DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150869

FINAL SYSTEM INSTRUMENTATION DESIGN PACKAGE FOR DECADE 80 SOLAR HOUSE

Prepared from documents furnished by

Copper Development Association, Inc.
405 Lexington Avenue
New York, New York 10017

Under Contract NAS8-32244 with

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

For the U. S. Department of Energy

U.S. Department of Energy

Solar Energy

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SECTION 1.0

SITE AND SYSTEM DESCRIPTION

1.0 <u>Site and System Description</u>

1.1 Site Contractor

Copper Development Association Inc.
405 Lexington Avenue
New York, New York 10017
(212) 953-7315

Field Office:
34 E. Madrid Place
Tucson, Arizona 85704
(602) 297-7020

1.2 Site Address

7779 N. Via Piccolina
Tucson, Arizona 85704

1.3 Purpose of Site

Single family residence.

1.5 System Descriptive Summary

1.5.1 Type:

Heating, absorption air-conditioning, and domestic water heating.

1.5.2 Collector area:

Gross area = 1923 sq ft

Clear aperture = 1766 sq ft

1.5.3 Collector description:

The collector is the Revere Copper and Brass Inc. <u>Laminated Panel Collector</u>, integral with the building roof. The collector is glazed with two panes of 1/8-inch glass preassembled in a frame. The glass is PPG <u>Herculite K</u> tempered glass as the outer pane, and annealed glass as the inner pane.

Flow through the collector is 25 gpm; mass flow is about 6.5 lb/sq ft-hr. Flow is through a grid-sinuous pattern of 22 parallel tubes. Each tube is folded back-and-forth in a sinuous path of about 200 ft with a balancing cock in each flow path.

1.5.4 Storage:

The storage medium is tap water, treated with soda ash and sodium sulfite to inhibit rusting in the storage tank.

The storage container is a steel tank of 3000 gallon capacity. The tank contains about 2700 gallons of water, with the remaining space for expansion.

The tank is built of 1/4-inch steel plate formed into a cylinder; the ends of the tank are domed. The cylinder stands vertically, about 8 1/2 ft in diameter. It was delivered to the site assembled.

The tank has an epoxy lining.

1.5.5 Space heating method:

The zoned heating system is a forced-air type, with two units, one serving the east zone and one serving the west zone. Air is heated by fan coils containing solar-heated water. Water is delivered to the fan coils at 5 to 11 gpm directly from the storage tank.

In the event that there is not sufficient heat in the storage tank to satisfy the demand, heat is provided to the fan coils by an auxiliary natural-gas-fired boiler.

1.5.6 Hot water subsystem:

Domestic water is heated through a heat exchanger and stored in a 66-gallon electric water heater, Rheem model 666H-660. The water heater electric elements are wired so they are in-circuit only when the main storage tank is below a preset temperature.

Hot water is circulated continuously to faucets throughout the house.

1.5.7 Energy transport:

Fans - All are 120 V AC, Single phase, 60 Hz.

East zone uses one 3/4-HP blower.

West zone uses one 1/2-HP blower.

There is a duct booster-fan that controls air flow to the guest cabana. The fan is operated by the homeowner when he desires.

Ducts - All ducts are rigid fiberglass, in diameters from 6" to 16". The duct layout is shown in Drawings, enclosed as Appendix A.

Air flow through the east system is 1750 cfm; air flow through the west duct system is 1500 cfm.

Pumps - All pumps are 120 V AC, single phase, 60 HZ.

Pipe details - The Heating-Cooling Water Piping Diagram (Appendix C) gives a detailed description of each pipe size and identifies all pumps, valves, heat exchangers, etc.

All tubes between the collector and HE-1 and HE-2 are 1-1/2 inch. All tubes into and out of the storage tank are 1-1/2 inch.

Tubes to and from the Arkla generators and condensers, and tubes to each heating fan coil, are 1 inch.

All tubing is Type L copper. Fittings are copper, brass, or bronze. All joints are brazed with "Sil-Fos" silver-phosphorous-copper brazing alloys.

Fluid type - All fluids are tap water.

The collector water has about 35% propylene glycol antifreeze added to it. It is inhibited with phosphate.

The storage tank water has sodium nitrite and sodium sulfite added to it as rust inhibitors. About 10 lbs of each were used. The sodium sulfite is periodically replenished. This water circulates through the heating fan coils and the Arkla generators.

The cooling tower water has a polyphosphate stabilizer metered into it at about 1 to 10 ppm. An algaecide is added to the water once a month. The algaecide is consumed in a few days. The cooling tower water is bled off whenever the air conditioners are operating; bleed rate is 10.5 gal per hr for each of the two Arkla air-conditioners.

1.5.8 Space cooling method:

Air-conditioners are three-ton Arkla lithium bromide absorption units, model XWF-501. Two are used; each cools one zone, or about half the living space. They are direct expansion types.

1.5.9 Auxiliary energy source:

Auxiliary energy for the heating and cooling subsystems is provided by a natural-gas-fired boiler: Teledyne Laars model HK--250--CN01A. The labelled input is 250,000 Btu per hr; output is 200,000 Btu per hr.

The boiler has been modified by the removal of its two-stage gas valve, and replacement of it by a modulating valve and a partial bypass. Maximum output is now expected to be about 150,000 Btu per hr, with minimum continuous output about 50,000 Btu per hr.

Auxiliary energy for domestic water heating is provided by the two electric heating elements within the domestic water storage tank. Each element is 4500 watts, wired to operate one at a time. Auxiliary electric power is allowed to come on only when the main storage tank temperature drops below a preset temperature.

1.5.10 Operational control sequence:

The operational control sequence is described in detail in Section 2.0 Operating and Control Modes

1.5.11 Energy conversion efficiency:

Collection efficiency - The collector efficiency has been measured continuously for over a year. Typical summertime day-long efficiency, integrated over the total run-time of the collector (about 10:30 a.m. to 3:30 p.m.) is about 24 to 26%. Typically 650,000 to 850,000 Btu are delivered to storage on a normal clear day.

Typical wintertime day-long efficiency, integrated similarly, is 30 to 40%. Up to 1,100,000 Btu are collected on a clear December or January day. Recall also that the collector is sloped at 26° above the horizontal, to emphasize collection of heat during the summer.

Storage losses - Heat delivered from storage to the HVAC system has been measured. On a typical day the air conditioning system draws from storage about 200,000 Btu less than was delivered to storage by the collector.

About half the 200,000 Btu appears to have been used for domestic water heating. The other half is attributed to losses through the storage tank insulation, plumbing insulation, and to measurement error.

Storage losses in the heating mode have not yet been analyzed.

Domestic water heating losses - The domestic water storage tank/heater is wired to its own watt-hour meter. Domestic water heating energy consumption can therefore be measured by forcing the heater to remain in the electric heating mode. (It is set to the same temperature, 135 F, that the solar water heating system.)

Typically the domestic water heating system will consume about 25 Kwh per day, with two occupants living in the house. Of this amount, about 8 Kwh per day is dissipated because of the continuous-circulation feature of the plumbing system. In addition, the circulator pump itself consumes about 2 Kwh per day.

Additional insulation was added to the domestic water storage tank during the past summer. Before it was added energy consumption by the subsystem was about 6 to 10 Kwh per day higher.

These measurements of electric energy consumption by the domestic water subsystem do not, of course, account for any losses that occur in the domestic water heat exchanger, HE-3 or its associated plumbing.

Arkla C.O.P. - Air-conditioner Coefficient of Performance has been measured approximately. Under steady-state operating conditions the COP of the Arklas has been measured at about 0.8 ± 0.1.

Day-long COP varied, of course, with the amount of cooling required throughout the day. During the summer it was about 0.8. Early and late in the cooling season it was lower, about 0.3 to 0.6. During the summer both air-conditioners ran continuously from early morning till late night, typically 16 to 20 hours per day. Early and late in the cooling season the machines cycled rather frequently, lowering their effective coefficients of performance.

SECTION 2.0

OPERATING AND CONTROL MODES

2.0 Operating and Control Modes

There are six basic operating modes in the Decade 80 Solar House energy system:

Energy collection
Space heating from storage
Space heating from auxiliary energy
Space cooling from storage
Space cooling from auxiliary energy
Domestic water heating

The heat transfer fluid flows for each of the six operating modes are shown schematically in the six drawings (Drawings 1 through 6) that make up Appendix B, and are described below.

2.1 Energy collection:

Energy collection is controlled by two differential thermostats (Rho Sigma Model 12 modified units). When the collector surface temperature exceeds the temperature at the bottom of the storage tank pump P-1 is turned on, circulating the water-antifreeze solution from the collector to heat exchangers HE-1 and HE-2, and back to the collector.

A second differential thermostat turns pump P-2 on when the temperature of the antifreeze solution, as measured near the inlet of HE-1, exceeds the temperature at the bottom of storage by about 3°F.

Pump P-2 circulates water from the bottom of the storage tank through HE-2 and HE-1, and back to the top of the storage tank.

All energy that is collected is delivered directly to the storage tank; there is no provision for bypass from the collector directly to the heating and cooling equipment.

2.2 Space heating from storage:

Upon demand for heat by either of the two room thermostats, pump P-3 draws water from the solar storage tank. Warm water is provided to both fan coils, but admitted only to the one for which a demand was registered. Heat can be provided to either or both heating zones.

Water flow to each fan coil is set at 6 gpm. Each fan coil has a water bypass, so that its status (on or off) does not effect the rate of water flow to the other fan coil.

2.3 Space heating from auxiliary energy

Auxiliary heat, when required, is provided by a natural gas boiler. Dur g the winter of 1975-1976 only 3% of the total heating Btu's were provided by the boiler. So far (January 1977) no auxiliary heat has been used during the current winter.

The heating system is controlled by a two-stage room thermostat in each zone. When the space temperature drops below the thermostat set-point, a stage-one demand is created. Heat is provided to the space from the storage tank. If the storage tank is too cold to satisfy the demand for heat, the space temperature will continue to drop.

When the space temperature drops 1.5 F below the set-point of the thermostat a stage-two demand is created. If this demand continues for seven minutes the auxiliary boiler will operate. The boiler will continue to operate, and provide heat to both fan coils, until the stage-two demand for heat is satisfied.

It has been found that the boiler might be needed during the coldest part of a morning, but as the day begins to warm there is sufficient heat still in storage to satisfy the smaller demand. Therefore the auxiliary heat source is load-dependent rather than supply temperature-dependent.

The seven minute time delay on the boiler was added to assure that the boiler does not operate unnecessarily. The occupant of the house might over adjust a thermostat upward or open a door on a cold, windy morning. This might create a sudden false stage two demand for heat that could actually be satisfied by stored heat.

For economy, water heated by the boiler should not be returned to the storage tank after passing through the fan coil. Therefore, whenever the gas boiler operates, proportioning valve V-2 moves to the full bypass position. In this position water travels from pump P-3 to the boiler, then to the heating coils, and finally through V-2 and back to the pump.

2.4 Space cooling from storage:

When the occupant of the house chooses to cool the house he sets a Summer/Winter switch to the Summer position. This causes valves V-3 and V-4 to deliver hot water to the Arklas instead of the fan coils.

For proper operation the Arkla air conditioners require hot water between 190 and 210 F. The storage tank may at times exceed 210 F; therefore the stored hot water must be tempered somewhat. This is done by valve V-2. If water from storage enters this valve too hot, cooler water returning from the air-conditioners is mixed with the hot water, until the proper temperature is achieved.

The Arklas also require a means to dissipate the heat extracted from the house. This is the purpose of the cooling tower. The tower delivers water to the Arklas between 70 and 85 F; the water is heated in the Arklas by 15 to 20 degrees and returned to the tower. At the tower some of the water is evaporated, causing the remaining water to be cooled. On a dry day the water may be cooled below 70 F; this is not desirable.

To maintain the cool water at no less than 70 F there is a proportioning valve, V-11, at the cooling tower. If the tower chills the water excessively, unchilled water is delivered to the bottom of the tower, instead of the top, from which it returns, unchilled, to the Arklas. Valve V-11 mixes chilled and unchilled water to achieve the proper temperature.

Upon demand by either room thermostat for cooling, pumps P-3 and P-6 start, delivering hot water from storage and cool water from the cooling tower to the Arklas. Each Arkla has three-way valves and bypasses, so that cycling of one machine does not effect the water flow rates to the operating machine. The machines can operate alone or simultaneously.

As mentioned previously, the hot and cool water into the Arklas must be within certain temperature limits. If the cool water is too warm, or the hot water too cool, there is a danger of solidification, or crystallization, of the lithium bromide solution. To prevent the possibility of solidification there is a safety thermostat on each Arkla. This thermostat is a differential type; it allows air-conditioner operation only when the hot water is at least 110 F hotter than the cool water.

2.5 Space cooling from auxiliary energy:

The cooling system, like the heating system, is controlled by two two-stage thermostats, one in each of the two zones of the house. A first-stage demand for cooling from either thermostat will operate its air-conditioner, if certain conditions are met. The first condition, as described above, is that the hot water to the Arkla's generator must be at least 110 F hotter than the cool water to the machine's condenser. The second condition is that the hot water be at least 190 F. If the water in the storage tank is below this temperature, thermostat T-4, in the storage tank, signals valve V-2 to close to the recirculate position. This prevents the water in the storage tank from circulating uselessly and losing heat through pipe insulation.

A second stage demand from either room thermostat indicates that, that zone has warmed more than 1.5 degrees above the thermostat set-point. If the storage tank is above 197 F, the second stage demand has no effect. If the tank is below 197 F a second stage demand will first cause valve V-2 to close to the recirculate position. It then causes proportioning valve V-14 to respond to its temperature sensor T-16. As V-14 begins to operate to admit water to the boiler, the opening of an end-switch on the valve allows the boiler circulating pump, P-10, to start and sends a signal to the boiler gas valve. Flow through the boiler and P-10 trips a flow switch which then allows the boiler to begin operating.

There is a modulating gas valve in the boiler. The valve's regulator is set to raise the incoming water temperature by about 10 to 12 degrees. The boiler also has an over-temperature thermostat, set to 230 F, which shuts off the boiler if the water becomes too hot.

Modulating valve V-14 regulates the temperature of the water flowing from the boiler to the Arklas, holding the water to about 205 F.

The boiler will come on and operate both Arklas whenever there is a second-stage cooling demand from either thermostat. There is no time delay in the cooling mode, as there is in the heating mode.

If the storage tank temperature is between 190 and 197 F, the Arklas will operate from solar storage upon first-stage cooling demands and from the auxiliary boiler when either thermostat registers a second demand.

2.6 Domestic water heating:

The final mode of operation is domestic water heating. Water is received from the city supply between 50 and 90 F, and heated to 135. Domestic hot water is stored in a 66-gallon commercial electric water heater, whose electric heating elements are normally disabled.

The hot water is circulated continuously through the house past all faucets. The water temperature is sensed by thermostat T-7 as the water returns to the base of the storage tank.

