TANK	EQUIP RM	ASME 125 PSI	HORIZONTAL	SEE DET'L ON M-202	NONE	BRACKET TO WALL & SUSPENDED	100	[illegible]	

HEAT EXCHANGER SCHEDULE

SYMBOL	SERVICE	LOCATION	MANUFACTURER	MODEL	TYPE	SIZE	NO OF PASSES	SYSTEM H_2O				SERVICE H_2O				DRAWING REF NO	REMARKS
								[illegible]	GPM	IN °F	OUT °F	[illegible]					
HX-1ZE	DOMESTIC HOT WATER	IN HOT WATER STORAGE TANK	B&G	[illegible]	[illegible]	[illegible]	4	—	[illegible]	70	40	—	—	[illegible]	—	M-202	

CHILLER UNIT SCHEDULE

SYMBOL	LOCATION	MANUFACTURER MODEL NO	CAP-TONS	[illegible]			CHILLED WATER				CONDENSER WATER				ELECTRICAL				REMARKS
CH-1OZE	EQUIP. RM	ARKLA WF-300	25	55	[illegible]	325	60	[illegible]	55	45	90	25	85	95	115	1	[illegible]	130	

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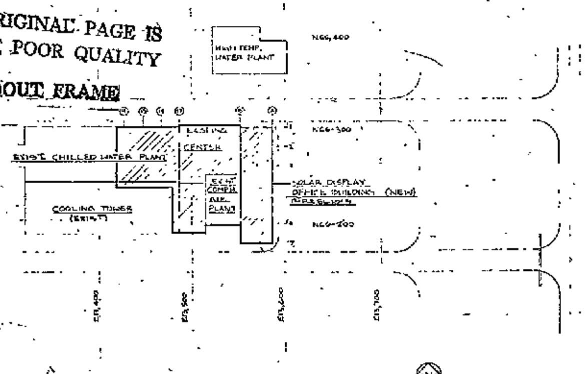

① SITE PLAN

LIST OF DRAWINGS

MECHANICAL

M-101 SITE PLAN, LEGEND, SCHEDULES, GENERAL NOTES
M-201 PARTIAL CHILLER BLDG PLAN & ROOF PLAN SECTIONS DETAILS
M-202 SOLAR ENERGY EQUIPMENT ROOM PLANS & SECTIONS
M-203 SOLAR ENERGY EQUIP RM SECTIONS & DETAILS
M-204 FLOW DIAGRAM

LEGEND

SYMBOL	ABBREV.	DESCRIPTION
—CW—	CW	DOMESTIC COLD WATER
—ICW—	ICW	INDUSTRIAL COLD WATER
—CH—	CH	CHILLED WATER SUPPLY
—CHR—	CHR	CHILLED WATER RETURN
—TW—	TW	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
		EXISTING PIPING OR EQUIPMENT
		[illegible]
—ID—	ID	INDIRECT DRAIN
—CS—	CS	CONDENSER WATER SUPPLY
—CR—	CR	CONDENSER WATER RETURN
—A—	A	COMPRESSED AIR
	POC	POINT OF CONNECTION
	BOP	BOTTOM OF PIPE
		DIRECTION OF FLOW
		TYPICAL PIPE SIZE DESIGNATION
		FLEXIBLE CONNECTION
		CAP/PLUG
	GV	GATE VALVE
	GLV	GLOBE VALVE
		BUTTERFLY VALVE
	CV	CHECK VALVE
		PLUG VALVE
		BALL VALVE
		NEEDLE VALVE
		CONTROL VALVE
		MOTOR OPERATED VALVE
	PRV	PRESSURE REDUCING VALVE
		3 WAY VALVE W/OPERATOR
		ANGLE VALVE
	[illegible]	PRESSURE (PRESSURE-TEMP) RELIEF VALVES
	FMD	FLOW MEASURING DEVICE
		HOSE DRAIN VALVE
		UNION (SCREWED)
		MECHANICAL COUPLING
		"Y" TYPE STRAINER W/[illegible] VALVE
	SOV	SHUT-OFF VALVE
		REDUCER OR INCREASER (CONC)
		REDUCER OR INCREASER (ECC)
		PRESSURE GAUGE
		ORIFICE FLG.
		THERMOMETER
		THERMOMETER WELL COUPLING ONLY - ¾"
	LOC.	LIMIT OF CONTRACT
	NC.	NORMALLY CLOSED
	NO.	NORMALLY OPEN

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

HENRY SUDTELL ENGINEERING, INC
CONSULTING MECHANICAL ENGINEERS

Reedy Creek Utilities Co., Inc.
FLORIDA

Ron Stevens

BILL DENNIS

WED ENTERPRISES

CENTRAL ENERGY PLANT ADDITION

SOLAR/DISPLAY OFFICE BUILDING

SITE PLAN, LEGEND, SCHEDULE, GENL. NOTES

M-101

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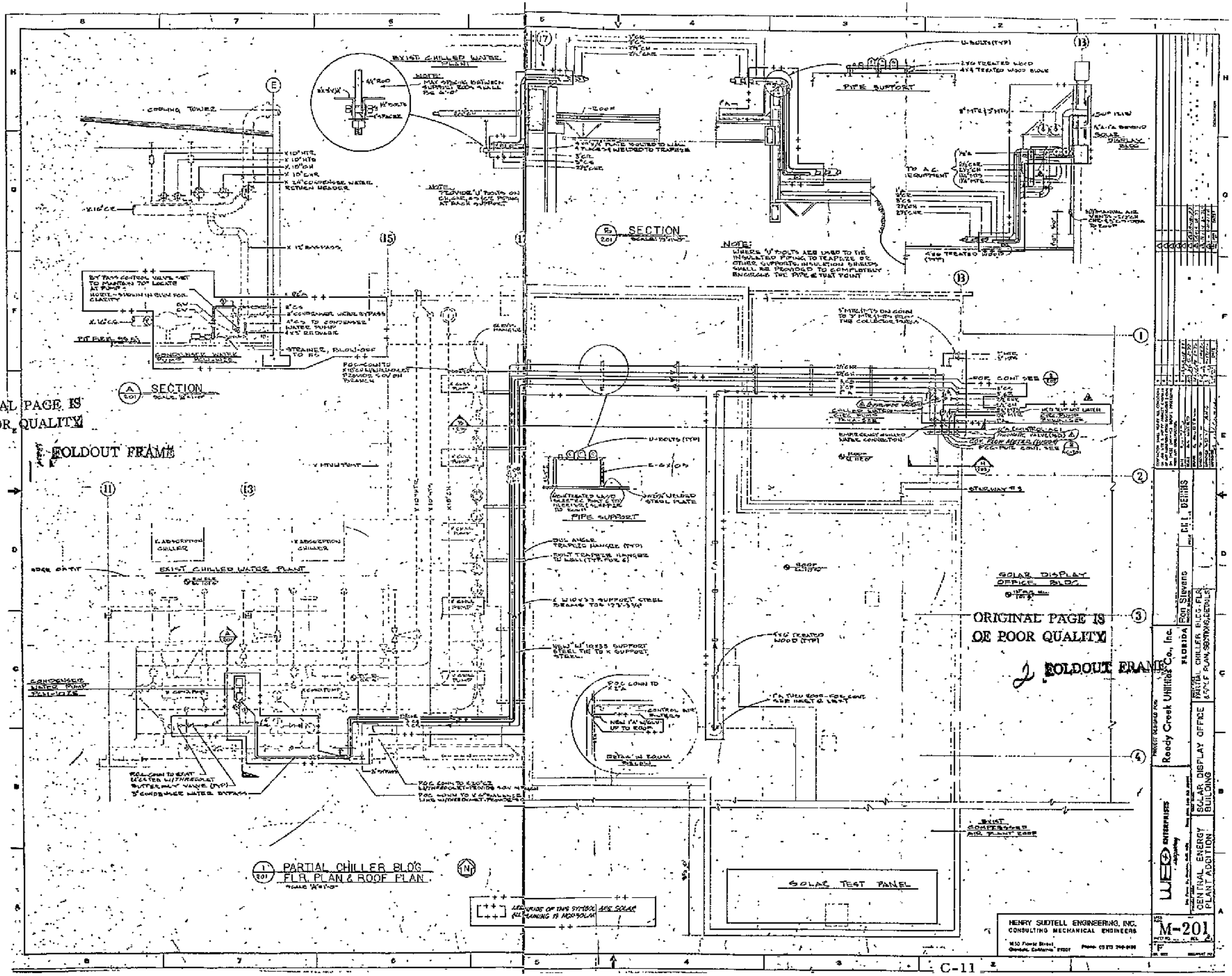

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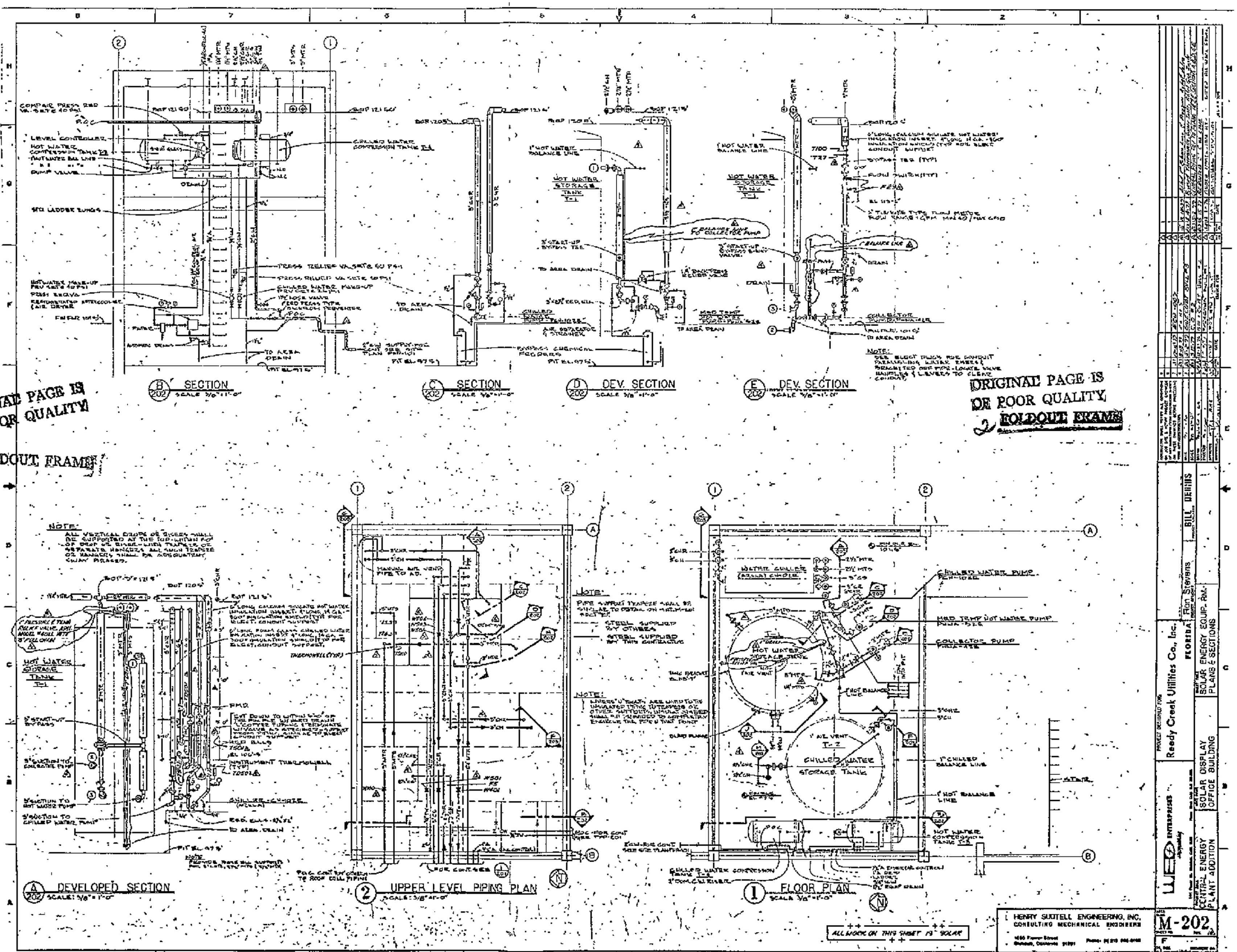
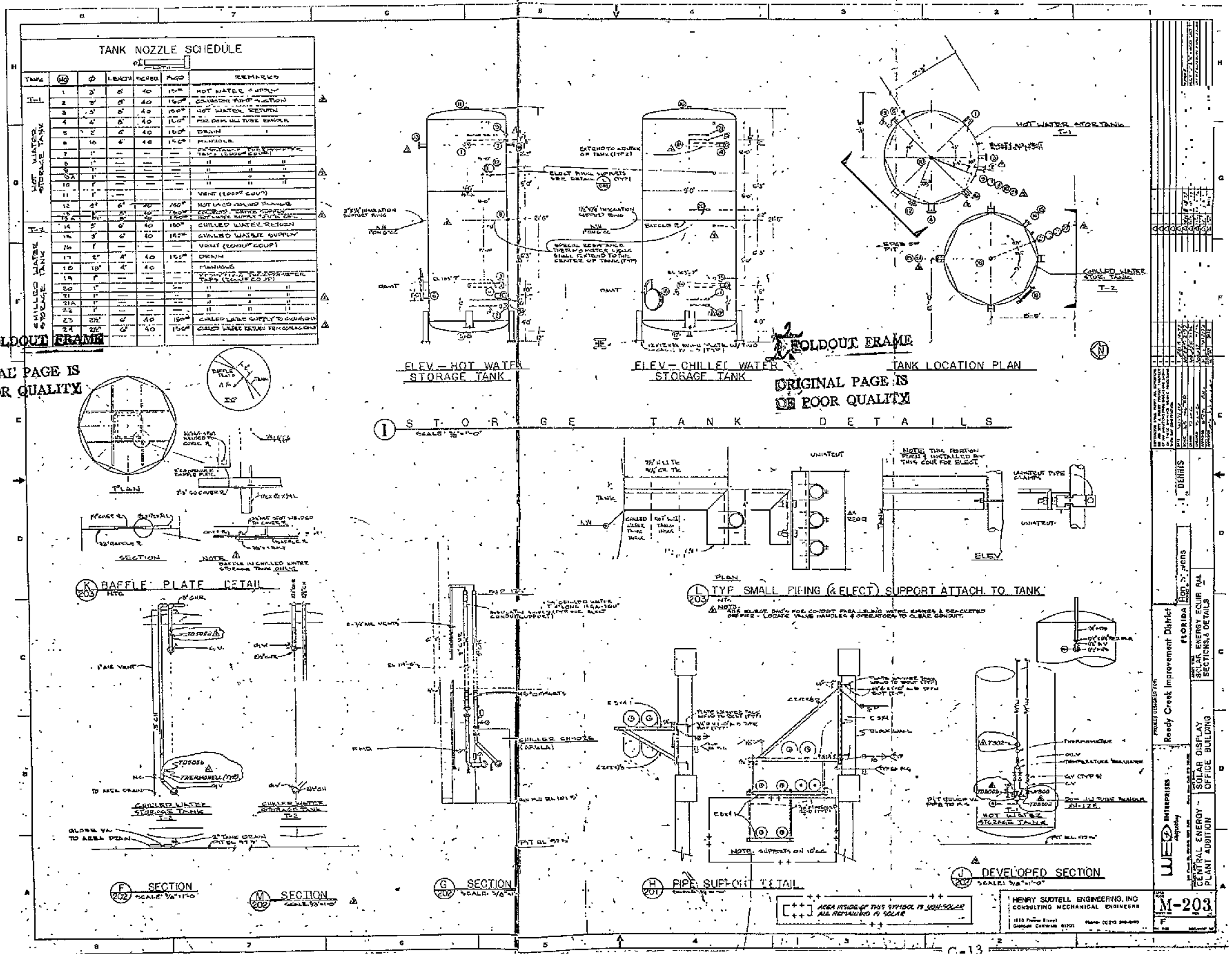

B SECTION 202 SCALE 3/8"=1'-0"
C SECTION 202 SCALE 3/8"=1'-0"
D DEV. SECTION 202 SCALE 3/8"=1'-0"
E DEV. SECTION 202 SCALE 3/8"=1'-0"
A DEVELOPED SECTION 202 SCALE: 3/8"=1'-0"
2 UPPER LEVEL PIPING PLAN SCALE: 3/8"=1'-0"
1 FLOOR PLAN SCALE 3/8"=1'-0"
HOT WATER STORAGE TANK T-1
CHILLED WATER STORAGE TANK
CHILLED WATER PUMP
COLLECTOR PUMP
ALL WORK ON THIS SHEET IS SOLAR
HENRY SUDTELL ENGINEERING, INC.
CONSULTING MECHANICAL ENGINEERS
Ready Creek Utilities Co., Inc.
FLORIDA
BILL DENNIS
Ron Stevens
SOLAR ENERGY EQUIP. RM.
PLANS & SECTIONS
SOLAR DISPLAY
OFFICE BUILDING
CENTRAL ENERGY
PLANT ADDITION
M-202

TANK NOZZLE SCHEDULE

TANK	NO.	ϕ	LENGTH	SCHED.	RATING	REMARKS
T-1 HOT WATER STORAGE TANK	1	3"	6"	40	150#	HOT WATER SUPPLY
	2	3"	6"	40	150#	CONDENSER PUMP SUCTION
	3	3"	6"	40	150#	HOT WATER RETURN
	4	4"	6"	40	150#	FOR DOM. HW TUBE BUNDLE
	5	2"	6"	40	150#	DRAIN
	6	16"	6"	40	150#	MANHOLE
	7	1"	—	—	—	RESISTANCE THERMOMETER TAPS (2000# COUP.)
	8	1"	—	—	—	" " "
	9	1"	—	—	—	" " "
	9A	1"	—	—	—	" " "
	10	1"	—	—	—	" " "
	11	1"	—			VENT (2000# COUP.)
	12	5"	6"	40	150#	NOT USED ROUND FLANGE
	13	[illegible]	6"	40	150#	[illegible] SUPPLY
	13A	[illegible]	6"	40	150#	HOT WATER SUPPLY [illegible]
T-2 CHILLED WATER STORAGE TANK	14	5"	6"	40	150#	CHILLED WATER RETURN
	15	5"	6"	40	150#	CHILLED WATER SUPPLY
	16	1"	—	—	—	VENT (2000# COUP.)
	17	2"	4"	40	150#	DRAIN
	18	18"	4"	40		MANHOLE
	19	1"	—	—	—	RESISTANCE THERMOMETER TAPS (2000# COUP.)
	20	1"	—	—	—	" " "
	21	1"	—	—	—	" " "
	21A	1"	—	—	—	" " "
	22	1"	—	—	—	" " "
	23	2½"	6"	40	150#	CHILLED WATER SUPPLY TO COOLING COILS
	24	2½"	6"	40	150#	CHILLED WATER RETURN FROM COOLING COILS



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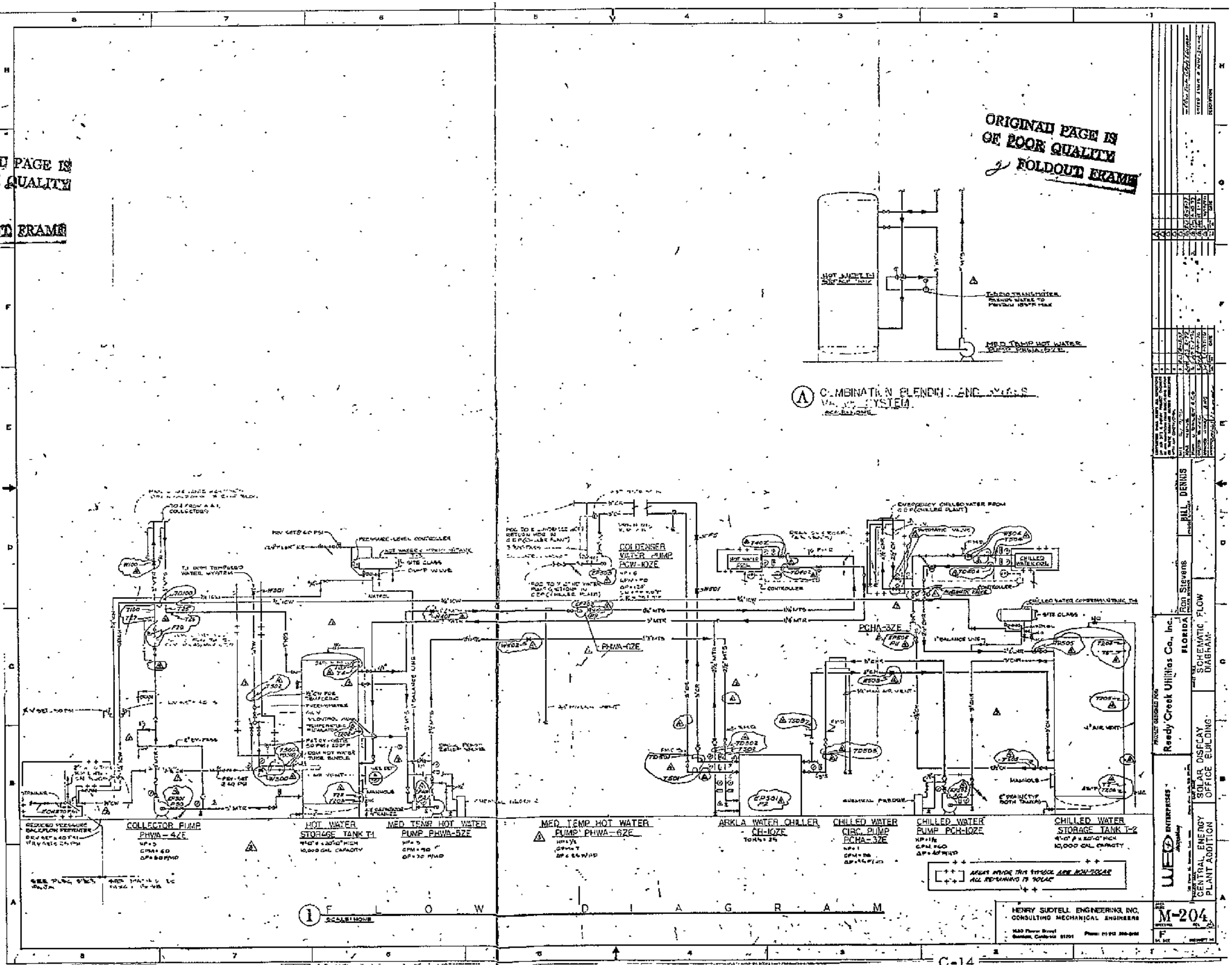

APPENDIX D

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 Sheet 1 of 1	-	Receiver Installation
AAI-57939-40144 Sheet 1 of 1	-	Receiver Assembly
AAI-57607-40107 Sheet 1 of 1	-	Electrical Schematic Amplifier - Sun Follower
AAI-57607-1A1A2 Sheet 1 of 1	-	Overheat - Defocus and Pump Control Logic (Schematic)
AAI-57607-1A1A3 Sheet 1 of 1	-	Sun Tracker Control Logic (Schematic)

