DOCUMENT RESUME

ED 194 329 SE 033 152

TITLE	Sclar Energy System Description Document: Scattergood School, Site ID 009, PCN 2249.
INSTITUTICN	International Business Machines Corp., Huntsville, Ala.
SPONS AGENCY	Department of Energy, Washington, D.C.
REPORT NO	SOLAR/2003-77/13
PUB DATE	28 Oct 77
CONTRACT	EG-77-C-01-4049
NOTE	26p.: Contains occasional marginal legibility in Tables.
AVAILABLE FROM	National Technical Information Service, Operations Div., Springfield, VA 22161 ($5.00).
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Building Systems: *Demcnstration Programs; *Energy: Federal Programs: *Heating: *School Buildings: *Solar Radiation: Utilities

ABSTRACT

Described are the compcnents, functions, and monitoring instrumentation of a solar heating system at Scattergood School, a Quaker school located in Iowa. The system provides the school gymnasium's space heating and preheating for domestic hot water. This project was constructed and is being evaluated under the United States Department of Energy's National Solar Heating and Cocling Demonstration Program. (WB)

SOLAR/2003-77/13
Distribution Category UC-59
(Modified)

Solar Energy System Description Document

Scattergood School
Site ID 009
PON 2249

October 28, 1977

Contract
EG-77-C-01-4049

IBM Corporation
Huntsville, AL 35805

United States Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

This report has been reproduced directly from the best available copy.

Available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161.

Price: Paper Copy $4.00
Microfiche $3.00

Printed in the United States of America
USDOE Technical Information Center, Oak Ridge, Tennessee

TABLE OF CONTENTS

4

1.0 INTRODUCTION

A. SYSTEM DESCRIPTION

Scattergood School is a Quaker School, located about two (2) miles east and south of West Branch, Iowa. Its solar heating system provides space heating for the school gymnasium and preheating for the domestic hot water system serving the gymnasium. Air is used as the circulating heat transfer medium. Modern Metals, Inc., is the site contractor.

The system is composed of flat-plate collectors, rock storage, water storage tanks, auxiliary heaters, and an air handling unit. Solar heated air is transmitted through the duct system and the air heating unit to either the gymnasium or heat storage. An air-to-water heat exchanger in the solar air path provides hot water preheating. Gymnasium heat is provided from rock storage or auxiliary heaters whenever solar heat is not available.

The anticipated heating load is 56,000 BTUs per degree day, 75% of which the solar system is expected to supply.

B. BUILDING TYPE AND USE

The building is a single story school gymnasium with a utility storage and locker room addition. The metal building contains 6,900 square feet in the main gymnasium portion and 1,066 square feet in the utility storage/locker room addition. The solar collector panels are mounted against the south wall of the gymnasium at a tilt of 50^{o}.

C. CLIMATOLOGICAL DESCRIPTION

Local climatological data are not available for West Branch, Iowa. The nearest location for which these data are available is the Quad City Airport located in Moline, Illinois, approximately fifty (50) miles east of West Branch. Table 1-1 contains local data for the Quad City Airport for reference.

No measurements of solar insolation are available for either West Branch or Quad City Airport. Therefore, the solar insolation values were estimated based on regional data for the Iowa-Illinois area.

TABLE 1-1 SCATTERGOOD SCHOOL (QUAD CITY AIRPORT) CLIMATIC CHARACTERISTICS

MONTH	NORMAL TEMPERATURES °F			NORMAL DEGREE DAYS BASE 65°F		AVERAGE DAILY INSOLATION LANGLEYS/DAY (ESTIMATED)
	DAILY MAX	DAILY MIN	MONTHLY	HEATING	COOLING	
J	30.0	13.0	21.5	1349	0	159
F	34.3	17.0	25.7	1100	0	221
M	45.0	26.4	35.7	908	0	318
A	61.3	39.8	50.6	436	0	402
M	72.0	50.2	61.1	184	63	494
J	81.4	60.2	70.8	20	194	558
J	85.2	63.8	74.5	0	298	566
A	83.8	62.0	72.9	11	255	497
S	76.0	53.2	64.6	79	67	407
O	66.0	42.8	54.4	344	16	289
N	48.1	30.2	39.2	774	0	176
D	34.6	18.5	26.6	1190	0	134
YR	59.8	39.8	49.9	6395	893	352

2.0 SYSTEM FUNCTIONAL DESCRIPTION

A. GENERAL

Four modes of operation are provided for the Scattergood School. Modes 1, 2, and 3 operate in winter when space heating, solar heat storage and hot water preheating are performed. Mode 4 operates in summer when only hot water preheating is performed. These modes are described in the paragraphs which follow.