When the water temperature drops below 135 F, T-7 causes pump P-4 to start. This pump draws hot water from the solar storage tank and sends it through the shell side of HE-3. After a 30-second delay (to allow the heat exchanger to warm up) pump P-5 starts sending domestic water from its storage tank to the tube side of HE-3. Both pumps run until T-7 is satisfied. During the summer, with the storage tank normally above 180 F, these pumps run for a one to two minute cycle every hour or two. During the winter the pumps run somewhat longer and more frequently.

Thermostat T-5 measures the storage tank temperature. If the main tank is below about 140 F pumps P-4 and P-5 would run excessively, or continuously. Thus T-5 disables the pumps below its 140 F set-point, and instead puts the domestic water heater's electric heating elements into circuit.

3.0 Architectural Rendering

An aerial photograph of the Decade 80 Solar House appears as Figure 1, page 18, showing pyranometer location and collector orientation. There are no interfering surrounding structures.

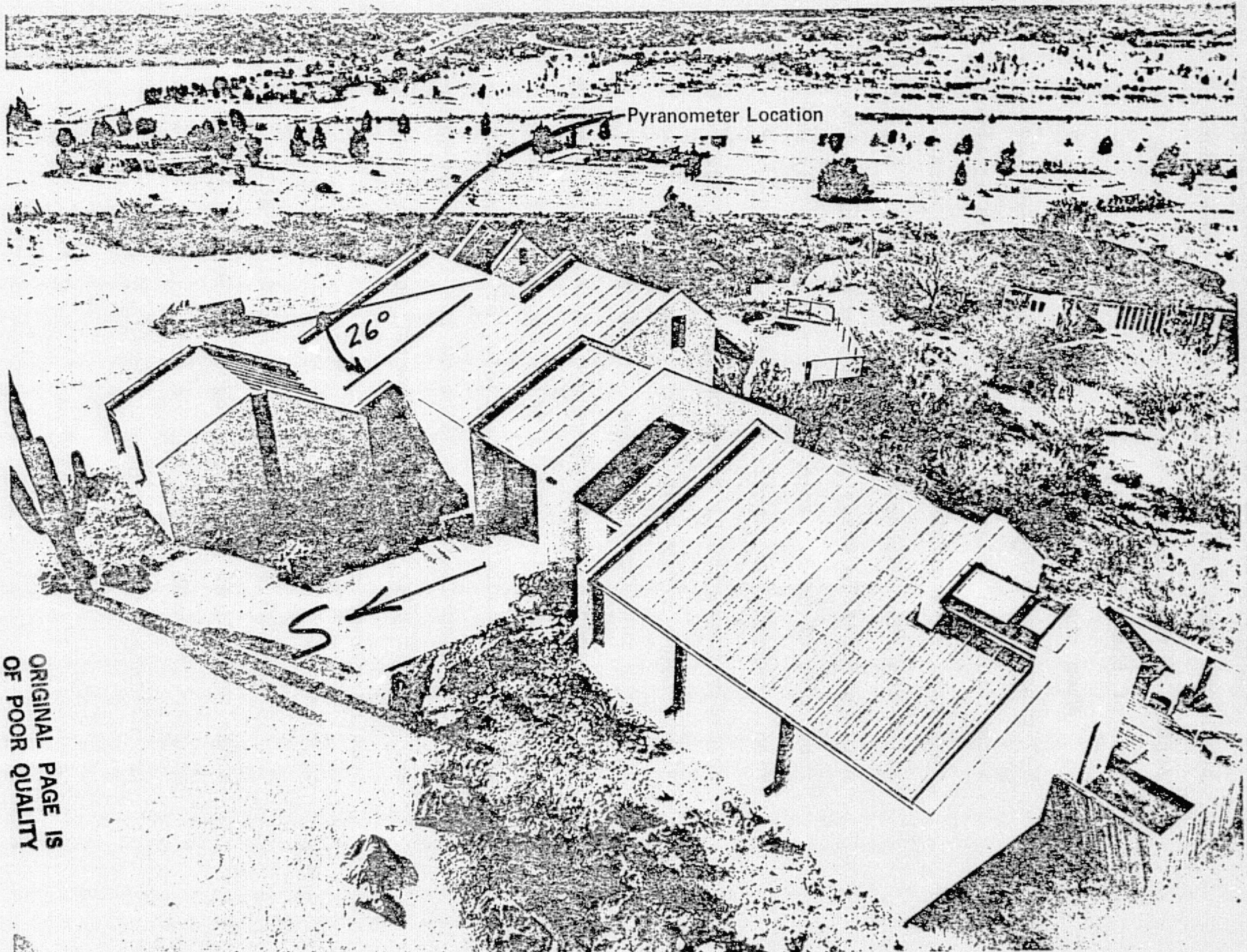

FIGURE 1. VIEW OF DECADE 80 SOLAR HOUSE SHOWING COLLECTOR ORIENTATION AND PYRANOMETER LOCATION

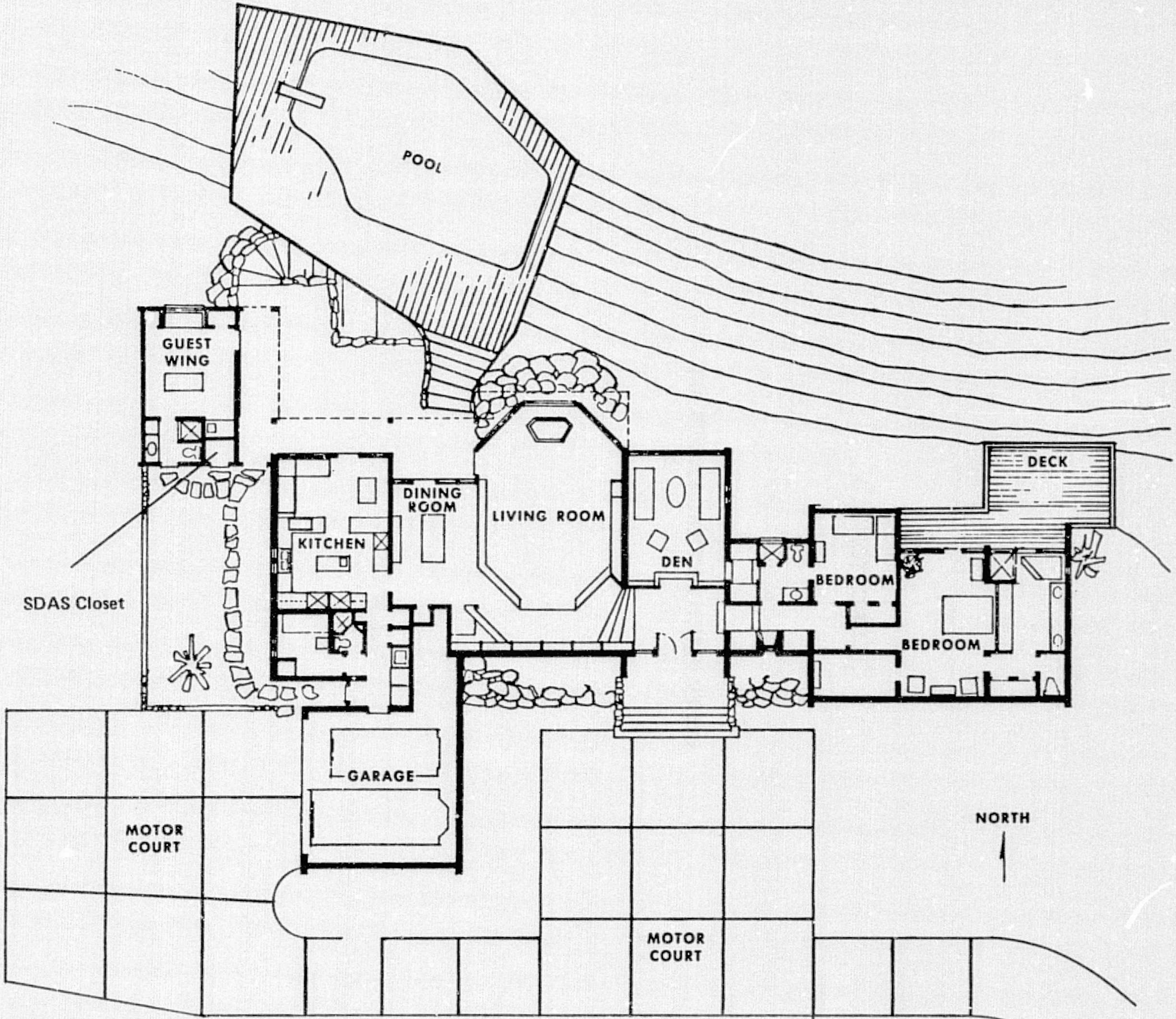

FIGURE 2. DECADE 80 SOLAR HOUSE FLOOR PLAN SHOWING LOCATION OF SDAS AND JUNCTION BOX.

SECTION 3.0

INSTRUMENTATION PROGRAM

DWG NO. IP7933729

H

REVISIONS					
CHK	ENGRG NOTICE	LTR	DESCRIPTION	DATE	APPROVED
R	66352HR	G	Replace page 1-See EN. Rev pages 23-29. Rev channel 14 changed T coefficient.	5/16/8	GM/YJ
R	66352NV	H	Rev page 17 schematic.	6/26/8	GM

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OF POOR QUALITY

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PREPARATION	TITLE INSTRUMENTATION PROGRAM DECADE 80 HOUSE		
DSGN CHK			
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DSGN. APPROVAL	SIZE A	CODE IDENT NO. 20234	DWG NO. IP7933729
22	SCALE	WT	SHEET 1 of 29

955-1685-0

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- DECADE 80 HOUSE 4/25/77

IP 7933729 REV____

INTRODUCTION

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

THE SECTIONS OF THIS DOCUMENT ARE DESCRIBED AS FOLLOWS:

1. PREAMBLE SECTION — CONTAINS DESCRIPTIONS, EXPLANATIONS, INSTRUCTIONS AND DIAGRAMS NECESSARY TO UNDERSTAND THIS DOCUMENT AND THE APPLICATION OF THE DATA COLLECTION SYSTEM TO A SPECIFIC SITE.

2. INSTRUMENTATION COMPONENTS SECTION — LISTS ALL HARDWARE ELEMENTS OF THE DATA COLLECTION EQUIPMENT NOT SUBSEQUENTLY LISTED IN THE MEASUREMENTS SECTION.

3. MEASUREMENTS SECTION — LISTS ALL MEASUREMENTS WHICH ORIGINATE IN A SOLAR HEATING AND COOLING OPERATIONAL SITE WITH APPROPRIATE INFORMATION FOR EACH MEASUREMENT.

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PREAMBLE SECTION

INSTRUMENTATION PROGRAM AND COMPONENTS LIST: DECADE 80 HOUSE — 7/28/77

IP 7933729 — RE: A

OPERATIONAL SITE IDENTIFICATION

1. SITE NAME: DECADE 80 HOUSE
2. PON: N/A
3. SITE NUMBER: 0022
4. SITE SDAS TELEPHONE NUMBER: 602-297-8092
5. SITE SDAS COMPUTER ADDRESS: 013
6. SITE ADDRESS: 7779 North Vie Piccolina
7. LOCATION: Tucson, AZ 85704
8. SYSTEM DESIGNER: Copper Development Association
9. SYSTEM TYPE: Solar Heating and Cooling
10. FLUID MEDIA: Water

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INSTRUMENTATION PROGRAM AND COMPONENTS LIST: DECADE 80 HOUSE 02/08/78

IP7933729 REV D

1. SOLAR HEATING AND COOLING INSTRUMENTATION INSTALLATION GUIDELINES, OCTOBER 1, 1977.

2. [X] SITE DATA ACQUISITION SUBSYSTEM PERFORMANCE SPECIFICATION, MAY 14, 1976, IBM NO. 7932905.
   [ ] SITE DATA ACQUISITION SUBSYSTEM MODEL II, PERFORMANCE SPECIFICATION, 7934354.
   [ ] SITE DATA ACQUISITION PERFORMANCE SPECIFICATION. ACUREX MODEL.

3. CENTRAL DATA PROCESSING SOFTWARE PERFORMANCE SPECIFICATION, JULY 28, 1976, IBM NO. 7933251.

4. THERMAL DATA REQUIREMENTS AND PERFORMANCE EVALUATION PROCEDURES FOR THE NATIONAL SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM, AUGUST, 1976 (NBSIR 76-1137).

5. JUNCTION BOX PERFORMANCE SPECIFICATION, OCTOBER 26, 1976, IBM NO. 7933446.

6. ON SITE MONITOR (OSM) OPERATION MANUAL, OCTOBER 17, 1977, IBM NO. 7934365.

INSTRUMENTATION PROGRAM AND COMPONENTS LIST: DECADE 80 HOUSE 02/08/78

IP7933729 REV D

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 NUMBER SCALE FACTOR UNITS CDPS SCALE FACTOR (A0, A1, A2, A3)	SENSOR TYPE SENSOR MANUFACT SENSOR P/N WELL P/N	NOTES SERIAL #

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	PARAMETER SEQUENCE	SEPARATOR	SITE IDENTIFIER

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 16 OF THIS DOCUMENT.

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 #

THIS COLUMN DEFINES THE SDAS CHANNEL ASSIGNED TO EACH MEASUREMENT (2 — 48). 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. # WIRES

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

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.

THIS COLUMN CONTAINS THREE DATA SETS AS DEFINED BELOW:

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

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

<u>CDPS SCALE FACTOR</u> -- 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.

<u>COLUMN 10.</u> (MULTIPLE DATA SETS)

THIS COLUMN CONTAINS FOUR DATA SETS AS DEFINED BELOW:

<u>SENSOR TYPE</u> - THE FIRST LINE OF THIS COLUMN LISTS THE TYPE (NAME) OF THE EMPLOYED SENSOR.

<u>SENSOR MANUFACT</u> - THE SECOND LINE OF THIS COLUMN LISTS THE SENSOR MANUFACTURER.

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

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

COLUMN 11. (MULTIPLE DATA SETS)

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

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

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 - INSOLATION WITHIN ± 5 BTU OF DISPLAYED VALUE.