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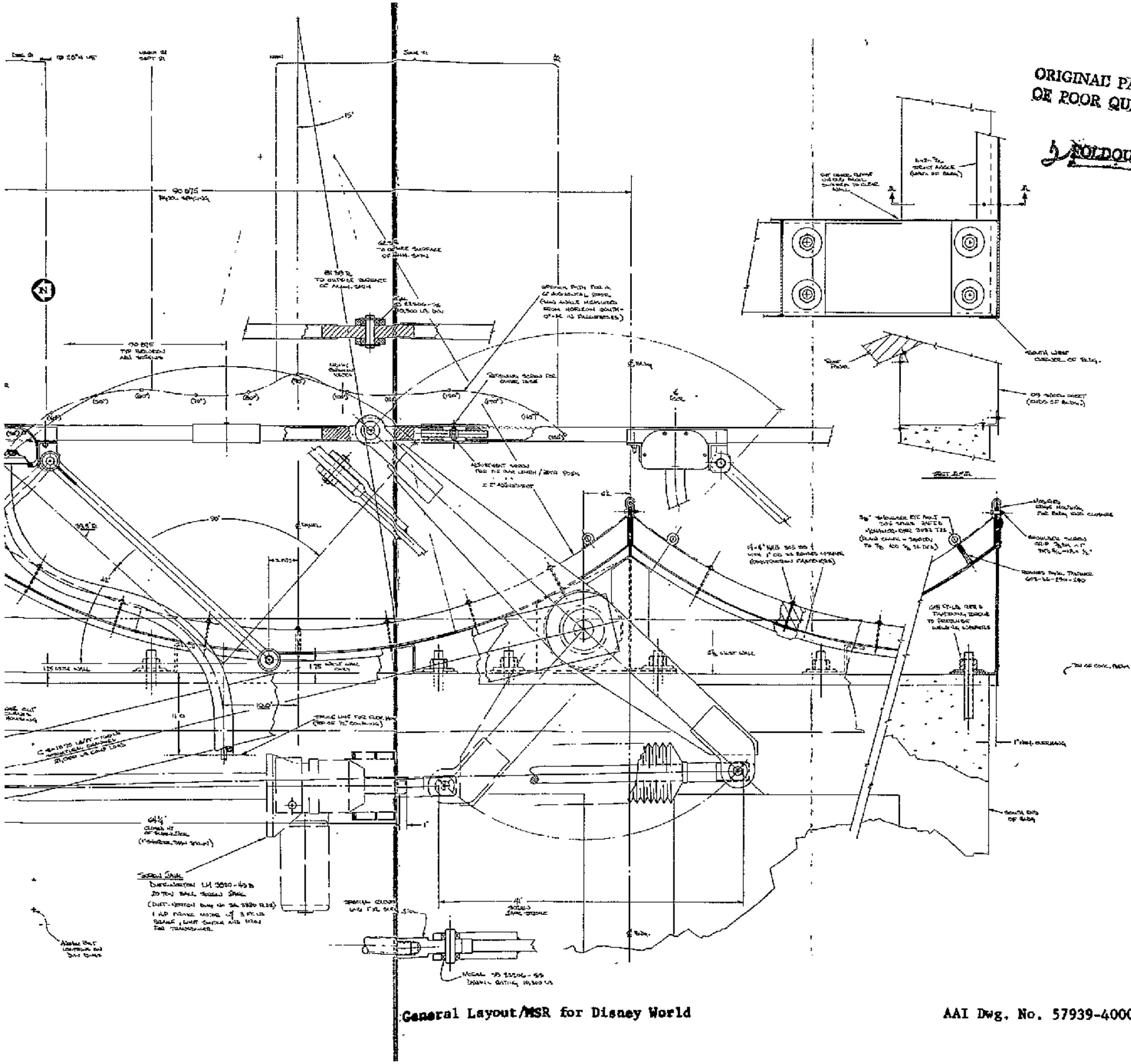
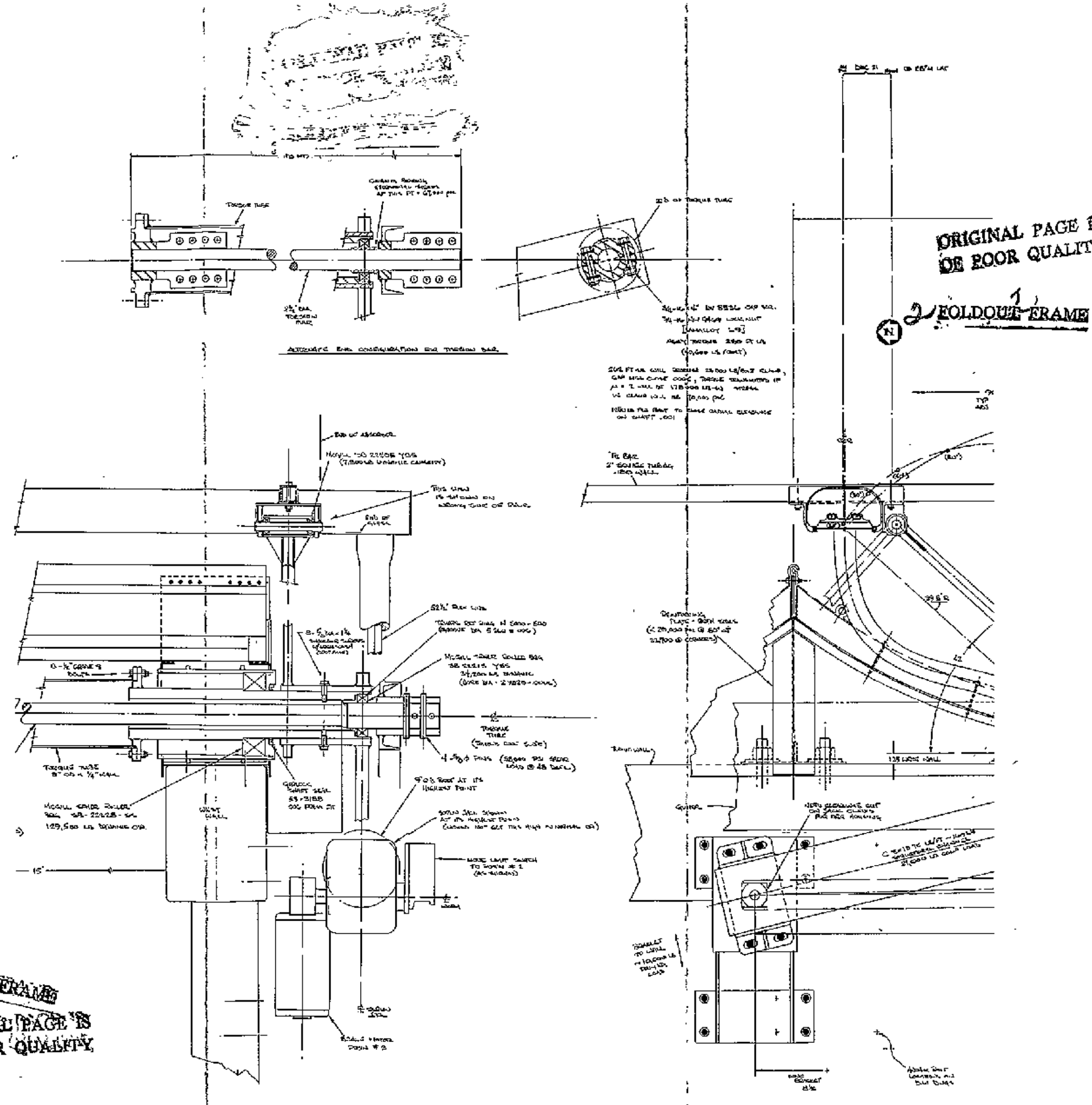


General Layout/MSR for Disney World

AAI Dwg. No. 57939-40001



General Layout/MSR for Disney World

AAI Dwg. No. 57939-40001 - Continued

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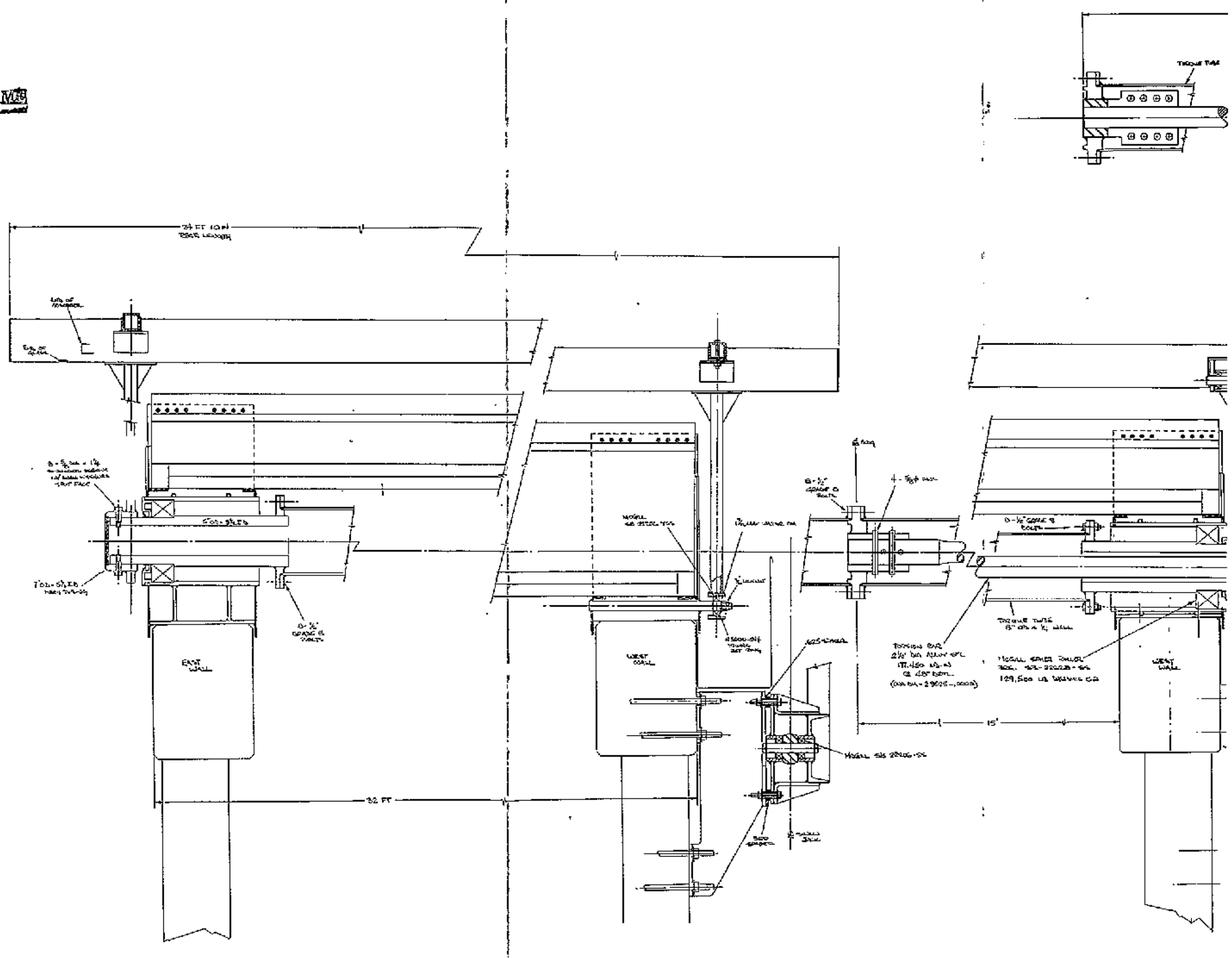
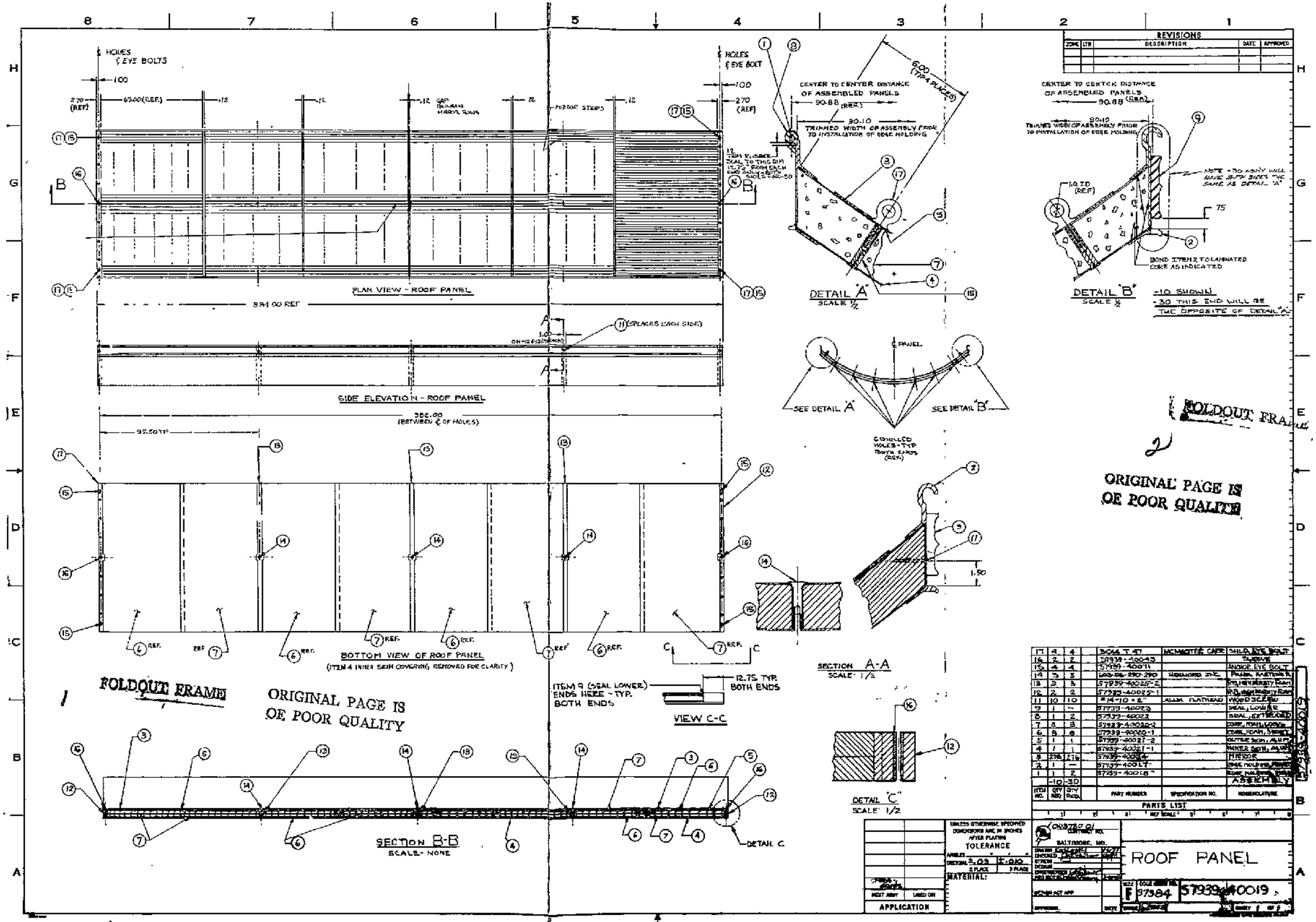


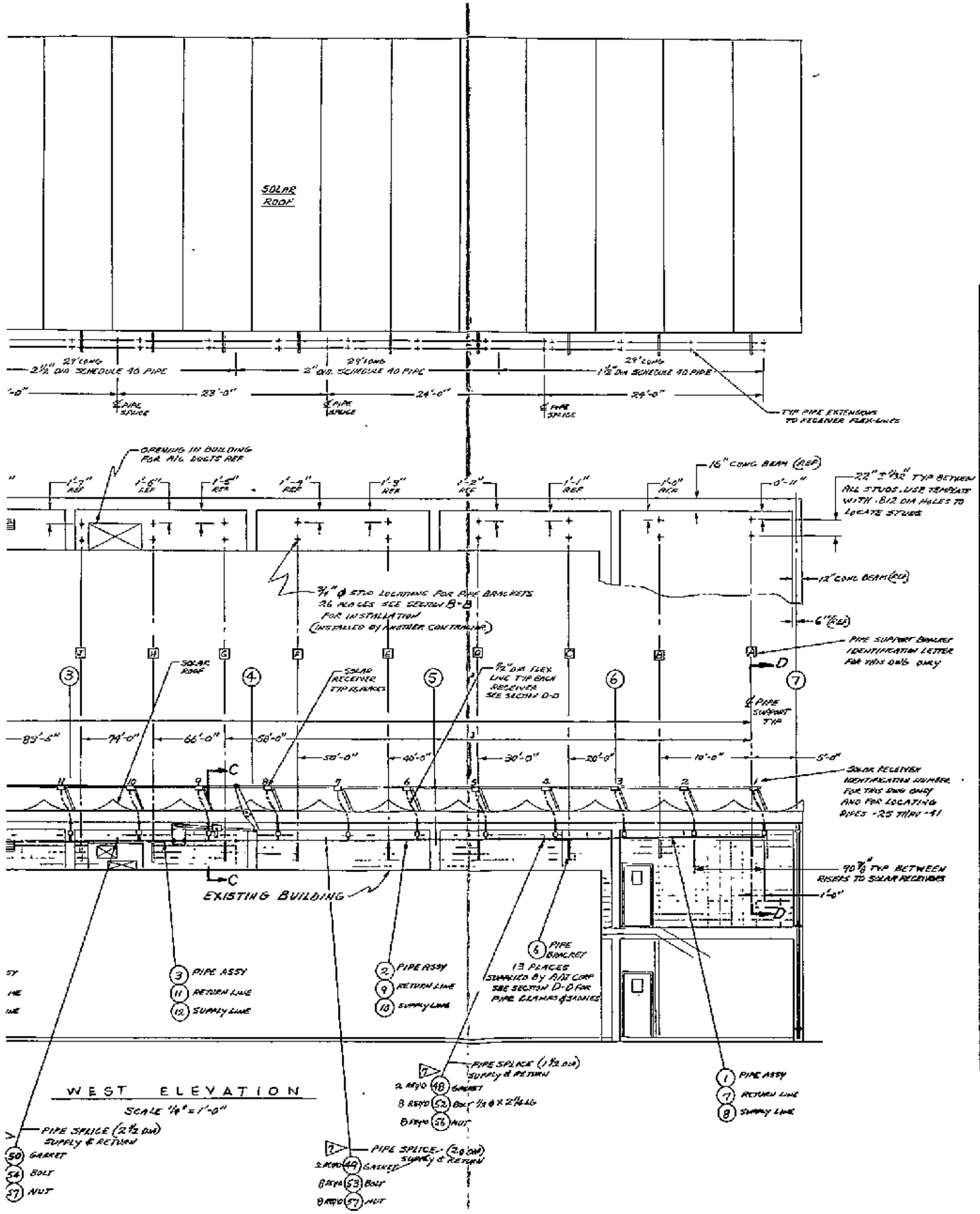
General Layout/MSR for Disney World

AAI Dwg. No. 57939-40001 - Continued D-6



Roof Panel

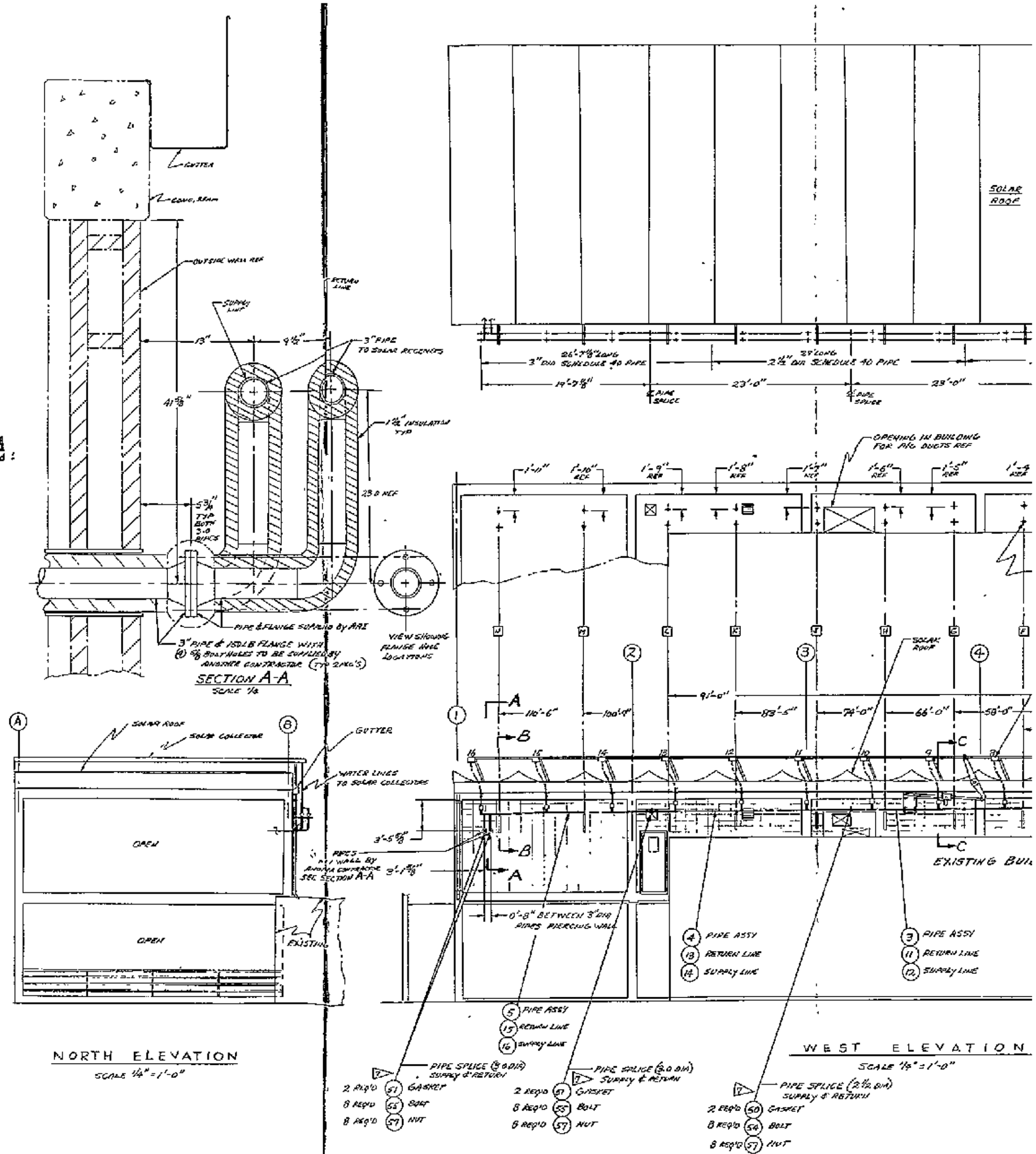
AAI Dwg. No. 57939-40019, Sheet 1 of 1



SEE SHEET #2 FOR NOTES & ▷

67						300		MS35338-80		LOCK WASHER
66						400		MS27183-21		WASHER
65						400		MS5969-20		NUT
64						64		SIZE 10 MEDIUM-18 8 CRES		LOCK WASHER
63						64		10/32 x 3/4 PAN HD PHILLIPS-TYPE 18-8		MACH SCREW-PAN HD
62						16		MURRAY-PART #64 TDEN WORM GEAR DRIVE		HOSE CLAMP
61						16		57939-40146-10		PROTECTIVE HOSE ASSY
60						26		▷		PIPE ROLLER SUPPORTS
59						26		MS27183-23 GALVANIZED FLAT WASHER		WASHER
58						26	▷	3/4" DIA HEAVY HEXAGON		NUT
57						32	▷	5/8" DIA HEAVY HEXAGON		NUT
56						8	▷	1/2" DIA HEAVY HEXAGON		NUT
55						16	▷	5/8" DIA X 3½ LG		BOLT
54						8	▷	5/8" DIA X 3½ LG		BOLT
53						8	▷	5/8" DIA X 5.0 LG		BOLT
52						8	▷	1/2" DIA X 2¾ LG		BOLT
51						4	▷	3" FLAT RING GASKET 150 LB FLANGE		GASKET
50						2	▷	2½" FLAT RING GASKET 150 LB FLANGE		GASKET
49						2	▷	2" FLAT RING GASKET 150 LB FLANGE		GASKET
48						2	▷	1½" FLAT RING GASKET 150 LB FLANGE		GASKET
47						16		▷		INSULATION
46	3	9	9	3	4			▷		CIRCUIT SETTER
45						32		57939-40096-10		FLEXIBLE HOSE ASSY
44			1				▷	1/2" 45° ELBOW - ASA 150 LB		ELBOW
43	3	3	2	3	4		▷	1/2" 45° STREET ELBOW - ASA 150 LB		STREET ELBOW
42	6	6	6	6	8		▷	1/2" PIPE COUPLING ASA 150 LB		COUPLING
41	1							57939-40072-41		PIPE
40	1							-39		
39	1							-35		
38			1					-33		
37		1						-31		
36		1						-27		
35			1					-25		
34		1						-23		
33			1					-21		
32			1					-17		
31				1				-15		
30				1				-13		
29				1				-11		
28					1			-7		
27					1			-5		
26					1			-3		
25					1			57939-40072-1		PIPE
24						6		57939-40054-7		PIPE SADDLE
23						8		57939-40054-5		PIPE SADDLE
22						6		57939-40054-3		PIPE SADDLE
21						6		57939-40054-1		PIPE SADDLE
20						12		57939-40058-3		STUD
19						40		57939-40058-1		STUD
18						6		57939-40055-1		PIPE CLAMP
17						20		57939-40053-1		PIPE CLAMP
16	1							57939-40063-30	SUPPLY LINE	PIPE - WELDED
15	1							57939-40063-10	RETURN LINE	
14		1						57939-40062-70	SUPPLY LINE	
13		1						57939-40062-50	RETURN LINE	
12			1					57939-40062-30	SUPPLY LINE	
11			1					57939-40062-10	RETURN LINE	
10				1				57939-40061-70	SUPPLY LINE	
9				1				57939-40061-50	RETURN LINE	
8					1			57939-40061-30	SUPPLY LINE	
7					1			57939-40061-10	RETURN LINE	PIPE - WELDED
6	2	3	3	2	3			57939-40051-10		PIPE BRACKET
5						1		-130		PIPE ASSY
4						1		-110		PIPE ASSY
3						1		-70		PIPE ASSY
2						1		-50		PIPE ASSY
1						1		-30		PIPE ASSY
ITEM	-130	-110	-70	-50	-30	-10		-10		INSTALLATION