System energy flows for both air and water, together with the interconnection of the major system components, are illustrated in Figure 2-1 and described in the following mode descriptions.

MODE 1 - Solar Heating

Solar heating occurs when solar energy collection is sufficient to supply heat for the school. In this mode, the air handling unit fan F-1 circulates solar heated air from the collector panel through the air-to-water heat exchanger X-1, motorized damper MD-3, the air handling unit, and motorized damper MD-2 into the school gymnasium. Air collected from the gymnasium is returned to the collector panels for heating. Solar heated air, flowing through X-1, performs domestic hot water preheating.

Solar heating operation is initiated when the following control and temperature conditions are present:

1) The SUMMER/WINTER control S/W is manually set to WINTER

2) Space heat is requested by the two stage thermostat T_G

3) The collector outlet air temperature T_{CO} exceeds the collector inlet air temperature T_{CI} by 45^oF or more.

Sensing of the 45^oF or greater collector differential temperature energizes a ΔT control relay (not shown). The relay remains energized with a 30^oF or greater temperature differential across the collector. The operation of the ΔT control relay energizes motorized dampers MD-3 and MD-4 and turns on fan F-1. When energized MD-3 positions OPEN and MD-4 CLOSED to route the flow of solar heated air through the air handling unit. MD-3 and MD-4 operate aginst a spring force which returns them to the CLOSED and OPEN positions, respectively, when they are not energized.