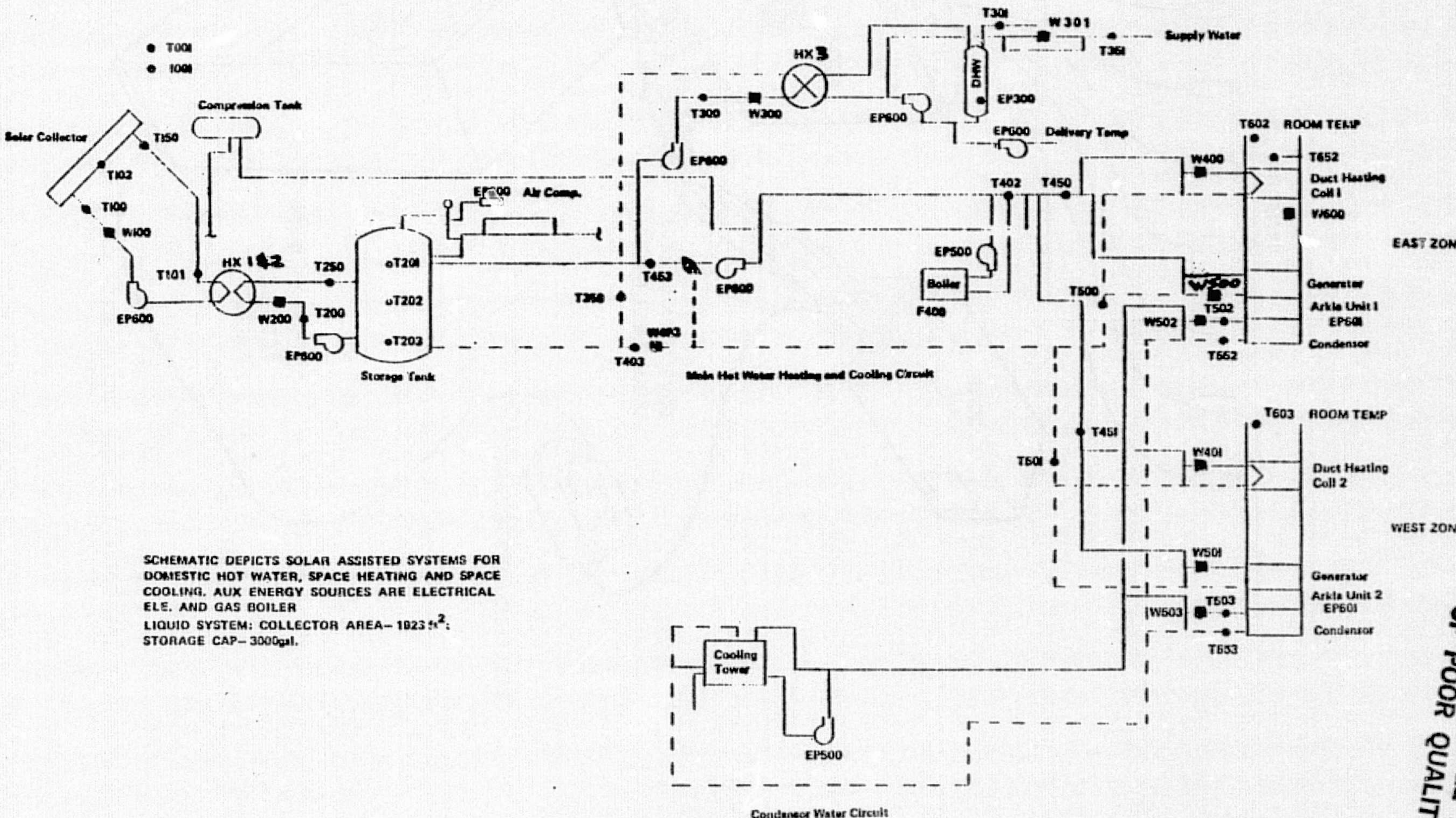
NOTE 5 - POWER MEASUREMENT RANGE VALUES & SCALE FACTORS ARE HALVED DUE TO FOUR TURNS THRU TRANSDUCERS.

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: DECADE 80 HOUSE 6/26/78

IP7933729 REV H



SCHEMATIC DEPICTS SOLAR ASSISTED SYSTEMS FOR DOMESTIC HOT WATER, SPACE HEATING AND SPACE COOLING. AUX ENERGY SOURCES ARE ELECTRICAL ELE. AND GAS BOILER

LIQUID SYSTEM: COLLECTOR AREA– 1923 ft^2; STORAGE CAP– 3000gal.

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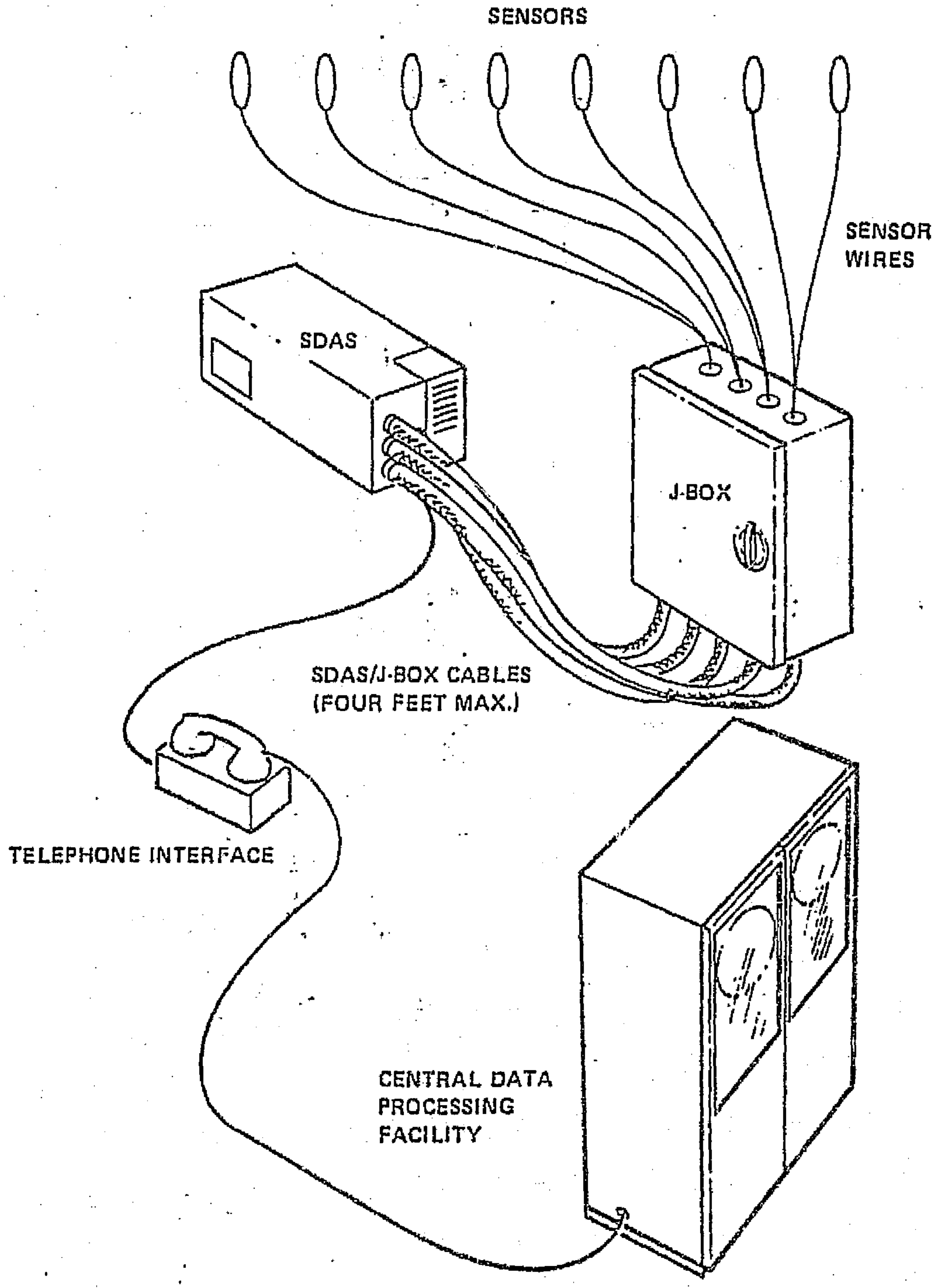

DATA COLLECTION SYSTEM

INSTRUMENTATION COMPONENTS SECTION

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- DECADE 80 HOUSE 7/28/77

IP 7933729 REV A

EQUIPMENT NAME		PART NUMBER	SERIAL NUMBER
JUNCTION BOX	#1	7933575	036
	#2		
CABLES (J-BOX TO SDAS)			
NO. 1		7933579-1	
NO. 2		7933583	
NO. 3		7933579-2	
NO. 4		7933579-3	
NO. 5		7933578	
SDAS	#1	7932922	028
	#2		

IBM DRAWING NUMBER 7933729

MEASUREMENTS SECTION

MEASUREMENT SUMMARY

PARAMETER	NUMBER
WIND DIRECTION	--
ELECTRICAL POWER	4
FLOWRATE (NATURAL GAS)	1
SOLAR FLUX	1
HUMIDITY	--
SPARE	(1)
TEMPERATURE	28
DIFFERENTIAL TEMPERATURE	--
FLOWRATE (LIQUID/AIR)	12
WIND SPEED	--
TOTAL	46

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 CPOS SCALE FACTORS (A0,A1,A2,A3)	SENSOR TYPE SENSOR MANUFACT SENSOR P/N WELL P/N	NOTES SERIAL #
T453 -0022 0202	STORAGE TO LOAD TEMP	02	-	3	30/230 DEGF 0-100 MV 50 +31.365 /+242.86	BRIDGE 7932988	DEGF/BIT +3136507E-05 +2017434E-07 +0004707E-09 +0001821E-13	PRT MINCO S53P40Z36 F203U15	(TD403)
EP300-0022 0346	DHW AUX ELECT POWER	03	A	2	0/10 KW 0-50 MV 50	STRAIGHT 7932985	KW/BIT 0. +0195312E-07	WATT XDCR OHIO SEMITRONICS PC5-29	
T350 -0022 0402	DHW/HX-3 STOR SIDE RET TMP	04	-	3	30/230 DEGF 0-100 MV 50 +31.909 /+242.14	BRIDGE 7932988	DEGF/BIT +3190960E-05 +2005754E-07 +0004639E-09 +0001761E-13	PRT MINCO S53P40Z36 F203U15	(TD300)
EP600-0022 NOTE 2	SYSTEM OPER PWR P1-P5&P9	05	A	2	0/5 KW 0-100 MV 50	STRAIGHT 7932985	KW/BIT 0. .0048828	WATT XDCR OHIO SEMITRONICS PC5-52	NOTE 5
T351 -0022 0602	DHW MAKEUP TEMP	06	-	3	30/230 DEGF 0-100 MV 50 +31.458 /+241.72	BRIDGE 7932988	DEGF/BIT +3145888E-05 +2006045E-07 +0004638E-09 +0001802E-13	PRT MINCO S53P40Z36 F203U15	(TD301)
I001 -0022 0722	TOTAL SOLAR RADIATION	07	A	2	0/355.19 BTU/FT2-HR 0-12 MV 50	CAPACITOR 7934363	B/F2-H/BIT 0. 2.8905765	PYRONOM EPPLEY PSP	15389F3
T403 -0022 0802	LOAD TO STORAGE RETURN TEMP	08	-	3	30/230 DEGF 0-100 MV 50 +32.226 /+243.83	BRIDGE 7932988	1621 DEGF/BIT +3222644E-05 +2018420E-07 +0004706E-09 +0001816E-13	PRT MINCO S57P40Z36 F203U15	
F400 -0022 NOTE 2	AUX BOILER NAT GAS FLOW	09	-	2	0/1000 FT3 0-5 V 1	STRAIGHT 7932985 +5 VDC	FT3/BIT 0. +9775170E-07	GAS METER AMERICAN METER AL-250 H-NGF	

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REPORT BY CHANNEL ASSIGNMENT

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LINE	MEAS NUMBER / OSN 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 #
1	T150 -0022	COLL-ARRAY	10	-	3	30/450	DEGF	BRIDGE		PRT	(TD100)
2		OUTLET TEMP				0-100	MV	7932987	DEGF/BIT	MINCO	
3	1003					50			+3272356E-05	S53P40736	
4						+32,724 /+465.77			+4055294E-07	F203U15	
5									+0001604E-09		
6									+0001315E-12		
7	EP500-0022	P6,P10,COOLING	11	A	2	0/3	KW	STRAIGHT		WATT XDCR	
8		TOWER FANEPPW				0-100	MV	7932985	KW/BIT	OHIO SEMITRONICS	
9	1142					50			0.	PC5-22	
10									+0029325E-07		
11	T101 -0022	COLLECTOR/HX-1	12	-	3	30/230	DEGF	BRIDGE		PRT	
12		INLET TEMP				0-100	MV	7932988	DEGF/BIT	MINCO	
13	1202					50			+3199988E-05	S53P40736	
14						+32.000 /+236.03			+1947871E-07	F203U15	
15									+0004388E-09		
16									+0001609E-13		
17	EP601-0022	EAST&WEST ARKLA	13	A	2	0/1.667	KW	STRAIGHT		WATT XDCR	NOTE 6
18		BLOWECTRL PW				0-50	MV	7932985	KW/BIT	OHIO SEMITRONICS	
19	NOTE 2					50			0.	PC5-28	
20									.0032617		
21	T300 -0022*	STORAGE WATER	14	-	3	30/230	DEGF	BRIDGE	1493	PRT	
22		TEMP TO HX3				0-100	MV	7932988	DEGF/BIT	MINCO	
23	1402					50			+3345099E-05	S53P40736	
24						+33.451 /+245.14			+2019327E-07	F203U15	
25									+0004699E-09		
26									+0001826E-13		
27	W600 -0022	EAST DUCT AIR	15	-	2	0/1250	FPM	STRAIGHT		ANEMOMETER	. INDIC STP
28		FLOW RATE				0-5	V	7932985	FPM/BIT	SIERRA	
29	1581					1		125 VAC	0.	430-2	
30									+1442508E-07		
31									+0003687E-07		
32									+0006569E-10		
33	T402 -0022	AUX BOILER RTN	16	-	3	30/230	DEGF	BRIDGE		PRT	
34		INLET TEMP				0-100	MV	7932988	DEGF/BIT	MINCO	
35	1602					50			+3199988E-05	S53P40736	
36						+32.000 /+236.03			+1947871E-07	F203U15	
37									+0004398E-09		
38									+0001609E-13		

REPORT BY CHANNEL ASSIGNMENT

MEAS NUMBER DSM 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 #
W100 -0022 1759	COLLECTOR FLOW RATE	17	-	2	0/30.61 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +3025000E-06 SQCT	FLOW METER RAMAPO MKV-1-1/2J07	S/N4283
T500 -0022 1802	EAST FAN COIL/ GEN WTR OUTL	18	-	3	30/230 DEGF 0-100 MV 50 +31.366 /+242.30	BRIDGE 7932988	DEGF/BIT +3136665E-05 +2012212E-07 +0004674E-09 +0001823E-13	PRT MINCO S53P40Z36 F203U15	(TD450)
W200 -0022 1959	COLLECTOR-HX TO STOR FLW RTE	19	-	2	0/30.53 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +3017089E-06 SQCT	FLOW METER RAMAPO MKV-1-1/2J07	S/N4284
T501 -0022 2002	WEST FAN COIL/ GEN WTR OUTL	20	-	3	30/230 DEGF 0-100 MV 50 +31.863 /+244.10	BRIDGE 7932988	DEGF/BIT +3186329E-05 +2024293E-07 +0004746E-09 +0001816E-13	PRT MINCO S53P40Z36 F203U15	(TD451)
W400 -0022 2153	EAST FAN COIL HTR FLOW RATE	21	-	2	0/6.96 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +6879149E-07 SQCT	FLOW METER RAMAPO MKV-1-J07	S/N4233
T552 -0022 2202	EAST ARKLA COND OUTLET TEMP	22	-	3	30/230 DEGF 0-100 MV 50 +32.452 /+243.54	BRIDGE 7932988	DEGF/BIT +3245196E-05 +2013727E-07 +0004676E-09 +0001803E-13	PRT MINCO S53P40Z36 F203U15	(TD502)
SP002-0022	SPARE	23	-	2	N/A N/A 50	SHORT 7932938	N/A N/A	N/A N/A	
T553 -0022 2402	WEST ARKLA COND OUTLET TEMP	24	-	3	30/230 DEGF 0-100 MV 50 +32.226 /+243.57	BRIDGE 7932988	DEGF/BIT +3222617E-05 +2016094E-07 +0004693E-09 +0001807E-13	PRT MINCO S53P40Z36 F203U15	(TD503)