D-8



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Solar Receiver Supply and Return Pipe Installation AAI Dwg. No. 57939-40064, Sheet 1 of 2 - Continued

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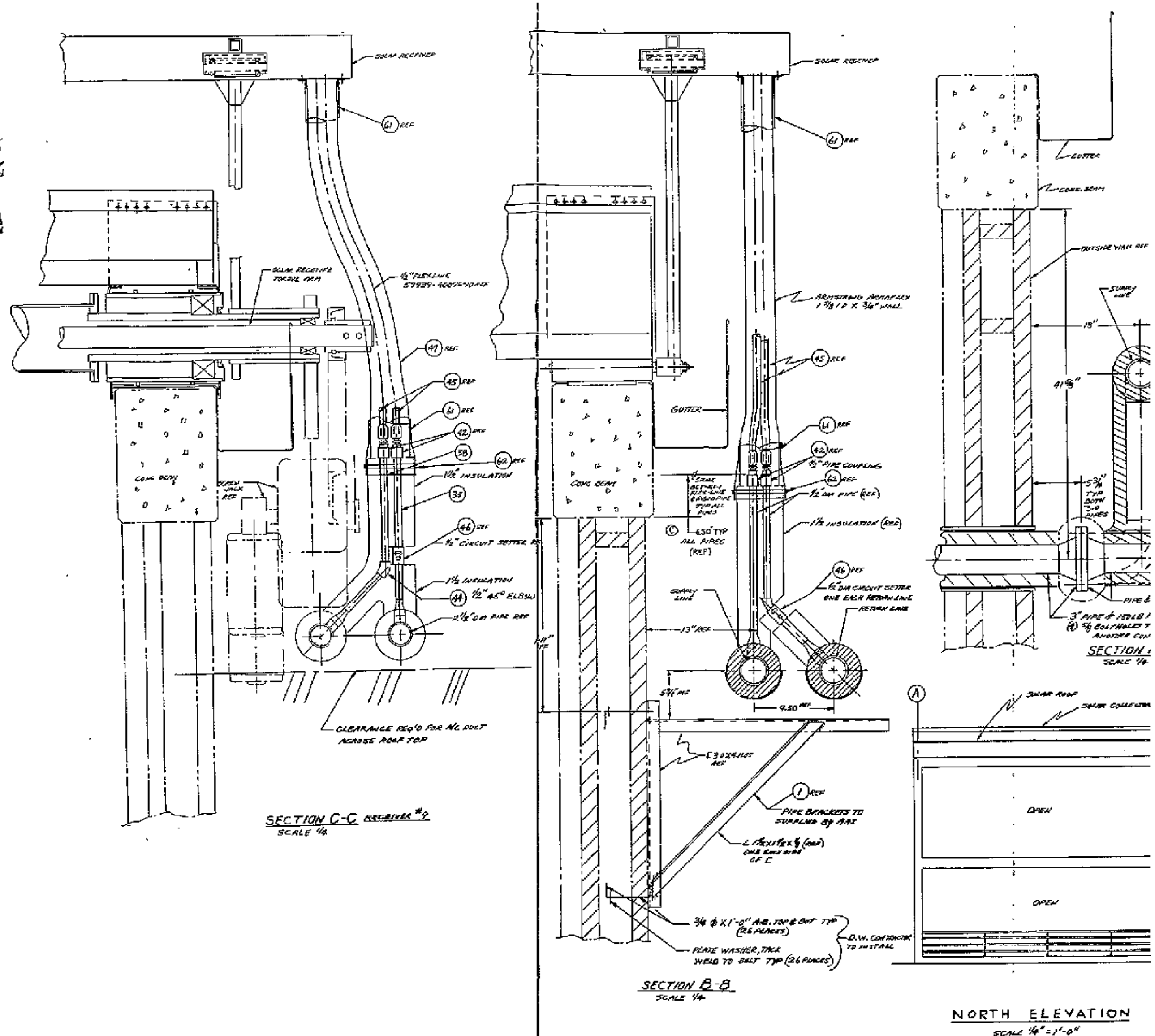

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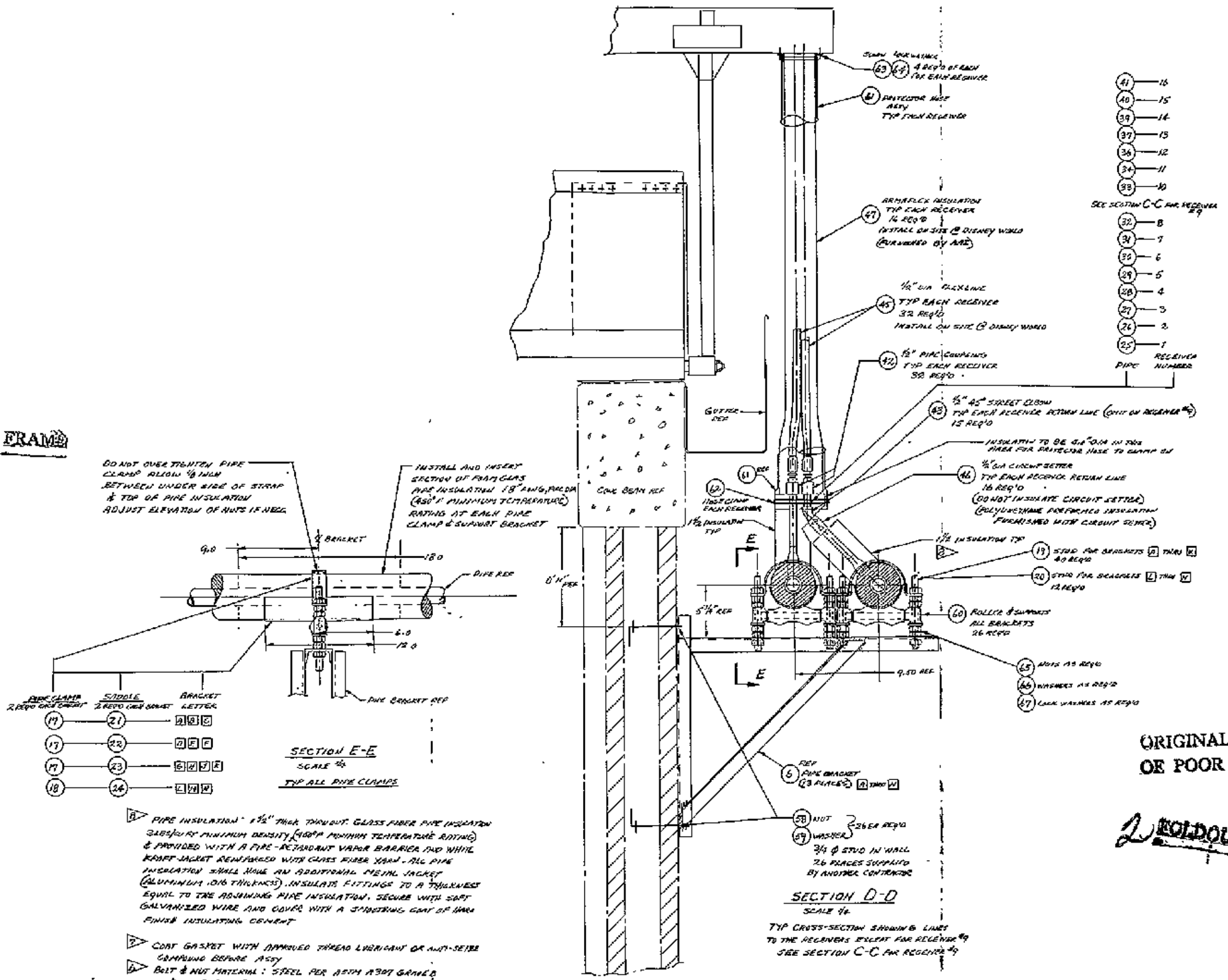
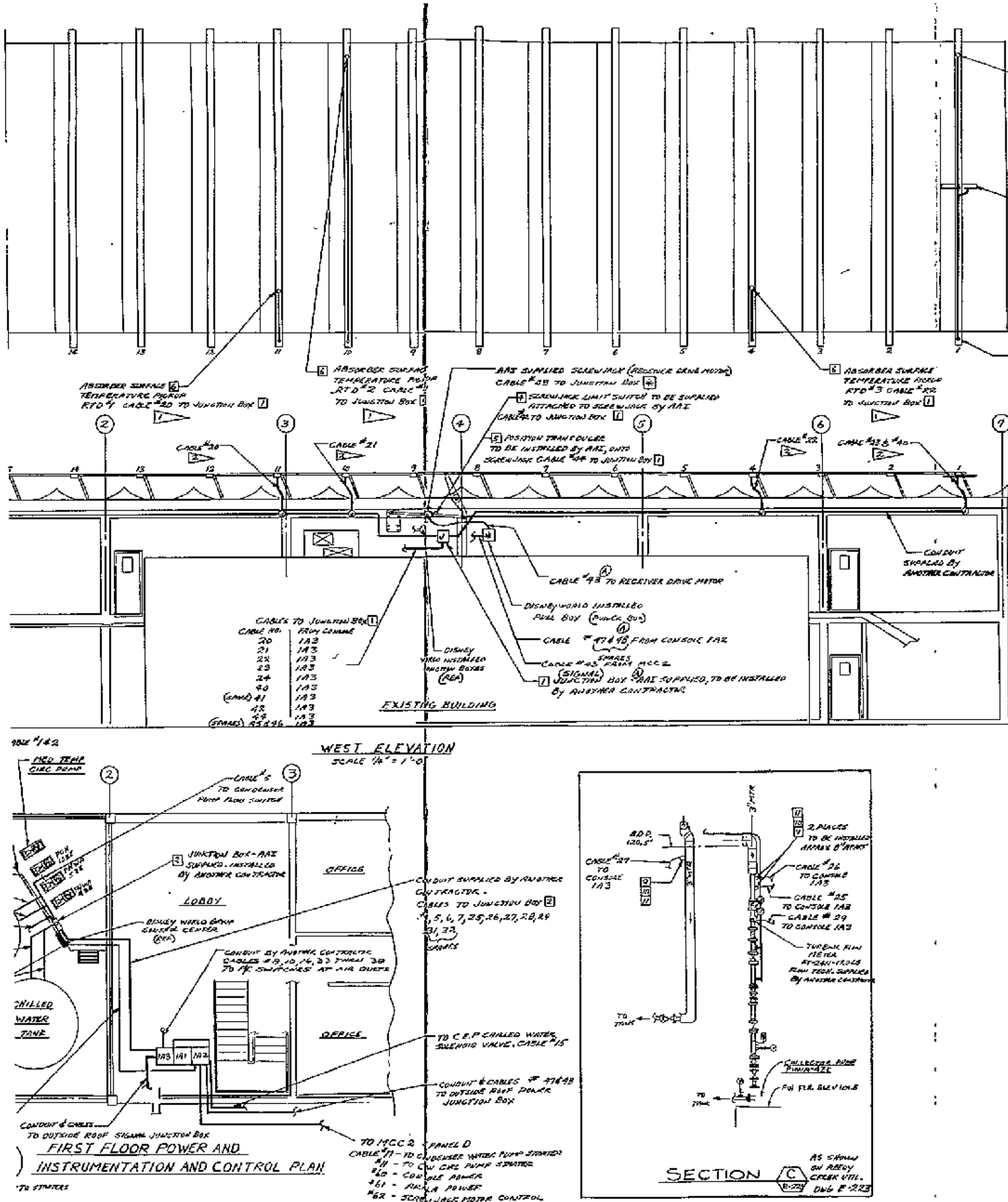
Solar Receiver Supply and Return Pipe Installation AAI Dwg. No. 57939-40064, Sheet 1 of 2 - Continued



NOTES:

1. PIPE ROLL WITH SOCKETS FIG #15-5" DIA. PIPE, (ZINC PLATE ALL COMPONENTS) ELCEN METAL PRODUCTS CO. FRANKLIN PARK, ILL
2. CIRCUIT SETTER MODEL NO. CB-1/2 BELL & GOSSETT WITH PREFORMED POLYURETHANE INSULATION
3. INSULATION - ARMSTRONG ARMAFLEX 1 5/8" I.D X 3/4" WALL X 5ft 00 LONG
4. GASKET MATERIAL 1/16" THICK ASBESTOS COMPOSITION EQUAL TO GARLOCK #900
5. FITTINGS: 150LB (W.S.P) MALLEABLE IRON, SCREWED, BANDED, PER ASTM A 197 AND ANSI B16.3
6. BOLT & NUT MATERIAL: STEEL PER ASTM A307 GRADE B & ASI B18.2, BOLTS SQUARE HEAD, NUTS HEAVY DUTY, HEXAGON
7. COAT GASKET WITH APPROVED THREAD LUBRICANT OR ANTI-SEIZE COMPOUND BEFORE ASSY
8. PIPE INSULATION 1 1/2" THICK THRUOUT. GLASS FIBER PIPE INSULATION 3LBS/CU FT MINIMUM DENSITY (450°F MINIMUM TEMPERATURE RATING) & PROVIDED WITH A FIRE-RETARDANT VAPOR BARRIER AND WHITE KRAFT JACKET REINFORCED WITH GLASS FIBER YARN. ALL PIPE INSULATION SHALL HAVE AN ADDITIONAL METAL JACKET (ALUMINUM .016 THICKNESS). INSULATE FITTINGS TO A THICKNESS EQUAL TO THE ADJOINING PIPE INSULATION. SECURE WITH SOFT GALVANIZED WIRE AND COVER WITH A SMOOTHING COAT OF HARD FINISH INSULATING CEMENT

Solar Receiver Supply and Return Pipe Installation AAI Dwg. No. 57939-40064, Sheet 2 of 2



NOTES.

1. AAI TO INSTALL CABLE INSIDE RECEIVER HOUSING BEFORE DELIVERY, WITH 10 FT OF CABLE COMING UP OUTSIDE
2. ALL CABLES TO BE CLAMPED TO THE FLEXIBLE WATER LINES & THEN INTO JUNCTION BOXES ON WALL

PART	PART NUMBER	PART NAME	MANUFACTURER
15		P/E SWITCH	JOHNSON
14	T5210	TEMP. TRANSMITTER	JOHNSON
13	S59P150Z12	TEMPERATURE SENSOR	MINCO
12	F203X12" LONG	THERMOWELL	MINCO
11	S53P40Z12	TEMPERATURE SENSOR	MINCO
10	F203X1½ LONG	THERMOWELL	MINCO
9	F102-4T	TERMINAL HEAD	MINCO
8	57939-40164-10	SUN SENSOR	AAI CORP
7	MODEL 1139-2	AIR TEMPERATURE SENSOR	TEMPLINE
6	MODEL 2018-1	TEMPERATURE SENSOR	TEMPLINE
5	SK-6200T	POSITION TRANSDUCER	DUFF NORTON
4	SK-6000B	LIMIT SWITCH	DUFF NORTON
3	A-16P14	PANEL	HOFFMAN
2	57939-40216	JUNCTION BOX	NEMA #4 J.I.C.-HOFFMAN
1	57939-40215	JUNCTION BOX	NEMA #4 J.I.C.-HOFFMAN

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Electrical Installation Solar - DISNEY WORLD

AAI Dwg. No. 57939-40092, Sheet 1 of 1

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(A) [1] REVERSING STARTER AT MCC2

(A) [2] ARKLA POWER DISCONNECT

(A) [3] CONSOLE POWER OUTLET NEAR CONSOLE LOCATION

(A) [4] 115V 60 Hz 1Φ CONTROL SIGNAL FROM ARKLA TO CONDENSER WATER PUMP STARTER, VOLTAGE NOT SUPPLIED BY STARTER CONTROL TRANSFORMER

(A) [5] VOLTAGE SUPPLIED BY STARTER CONTROL TRANSFORMER

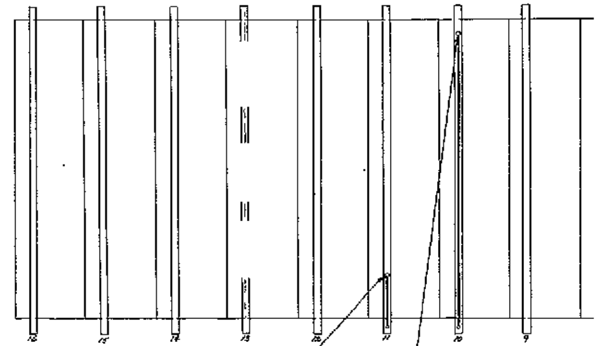
CABLE LIST

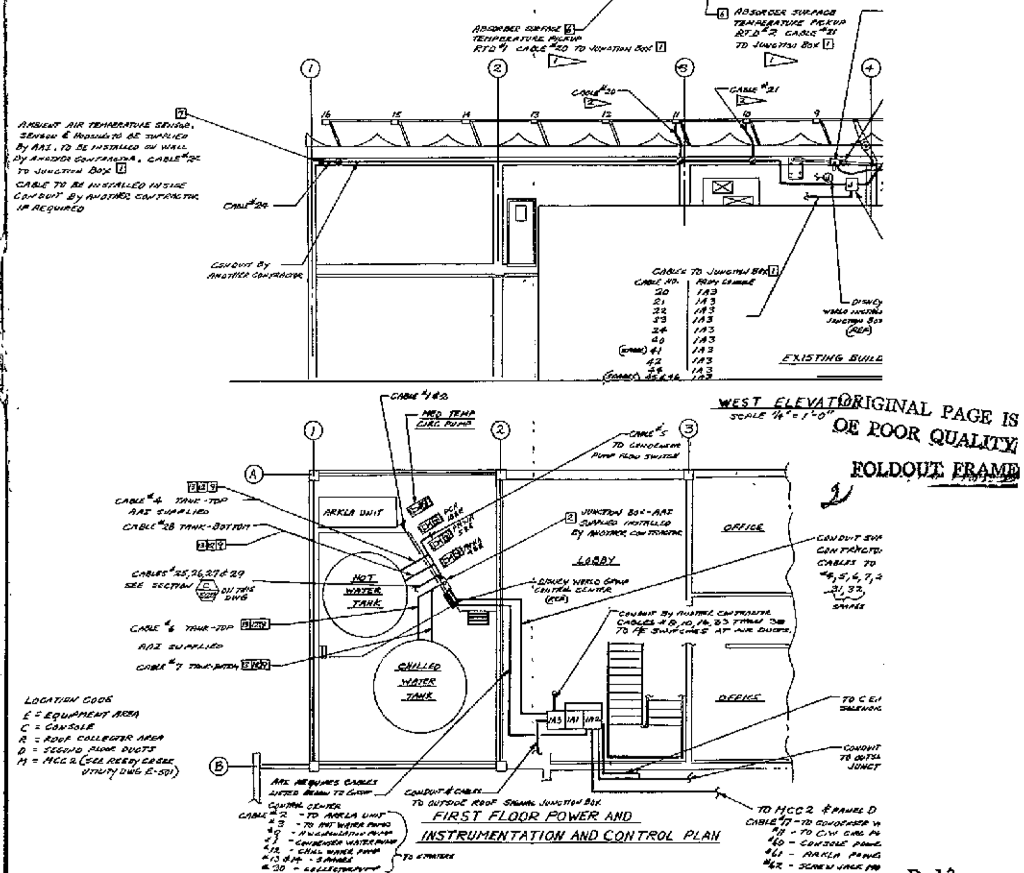
CABLE NUMBER	P=POWER S=SIGNAL	NUMBER OF CONDUCTORS	GAUGE #	SHIELDED CABLE	FROM LOC	FROM UNIT	FROM DESIGNATION	TO LOC	TO UNIT	TO DESIGNATION	NOTE
1	P	2	14		E	ARKLA	CHN-2E	C	CONSOLE	1A2	4 (A)
2	P	2	14		C	CONSOLE	1A2	E	ARKLA	CHU-2E	2 (A)
3	P	2	14		C		1A2	E	HW PUMP STARTER	PHWA-5EE	5 (A)
4	S	3	20	✓	C		1A3	E	HW TANK TOP RTD	3A1RT01	
5	S	2	20	✓	C		1A3	E	CONDENSER WATER FLOW SW	3A1S1	
6	S	3	20	✓	C		1A3	E	CW TANK TOP RTD	3A1RT03	
7	S	3	20	✓	C		1A3	E	CW TANK BOTTOM RTD	3A1RT04	
8	S	2	20	✓	C		1A3	D	[illegible]	3A1S2	
9	P	2	14		C		1A2	E	HW CIRCULATOR PUMP STARTER		5 (A)
10	S	2	20	✓	C		1A3	D	F/E SWITCH, 76°F ZONE 4	3A1S3	
11	P	2	14		C		1A2	E	CW CIRCULATOR PUMP STARTER	PCHA-3EE	5 (A)
12	P	2	14		C		1A2	C	COLD WATER PUMP STARTER	PCH-102E	5 (A)
13	P	2	14		C		1A2	C	SPARE		
14	P	2	14		C		1A2	E	SPARE		
15	P	2	14		C		1A2	E	[illegible]		
16	S	2	20	✓	C		1A3	D	F/E SWITCH - FAN ON	3A1S5	
17	P	2	14		C		1A2	E	COND WATER PUMP STARTER	PCWJ-103E	4 (A)
18											
19											
20	S*	3	20	✓	C		1A3	R	ABSORBER SURFACE RTD #1	2A1RT01	
21	S*	3	20	✓	C		1A3	R	RTD #2	2A1RT02	
22	S*	3	20	✓	C		1A3	R	RTD #3	2A1RT03	
23	S*	3	20	✓	C		1A3	R	ABSORBER SURFACE RTD #4	2A1RT04	
24	S	3	20	✓	C		1A3	R	OUTSIDE AMBIENT AIR RTD	2A1RT05	
25	S	3	20	✓	C		1A3	E	ABSORBER OUTPUT RTD	3A1RT05	
26	S	2	20	✓	C		1A3	E	ABSORBER OUTPUT RTD	3A1RT06	
27	S	2	20	✓	C		1A3	E	ABSORBER INPUT RTD	3A1RT07	
28	S	3	20	✓	C		1A3	E	HW TANK BOTTOM RTD	3A1RT08	
29	S	2	20	✓	C		1A3	E	THERMAL FLOW METER	3A1FL1	
30	P	2	14		C		1A2	E	COLLECT PUMP STARTER	PHWA-4ZE	5 (A)
31	S	3	20	✓	C		1A3	E	SPARE		
32	S	3	20	✓	C		1A3	E	SPARE		
33	S	2	20	✓	C		1A3	D	F/E SWITCH 76°F ZONE 1	3A1S4	
34	S	2	20	✓	C		1A3	D	F/E SWITCH 76°F ZONE 2	3A1S6	
35	S	2	20	✓	C		1A3	D	F/E SWITCH 76°F ZONE 3	3A1S7	
36	S	2	20	✓	C		1A3	D	F/E SWITCH 76°F ZONE 4	3A1S8	
37	S	2	20	✓	C		1A3	D	F/E SWITCH SUMMER #1	3A1S9	
38	S	2	20	✓	C		1A3	D	F/E SWITCH SUMMER #2	3A1S10	
39											
40	S	5	20	✓	C		1A3	R	SUN TRACKING SENSOR	2A1A1	
41	S	5	20	✓	C		1A3	R	SPARE		
42	S	3	20	✓	C	CONSOLE (A)	1A3	R	COLLECTOR LIMIT SWITCHES	2A1S1, 2A1S2	
43	P	4	14		M	3Φ POWER	MCC2	R	COLLECTOR DRIVE MOTOR	2A1M1	
44	S	3	20	✓	C	CONSOLE	1A3	R	COLLECTOR POSITION SENSOR	2A1R1	
45	S	3	20	✓	C		1A3	R	SPARE		
46	S	3	20	✓	C		1A3	R	SPARE		
47	P	2	14		C		1A2	R	SPARE		
48	P	2	14		C		1A2	R	SPARE		3 (A)
60	P	4	12		C		1A2	M	208/120V 3Φ PWR SOURCE	MCC2	3 (A)
61	P	2	14		C		1A2	M	115V 1Φ PWR SOURCE	MCC2	3 (A)
62	P	4	14		C	CONSOLE	1A2	M	COLLECT. DRIVE MOTOR CONTROL	MCC2	1 (A)