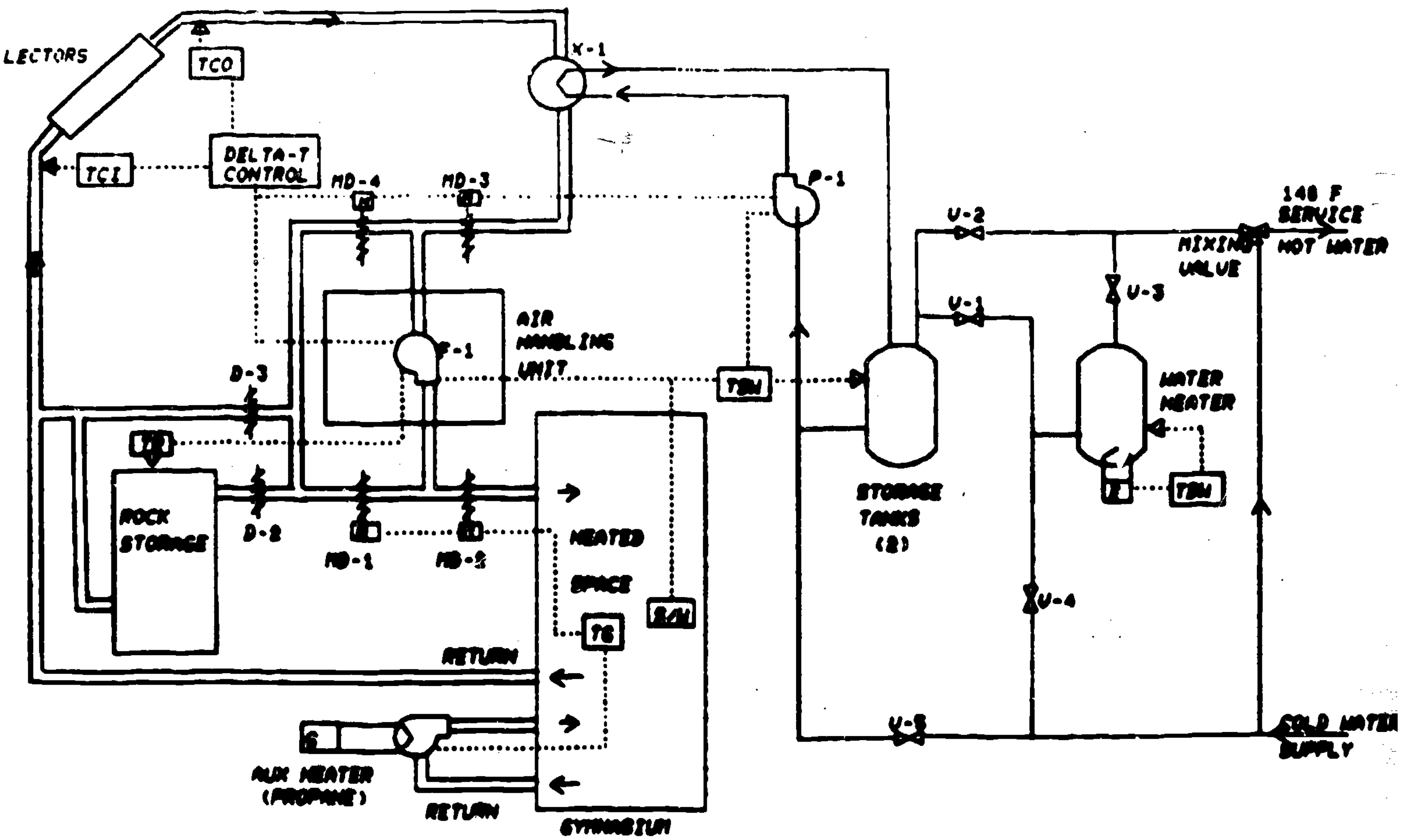

FIGURE 2-1 SCATTERGOOD SITE CONTROL SCHEMATIC

A two stage thermostat, located in the gymnasium, controls space heat requests. Stage 1 (T_{G1}) requests space heat when the gymnasium temperature drops to the manually preset control temperature level. When heat is requested, motorized dampers MD-1 and MD-2 deenergize and position CLOSED and OPEN, respectively. These positions direct the heated air flow into the gymnasium and bypass heat storage. These dampers are mechanically coupled to operate together.

Stage 2 (T_{G2}) operates in conjunction with Stage 1 and actuates auxiliary heaters to supplement solar heat. When the gymnasium temperature drops to a level 1.5^{o}F or more below the preset control temperature level, Stage 2 actuates to turn on auxiliary propane heaters in the gymnasium. Separate supply and return ducts are used for auxiliary heating.

Solar preheating of domestic hot water is enabled by the energized Δ T control relay which supplies energizing power for the water circulating pump P-1. On/Off control of P-1 is controlled by a manually adjustable thermostat (current setting: 140^{o}F) located in storage tank 2. When storage water temperature is less than the set level, P-1 circulates water from the storage tanks through the air-to-water heat exchanger X-1. A manually set time delay in the P-1 control path prevents its recycling on within 3 minutes after it is turned off. In summer this time delay is increased to 20 minutes (see Mode 4 description). Preheated water from the storage tanks is available at the cold input to the domestic hot water tank to replenish water used in hot water service. The cold water supply replenishes storage tank water thus used.

Auxiliary electric heat is available, if required, to raise the domestic hot water temperature to set level (current level: 140^{o}F). A thermostat T_{DW}, located in the domestic hot water tank, controls this auxiliary heat.

A mixing valve in the hot water supply line limits the service water temperature to 140^{o}F. Cold water enters the service line through the mixing valve to maintain the service water temperature.

Water shutoff valves V-1, V-2 and V-3 permit manual control of the hot water source for the service lines. This is illustrated in Table 2-1 below.

Table 2-1 Hot Water Control

Valve Positions			Hot Water Source to Service Lines
V-1	V-2	V-3	
OP	CL	OP	Service supplied by domestic hot water tank. Preheated water available at input to tank.
CL	OP	CL	Service supplied directly by storage tanks.
CL	CL	OP	Service supplied by domestic hot water tank. Preheated water not available to tank.

Shutoff valves V-4 and V-5 control the cold water supply to the indicated tanks.