INSTRUMENTATION PROGRAM AND COMPONENTS LIST --- DECADE 80 HOUSE IP7933729 05/16/78

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REPORT BY CHANNEL ASSIGNMENT

LINE	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 EPDS SCALE FACTORS (A0,A1,A2,A3)	SENSOR TYPE SENSOR MANUFACT SENSOR P/N WELL P/N	NOTES SERIAL #
1 2 3 4	W401 -0022 2553	WEST FAN COIL WTR FLOW RATE	25	-	2	0/6.98 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +6897913E-07 SQCT	FLOW METER RAMAPO MKV-1-J07	S/N4234
5 6 7 8 9 10	T652 -0022 2601	EAST DUCT H C AIR OUTL TEMP	26	-	3	30/160 DEGF 0-100 MV 50 +32.680 /+165.85	BRIDGE 7932990	DEGF/BIT +3268000E-05 +1278545E-07 +0002217E-09 +0005692E-14	PRT MINCO S53P85Z36 F132	(TD600)
11 12 13 14 15 16	T102 -0022 2703	COLLECT SURFACE TEMP	27	-	2	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 S34A	PINS 4&7
17 18 19 20 21 22	T001 -0022 2800	OUTDOOR DRY BULB TEMP	28	-	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 S53P40Z36 TS4	
23 24 25 26	W500 -0022 2955	EAST ARKLA GEN WTR FLOW RATE	29	-	2	0/12.09 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +1194780E-06 SQCT	FLOW METER RAMAPO MKV-1-J07	S/N4235
27 28 29 30 31 32	T100 -0022 3002	COLLECTOR INLET TEMP	30	-	3	30/230 DEGF 0-100 MV 50 +31.637 /+243.14	BRIDGE 7932988	DEGF/BIT +3163712E-05 +2017480E-07 +0004705E-09 +0001811E-13	PRT MINCO S57P40Z36 F203U15	
33 34 35 36	W301 -0022 NOTE 2	DHW FLOW TO LOAD	31	-	2	0/190 GAL 0-5 V 1	STRAIGHT 7932985 115 VAC	GAL/BIT .0977517	FLOWMETER HERSEY AMERICAN 440-3/4-3/4M	
37 38 39 40 41 42	T602 -0022 3201	EAST ZONE LIVE SPACE TEMP	32	-	3	30/160 DEGF 0-100 MV 50 +32.044 /+164.78	BRIDGE 7932990	DEGF/BIT +3204475E-05 +1274464E-07 +0002204E-09 +0005598E-14	PRT MINCO S53P40Z36	

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 #
W403 -0022 NOTE 2	STORAGE TO H/C SYSTEM FLOW	33	-	2	0/23.22 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +2294691E-06 SOCT	FLOW METER RAMAPO MKV-1-1/2J07	S/N4285
T603 -0022 3401	WEST ZONE LIVE SPACE TEMP	34	-	3	30/160 DEGF 0-100 MV 50 +31.774 /+160.92	BRIDGE 7932990	DEGF/BIT +3177459E-05 +1240522E-07 +0002089E-09 +0005081E-14	PRT MINCO S53P40Z36	
W300 -0022 3558	STORAGE TO DHW FLOW RATE	35	-	2	0/24.44 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +2415256E-06 SOCT	FLOW METER RAMAPO MKV-1-J07	S/N4231
T200 -0022 3602	STORAGE TO HX-2 TEMP	36	-	3	30/230 DEGF 0-100 MV 50 +32.226 /+239.21	BRIDGE 7932988	1424 DEGF/BIT +3222662E-05 +1975429E-07 +0004505E-09 +0001733E-13	PRT MINCO S57P40Z36 F203U15	
W501 -0022 3755	WEST ARKLA GEN HTR FLOW RATE	37	-	2	0/11.78 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +1164145E-06 SOCT	FLOW METER RAMAPO MKV-1-J07	S/N4236
T201 -0022 3802	STORAGE TANK TEMP - TOP	38	-	3	30/230 DEGF 0-100 MV 50 +31.954 /+237.39	BRIDGE 7932988	DEGF/BIT +3195472E-05 +1961132E-07 +0004433E-09 +0001656E-13	PRT MINCO S53P180Z36 F203U154	
W502 -0022 3955	EAST ARKLA COND FLOW RATE	39	-	2	0/11.76 GPM 0-10 MV 50	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +1162168E-06 SOCT	FLOW METER RAMAPO MKV-1-J07	S/N4237
T202 -0022 4002	STORAGE TANK TEMP - MIDDLE	40	-	3	30/230 DEGF 0-100 MV 50 +31.818 /+237.96	BRIDGE 7932988	DEGF/BIT +3181883E-05 +1967637E-07 +0004470E-09 +0001667E-13	PRT MINCO S53P180Z36 F203U154	

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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 #
W503 -0022 4155	WEST ARKLA COND FLOW RATE	41	-	2	0/11.88 0-10 50	GPM MV	STRAIGHT 7932985 +5 VDC	GPM/BIT 0. +1174028E-06 SOCT	FLOW METER RAMAPO 4KV-1-J07	S/N4238
T203 -0022 4202	STORAGE TANK TEMP - BOTTOM	42	-	3	30/230 0-100 50 +31.728 /+237.90	DEGF MV	BRIDGE 7932988	DEGF/BIT +3172820E-05 +1968649E-07 +0004474E-09 +0001694E-13	PRT MINCO S53P180Z36 F203U154	
T250 -0022 4302	STOR INLET TEMP FRM HX-1	43	-	3	30/230 0-100 50 +32.226 /+239.15	DEGF MV	BRIDGE 7932988	DEGF/BIT +3222644E-05 +1974918E-07 +0004501E-09 +0001737E-13	PRT MINCO S57P40Z36 F203U15	[TD200]
T301 -0022 4402	DELIVERED DHW TEMP	44	-	3	30/230 0-100 50 +32.409 /+240.22	DEGF MV	BRIDGE 7932988	DEGF/BIT +3240980E-05 +1993034E-07 +0004551E-09 +0001725E-13	PRT MINCO S57P40Z36 F203U15	
T450 -0022 4502	EAST FAN COIL/ GEN INLET TMP	45	-	3	30/230 0-100 50 +32.226 /+238.73	DEGF MV	BRIDGE 7932988	1437 DEGF/BIT +3222616E-05 +1970985E-07 +0004487E-09 +0001675E-13	PRT MINCO S57P40Z36 F203U15	
T451 -0022 4602	WEST FAN COIL/ GEN INLET TMP	46	-	3	30/230 0-100 50 +32.226 /+238.71	DEGF MV	BRIDGE 7932988	1429 DEGF/BIT +3222600E-05 +1970860E-07 +0004484E-09 +0001685E-13	PRT MINCO S57P40Z36 F203U15	
T502 -0022 4701	EAST ARKLA COND INLET TEMP	47	-	3	30/160 0-100 50 +32.453 /+162.57	DEGF MV	BRIDGE 7932990	DEGF/BIT +3245323E-05 +1249696E-07 +0002123E-09 +0005057E-14	PRT MINCO S57P40Z36 F203U15	

REPORT BY CHANNEL ASSIGNMENT

LINE	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 #
1	7503 -0022	WEST ARKLA COND	49	-	3	30/160 DEGF	BRIDGE		PRT	
2		INLET TEMP				0-100 MV	7932990	DEGF/BIT	MINCO	
3	4801					50		+3227036E-05	S57P40Z36	
4						+32.270 /+161.68		+1243055E-07	F203U15	
5								+0002101E-09		
6								+0004817E-14		

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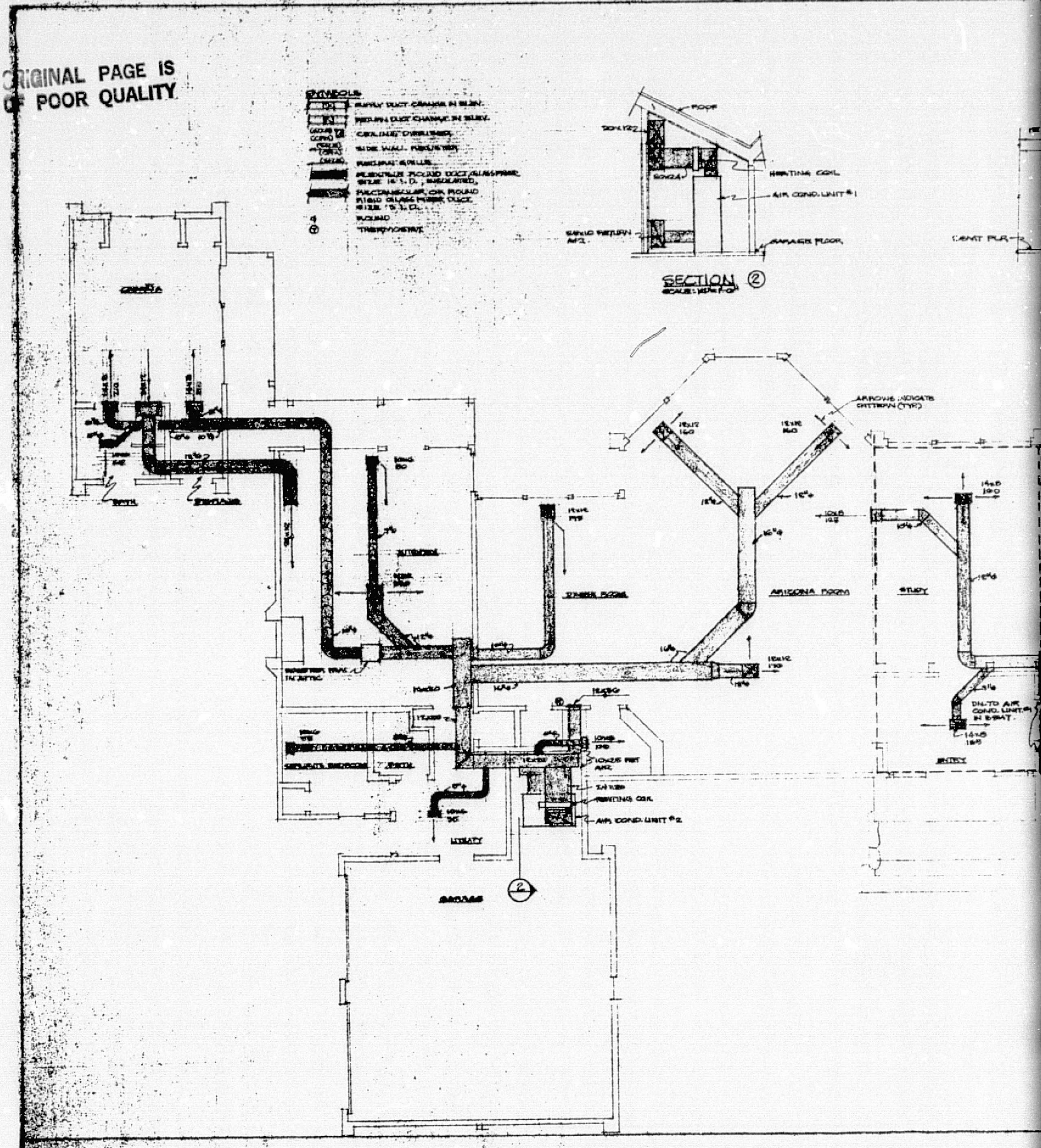
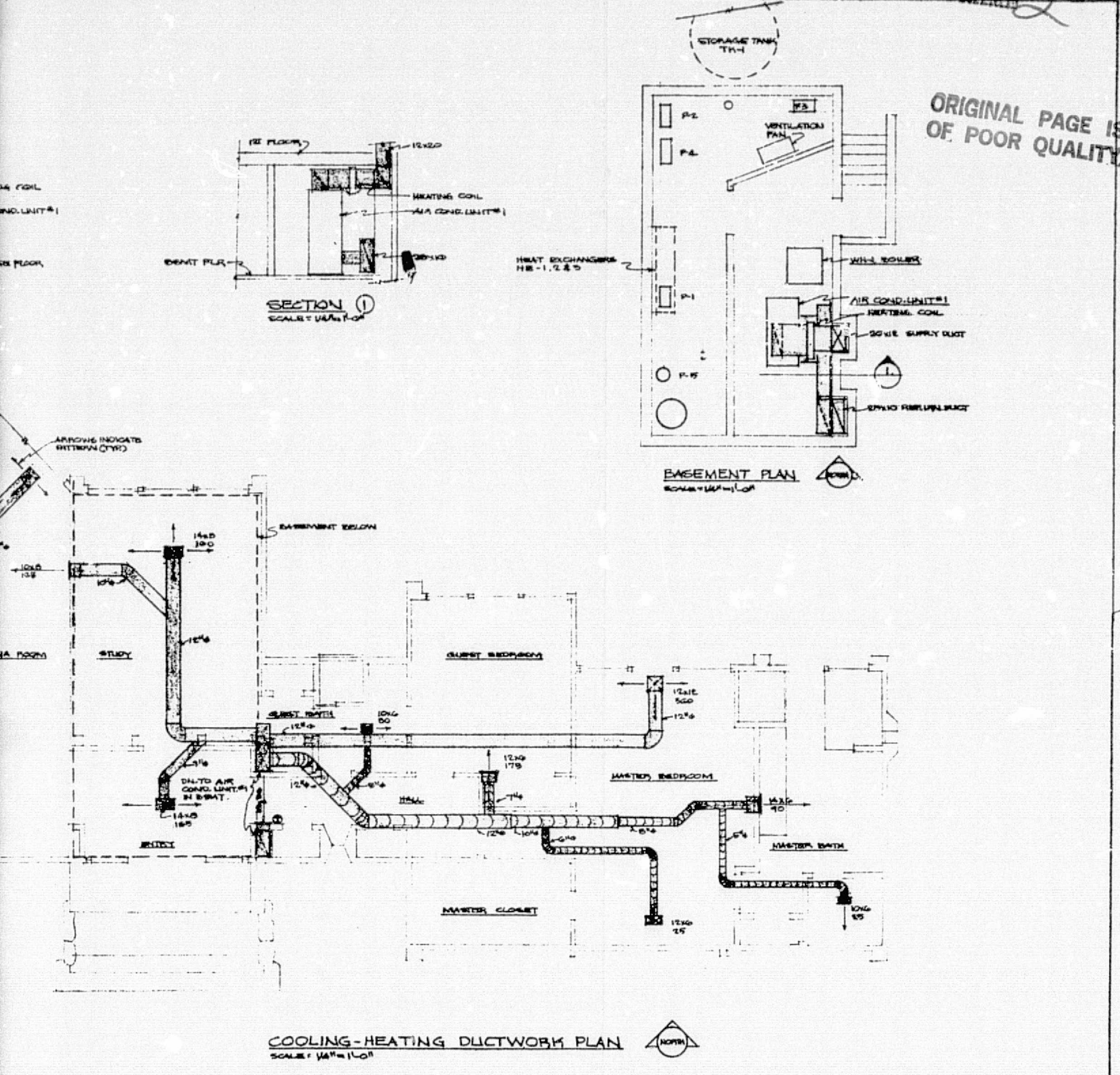