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 DUCTS
M = MCC 2 (SEE REEDY CREEK UTILITY DWG E-501)

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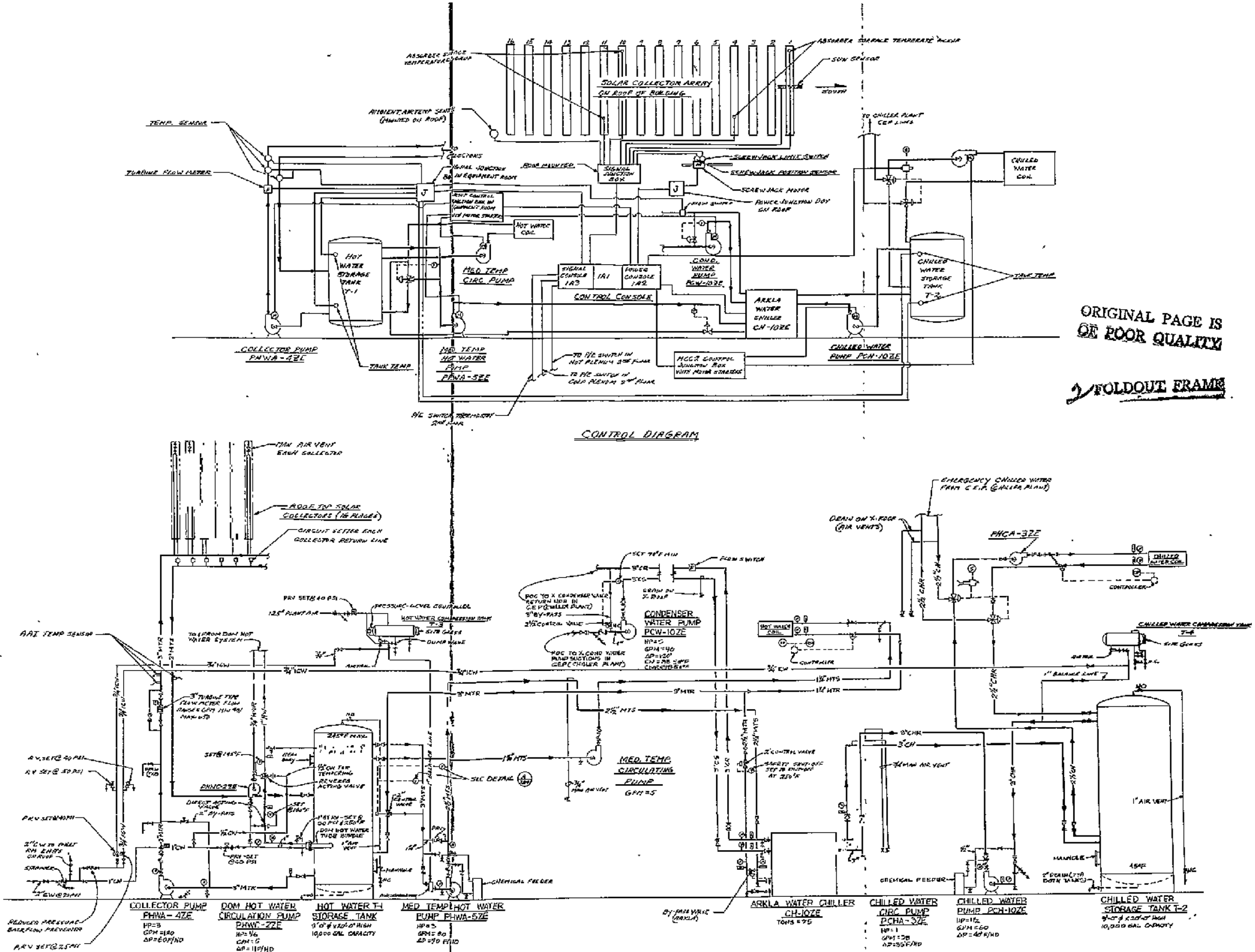
Electrical Installation Solar - DISNEY WORLD   AAI Dwg. No. 57939-40092, Sheet 1 of 1 - Continued

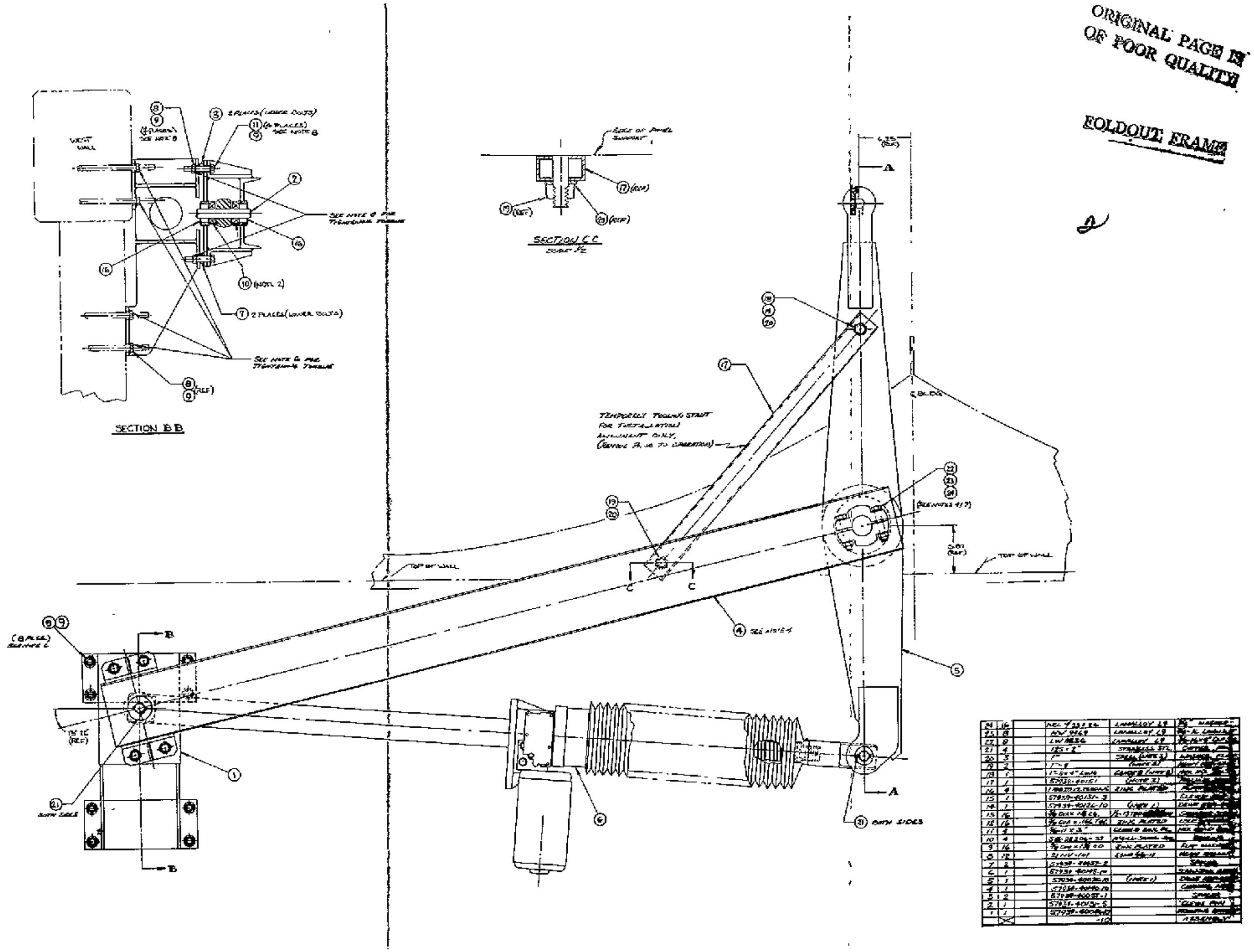


D-14

Piping and Control Diagram

AAI Dwg. No. 57939-40099, Sheet 1 of 1

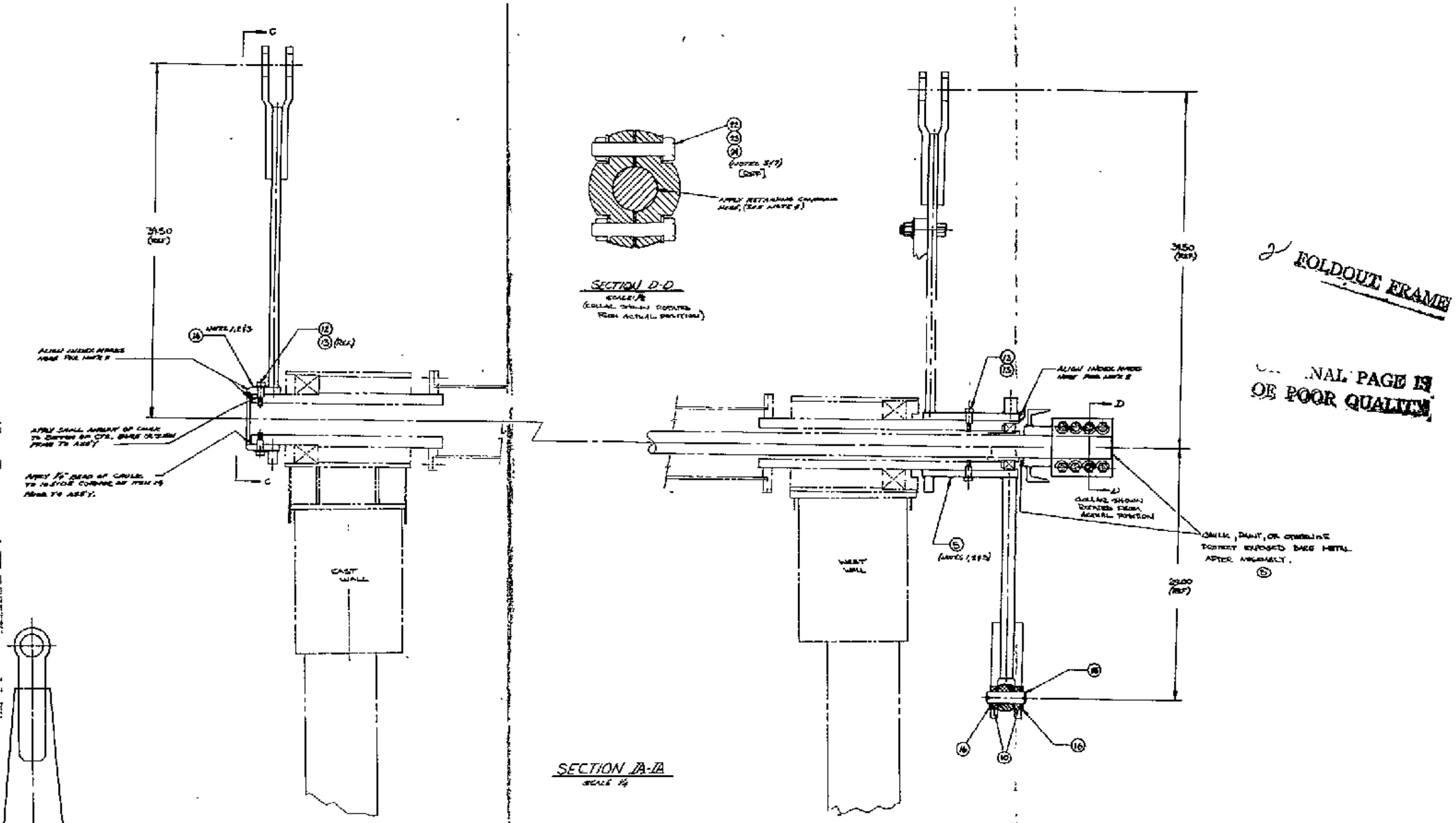
1

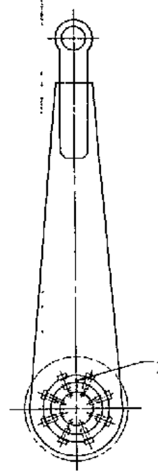


2

C-2

Driver Mechanism Installation   AAI Dwg. No. 57939-40128, Sheet 1 of 2





VIEW C-C

NOTES

Ⓐ 1 ITEMS 5 & 14 MUST BE MACHINED PER DWG NO 57939-40150-10 AND DWG NO 57939-40151-10 RESPECTIVELY, PRIOR TO ASSEMBLY HERE.

2 ITEM NOS 5 AND 14 MUST BE ASSEMBLED PRIOR TO INSTALLATION OF SCREW JACK OR CHANNEL ASSY. BE SURE TO ALIGN 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 COVER PLATE 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 RECIE INSTALLATION (57939-40143) IS COMPLETE. ITEMS 17, 18, 19, & 20 ARE FOR INSTALLATION ALIGNMENT ONLY. THEY MUST BE REMOVED PRIOR TO OPERATION OF SYSTEM.

4. AFTER BRACKET (ITEM 1) AND DRIVE ARMS (ITEMS 5 AND 14) HAVE BEEN INSTALLED, THE CHANNEL ASSY (ITEM 4) CAN BE ASSEMBLED. BE SURE THAT MATING SURFACES OF TORSION BAR AND THE CHANNEL COLLAR ARE THOROUGHLY CLEANED, DEGREASED AND DRIED. APPLY A LIGHT COAT OF Ⓑ SILICON CARBIDE GRIT (CRYSTOLON) SIZE [illegible] TO TORSION BAR PRIOR TO ASSY. ITEM 4 [illegible] ENTIRE AREA OF CONTACT. SEE NOTES 5 & 7

5. TIGHTEN THE BOLTS ON THE BRACKET END OF ITEM 4 PRIOR TO TIGHTENING THE BOLTS ON THE TORSION BAR END.

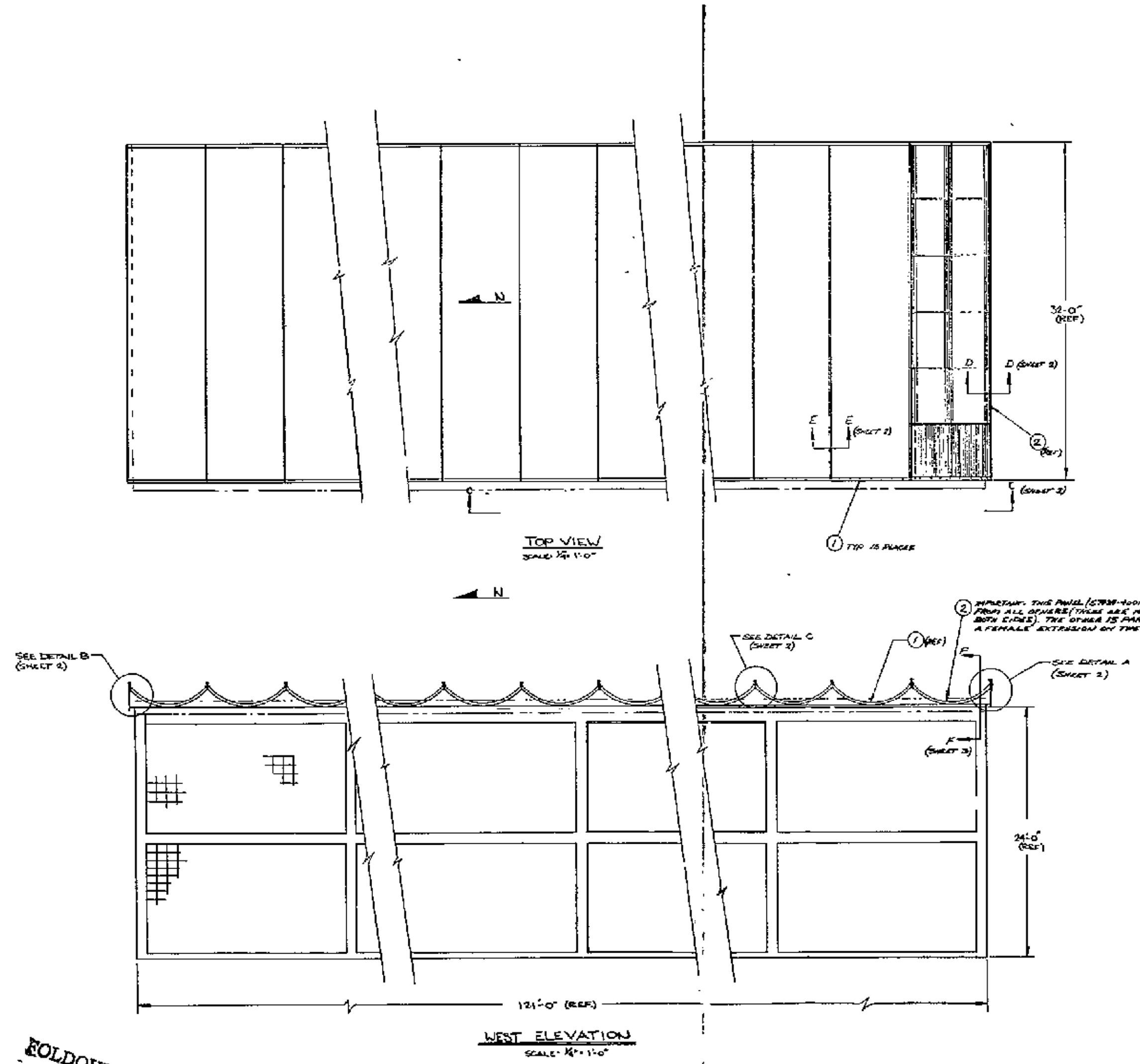
6. ASSEMBLY TORQUE FOR 8 - 5/8 DIA. ANGLE BOLTS - 230 FT LBS

Ⓑ 7. ASSEMBLY TORQUE FOR 8-3/4 [illegible] TORSION BAR BOLTS 280 FT. LBS.