When the space heating requirements become satisfied (the gymnasium temperature rises to or above the thermostat setting), the system automatically switches to Mode 3. Mode 3, Storing Solar Heat, is described in a subsequent paragraph.

Should the differential temperature, ΔT, across the collector drop below 30°F, solar collection is terminated and an automatic switch is made to Mode 2, Heating from Storage. This mode is described in the next paragraph.

2 - Heating from Storage

Heating from storage is initiated when the following control and temperature conditions are present:

1) The SUMMER/WINTER control S/W is manually set to WINTER

2) Space heat is requested by the two stage thermostat T_G

3) The temperature differential between the collector outlet air temperature T_{CO} and the collector inlet air temperature T_{CI} is less than 30°F

4) The rock storage temperature is 90°F or greater.

In this mode, the air handling unit fan F-1 circulates heated air from rock storage through manual damper D-2, motorized damper MD-4, the air handling unit, and motorized damper MD-2 into the the school gymnasium. Air collected from the gymnasium is returned through rock storage for heating. Hot water preheating is not performed in this mode.

Heating from storage is initiated when collector differential temperature becomes less then 30°F. MD-3 and MD-4 deenergize and revert to CLOSED and OPEN positions, respectively. This changes the source of heated air for the inlet to the air handling unit from the solar collector to rock storage. MD-1 and MD-2 remain in their deenergized positions of CLOSED and OPEN, respectively, so as to route heated air to the gymnasium.

Manual dampers D-2 and D-3 are positioned in accordance with the position of the SUMMER/WINTER switch. In WINTER D-2 is positioned OPEN, D-3 CLOSED. In SUMMER D-2 is positioned CLOSED, D-3 OPEN.

The two stage thermostat control, discussed for Mode 1, functions in same way for Mod 2 with one exception. Energizing power for fan F-1 is now controlled by Stage 1 activation and the rock storage temperature. When the rock storage temperature is greater than 90°F (which it must be to operate in this mode) and heat is requested, F-1 is turned on. When the heat request is satisfied, F-1 turns off. Supplemental auxiliary heat remains available through the Stage 2 control.

Hot water preheating is disabled by the re-routing of heated air from the air-to-water heat exchanger X-1, and the removal of energizing power for the water circulating pump P-1. Hot water service is supplied entirely by the domestic hot water tank.

Should the rock storage temperature drop below 90°F and the solar collector differential temperature remain less than 45°F, the system will automatically switch to the auxiliary propane heaters as the sole heat source. In this condition, the air handling unit is not operating and air flow through the solar collector and/or the rock storage is disabled.

MODE 3 - Storing Solar Heat

Operationally, Mode 3 is identical to Mode 1 with one exception. In Mode 3, space heat is not requested. This condition energizes motorized dampers MD-1 and MD-2 and places them in the OPEN and CLOSED positions, respectively. In these positions, the air handling unit fan F-1 circulates solar air from the collector panels through motorized damper MD-3, the air handling unit, motorized damper MD-1, and manual damper D-2 into rock storage. Return air is drawn from rock storage through the collector panels for heating.

Should space heat be requested while operating in this mode, the system automatically switches to Mode 1. When the heating requirements of Mode 1 are satisfied, the system automatically reverts back to Mode 3. The functions of domestic hot water preheating continue unchanged during switching between Modes 1 and 3.

Mode 4 - Hot Water Preheat Only

Mode 4 is identical to Modes 1 and 3 insofar as the operational functions related to hot water preheating are concerned. Mode 4 differs from Modes 1 and 3 in that the solar heated air from the collector, after flowing through the air-to-water heat exchanger, returns directly to the collector. This contrasts with Mode 1 where the heated air goes into the gymnasium and Mode 3 where it goes to heat storage.

Mode 4 is initiated with the following control and temperature conditions:

1) The SUMMER/WINTER control S/W is manually set to SUMMER

2) The collector outlet air temperature T_{CO} exceeds the collector inlet air temperature T_{CI} by $45^{o}F$ or more

3) Manual dampers D-2 and D-3 are set to their summer positions of CLOSED and OPEN respectively.