DECADE 80 SOLAR HOUSE

A-1



JAN. 24, 1977

HOUSE

A-1

TUCSON, ARIZONA

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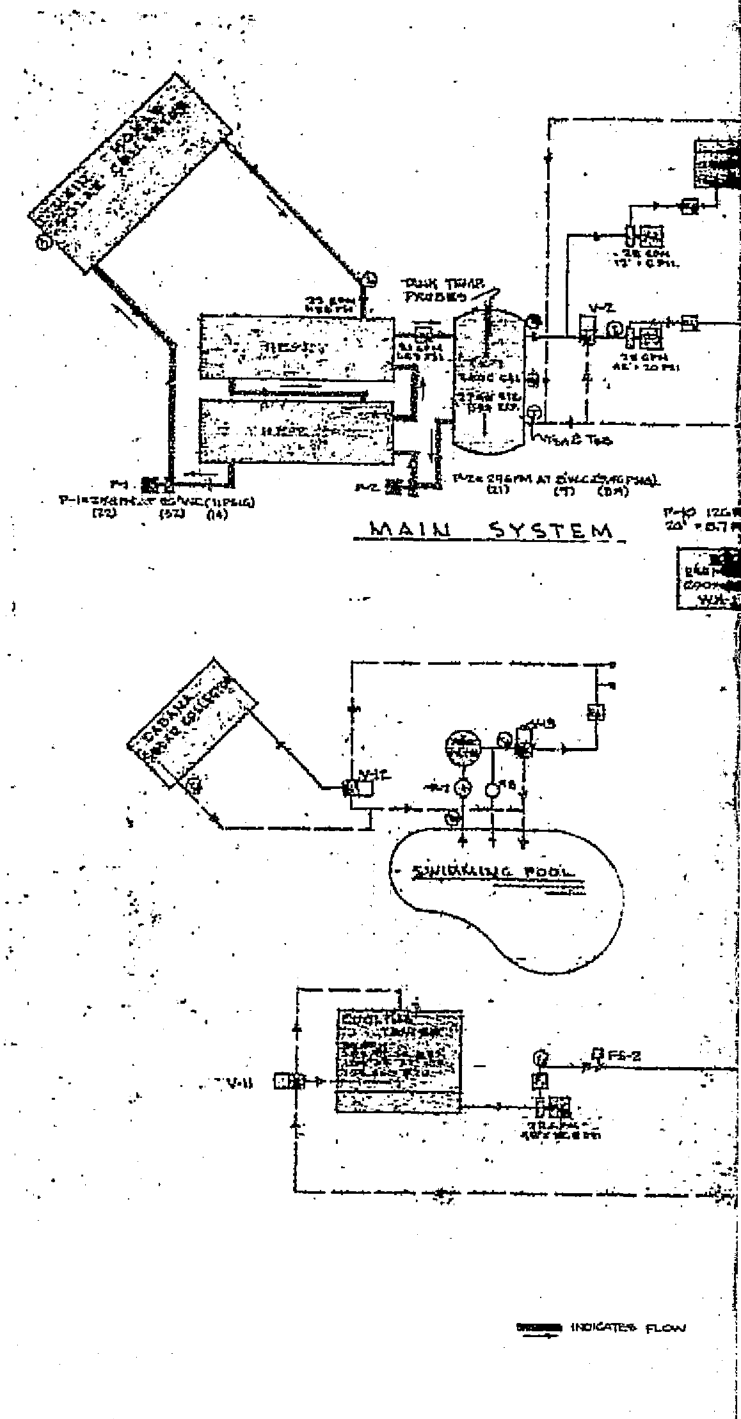

DECADE 80 SOLAR HOUSE

TUCSON, ARIZONA

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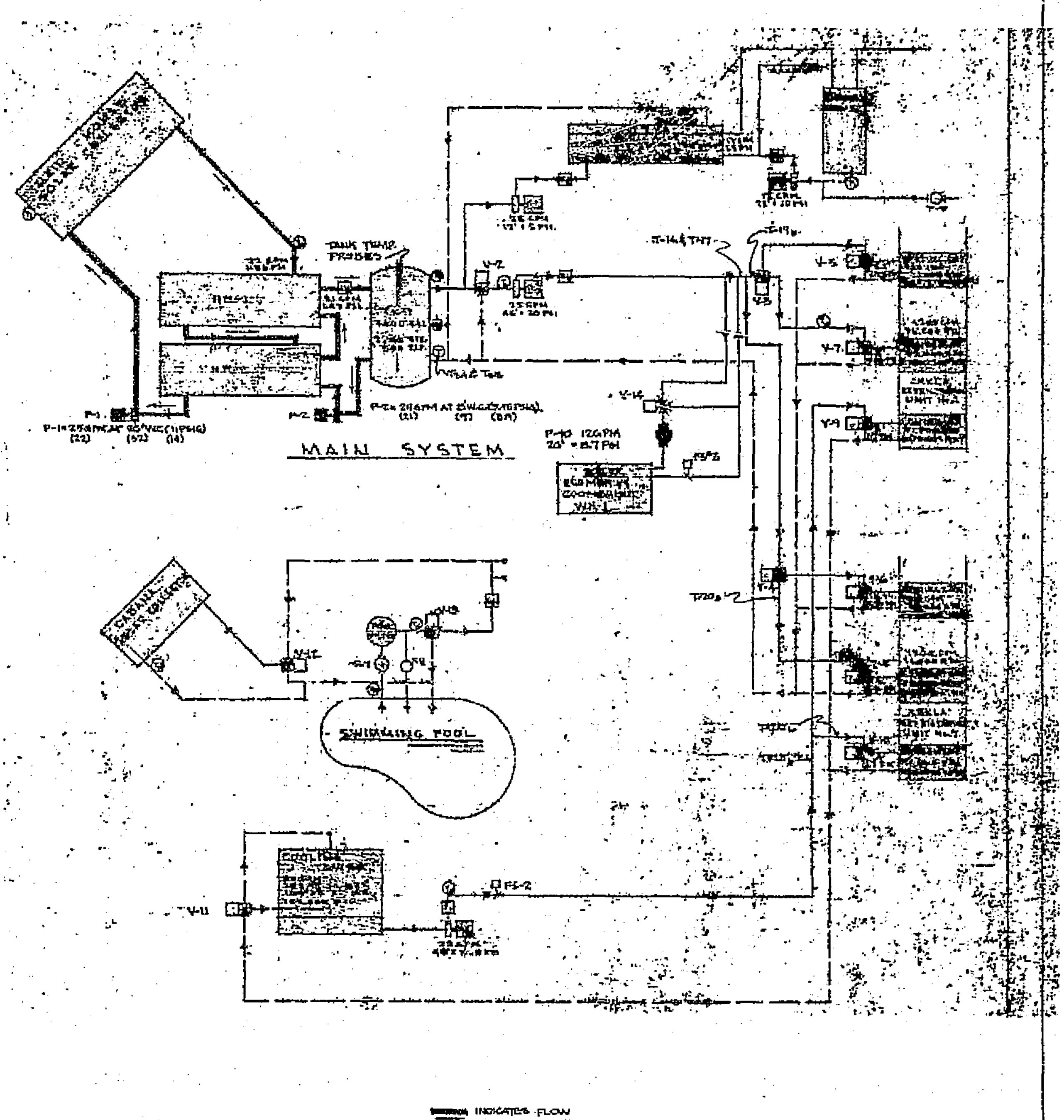


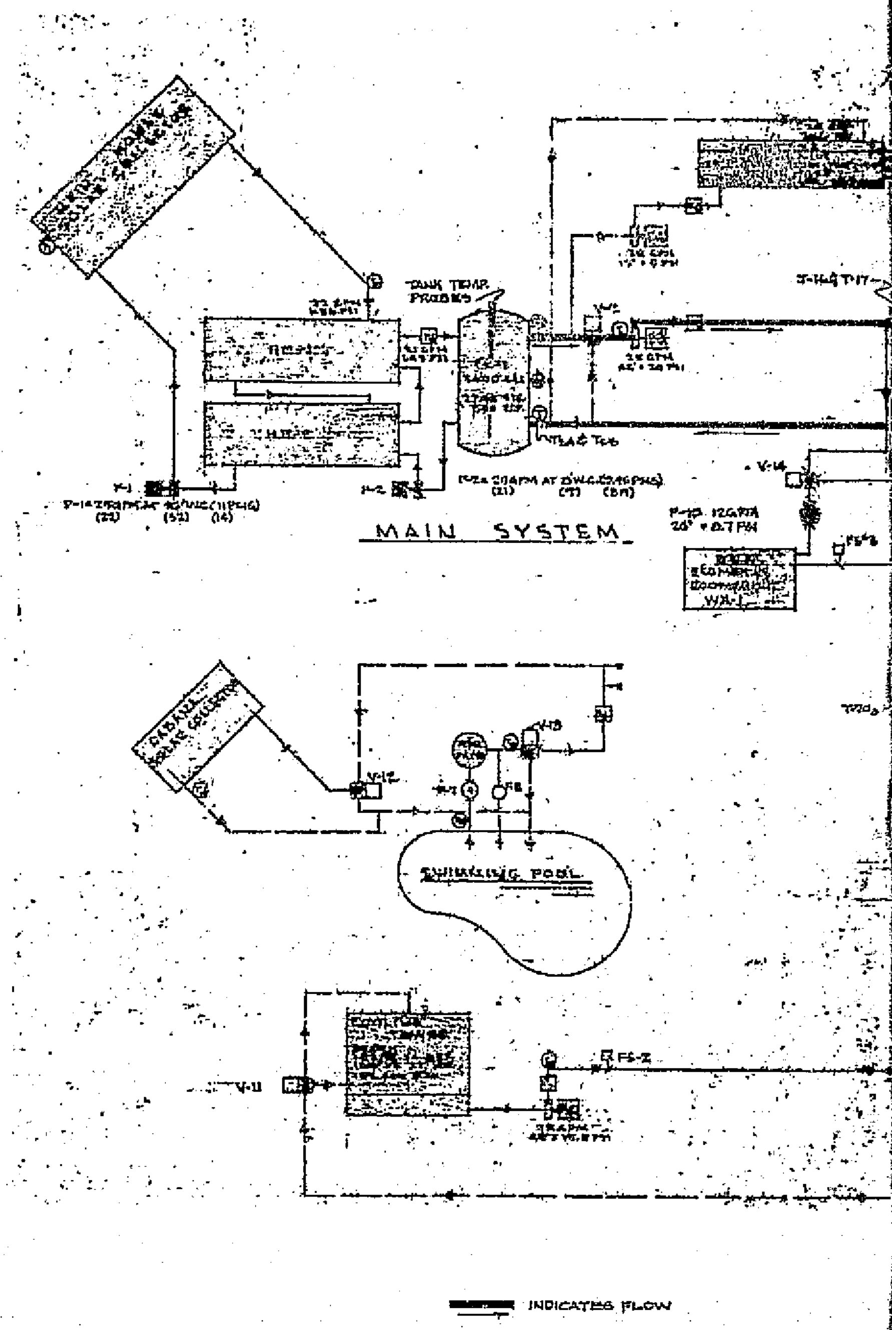
JAN. 12, 1977

HOUSE

TUCSON, ARIZONA

HEAT TRANSFER FLUID FLOW
ENERGY COLLECTION

B-1



DECADE 80 SOLAR HOUSE

TUCSON, ARIZONA

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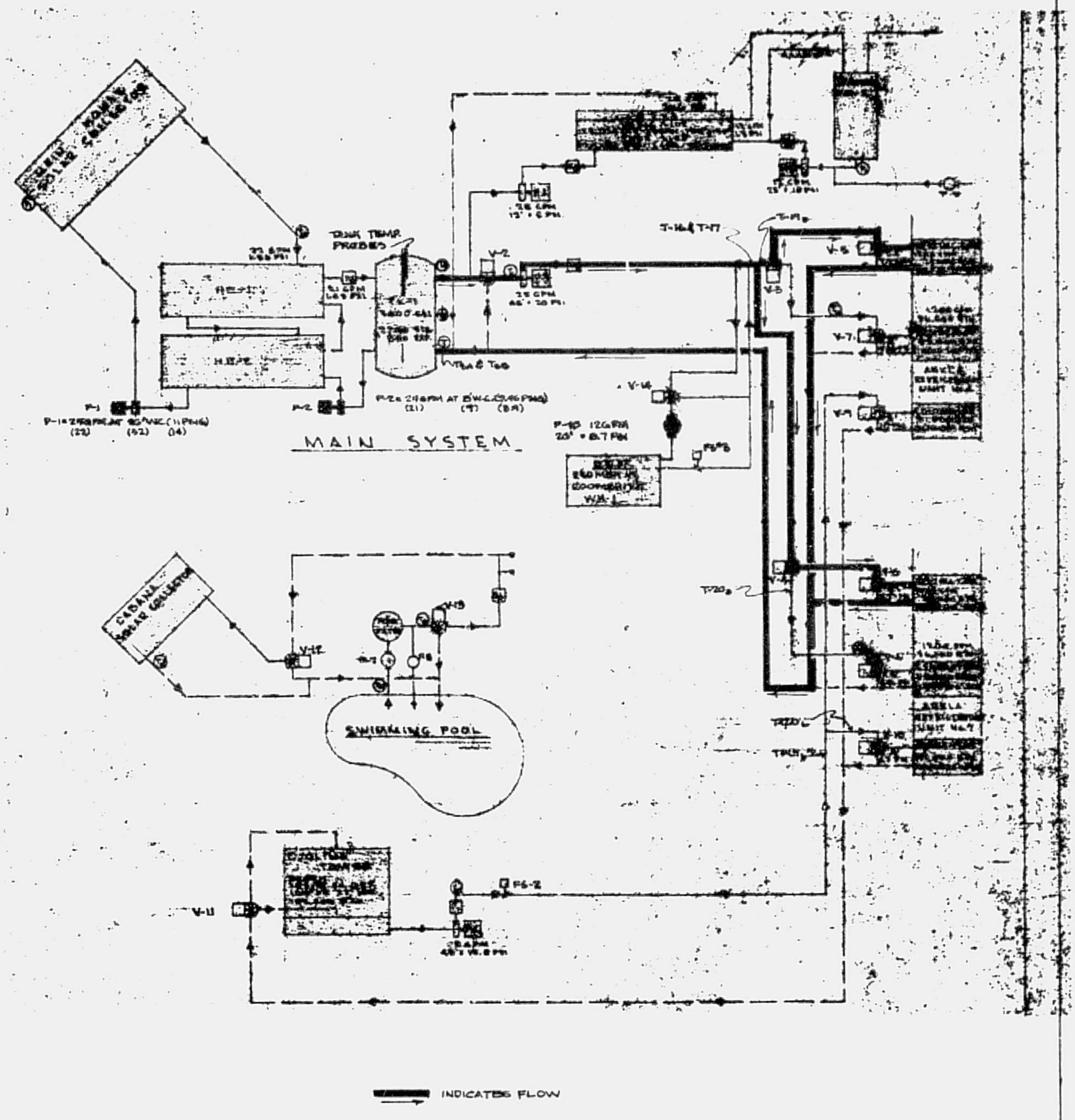