8. ASSEMBLY TORQUE FOR 4-5/8 DIA CHANNEL ASSY BOLTS - 240 FT LBS.

Driver Mechanism Installation

AAI Dwg. No. 57939-40128, Sheet 2 of 2



NOTES

1. THIS DRAWING SHOULD BE USED IN CONJUNCTION W/AAI REPORT NO. ER-9008 "SOLAR SYSTEM ASSEMBLY AND INSTALLATION INSTRUCTIONS" DATED APRIL 1, 1977.
2. PANEL SUPPORT INSTALLATION PER DWG. NO. 57939-40068 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 PREDRILLED HOLES. ANY AVAILABLE 1/4" SCREW 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 5/16" DIA. HOLES IN THE PANELS. A #4 DRILL (.209 DIA) SHOULD BE USED FOR THIS PURPOSE. SELF TAPPING SCREWS WITH 1" SEALING WASHERS (ITEMS 27 & 28) SHOULD BE INSTALLED IN THESE HOLES TO INSURE CONTACT BETWEEN ROOF PANEL AND RUBBER SEAL. EACH PANEL SHOULD THEN BE DRILLED 32 PLCS (8 HOLES ON EACH CORNER) FOR SHOULDER SCREWS (ITEMS 21, 22, 25, & 26). THESE HOLES MUST BE MATCHED DRILLED THRU EXISTING HOLES IN THE VERTICAL 1/2" PLATES ON 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)

34	[illegible]		SHEET METAL SCREWS TO BE SUPPLIED BY MFG.		
33	64		1/4 OD SS [illegible]	NOTE 10	DOMED WASHER
32	64		#14 x 1" HHB 305 SS	NOTE 10	SELF TAPPING SCR.
31	272		57939-40122		SPACER
30	12		#14 x 2" LG [illegible]	ALUMINUM	WOOD SCREWS
29	100		3/8" DIA. [illegible]	ANCHORS TO BE SUPPLIED BY MFG.	
28	224		.500 SS [illegible]	NOTE 10	DOMED WASHER
27	224		#14 x 1" HHB 305 SS	NOTE 10	SELF TAPPING SCREW
26	272		21NE-068	ESNA	[illegible]
25	272		[illegible] 3/8 DIA x 1" [illegible]		SHOULDER SCREW
24	[illegible]		[illegible]	NOTE 8	INSULATION
23	[illegible]		895-367	NOTE 7	CAULKING
22	272		5/16 DIA. [illegible]	NOTE 6	NYLITE SEAL
21	272		3/8 DIA [illegible]	NOTE 6	NYLITE SEAL
20	1		57939-40156-4		HOLDING ANGLE
19	1		57939-40156-3		HOLDING ANGLE
18	1		57939-40156-2		HOLDING ANGLE
17	1		57939-40156-1		HOLDING ANGLE
16	2		57939-40155-3		HOLDING STRIP
15	2		57939-40155-2		HOLDING STRIP
14	2		57939-40155-1		HOLDING STRIP
13	2		57939-40154-4		CLOSURE PANEL
12	2		57939-40154-3		CLOSURE PANEL
11	2		57939-40154-2		CLOSURE PANEL
10	2		57939-40154-1		CLOSURE PANEL
9	8		57939-40153		[illegible]
8	2		57939-40152-2		[illegible]
7	2		57939-40152-1		[illegible]
6	4		57939-40149		[illegible] CLOSURE [illegible]
5	2		57939-40147		ANGLE END CLOSURE
4	1		57939-40137-20		END CLOSURE ASSY.
3	1		57939-40137-10		END CLOSURE ASSY.
2	1		57939-40019-30		ROOF PANEL
1	15		57939-40019-10		ROOF PANEL
			-10		ASSEMBLY

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Roof Panel Installation

AAI Dwg. No. 57939-40142, Sheet 1 of 3

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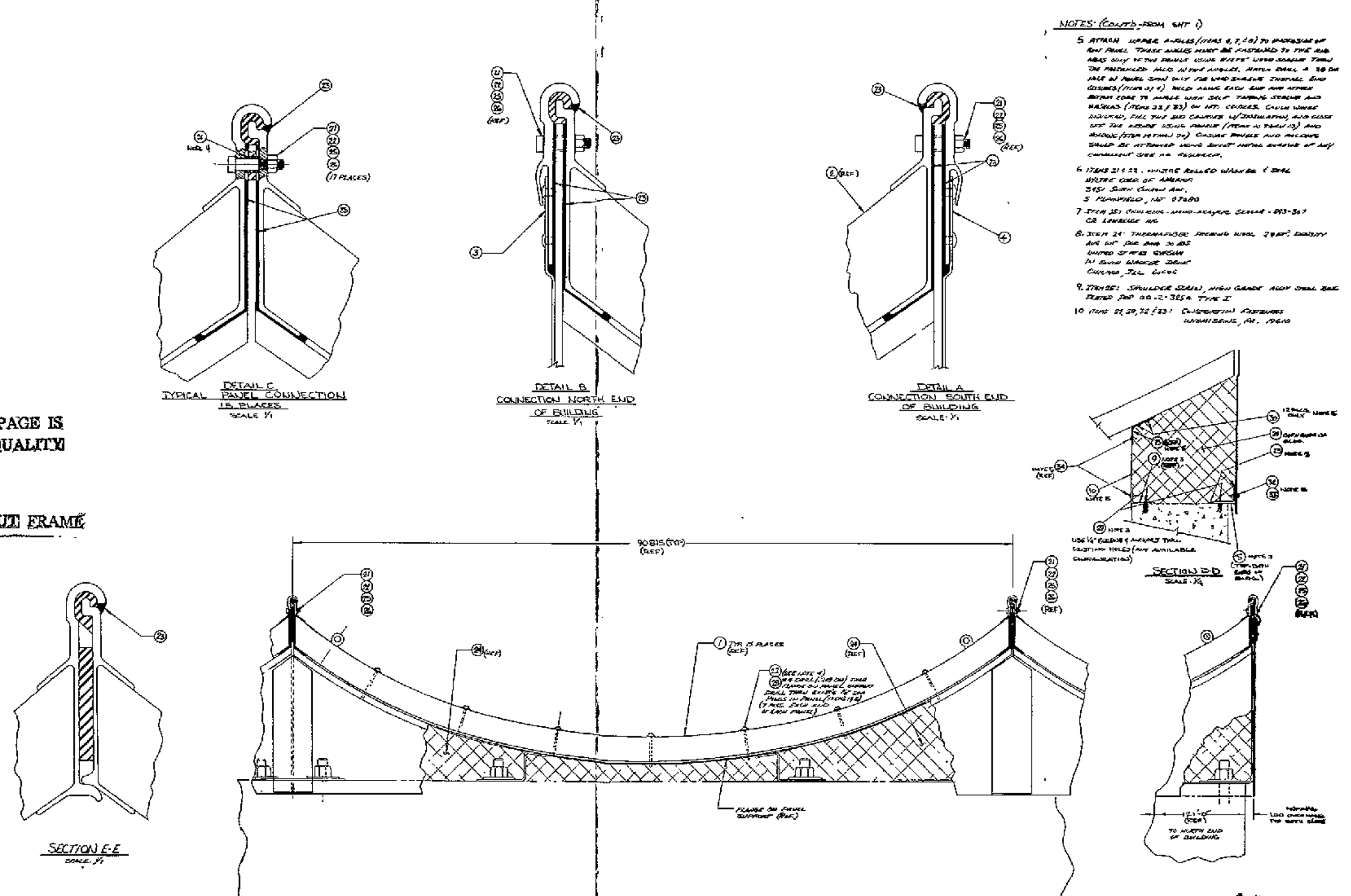

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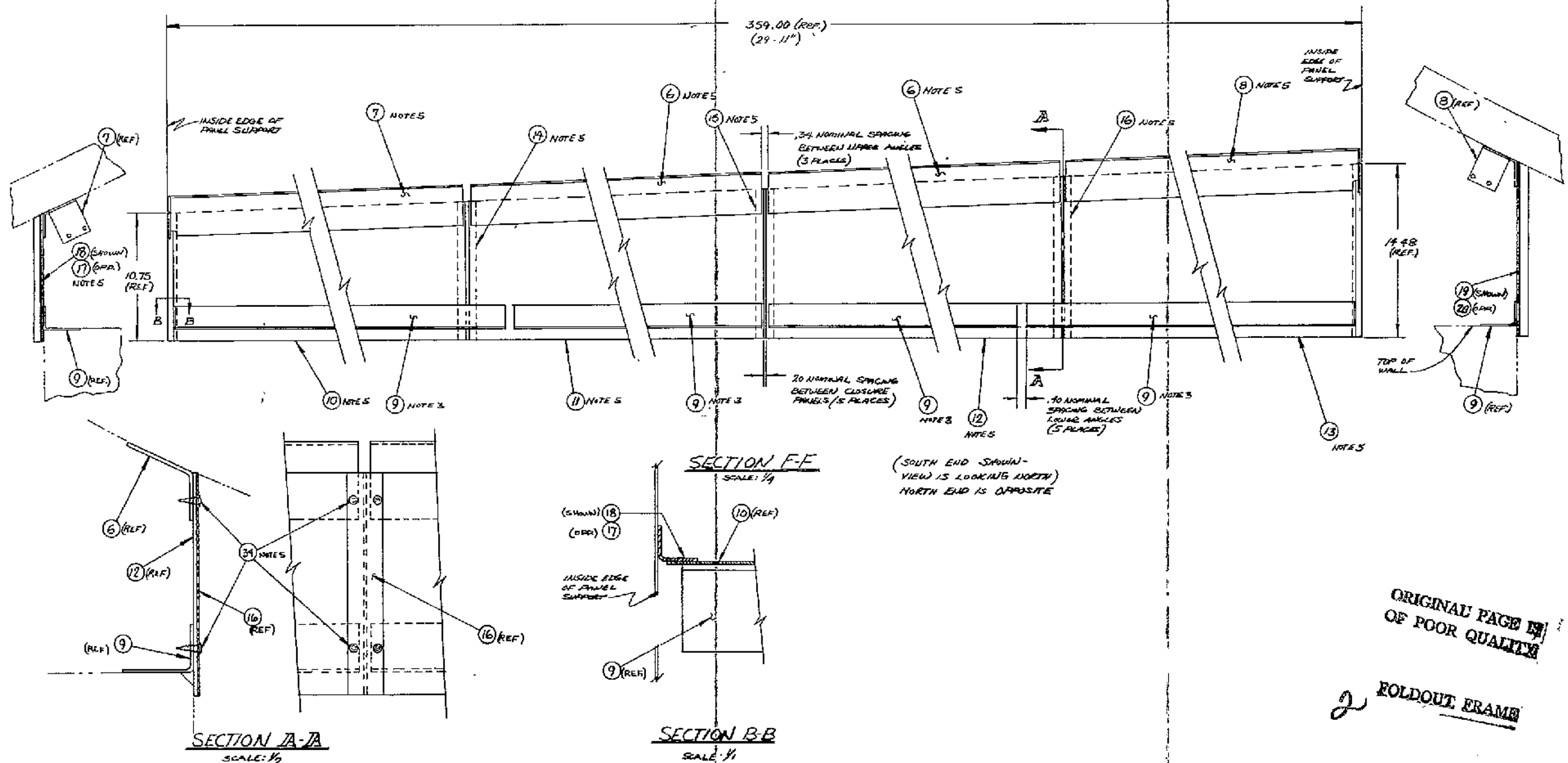
Roof Panel Installation

AAI Dwg. No. 57939-40142, Sheet 2 of 3



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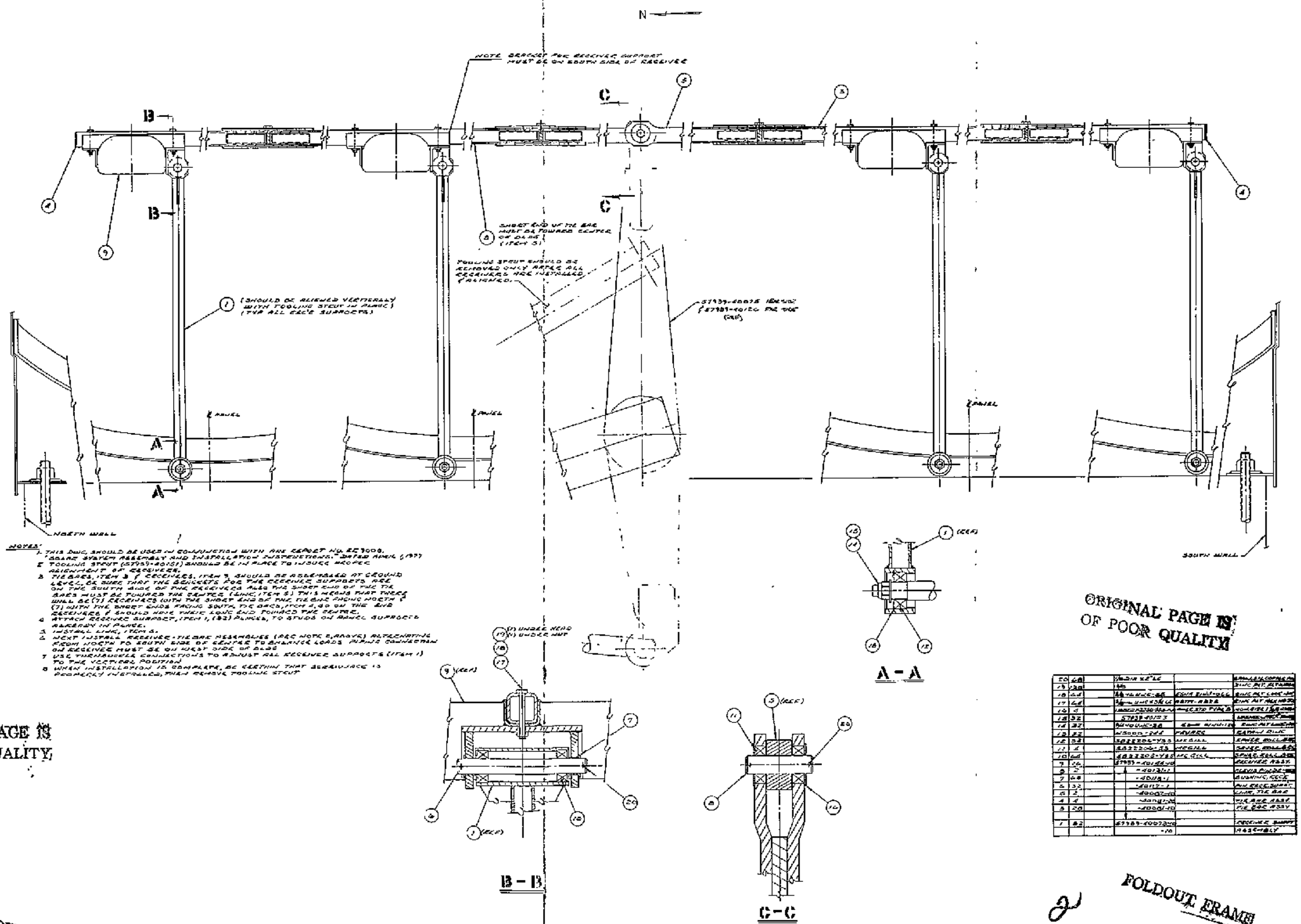
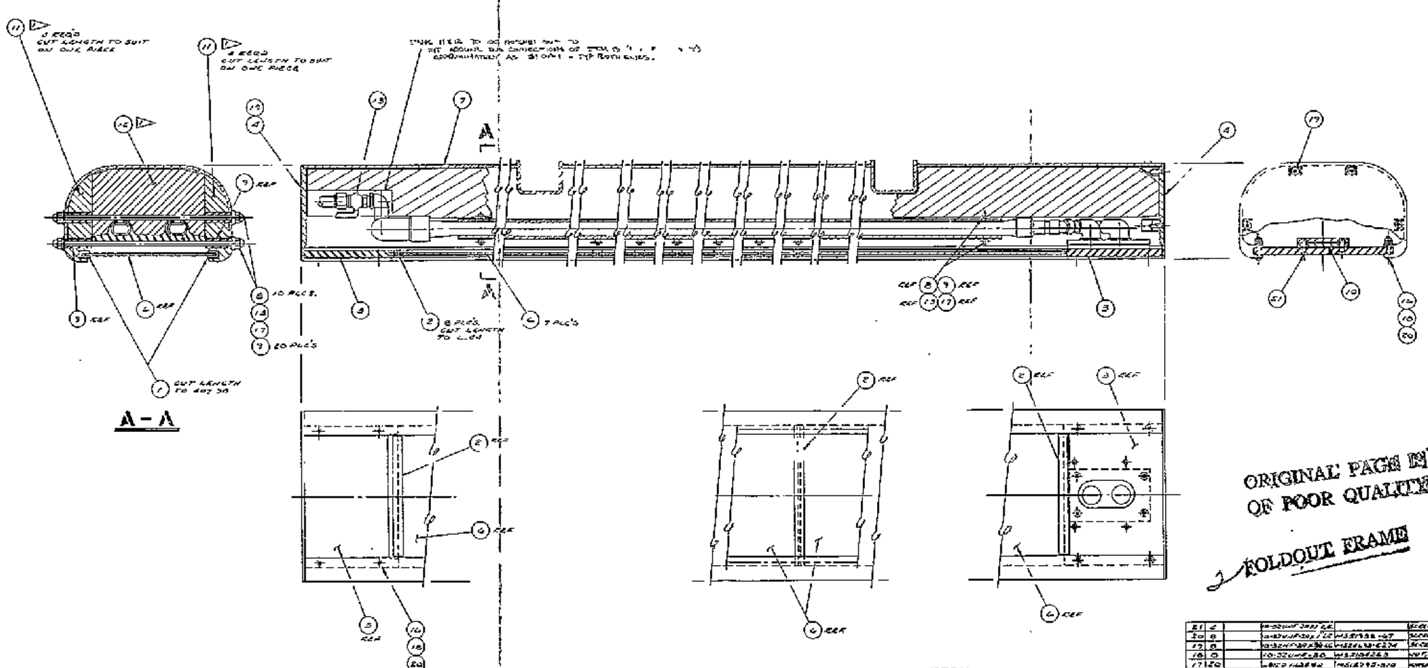
Roof Panel Installation

AAI Dwg. No. 57939-40142, Sheet 3 of 3



Receiver Installation

AAI Dwg. No. 57939-40143, Sheet 1 of 1



NOTES:

1. ⊳ FIT UP ALL SECTIONS IN RECEIVER, WITH NO GAPS B'TWN SECTIONS. CUT OUT END PIECES TO CLEAR ANCHOR NUTS, DRILL OR CLEAN AREAS WHERE BUSHINGS & RODS ARE INSTALLED. CUT OUT AROUND THE BRC CHANNELS, ETC. REMOVE ALL PIECES & SPRAY COAT ALL SURFACES WITH RFU-TEST 300 WHITE EPOXY PAINT & RE-INSTALL

(A) 2. ITEM NOS. 1, 2, 4, 10, 11 & 12 MUST HAVE TEMP. MARKS AND LEAD WIRES ATTACHED TO ASSEMBLIES PER ENGRG. INSTRUCTIONS PRIOR TO FINAL ASSEMBLY.

21	4		10-32UNF 3A?? LG.		SCREW, [illegible]
20	8		[illegible]	MS35?38-47	SCREW, [illegible]
19	8		10-32NF [illegible]	MS246?? -6234	SCREW, [illegible]
18	8		10-32UNF-2B	MS21042L3	NUT, LOCK [illegible]
17	20		[illegible]	MS15795-810	WASHER, FLAT [illegible]
16	8		[illegible]	MS15795-808	WASHER, FLAT [illegible]
15	20		.250-28 UNF-2B	[illegible]	NUT, ACORN
13	1		57939-40150-10		HARNESS [illegible]
12	4		-40137-1		INSULATION [illegible]
11	8		-40138-1		INSULATION, REC
10	1		-40103-1		PLATE, [illegible]
9	20		-40103-1		BUSHING
8	10		-40102-1		ROD
7	1		-40101-10		REC HOUSING ASSY
6	7		-40094-1		CLAMPING, DETAIL
5	1		-40086-1		PLATE
4	2		-40085-1		PLATE, COVER
3	1		-40082-1		PLATE
2	8		-40087-1		SEAL, SILIC RUBBER
1	2		57939-40038-1		SEAL, SILIC RUBBER
	X		-10		ASSEMBLY

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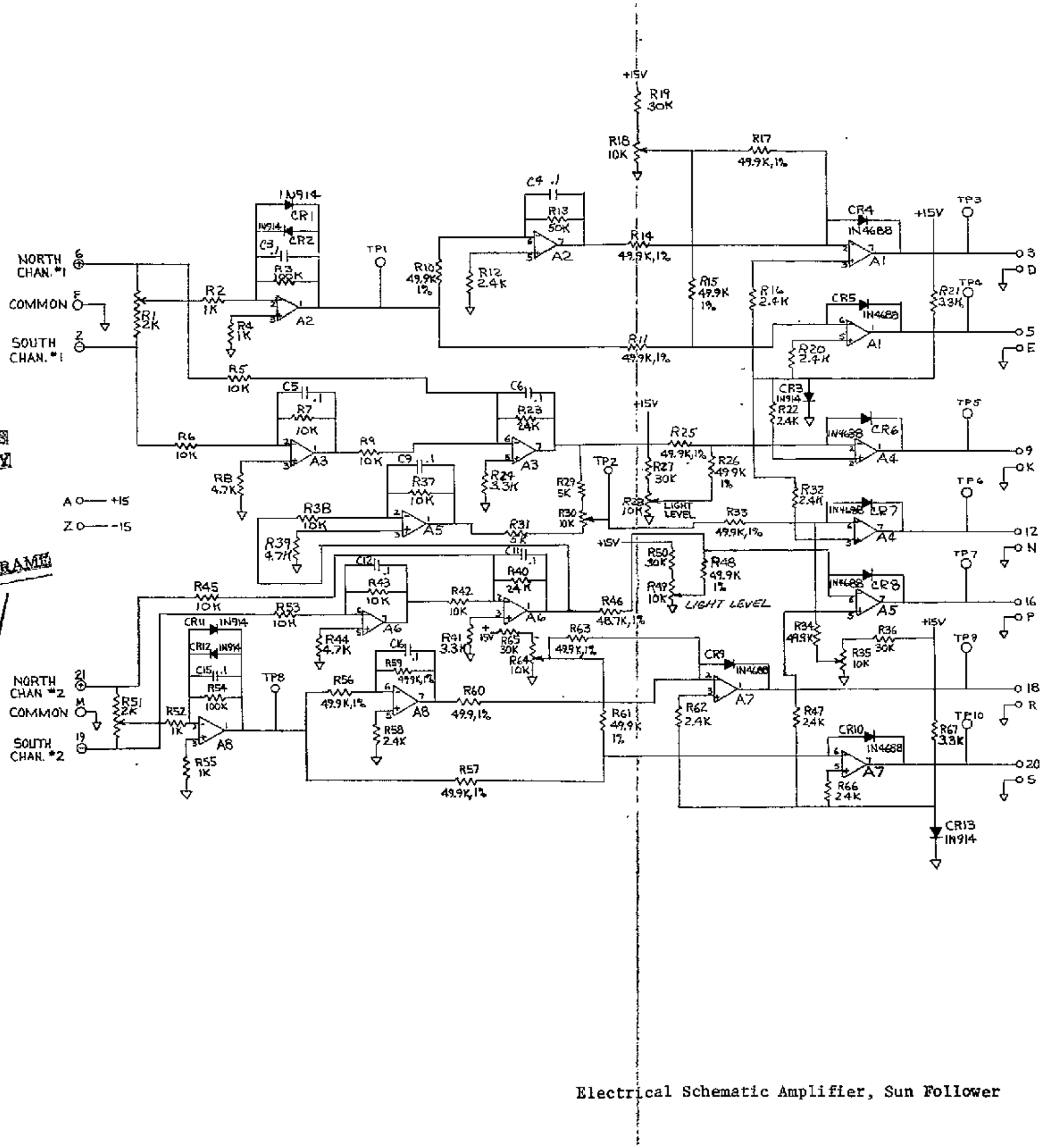
Receiver Assembly

AAI Dwg. No. 57939-40144, Sheet 1 of 1



1. ALL RESISTOR VALUES ARE IN OHMS.
ALL RESISTANCE TOLERANCES ARE ±5% EXCEPT WHERE NOTED.
ALL CAPACITOR VALUES ARE IN µf.