In this mode, the air handling unit fan F-1 circulates solar heated air from the collector panels through the air-to-water heater exchanger X-1, motorized damper MD-3, the air handling unit, motorized damper MD-1, and manual damper D-3. The outlet air from D-3 returns to the collector panels for heating.

Motorized dampers MD-1 and MD-2 are energized by the absence of a space heat request. MD-3 and MD-4 are energized by the presence of a $45^{o}F$ or greater temperature differential across the collector panels and remain energized until the collector temperature differential drops below $30^{o}F$. F-1 is controlled by thermostat T_{SW} which also controls the water circulating pump P-1. The time delay associated with on/off cycling of P-1 is 20 minutes in summer to protect F-1 since, in this mode, it has same control path as P-1.

B. SYSTEM PARAMETERS

Collector Flat Plate Surface, Modular Panels

Number of Panels:	128
Panel Dimensions:	36 inches by 78 inches
Total Surface Area:	2496 square feet
Net Effective Area:	2164 square feet
Working Fluid:	Air
Collector Azimuth:	South
Collector Tilt:	50^{o}
Air Flow Rate:	2 FT^3/Minute/Square Foot of Collector
Manufacturer:	Solaron, Model 2001

Solar Storage Tank

Capacity:	1248 FT^3
Storage Medium:	3/4 inch Diameter Roack

Storage Water Heater Tank

Capacity:	240 Gallons (Two 120 Gallon Tanks)
Temperature Setting:	$140^{o}F$

Domestic Water Heater Tank

Capacity:	55 Gallons
Electric Auxiliary Heat:	4.5 KW
Temperature Setting:	$140^{o}F$

Fans

Air Handling Unit:	3 HP, 1 Phase, 4992 FT^3/Minute, Dayton Model SK9676G
Auxiliary Heater (250 KBTU)	1/2 HP for each of 2 Heaters
Auxiliary Heater (100 KBTU)	1/6 for Single Heater

Pumps

Water Circulating:	1/12 HP; 2 Gal/Min; March Model 821-BR

Auxiliary Heaters

Gymnasium:	Two 250,000 BTU/Hr. Bryant Propane Heaters
Locker Room:	One 100,000 BTU/Hr. Bryant Propane Heater

3.0 INSTRUMENTATION

A. IDENTIFICATION AND LOCATION

The instrumentation for the Scattergood School is illustrated in the schematic diagram of Figure 3-1. A listing of the instrumentation components is given in Table 3-1, which also includes measurement ranges and identifies the preliminary justification (intended use) of each measurement. The justification for each measurement is described in terms of a related National Bureau of Standards performance factor.

The solar collection loop is monitored by the air flow measurement W100, the temperature measurement T100, and the temperature differential measurement TD100. Solar energy delivered to storage is monitored by the air flow measurement W100, the temperature measurement T101, and the temperature differential measurement TD101. The heat removed from solar storage is monitored by the air flow measurement W400, the temperature measurement T402, and the temperature differential measurement TD402. The state of stored solar energy is monitored by the temperature measurements T200, T201 and T202. The space heating solar energy flow is measured by the air flow measurement W400, the temperature measurement T402, and the temperature differential measurement TD402. The auxiliary space heating energy flow is computed from the propane fuel flow F400 and the electrical energy flow EP402. The total energy delivered to hot water preheating is measured by the air flow measurement W300, the temperature measurement T300, and the temperature differential measurement TD300. The service hot water load is calculated from the water flow measurement W306, the temperature measurements T305 and T306 and the temperature differential measurement TD306. The auxiliary energy delivered to hot water heating is monitored by the electrical energy flow EP300. The climatic data are measured by the outside air wind direction measurement D001, the outside air relative humidity measurement RH001, the outside air temperature measurement T001, and the outside air wind velocity measurement V001. The solar insolation is monitored by the solar flux measurement I001. The solar collector surface temperature is measured by the temperature measurement T102.

B. PERFORMANCE DEFINITION

Table 3-2 identifies the performance factors applicable to the Scattergood School. These performance factors are specified by the National Bureau of Standards Document NBSIR 76-1137 as primary and secondary factors required for evaluation of solar energy systems.