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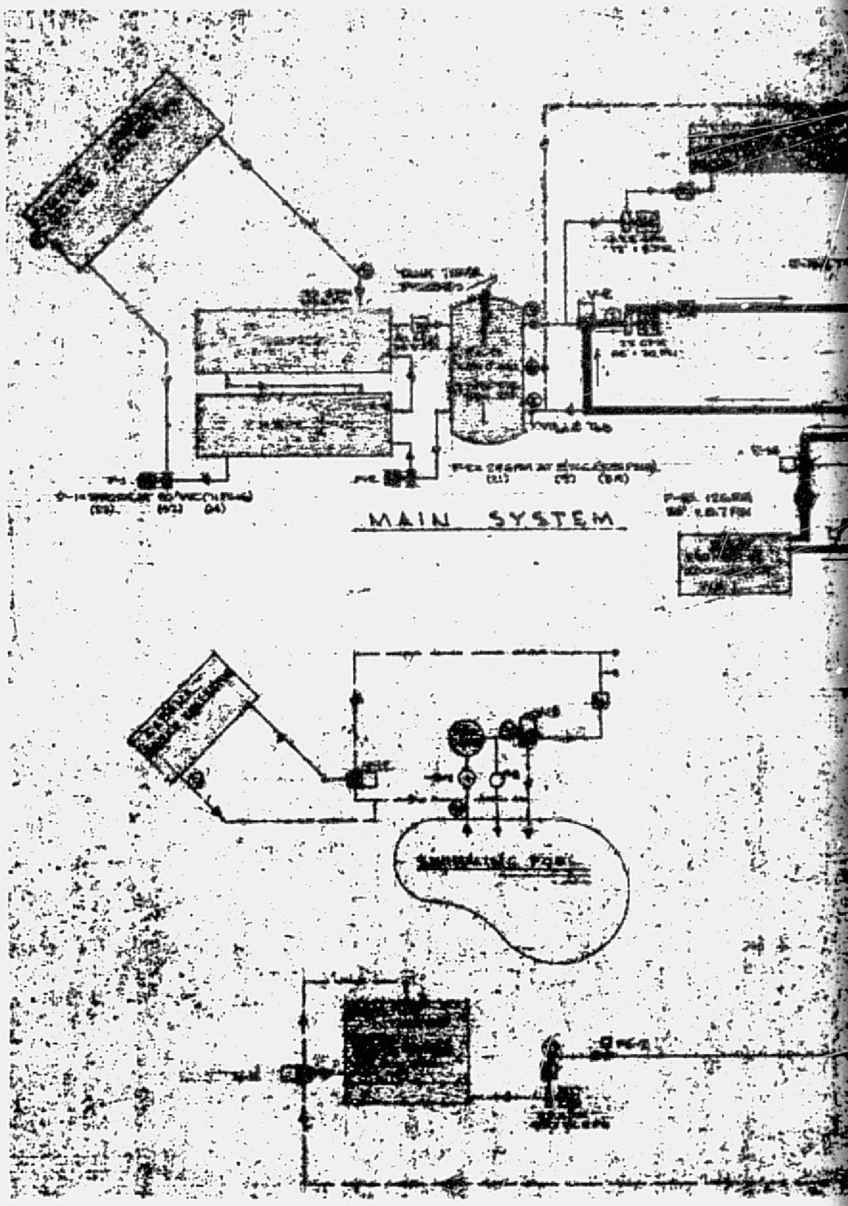
TUCSON, ARIZONA

HEAT TRANSFER FLUID FLOW
SPACE HEATING FROM STORAGE



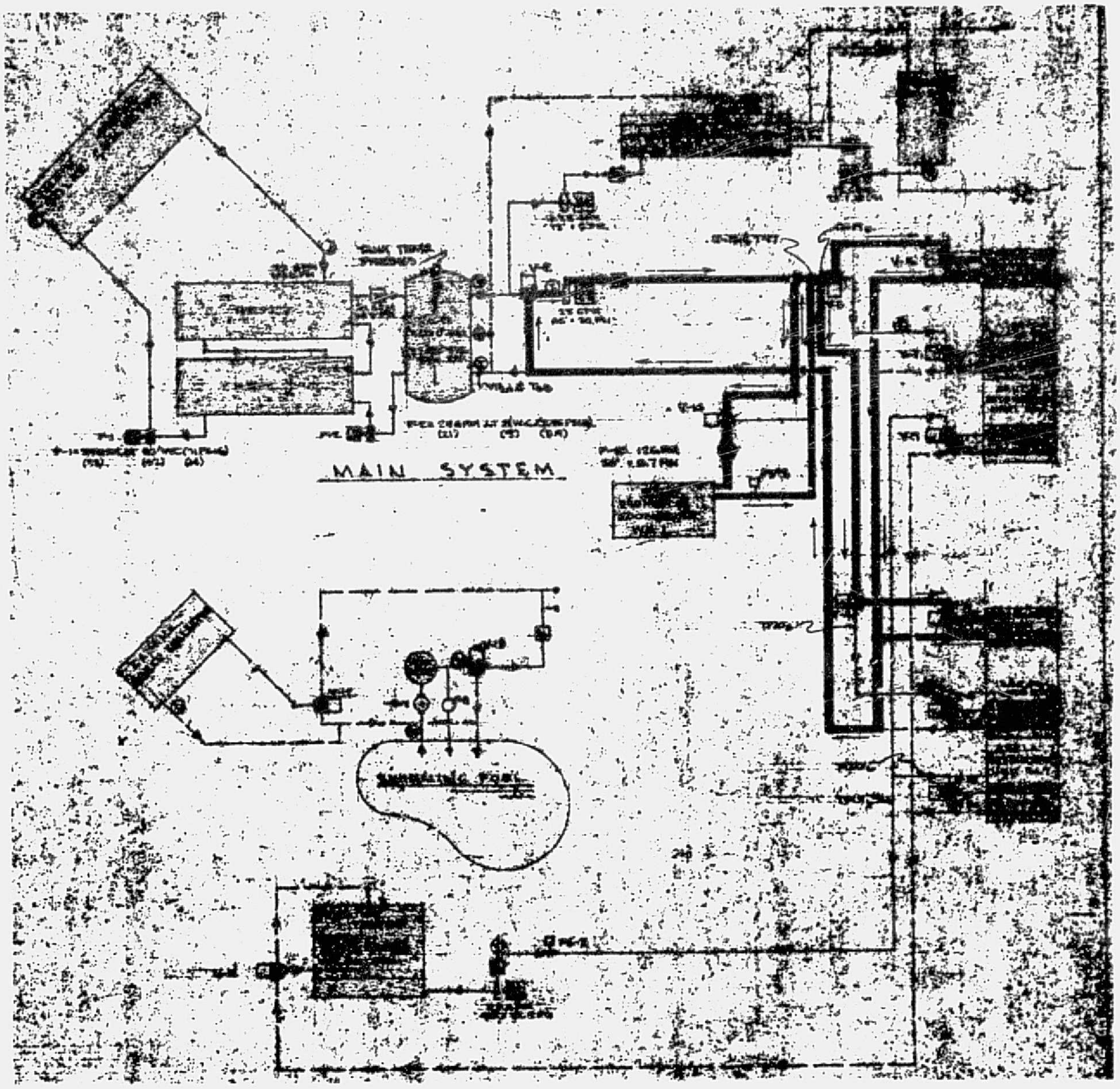
INDICATES FLOW

DECADE 80 SOLAR HOUSE

TUCSON, ARIZONA

HEA
SPA

FOLDOUT FRAME 2



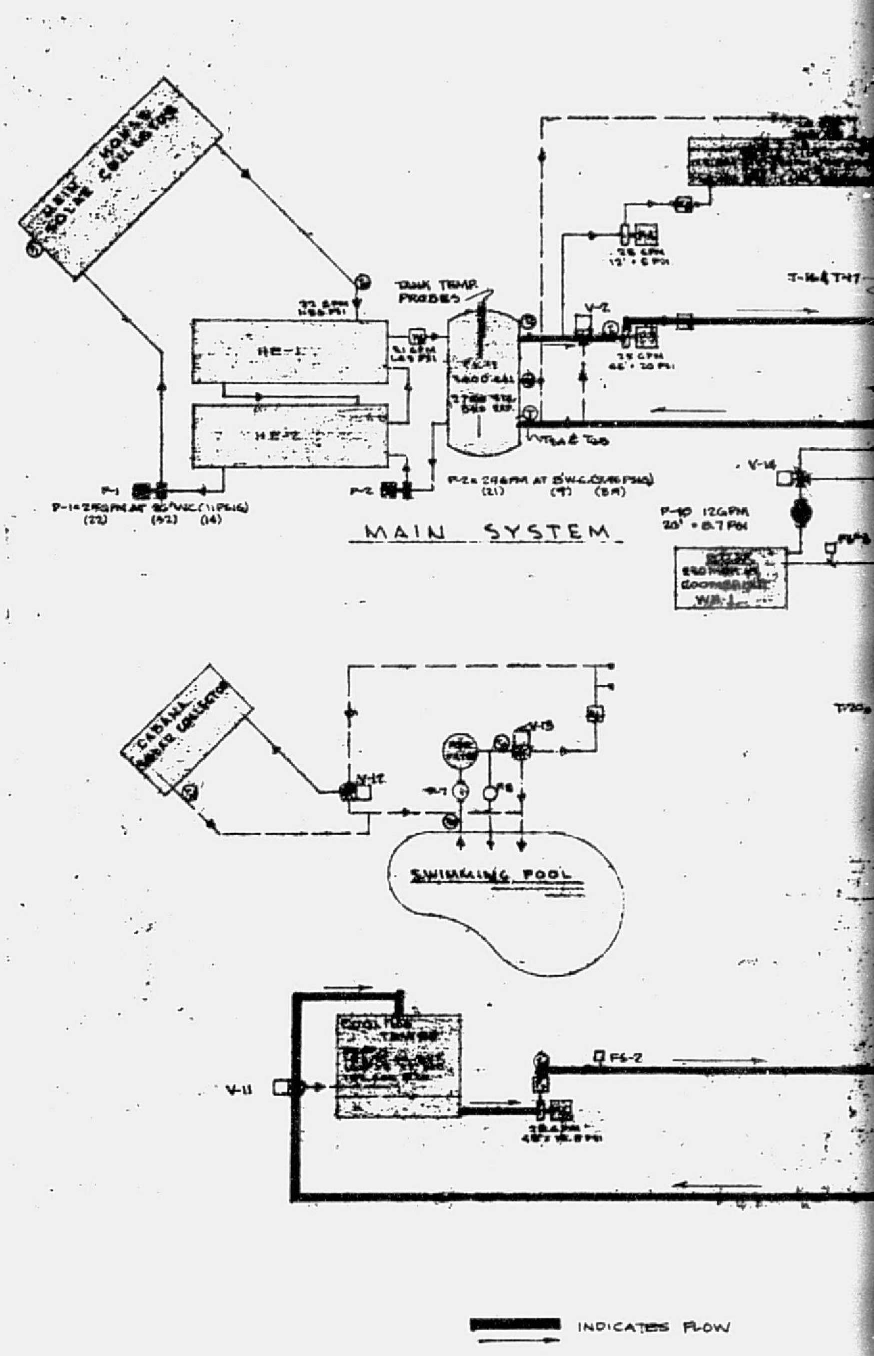
INDICATES FLOW

JAN 12, 1977

HEAT TRANSFER FLUID FLOW
SPACE HEATING FROM AUXILIARY

USE

TUCSON, ARIZONA



DECADE 80 SOLAR HOUSE

TUCSON, ARIZONA

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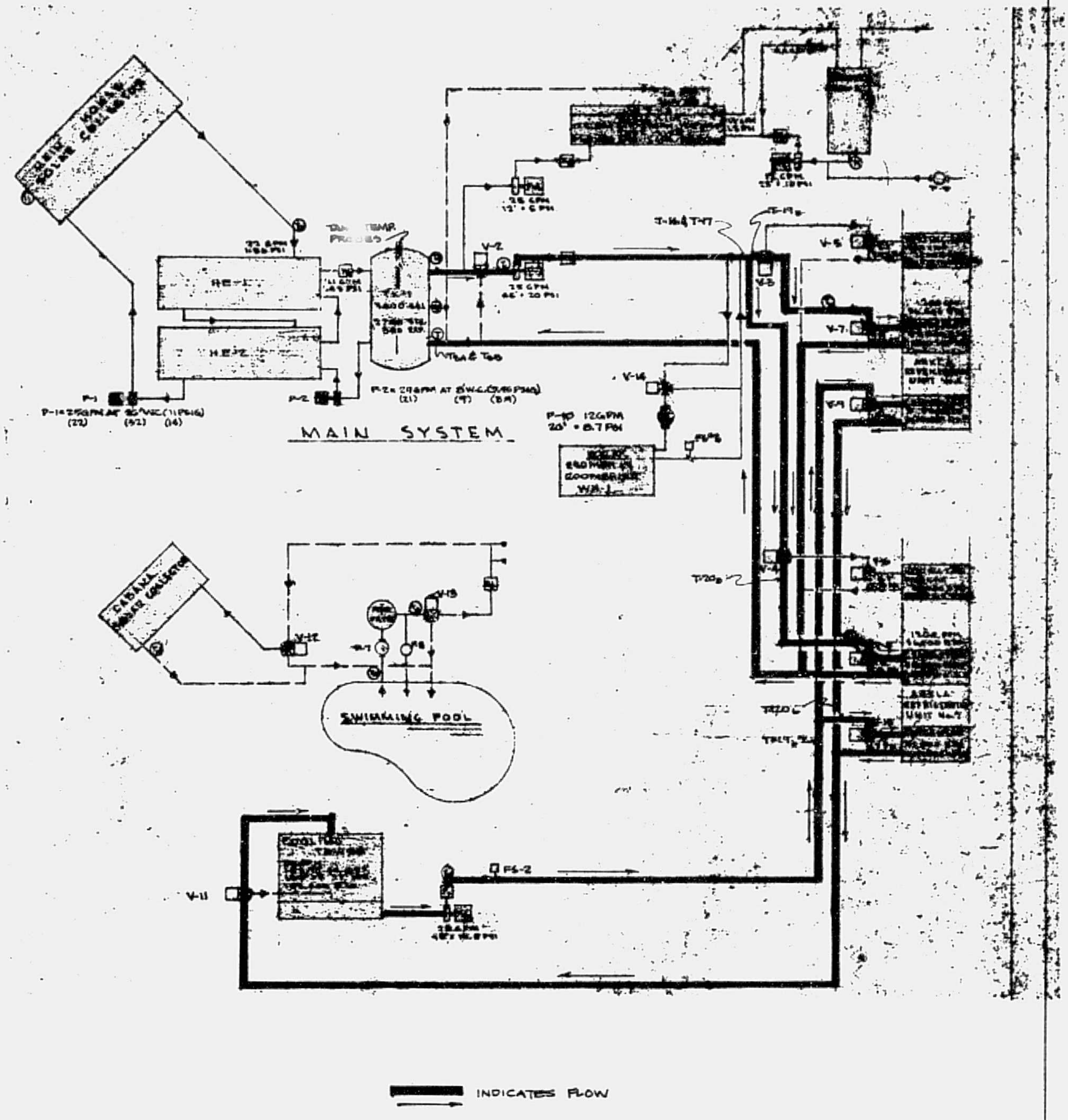
COOLI