Electrical Schematic Amplifier, Sun Follower

AAI Dwg. No. 57607-40107, Sheet 1 of 1

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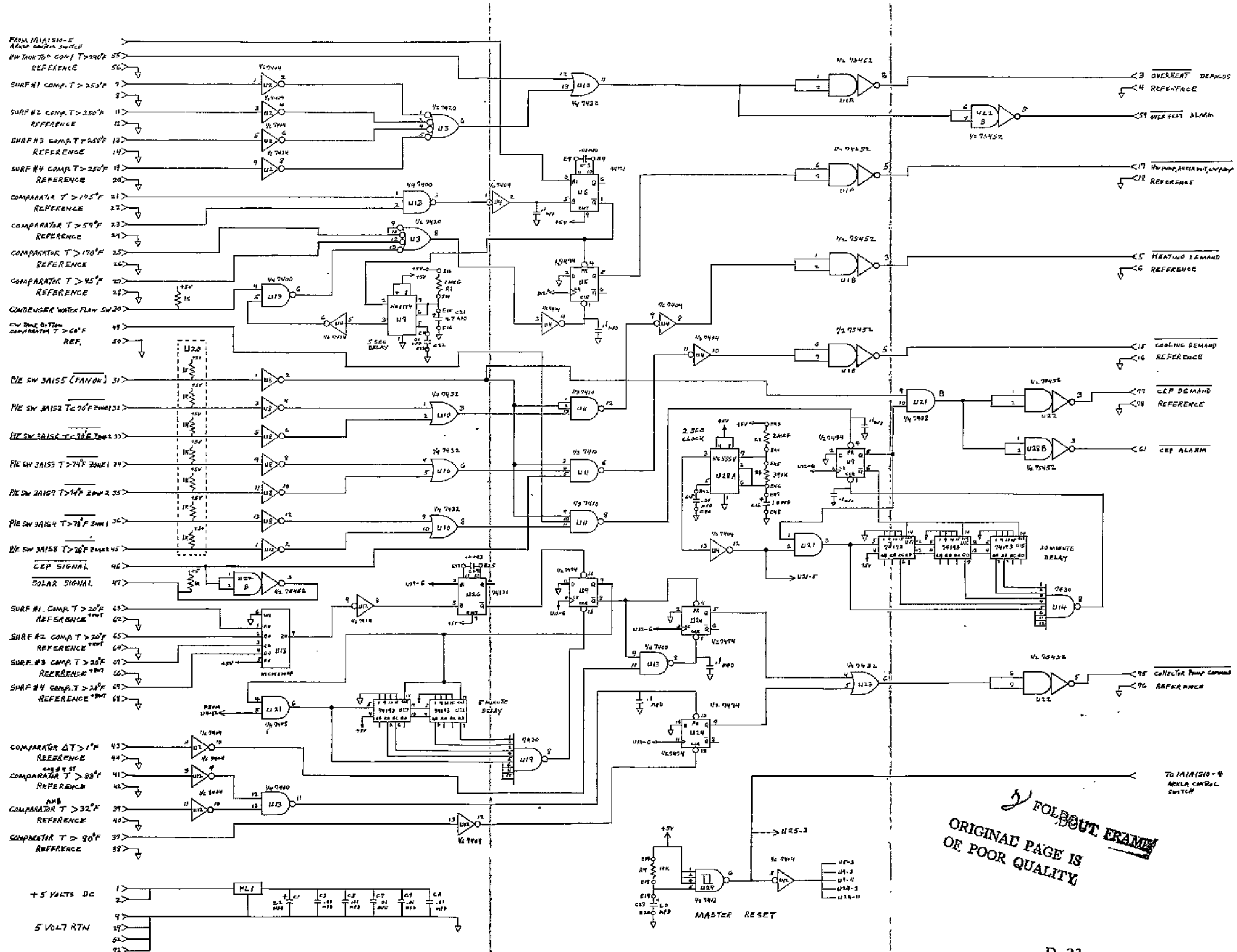

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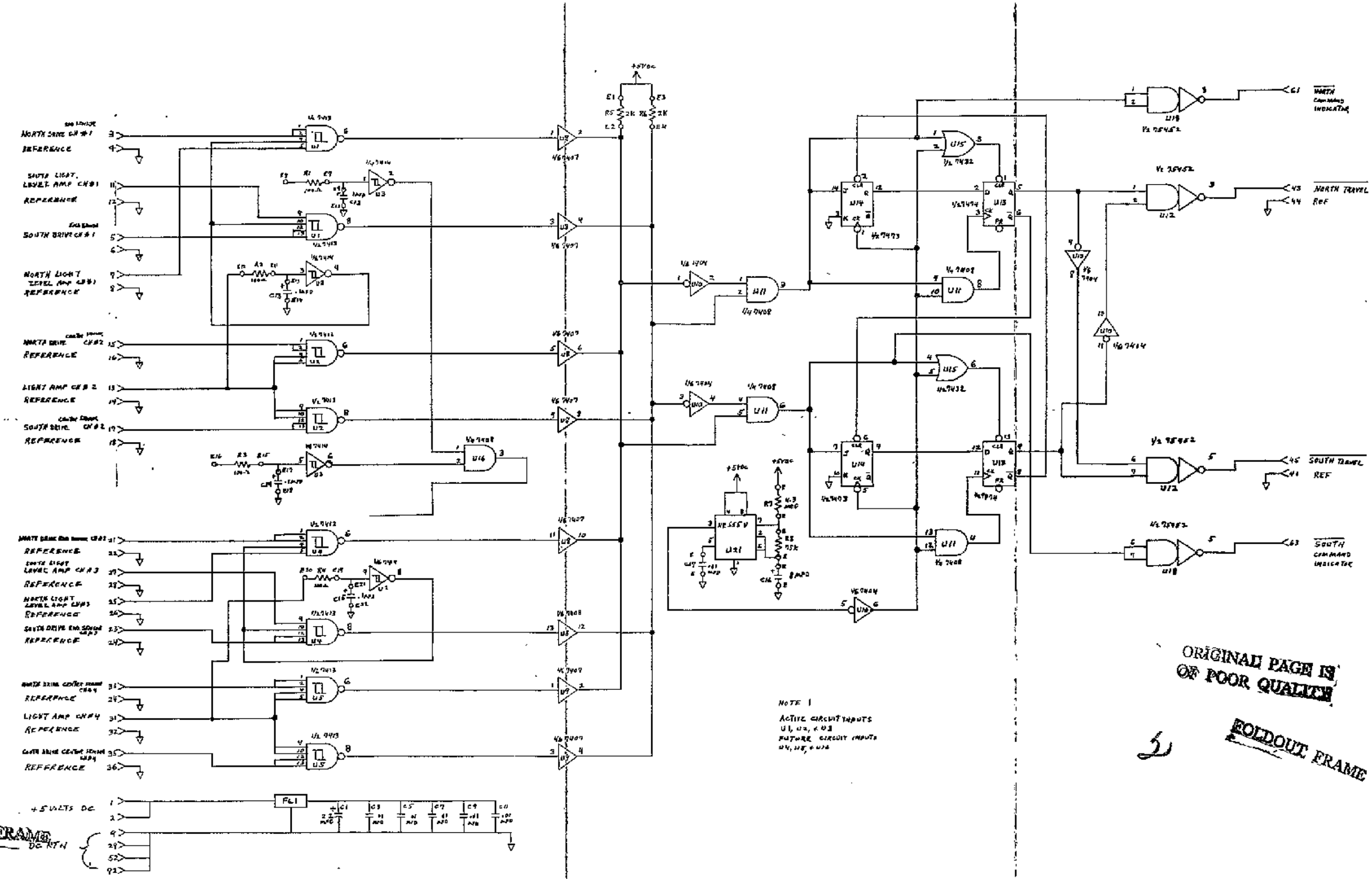
Overheat-Defocus and Pump Control Logic

AAI Dwg. No. 1A1A2 Schematic, Sheet 1 of 1



Sun Tracker Control Logic

AAI Dwg. No. 1A1A3 Schematic, Sheet 1 of 1

APPENDIX E

INSTRUMENTATION PROGRAM AND COMPONENTS LIST

IBM FORM NO 952-3260-2

ENCLOSURE No. 1

DWG NO. IP 7933707

REVISIONS

CHK	ENGRG NOTICE	LTR	DESCRIPTION	DATE	APPROVED
R	66333RH	-	RELEASE	5/26/7	RED
R	66348 GR	A	COMPLETE REVISION TO MOD II SDAS REQUIREMENTS & RE-NUMBER PAGES 17 TO 30.	11/21/7	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 QUANTITTES. REV PAGEs 23 TO 30-CHANGE TDs TO Ts, REDEFINE "A" CHANS, ADD "T" CORR & SCALE FACTORS, AND ADD CORR VALUES TO I001 & I002.	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. NAS8-32036	INTERNATIONAL BUSINESS MACHINES CORP. FEDERAL SYSTEMS DIVISION HUNTSVILLE, ALABAMA 35807
PREPARATION J. DUIGUINE	TITLE
DSGN CHK	INSTRUMENTATION PROGRAM- REEDY CREEK UTILITIES-DISNEY WORLD
DWG CHK	
DSGN APPROVAL	SIZE A / CODE IDENT NO. 20234 / DWG NO. IP 7933707
18	SCALE / WT / SHEET 1 of 29

Dietzgen N. O. 127 "Draftex"

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.

TABLE OF CONTENTS

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK UTILITIES 5/26/77
IP 7933707 REV____

PREAMBLE SECTION

E-5

'LOWRI'

INSTRUMENTATION PROGRAM AND COMPONENTS LIST: REEDY CREEK UTILITIES 1/26/78
IP 7933707 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 11/7/77
IP 7933707 REV A

ASSOCIATED 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.
   [X] 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

MEASUREMENTS LEGEND (CONTINUED)

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

THE COLUMN HEADINGS ARE DEFINED ON THE FOLLOWING SHEETS.

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

- PARAMETER TYPE (field 1)
- PARAMETER SEQUENCE (field 2)
- SEPARATOR (field 3)
- SITE IDENTIFIER (field 4)

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.

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK UTILITIES 11/7/77
IP 7933707 REV A

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

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:

NUMERIC SEQUENCE	SUBSYSTEM
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.

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.

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.

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK UTILITIES 5/26/77
IP 7933707 REV

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.

INSTRUMENTATION PROGRAM AND COMPONENTS LIST: REEDY CREEK UTILITIES
IP7933707

03/23/78
REV C

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 ± 5% OF DISPLAYED VALUE.

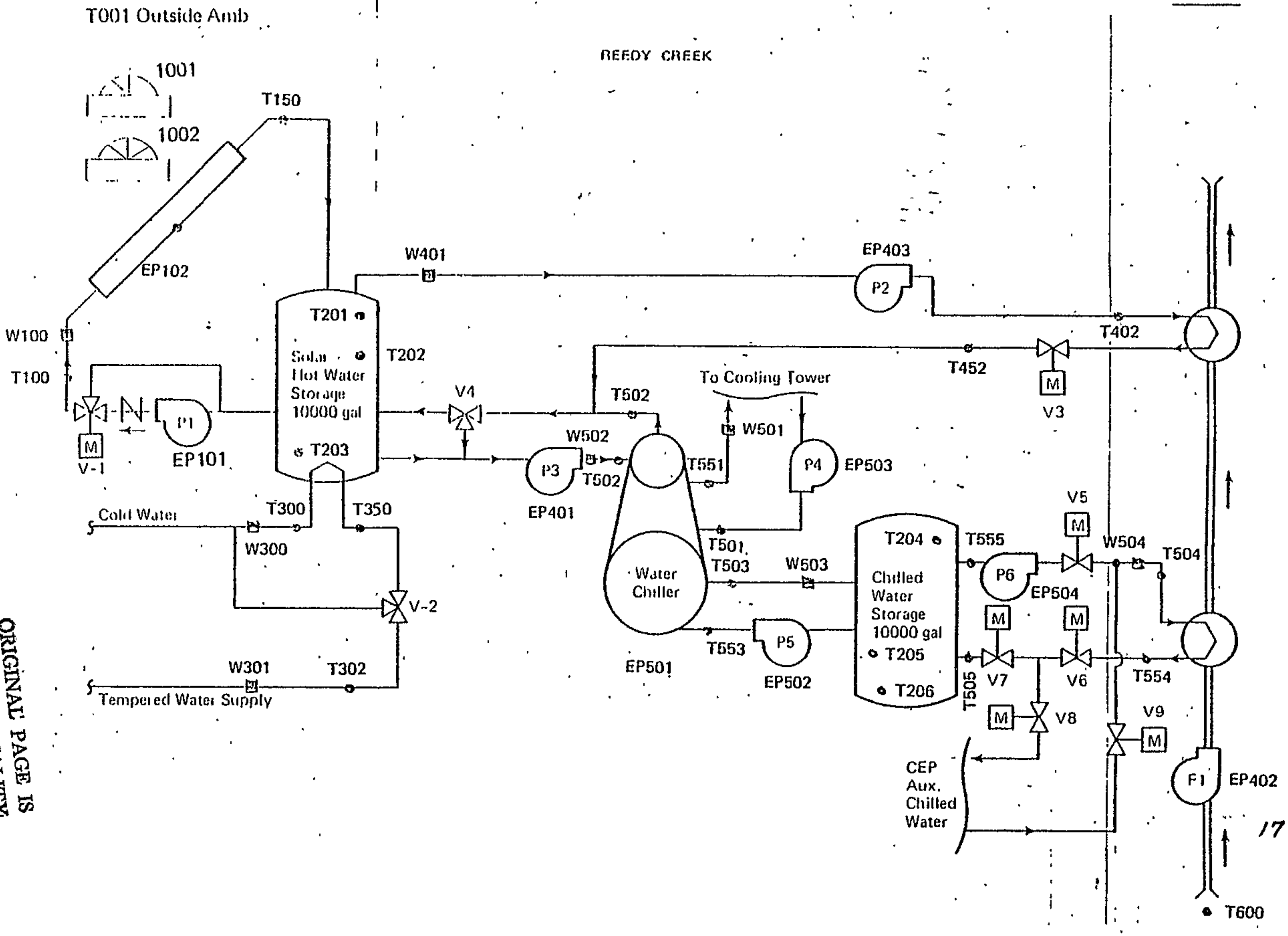
NOTE 4 - INSULATION WITHIN ± 5 BTU OF DISPLAYED VALUE.

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.

INSTRUMENTATION PROGRAM AND COMPONENTS LIST: REEDY CREEK UTILITIES IP7933707 03/23/78 REV C



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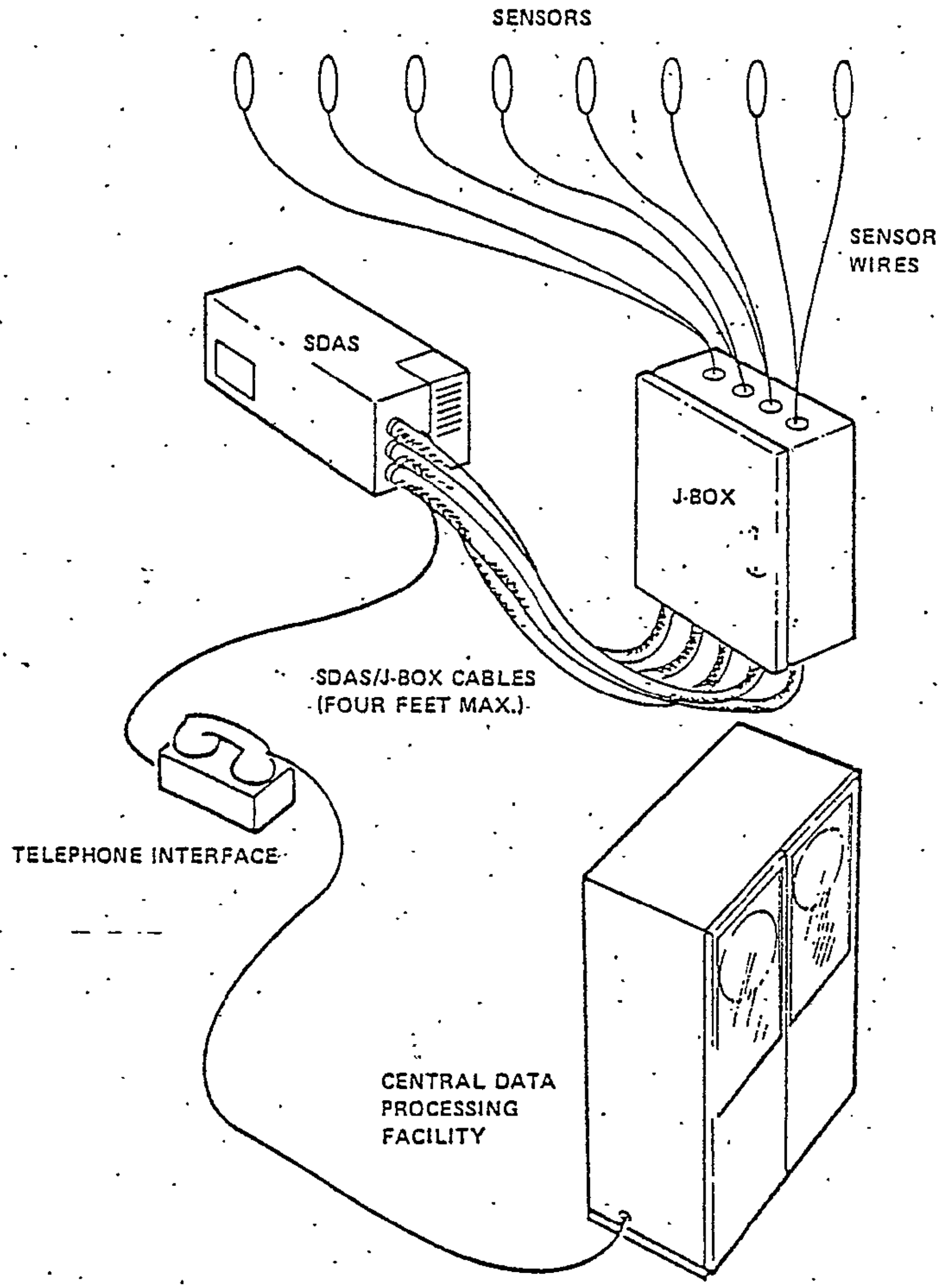

DATA COLLECTION SYSTEM

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INSTRUMENTATION COMPONENTS SECTION

INSTRUMENTATION PROGRAM AND COMPONENTS LIST REEDY CREEK UTILITIES 11/7/77

IP 7933707

REV A

EQUIPMENT NAME		PART NUMBER		SERIAL NUMBER
JUNCTION BOX	#1	7933657	#1	
	#2			
CABLES (J-BOX TO SDAS)				
NO. 1		7933654		
NO. 2		7933653-1		
NO. 3		7933653-2		
NO. 4		7933653-3		
NO. 5				
NO. 6				
NO. 7				
SDAS		7934400-2		
IBM DRAWING NUMBER		7933707		

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK UTILITIES 5/26/77
IP 7933707 REV

MEASUREMENTS SECTION

'RM07'

INSTRUMENTATION PROGRAM AND COMPONENTS LIST: REEDY CREEK UTILITIES IP7933707 1/26/78 REV B

MEASUREMENT SUMMARY

PARAMETER	NUMBER
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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INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- REEDY CREEK IP7933707 03/23/78

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REPORT BY CHANNEL ASSIGNMENT

MEAS NUMBER USM CODE	MEASUREMENT NAME	CHAN #	ASYN	# WIRE	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
T402 -0018 0202	SPACE HEATING SUPPLY TEMP	02	-	3	30-240 DEGF 0-100 MV 50 +32.226 /+236.23	BRIDGE 7932988	0013 DEGF/BIT +3222636E-05 +1947638E-07 +0004382E-09 +0001628E-13	PRT MINCO S53P40Z36 F203U10	
T452 -0018 0302	SPACE HEATING RETURN TEMP	03	-	3	30/240 DEGF 0-100 MV 50 +32.632 /+235.74	BRIDGE 7932988	0006 DEGF/BIT +3263187E-05 +1939427E-07 +0004335E-09 +0001598E-13	PRT MINCO S53P40Z36 F203U10	
T350 -0019 0402	DHW HX OUTLET TEMP	04	-	3	30/230 DEGF 0-100 MV 50 +32.226 /+236.71	BRIDGE 7932988	0007 DEGF/BIT +3222639E-05 +1952995E-07 +0004406E-09 +0001645E-13	PRT MINCO S53P40Z36 F203U10	
T551 -0018 0501	ARKLA CONDENSER WATER OUTLET	05	-	3	30/160 DEGF 0-100 MV 50 +33.671 /+161.57	BRIDGE 7932990	0009 DEGF/BIT +3367169E-05 +1228937E-07 +0002946E-09 +0004931E-14	PRT MINCO S53P40Z36 F203U15	
EP101-0018 NOTE 2	COLLECTOR PUMP POWER	06	A	3	0-4 KW 0-100 MV 50	STRAIGHT 7932985	KW/BIT 0. +0039100E-07	WATT XDCR OHIO SEMITRONICS PC5-6	
SP062-0018	*SPARE	07	-	3	N/A N/A 50	SHORT 7932939	N/A N/A	N/A N/A	
T501 -0018 0801	ARKLA CONDENSER WATER INL TMP	08	-	3	30-160 DEGF 0-100 MV 50 +31.815 /+162.34	BRIDGE 7932990	0014 DEGF/BIT +3181548E-05 +1253401E-07 +0002146E-09 +0005122E-14	PRT MINCO S57P40Z36 F203U15	

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REPORT BY CHANNEL ASSIGNMENT

MEAS NUMBER DSM CODE	MEASUREMENT NAME	CHAN #	ASYN	# WIRE	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
EP102-0018 NOTE 2	TRACKER MOTOR POWER	09	A	3	0-4 KW 0-100 MV 50	STRAIGHT 7932985	KW/BIT 0. +0039100E-07	WATT XDCR OHIO SEMITRONICS PC5-6	
T001 -0018 1000	OUTDOOR AMBIENT TEMP	10	-	3	-20-120 DEGF 0-100 MV 50 -19.297 /+119.42	BRIDGE 7932986	0003 DEGF/BIT -1828732E-05 +1322163E-07 +0002282E-09 +0005918E-14	PRT MINCO S53P85Z36 N/A	
T100 -0018 1103	COLLECTOR INLET TEMP	11	-	3	30-450 DEGF 0-100 MV 50 +31.953 /+455.54	BRIDGE 7932987	0015 DEGF/BIT +3195268E-05 +3969622E-07 +0001553E-08 +0001261E-12	PRT MINCO S57P40Z36 F203U15	
T150 -0018 1203	COLLECTOR ARRAY OUTLET TEMP	12	-	3	30/450 DEGF 0-100 MV 50 +31.637 /+449.39	BRIDGE 7932987	0009 DEGF/BIT +3163616E-05 +3915011E-07 +0001499E-08 +0001179E-12	PRT MINCO S53P40Z36 F203U15	
T102 -0018 1303	COLLECTOR SURFACE TEMP	13	-	3	30-450 DEGF 0-100 MV 50 +31.999 /+449.55	BRIDGE 7932987	DEGF/BIT +3199876E-05 +3915971E-07 +0001499E-08 +0001179E-12	PRT MINCO S344736 DC96-090	
T201 -0018 1403	HW STORAGE TANK TOP TEMP	14	-	3	30-450 DEGF 0-100 MV 50 +31.999 /+449.55	BRIDGE 7932987	DEGF/BIT +3199876E-05 +3915971E-07 +0001499E-08 +0001179E-12	PRT MINCO S53P180Z36 F2030154	
T202 -0018 1503	HW STORAGE TANK MIDDLE TEMP	15	-	3	30-450 DEGF 0-100 MV 50 +31.999 /+449.55	BRIDGE 7932987	DEGF/BIT +3199876E-05 +3915971E-07 +0001499E-08 +0001179E-12	PRT MINCO S53P180Z36 F2030154	