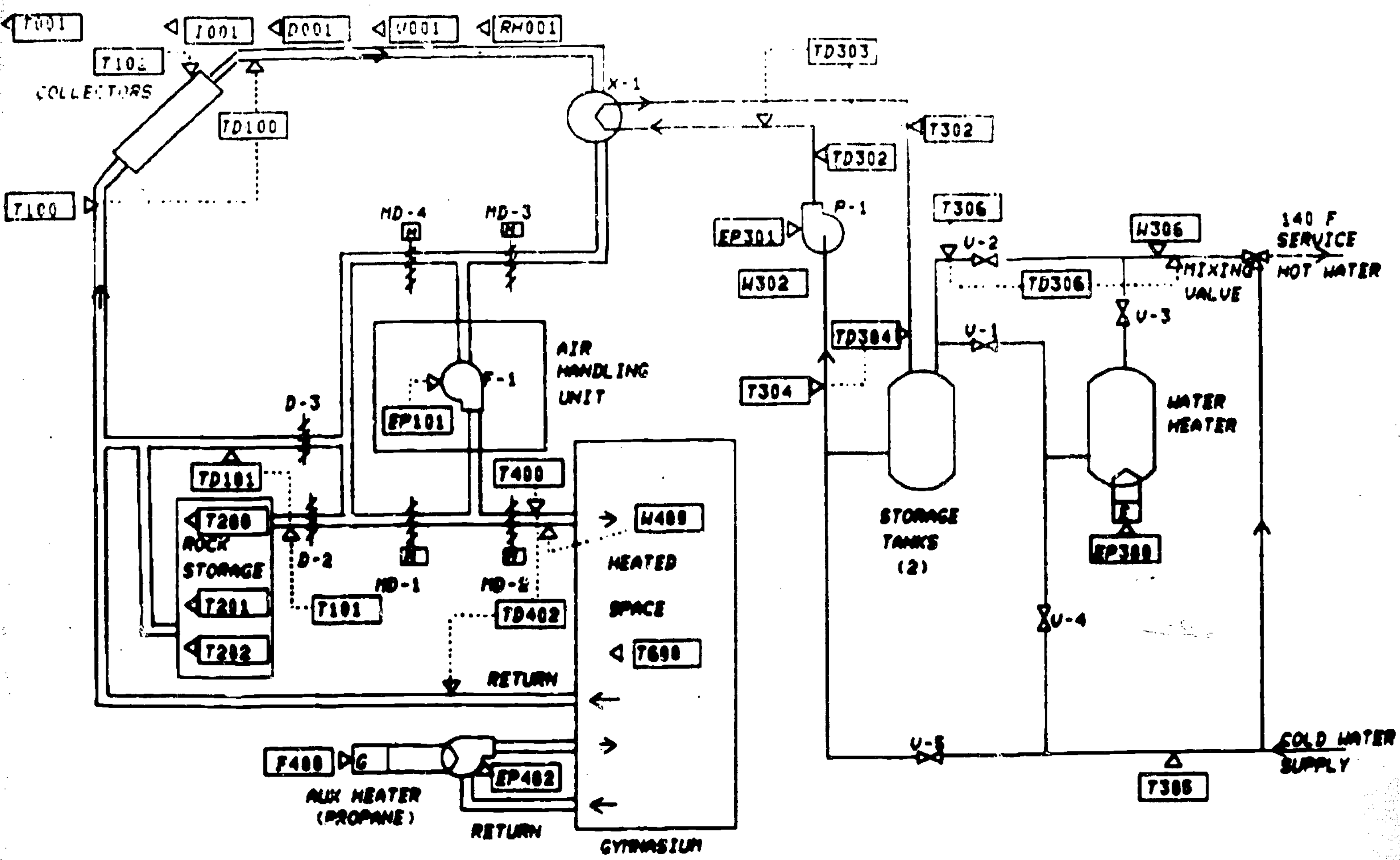

FIGURE 3-1 SCATTERGOOD SITE INSTRUMENTATION SCHEMATIC

TABLE 3-1. INSTRUMENTATION

PERATURE INSTRUMENTATION REQUIREMENTS for Scattergood School (PON 2249) Page 1 of 5