FOLDOUT FRAME 2



JAN. 12, 1977

TUCSON, ARIZONA

HEAT TRANSFER FLUID FLOW
COOLING FROM STORAGE

FOLDOUT FRAME

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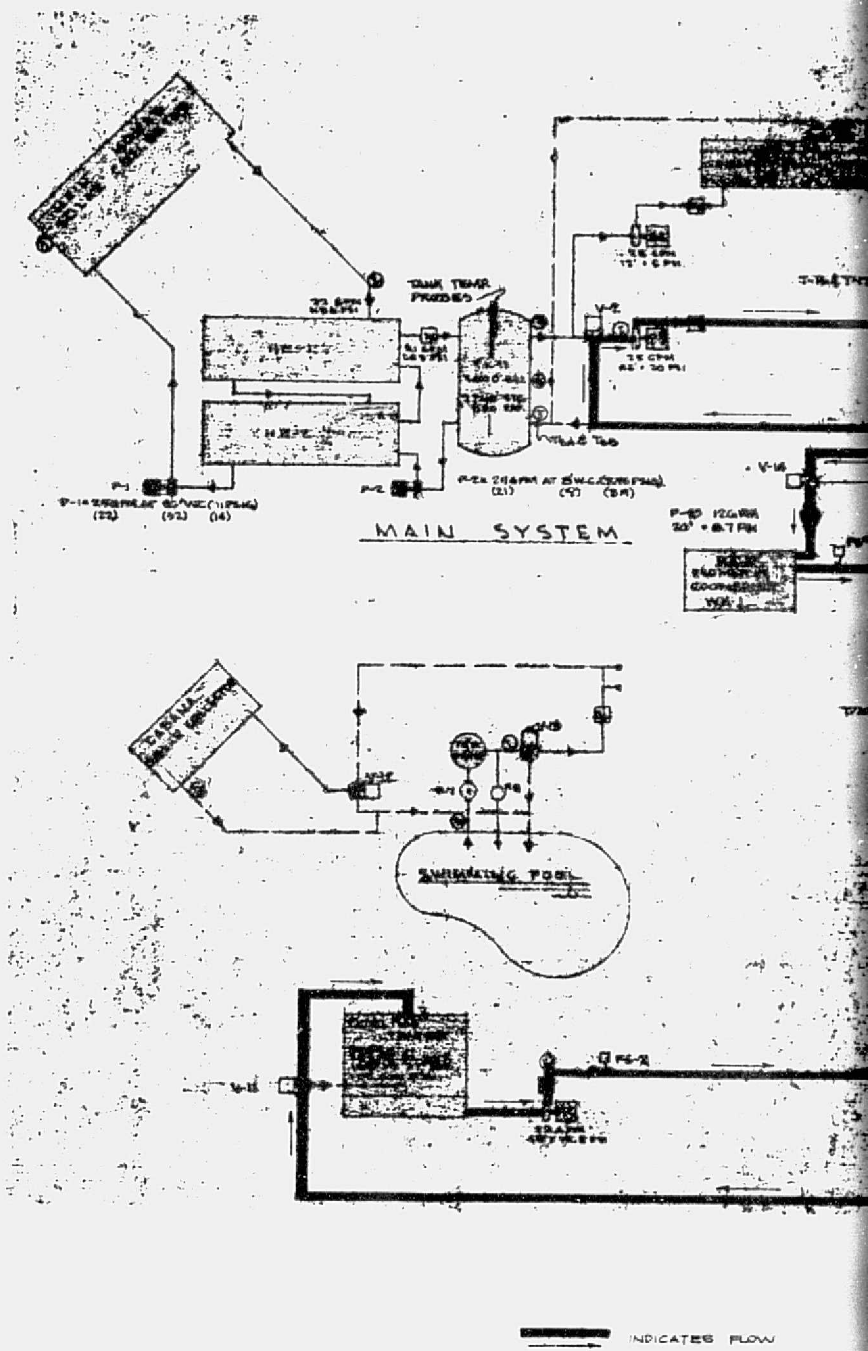
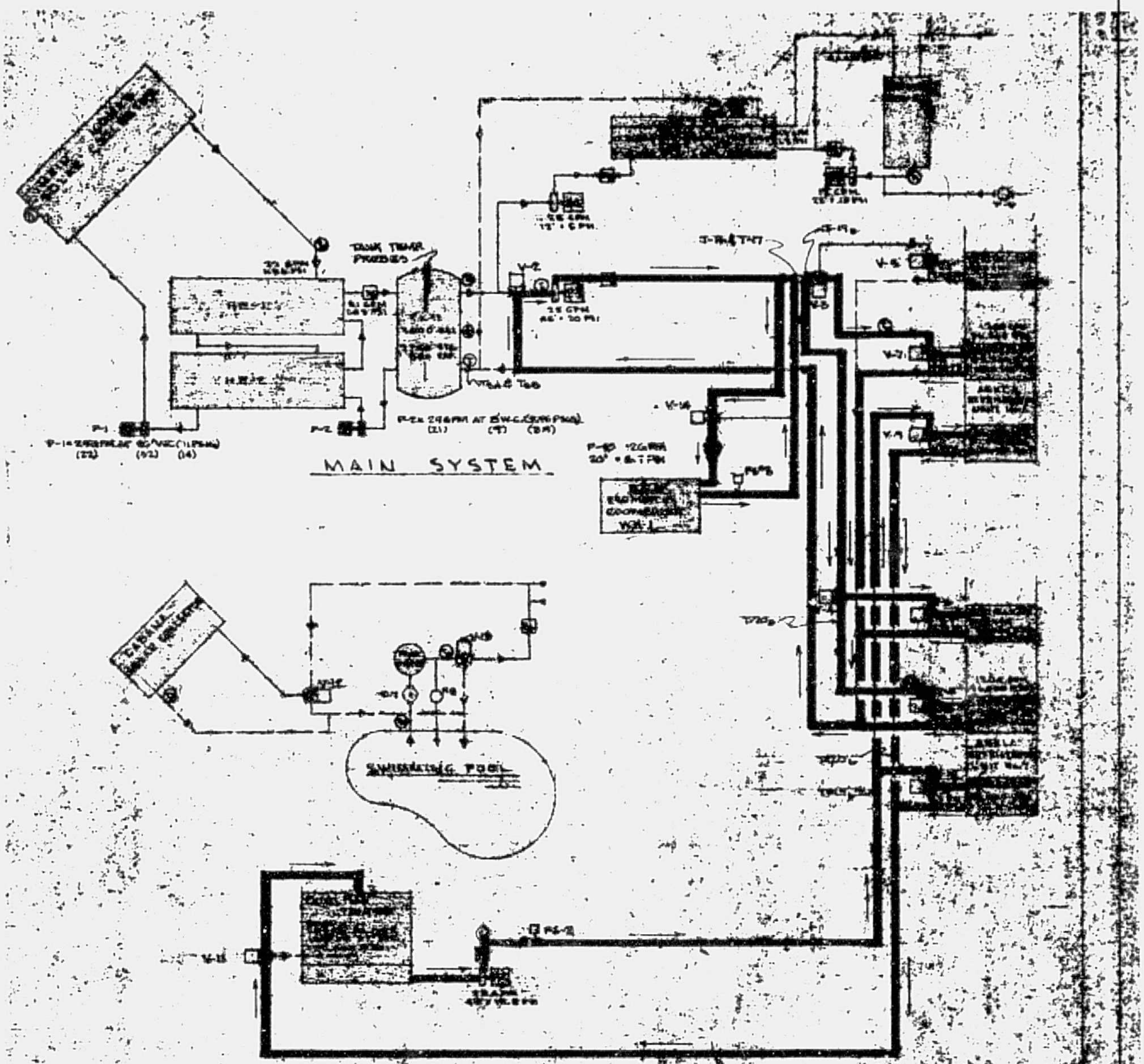