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MEAS NUMBER OSM CODE	MEASUREMENT NAME	CHAN #	A SYN	WIRE	OPERATING RANGE SENSOR OUTPUT RANGE SDAS GAIN ACTUAL OPER RANGE	MICROBRD TYPE MICROBRD P/N SENSOR EXCIT	TEMP SERIAL # SCALE FACTOR UNITS CPOS SCALE FACTORS (A0,A1,A2,A3)	SENSOR TYPE SENSOR MANUFACT SENSOR P/N WELL P/N	NOTES SERIAL # CROSS SECTION AREA
W100 -0018 1666	COLLECTOR ARRAY FLOW RATE	16	-	3	0-197.1 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +1947817E-05 SOCT	FLOW METER RAMAPO MKV-3-W01	S/N-4337
W300 -0018 1771	DHW SOLAR FLOW RATE	17	-	3	0-9.90 GPM 0-33 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +5648390E-07 SOCT	FLOW METER RAMAPO MKV-1-J01	S/N-4215
W301 -0018 1871	DHW SUPPLY FLOW RATE	18	-	3	0-9.93 GPM 0-33 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +5608452E-07 SOCT	FLOW METER RAMAPO MKV-1-J01	S/N-4230
I001 -0018 1922	COLLECTOR PLANE TOT INSOLAT	19	A	3	0/362.86 BTU/FT2-HR 0-12 MV 50	CAPACITOR 7934363	B/F2-H/BIT 0. 2.9529899	PYRONOM EPPLEY PSP	15350F3
T554 -0018 2000	CHILL H2O COIL OUTLET TEMP	20	-	3	-20/120 DEGF 0-100 MV 50 -18.049 /+121.01	BRIDGE 7932996	0010 DEGF/BIT -1804971E-05 +1334917E-07 +0002330E-09 +0006066E-14	PRT MINCO S53P40Z36 F203U10	
T504 -0018 2100	CHILLED WATER SUPPLY IN TMP	21	-	3	-20-120 DEGF 0-100 MV 50 -18.101 /+120.85	BRIDGE 7932996	0016 DEGF/BIT -1810160E-05 +1333892E-07 +0002325E-09 +0006103E-14	PRT MINCO S57P40Z36 F203U10	
T206 -0018 2200	CW STORAGE TANK BOTTOM TEMP	22	-	3	-20-120 DEGF 0-100 MV 50 -19.027 /+119.85	BRIDGE 7932986	DEGF/BIT -1902760E-05 +1333191E-07 +0002326E-09 +0006040E-14	PRT MINCO S53P180Z36 F203U154	
T302 -0018 2302	DHW SUPPLY TEMP	23	-	3	30-210 DEGF 0-100 MV 50 +32.451 /+235.55	BRIDGE 7932988	0011 DEGF/BIT +3245118E-05 +1939359E-07 +0003337E-09 +0001599E-13	PRT MINCO S53P40Z36 F203U10	

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REPORT BY CHANNEL ASSIGNMENT

MEAS NUMBER OSM CODE	MEASUREMENT NAME	CHAN #	ASYN	# WIRE	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
LP504-0318 NOTE 2	CHILLED WATER COIL PUMP PWR	24	A	3	0-4 0-100 50	KW MV	STRAIGHT 7932985	KW/BIT 0. +0039100E-07	WATT XDCR OHIO SEMITRONICS PC5-6	
W502 -0018 2563	ARKLA HW FLOW RATE	25	-	3	0-120.3 0-10 50	GPM MV	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +1188851E-05 SQCT	FLOW METER RAMAPO MKV-2-1/2W01	S/N-4314
W503 -0018 2666	ARKLA EVAPOR WATER FLW RTE	26	-	3	0-195.26 0-10 50	GPM MV	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +1929635E-05 SQCT	FLOW METER RAMAPO MKV-3-W01	S/N-4340
SP001-0018	SPARE	27	-	3	N/A N/A 50		SHORT 7932938	N/A N/A	N/A N/A	
T502 -0018 2802	ARKLA GEN WATER INLET TEMP	28	-	3	30-230 0-100 50 +32.099 /+234.49	DEGF MV	BRIDGE 7932988	0317 DEGF/BIT +3199938E-05 +1932830E-07 +0004307E-09 +0001554E-13	PRT MINCO S57P40Z36 F203U10	
T552 -0018 2902	ARKLA GEN WATER OUTLET TEMP	29	-	3	30/230 0-100 50 +31.503 /+234.62	DEGF MV	BRIDGE 7932988	0012 DEGF/BIT +3150315E-05 +1939477E-07 +0004347E-09 +0001570E-13	PRT MINCO S53P40Z36 F203U10	
EP401-0018 NOTE 2	HW SUPPLY PUMP POWER	30	A	3	0-4 0-100 50	KW MV	STRAIGHT 7932985	KW/BIT 0. +0039100E-07	WATT XDCR OHIO SEMITRONICS PC5-6	
T503 -0018 3101	ARKLA CHILLED WATER OUT TMP	31	-	3	30-160 0-100 50 +30.632 /+159.63	DEGF MV	BRIDGE 7932990	0018 DEGF/BIT +3063262E-05 +1239067E-07 +0012291E-09 +0005249E-13	PRT MINCO S57P40Z36 F203U15	

IBM07

+0007326E-09
+0036047E-14

REPORT BY CHANNEL ASSIGNMENT

MEAS NUMBER PSR LOC	MEASUREMENT NAME	CHAN	ASYN	# BITS	OPERATING RANGE SENSOR OUTPUT RANGE SCAN GAIN ACTUAL OPER RANGE		MICROBOARD TYPE MICROBOARD P/N SENSOR EXCIT	TEMP SERIAL # SCALE FACTOR UNITS CROSS SCALE FACTORS (A0,A1,A2,A3)	SENSOR TYPE SENSOR MANUFACT SENSOR P/N WELL P/N	NOTES SERIAL # CROSS SECTION AREA
1453 -0010 X 3201	ABKLA CHILLED WATER RETURN	32	-	3	30/160 0-100 50 +32.190 /+161.42	DEGF MV	BRIDGE 7912990	DEGF/BIT +32190556E-05 +12319771E-07 +00029591-03 +00051685-14	RHT MINCO S53P40236 F203015	
1006 -0011 3364	COLLECTOR PLANE TEF INSULAT	33	A	3	0/321.97 0-12 50	BTU/FT2-HR MV	CAPACITOR 7934363	B/F2-H/BIT 0. 3.1003417	PYRANOM EPPLEY 950	15273F3
4021 -0013 X NOTE 2	[illegible] COIL SUPPLY FLOW RATE	34	-	3	0/7[illegible].92 0-15 50	GPM MV	STRAIGHT 7732335 +5 VDC	GPM/BIT 0 .7973470 SQ.T	FLOW METER RAMAPO MKV-1-174371	4509
4001 -0014 3394	[illegible] COND WATER FLOW RATE	35	-	3	[illegible] 0-10 51	GPM MV	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +147506[illegible]E-05 SQ.T	FLOW METER RAMAPO MKV-3-W01	574-5674
[illegible] -0015 NOTE 2	CHILLED WATER SUPPLY FLOWRATE	36	-	3	0-60.0 0-10 51	GPM MV	STRAIGHT 7932975 +5 VDC	GPM/BIT 0. +59209[illegible]E-05 SQ.T	FLOW METER RAMAPO MKV-2-17[illegible]	[illegible]
1[illegible] -0016 3735	[illegible] STORAGE TANK BOTTOM TEMP	37	-	3	35/-45[illegible] 0-1.13 51 +11.030 /+442.55	DEGF MV	BRIDGE 7932987	DEGF/BIT +31000741E-05 +3917771E-07 +[illegible] +[illegible]E-12	RHT MINCO S53P180236 F2030154	
[illegible] [illegible]	[illegible] STORAGE TANK [illegible] TEMP	38	-	3	[illegible]-129 1-100 51 -10.127 /+113.95	DEGF MV	BRIDGE 7932986	DEGF/BIT -1022[illegible]E-15 +133[illegible]E-07 +[illegible]E-09 +[illegible]E-15	RHT MINCO S53P180236 F2030156	
1[illegible] -0017 3[illegible]	[illegible] STORAGE TANK [illegible] TEMP	[illegible]	[illegible]	[illegible]	[illegible] 0-100 [illegible] -10.[illegible] /+110.[illegible]	[illegible] MV	BRIDGE 79329[illegible]	DEGF/BIT -[illegible]E-15 +[illegible]E-07 +[illegible]E-09 +[illegible]E-14	RHT MINCO S53P180236 F2030154	

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REPORT BY CHANNEL ASSIGNMENT

MEAS NUMBER USM CODE	MEASUREMENT NAME	CHAN #	ASYN	# WIRF	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
T505 -0018 4000	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-P40Z36 F203U15	
T555 -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 S53P40Z36 F203U15	
T600 -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 +0002039E-09 +0004923E-14	PRT MINCO S53P85Z36 F132	
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	
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	
EP501-0018 4540	ARKLA 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	
EP502-0018 NOTE 2	ARKLA CHILLED WATER PMP PWR	46	A	3	0-4 KW 0-100 MV 50	STRAIGHT 7932985	KW/BIT 0. +0039100E-07	WATT XDCR OHIO SEMITRONICS PC5-6	
EP503-0018 4744	CONDENSER WATER PUMP POWER	47	A	3	0-8 KW 0-100 MV 50	STRAIGHT 7932985	KW/BIT 0. +0078201E-07	WATT XDCR OHIO SEMITRONICS PC5-15	

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REPORT BY CHANNEL ASSIGNMENT

LINE	MEAS NUMBER / USM CODE	MEASUREMENT NAME	CHAN #	ASYN	# WIRE	OPERATING RANGE / SENSOR OUTPUT RANGE / SDAS GAIN / ACTUAL OPER RANGE	MICROBRD TYPE / MICROBRD P/N / SENSOR EXCIT	TEMP SERIAL # / SCALE FACTOR UNITS / CRDS SCALE FACTORS (A0,A1,A2,A3)	SENSOR TYPE / SENSOR MANUFACT / SENSOR P/N / WELL P/N	NOTES / SERIAL # / CROSS SECTION AREA
1	1300 -0018 *	DCH HOT WAT HX	48	-	3	30/160 DEGF	BRIDGE		PRT	
2		INLET TEMP				0-100 MV	7932990	DEGF/BIT	MINCO	
3	4801					50		+3154756E-05	S57-P40736	
4						+31.547 /+159.71		+1231245E-07	F203010	
5								+0002060E-09		
6								+0004990E-14		

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APPENDIX F

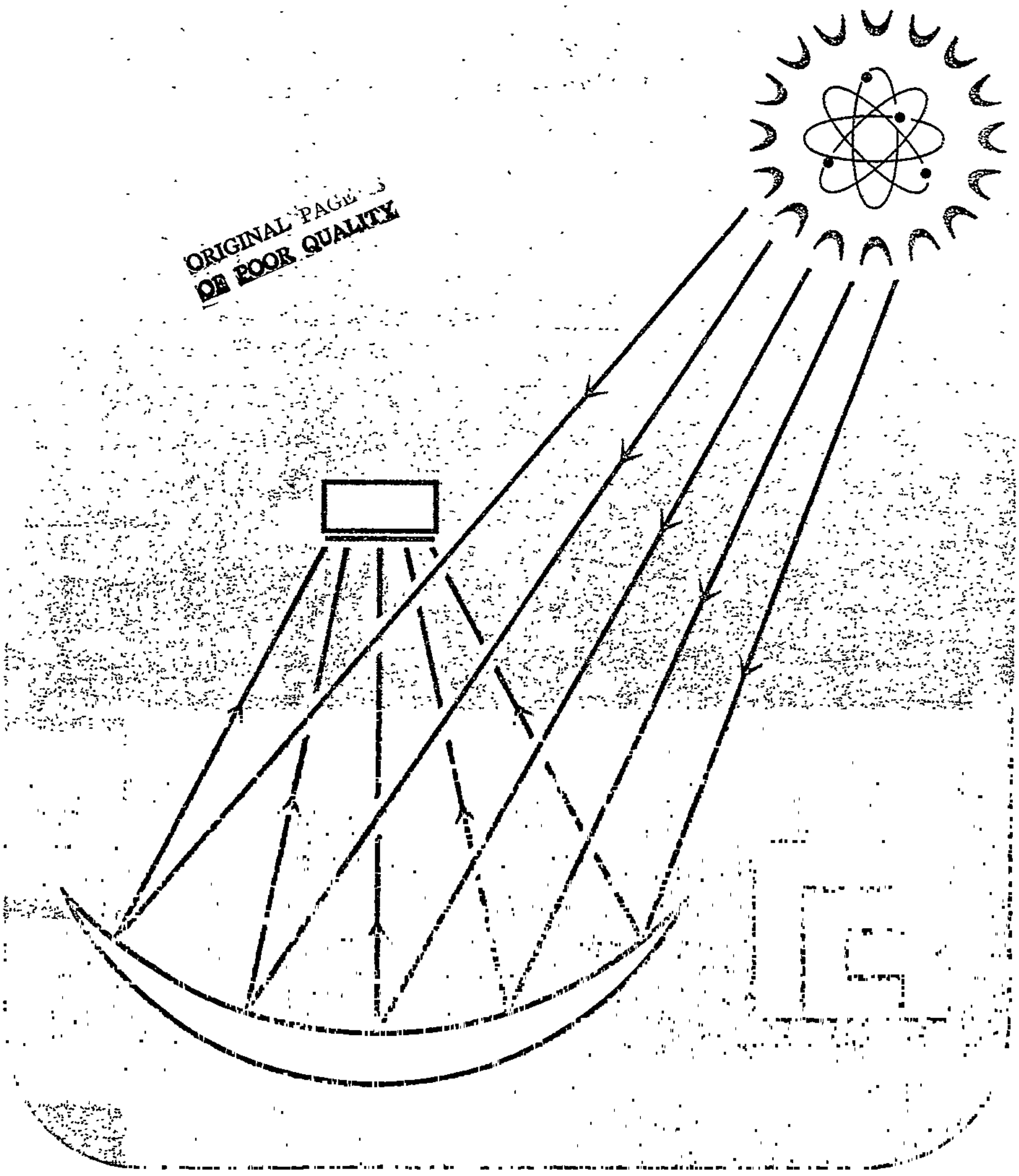
SOLAR ACCEPTANCE TEST

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

- Purpose: To determine if all fluid loop components have been included and properly installed per the complete Disney World Mechanical Specification.

- Method: Visually compare installation and component manuals with D/W drawings and design specification.

- 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

- Purpose: To determine if any water leaks exist in loop when pressured to 150 psi.

- Method: Pressurize loop only to 150 psi for four (4) hours. Must not leak.

- Results: Complete - No leaks

c. Calibration of Pressure Gages & Thermometers

- Purpose: To insure that all gages and thermometers are indicating properly.

- Method: Calibrate gages (must be within ±2 psi and thermometers within ±2°F) utilizing pressure and temperature standard or ice water and hot water bath.

- Results: Complete - All gages and thermometers tagged and dated.

d. Functional Tests

(1) Tank (T-1) Isolation Valves

- Purpose: To determine if valves isolate tank from collector circuits with no leaks.

- 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.

- Results: Complete - No leaks

(2) Drain Valves

- Purpose: To determine if valves will properly drain system.

- Results: Complete - The system was flushed, filled, and drained before the hydrotest.

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

- 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.
- 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.
- Results: Complete - 4.5 Amp

(4) Flow Distribution in Collector Array

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

- Purpose: To determine if any water leaks exist in loop when pressurized to 150 psi.
- Method: Pressurize loop only to 150 psi for four (4) hours. Must not leak.
- 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 $\pm 2°F$) 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 ±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 39-1/2". The proper travel is shown in the following sketch.

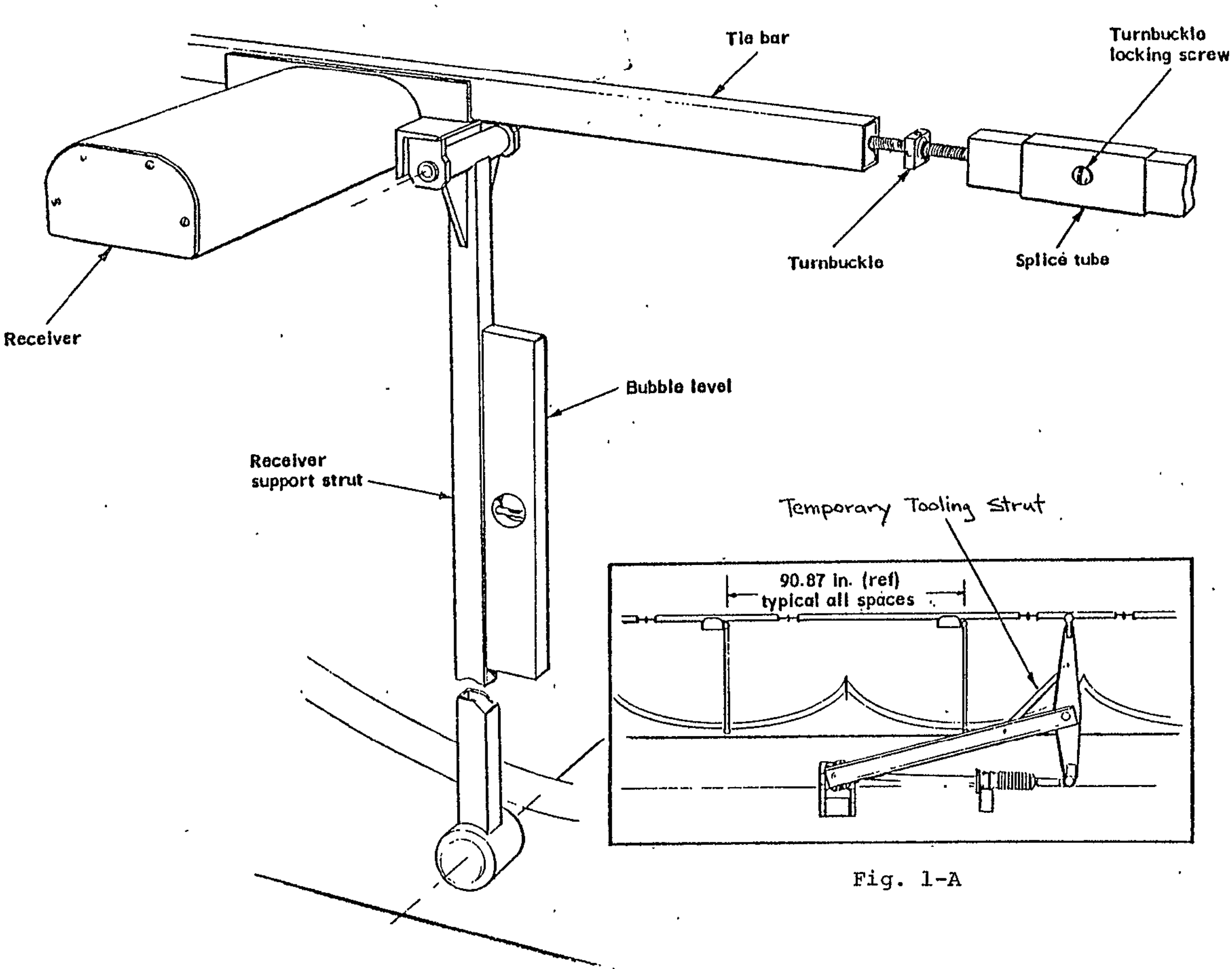

Tie bar
Turnbuckle locking screw
Turnbuckle
Splice tube
Receiver
Bubble level
Receiver support strut
Temporary Tooling Strut
90.87 in. (ref)
typical all spaces

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

      - Purpose: To determine if all fluid loop components have been included and properly installed per the mechanical specification.

      - Method: Visually compare installation and component manuals with drawings and design specifications.

      - 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 ±2°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

- Purpose: To determine if all control circuit components have been included and properly installed per the completed mechanical specification.

- Method: Visually compare installation and component manuals with drawings and design specifications.

- Results: The system is in agreement with the drawings and specifications.

b. Calibration of Thermometers

- Purpose: To insure that all thermometers are indicating properly.

- Method: Calibrate thermometers within $\pm 2°F$ utilizing pressure and temperature standard.

- 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 ±2°F above temperature of tank bottom.

  - If collector pump can maintain a Δt of 0.5° ±2°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° ±.2°F above the temperature of the tank bottom.

2. Hot Water Compression Tank (T3)

- 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.

- 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.

- 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

- Purpose: To determine if throttle valve and by-pass have been properly adjusted with respect to flow to chiller (CH-10ZE).

- 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.

- 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

- Purpose: To determine if the pump has the proper direction of rotation and supplies the required GPM to the heating coil.

- 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.

- Results: Complete - 7 GPM

b. Air Handling Equipment (AH-6ZE)

- Purpose: To determine if the air handling equipment will supply heating to the office space.

- 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.

- 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)

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

(2) Controls

- Purpose: To determine if the controls will limit the condenser water temperature a minimum of 70°F.
- 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.
- Results: Complete

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

- Purpose: To determine pump direction, GPM and operation of valves and control in piping to Tank T-2.

- 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.

- 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)

- Purpose: To determine if the piping to Tank T-2 has any water leaks. Tank T-2 was hydrotested before installation.

- Method: Pressurize loop only to 150 psi for four (4) hours. Must not leak.

- 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

Title	Page #

CAUTION

- The operating angular stroke of the receivers must not exceed 48° north of vertical or 42° south of vertical.

- Damage to receivers will occur if absorber temperature goes above 320°F (overheat) or, with water in the system, below 32°F.

- Walking on the reflective surface of the roof without proper padding may cause cracked mirrors.

- 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.

- 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

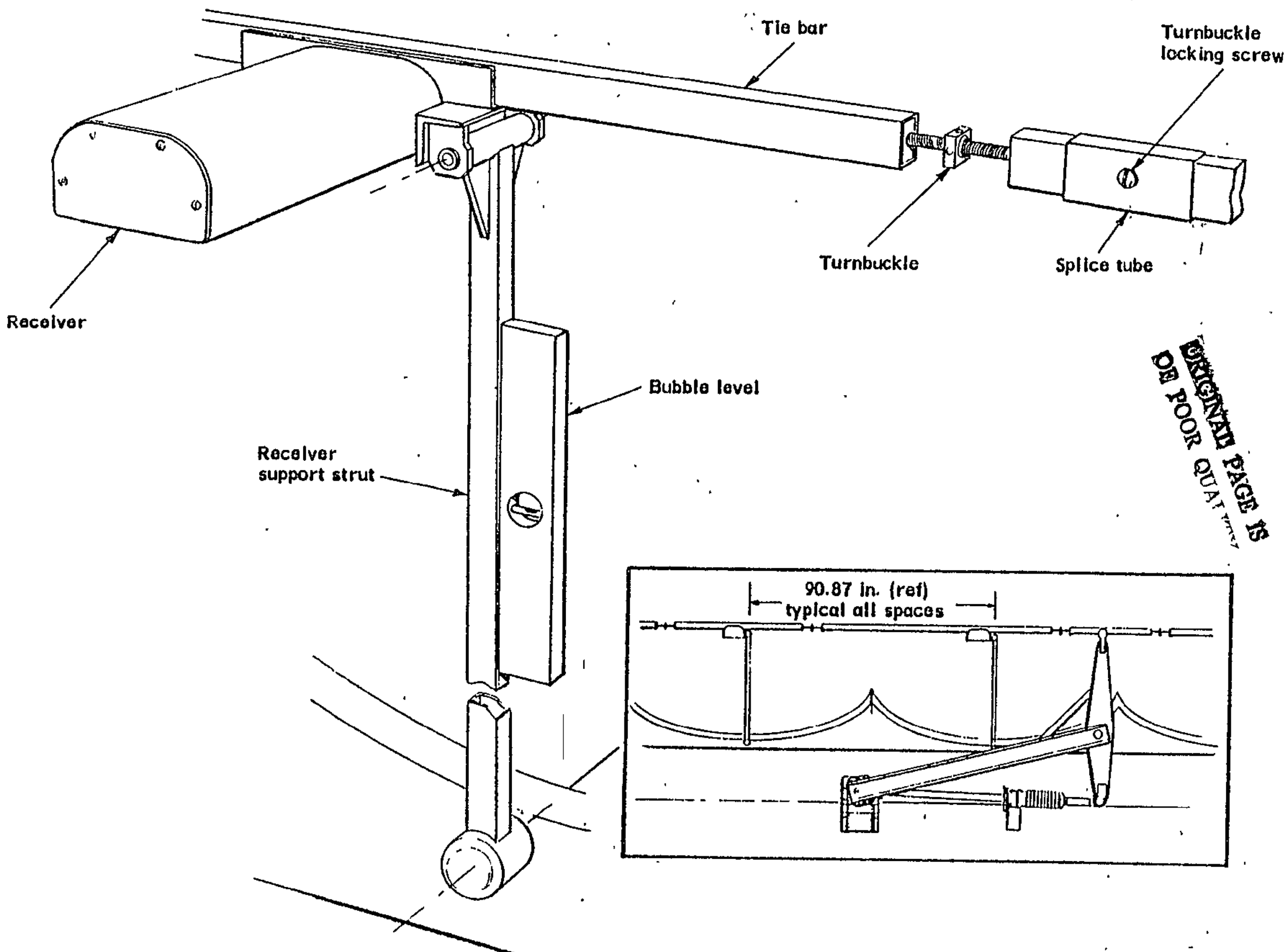

Tie bar
Turnbuckle locking screw
Turnbuckle
Splice tube
Receiver
Bubble level
Receiver support strut
90.87 in. (ref)
typical all spaces

FIGURE 1

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 39-1/2". The proper travel is shown in the sketch below. Be sure to use the manufacturer's recommended procedure for adjustment of the limit switches.