DECADE 80 SOLAR HOUSE

TUCSON, ARIZONA

HEAT
COOLI

FOLDOUT FRAME 2

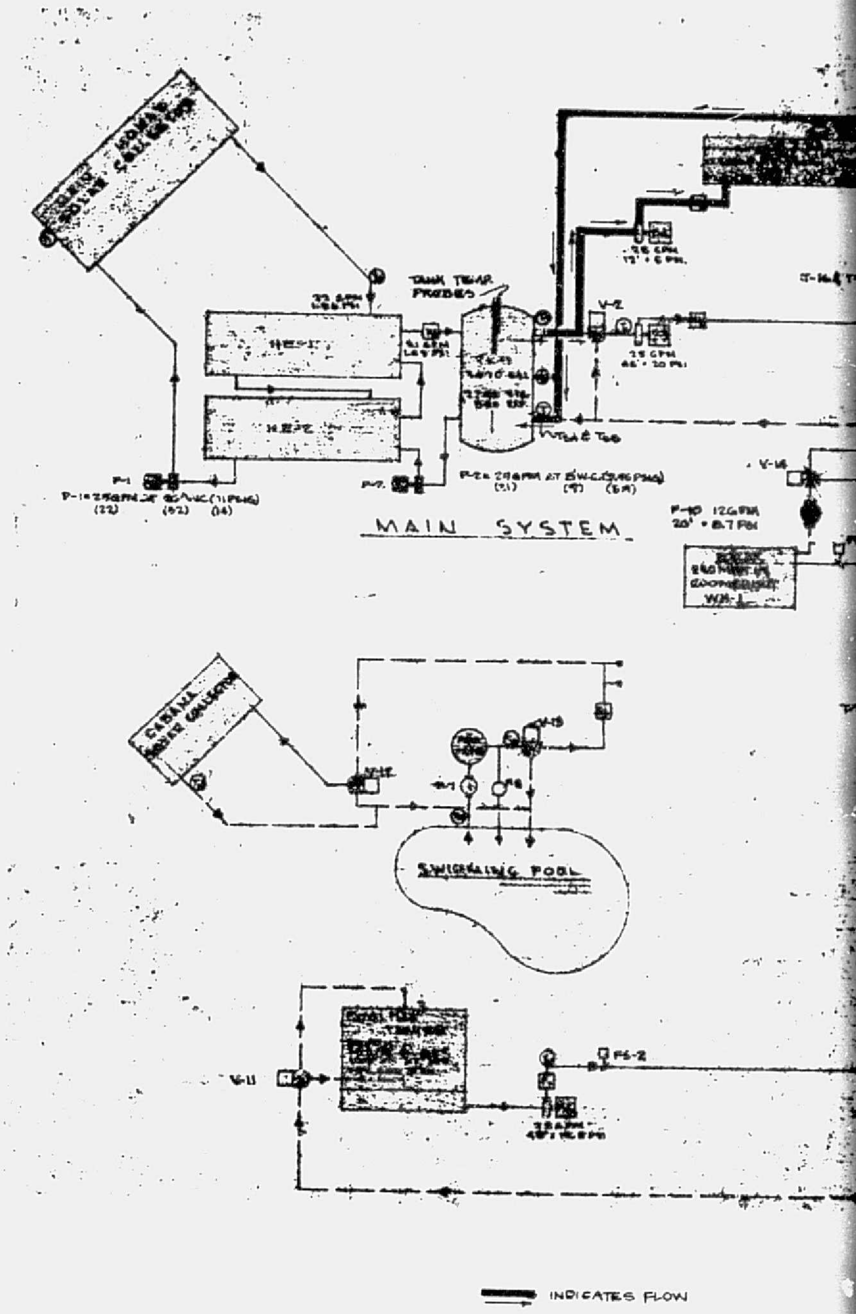


INDICATES FLOW

JAN-12, 1977

TUCSON, ARIZONA

HEAT TRANSFER FLUID FLOW
COOLING FROM AUXILIARY

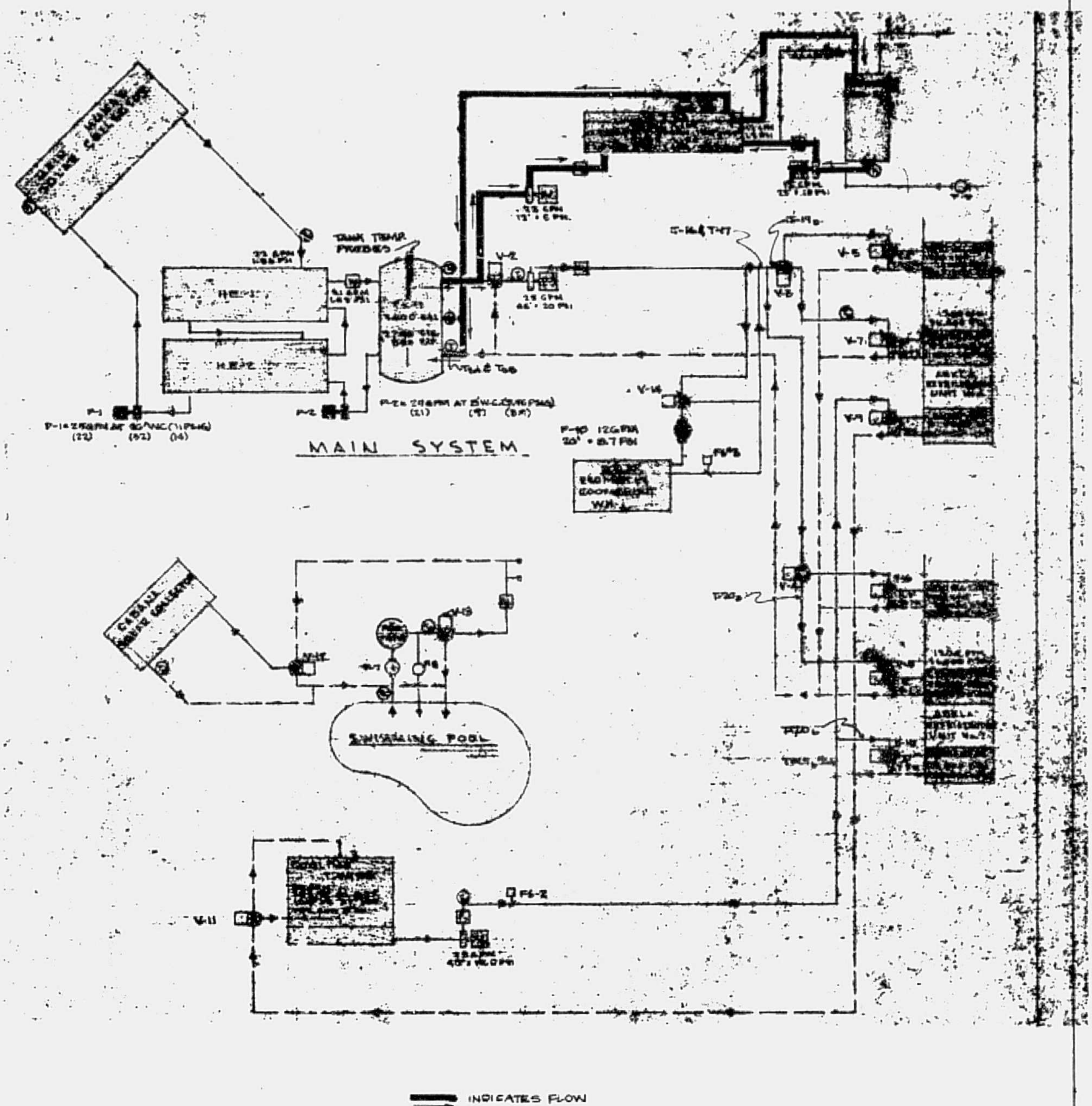


DECADE 80 SOLAR HOUSE

TUCSON, ARIZONA

HEAT
DOME

FOLDOUT FRAME 2



JAN. 12, 1977

OUSE

B-6

TUCSON, ARIZONA

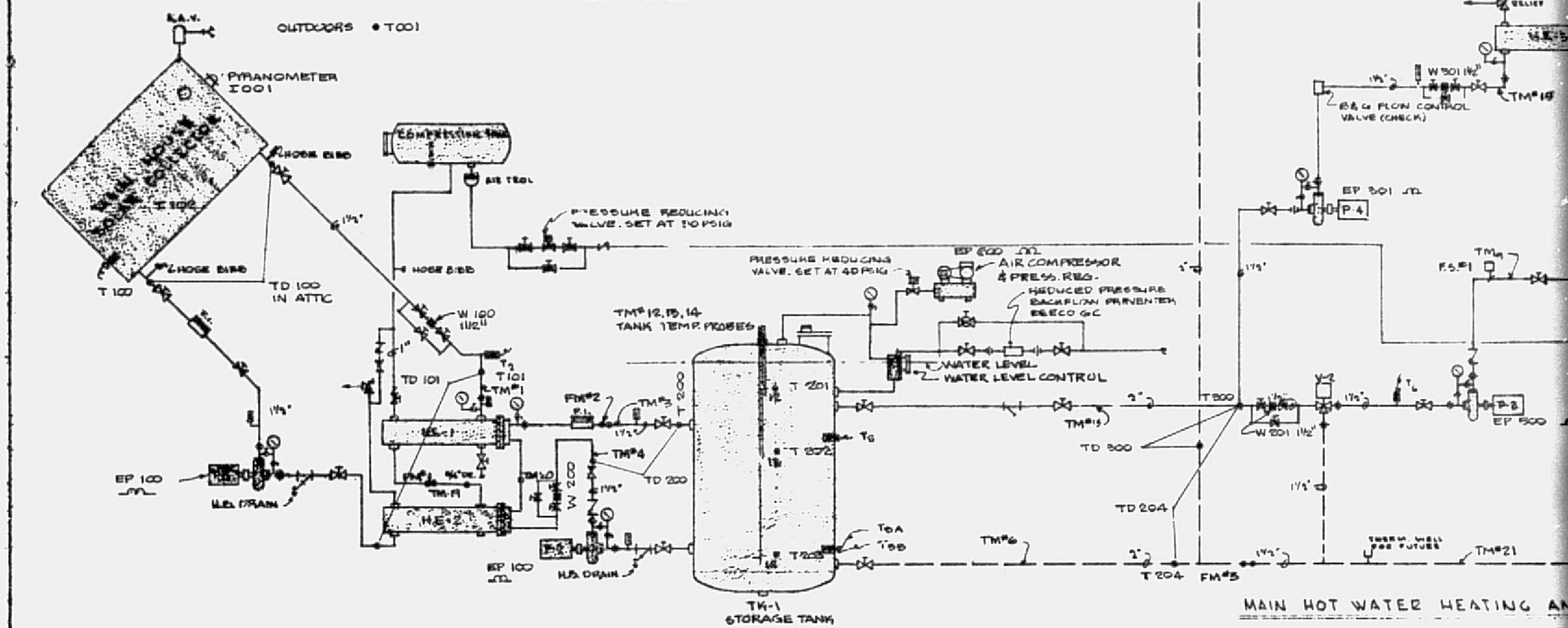
HEAT TRANSFER FLUID FLOW
DOMESTIC WATER HEATING

FOLDOUT FRAME

ORIGINAL PAGE IS OF POOR QUALITY

MISCELLANEOUS ELECTRONIC SENSING POINTS

23 PUMP P-1 ON
24 PUMP P-2 ON
25 PUMP P-3 ON
26 V-2 OPERATION D.F.S. (DOWN)
27 V-2 OPERATION RECIRC (UP)
37 V-9 OPERATION
47 V-10 OPERATION
19 P-4 ON
38 V-5 OPERATION
48 V-6 OPERATION
39 P-10 ON



PUMP SCHEDULE								
No.	MFG.	SERIES	SIZE	GPM	HD.	H.P.	RPM	IMPELLER
P-1	B&G	1522	1 1/2 AAB	25	26'	1/2	1750	5 1/4
P-2	B&G	1522	1 1/4 AAB	25	8'	1/4	1750	4 1/4
P-3	B&G	1522	1 1/4 AAB	22	47'	1	3500	8 5/8
P-4	B&G	1522	1 1/4 AAB	25	12'	1/4	1750	
P-5	B&G	1522	1 1/4 AAB	12	23'	1/4	1750	
P-6	B&G	1522	1 1/4 AAB	25	47'	1	3500	4 3/4
P-7	POOL FILTER				–	1		
P-8	POOL SWEEP					3/4		
P-9	GRUNDFOS	[illegible]		–		[illegible]		
P-10	B&G	BOOSTER	60-1" AA	22	15'	1/6	1750	

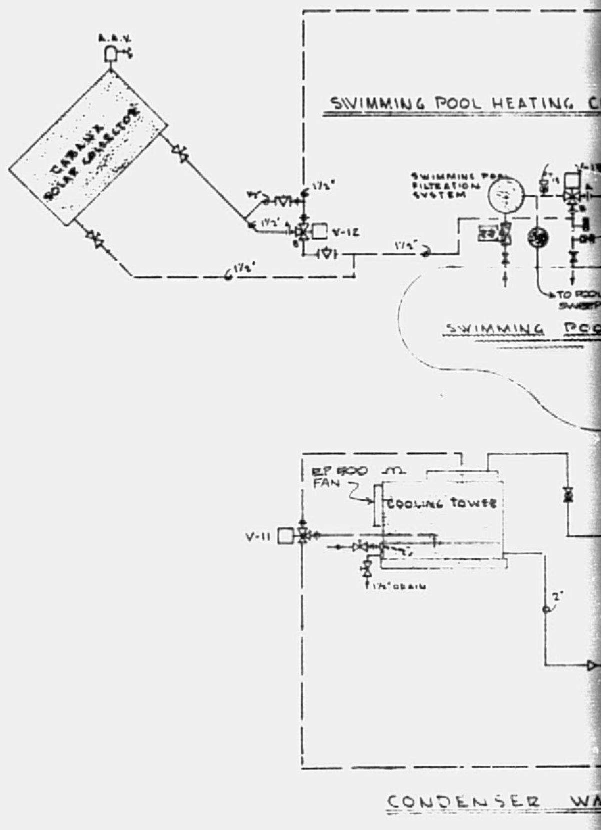
HEAT EXCHANGER SCHEDULE											
No.	MFG.	CAT. NO.	SHELL SIDE				TUBE SIDE				
			GPM	ΔP	EWT	LWT	GPM	ΔP	EWT	LWT	
HE-1	B&G	WU 67-42	25	3.6'	240°		25	4.7'	184°		PROPYLENE GLYCOL SHELL SIDE
HE-2	B&G	WU 67-42	25	5.9			25	4.7'			PROPYLENE GLYCOL SHELL SIDE
HE-3	B&G	WU 67-42	25	5.0'	150°	140°	12	<1'	110°	130°	

WATER HEATER SCHEDULE								
No.	MFG.	CAT. NO.	GPM	ΔP	EWT	LWT	KW	REMARKS
WH-1	LARRS		22	4	[illegible]	199/210		NATURAL GAS FIRED RATED AT 250 MBH INPUT
WH-2	RHEEM				60	140	4.5	

VALVE SCHEDULE							
No	MFG	SIZE	ΔP	VALVE CAT. NO.	MOTOR CAT. NO.	C_v	GPM
V-2	HONEYWELL	1 1/2	1.6'	V5013	M934/Q618	20	25
V-3	GENERAL	1	2'	V731FDB4872	H10A3218351	13	12
V-4	GENERAL	1	2'	V731FDB5872	H10A3218351	13	12
V-5	GENERAL	1	2'	"	"	13	12
V-6	GENERAL	1	2'	"	"	13	12
V-7	GENERAL	1	2'	"	"	13	12
V-8	GENERAL	1	2'	"	"	13	12
V-9	GENERAL	1	2'	"	"	13	12
V-10	GENERAL	1	2'	"	"	13	12
V-11	HONEYWELL	1 1/2	1.6'	V5013	M944/Q618	30	25
V-12	GENERAL	1 1/2	1.6	V731HDB4872	H10A3218751	30	25
V-13	GENERAL	1 1/2	1.6'	"	"	30	25
V-14	HONEYWELL	1 1/4	5.6'	V5018	M644/Q618	16	20

LEGEND

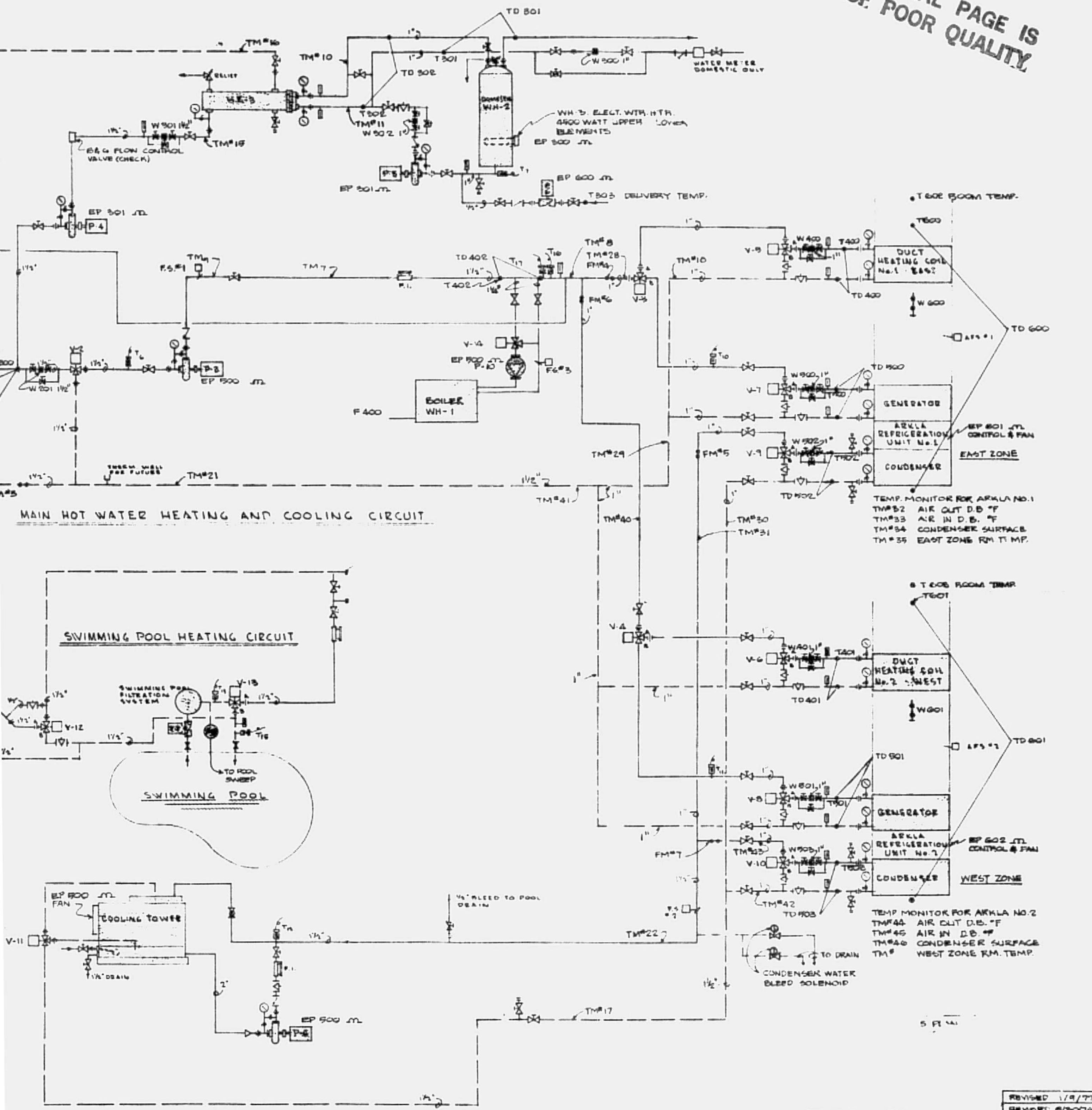
- GATE VALVE
- GLOBE VALVE
- BALANCING COCK
- CHECK VALVE
- STRAINER
- ELEC. MOT. VALVE (V)
- FLOW INDICATOR (F.I.)
- RELIEF VALVE
- UNION
- TEMP. SENSOR (T)
- GAUGE COCK
- THERM. & WELL
- FLOW METER TAPS
- TM TEMP. MONITOR POINT
- F.S. WATER FLOW SWITCH
- AFS AIR FLOW SWITCH
- (T) TEMPERATURE SENSOR
- PRV PRESS. REDUCING VALVE



DECADE 80 SOLAR HOUSE

C-1

FOLDOUT FRAME 2



SECTION 2.1
INSTRUMENT LOCATIONS
NASA INSTRUMENTATION
ALL CONTROL CIRCUITY EP 600 Ω

REVISED 1/9/77
REVISED 9/30/76
REVISED 2/11/76
REVISED 1/9/76
REVISED 4/25/75
REVISED 11/19/75
MARCH 3, 1975

COPPER DEV CORP

HOUSE C-1 TUCSON, ARIZONA

HEATING - COOLING
WATER PIPING DIAGRAM

1343