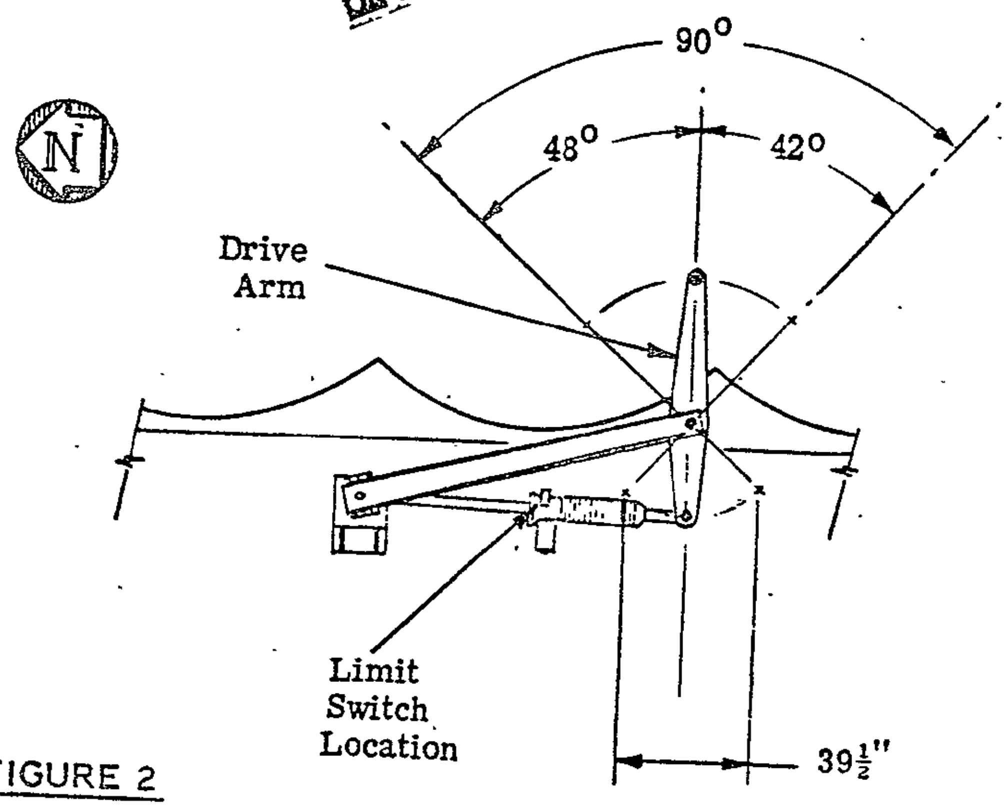


FIGURE 2

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_o (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 ±.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°F to a maximum of ±0.2°F. Procedures for performing these calibrations are included in the handbook. With no additional system calibration or adjustments, all temperature readings should be within ±1°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 <u>scale</u> pot for 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 + 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.

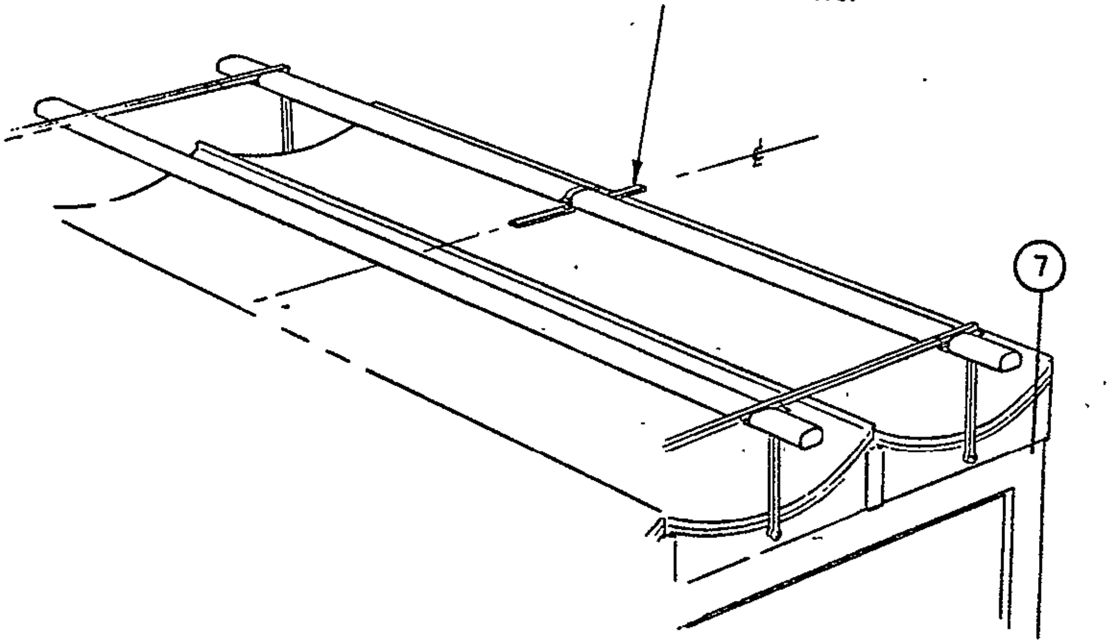

Sun sensor, 57939-40104-10.
Locate on C/L of No. 1 receiver
7
SOUTH END OF
BUILDING

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°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°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 ±5°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 ±5°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 ±5°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 ±3°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 ±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 ±3°F. Slowly reduce H.W. tank top and note turn off temperature which must be 170 ±3°F, and must also be 5 ±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 ±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 ±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 ±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 ±5°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.

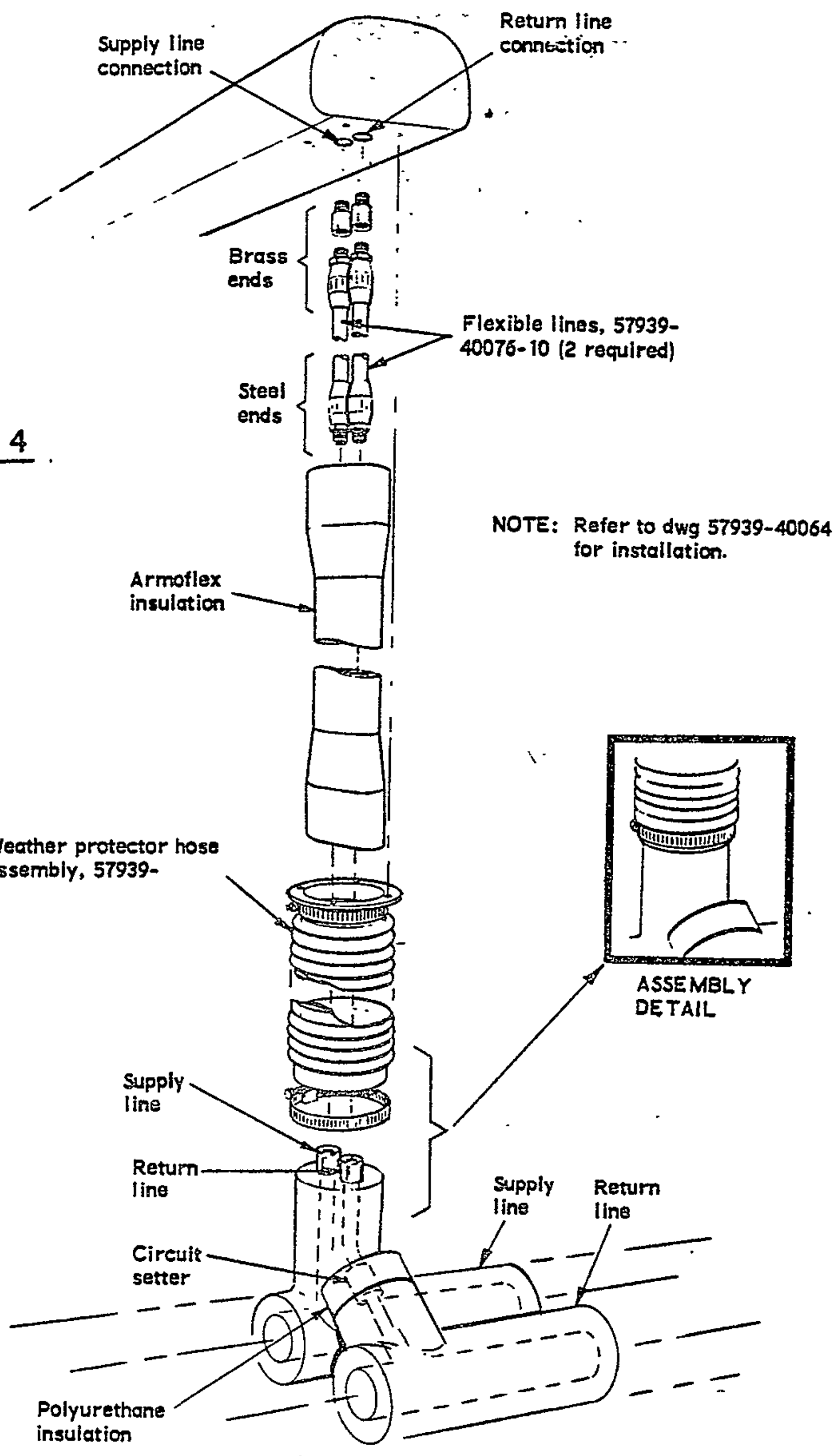
2. Operating Mechanism

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


Supply line connection
Return line connection
Brass ends
Flexible lines, 57939-40076-10 (2 required)
Steel ends
NOTE: Refer to dwg 57939-40064 for installation.
Armoflex insulation
Weather protector hose assembly, 57939-
ASSEMBLY DETAIL
Supply line
Return line
Circuit setter
Supply line
Return line
Polyurethane insulation

NOTE: For installation see dwg 57939-40128

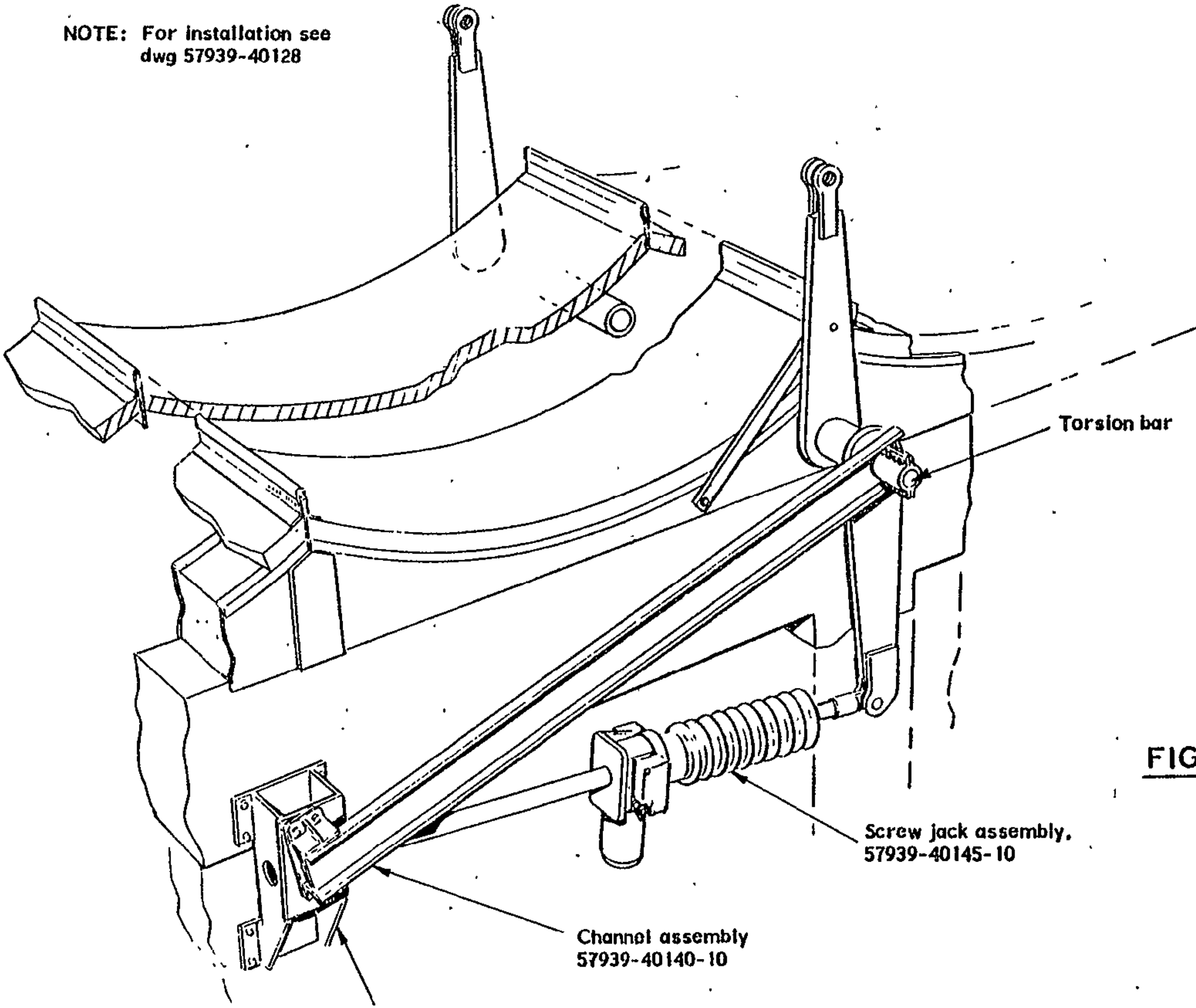


FIGURE 5

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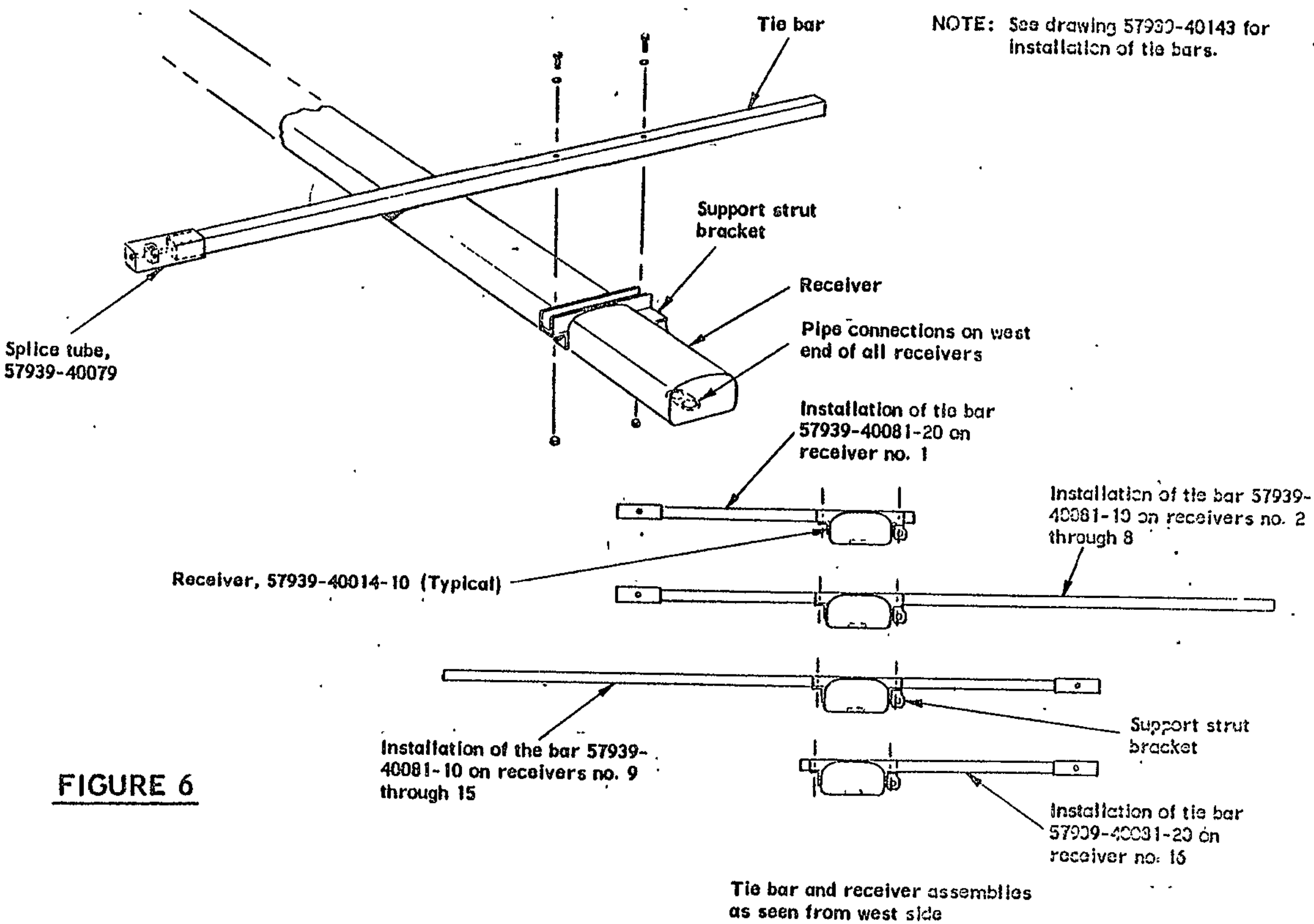
Tie bar
NOTE: See drawing 57930-40143 for installation of tie bars.
Support strut bracket
Receiver
Pipe connections on west end of all receivers
Splice tube, 57939-40079
Installation of tie bar 57939-40081-20 on receiver no. 1
Installation of tie bar 57939-40081-10 on receivers no. 2 through 8
Receiver, 57939-40014-10 (Typical)
Support strut bracket
Installation of the bar 57939-40081-10 on receivers no. 9 through 15
Installation of tie bar 57939-40031-20 on receiver no. 16
Tie bar and receiver assemblies as seen from west side

FIGURE 6

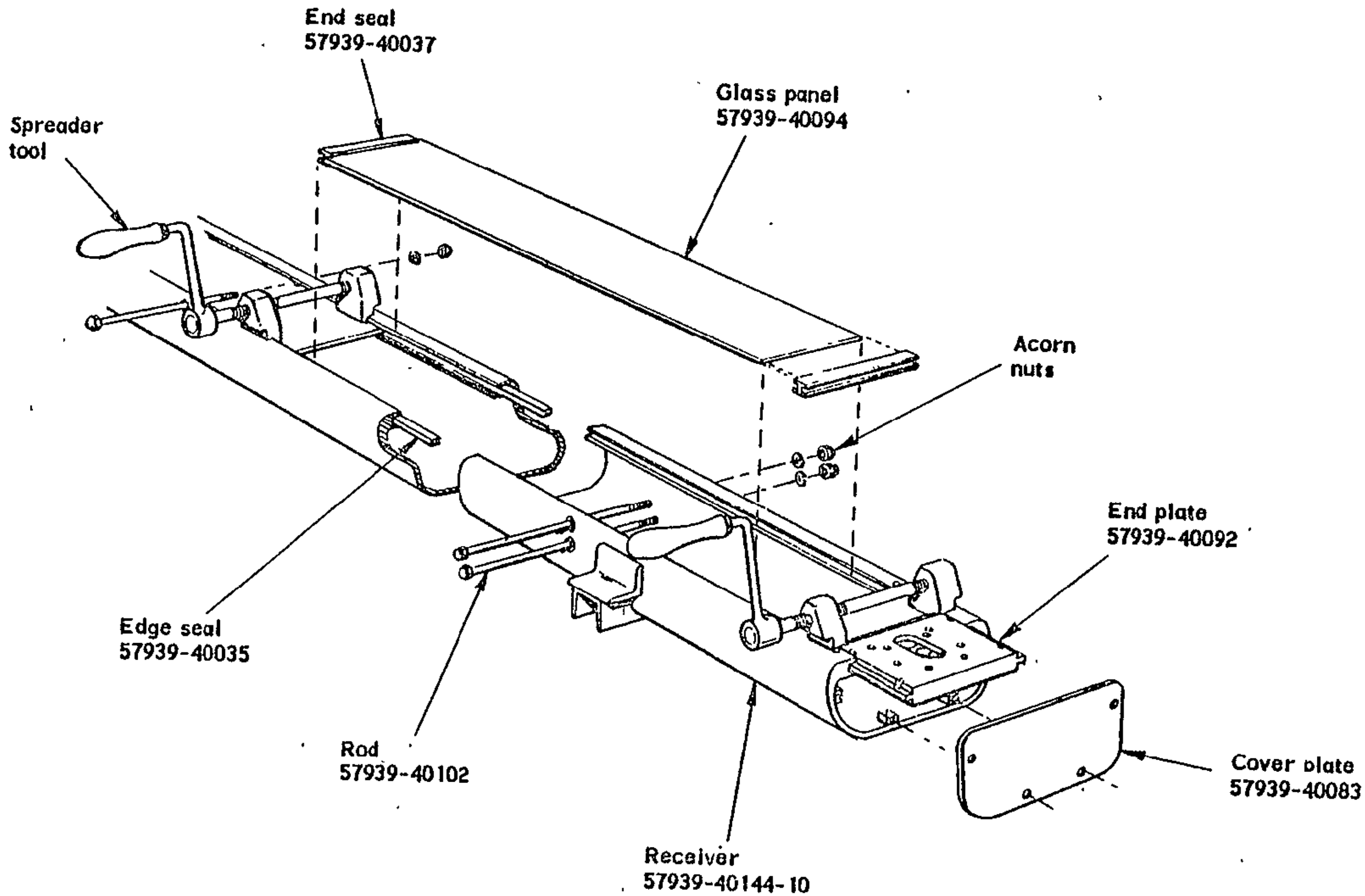

FIGURE 7

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