DATE: February 16, 1977

Measurement							Pipe Type	Pipe Size (Inches)	Size (Inches)	Installation Method	Ref. Fig. No.	Thermowell Part No.	Probe Part No.
Designation	Number		Justification	Name	Range (°F)								
	J-Box	SDAS			Min.	Max.							
T100			Q100	Collector Array Inlet Temperature	40	180			20x36	K	B-1	F132	S57P85
TD100			Q100	Collector Array Differential Temperature	0	100			20x36	K	B-1	F132	S53P85
T101			Q200	Rock Storage Outlet Temperature	40	180			24x30	K	B-1	F132	S57P85
TD101			Q200	Rock Storage Differential Temperature	0	100			24x30/ 36x36	K	B-1	F132	S53P85
T102			N116	Collector Surface Temperature	0	400				Surface Bond			S34AP736
T200			Q202	Rock Storage Temperature - Top	40	180				K	B-1	F203U240	S53P270
T201			Q202	Rock Storage Temperature - Middle	40	180				K	B-1	F203U555	S53P585
T202			Q202	Rock Storage Temperature - Bottom	40	130				K	B-1	F203U750	S53P780
T302			Q302	Temperature Outlet Hot Water Preheat Coil	45	170	Copper	1"		B	B-4	F203U28	S57P55
TD302			Q302	Diff. Temp. Across H.W. Preheat Coil (+ΔT)	0	40	Copper	1"		B	B-4	F203U28	S53P55
T304			Q302	Preheat Tank Outlet Temperature	45	170	Copper	1"		B	B-4	F203U28	S57P55
TD304			Q302	Diff. Temp. Across Pre-Heat Tank	0	50	Copper	1"		B	B-4	F203U28	S53P55
TD303			Q302	Diff. Temp. Across H.W. Preheat Coil (-ΔT)	0	40	Copper	1"		B	B-4	REVERSE OF TD302	
T306			Q301	Temp. Domestic Hot Water Inlet	45	160	Copper	1"		B	B-4	F203U28	S57P55
T305			Q302	Cold Water Supply Temperature	45	160	Copper	1"		B	B-4	F203U28	S53P55
TD306			Q301	Diff. Temperature Across DHW Tank	0	40	Copper	1"		B	B-4	F203U28	S53P55
T402			Q402	Space Heating Inlet Temperature	60	160			36x20	K	B-1	F132	S57P85
TD402			Q402	Diff. Temperature Across Heated Space	0	100			36x20/ 36x36	K	B-1	F132	S57P85

TABLE 3-1. INSTRUMENTATION (Continued)

URE INSTRUMENTATION REQUIREMENTS for Scattergood School (PON 2249)

DATE: February 16, 1977

Measurement														
nation	Number		Justification	Name	Range (°F)		Pipe Type	Pipe Size (Inches)	Tube Size (Inches)	Installation Method	Ref. Fig. No.	Thermowell Part No.	Probe Part No.
	J-Box	SDAS			Min.	Max.							
			N406	Inside Ambient	40	120						F132	S53P85
			N113	Outside Ambient	-40	120	IS4 INSOLATION SHIELD					F132	S53P85

TABLE 3-1. INSTRUMENTATION (Continued)

RATE INSTRUMENTATION REQUIREMENTS for Scattergood School (PON 2249)

DATE: February 16, 1977

Designation	Number J-Box	Number SDAS	Justification	Measurement Name	Range (GPM/CFM) Min.	Range (GPM/CFM) Design.	Range (GPM/CFM) Max.	Liquid Flow Pipe Type	Liquid Flow Pipe Size	Air Flow Duct Dimensions (In.) L	W	T	Model No.
100			Q100	Collector Array Flow	4000	5000	6000				20	36	SIERRA 430-2/F132
302			Q302	DHW Pre-Heat Loop Flow		6-10 GPM			1"				MKV-1-J07
306			Q301	Flow Pre-Heat to DHW Tank		5 GPM			1"				MKV-1-J07
400			Q203	Outlet Flow Air Duct	4000	5000	6000				20	36	SIERRA 430-2/F132
400			Q410	Propane Flow to Space Heating		3.5 CFM			3/8"				AL-800

TABLE 3-1. INSTRUMENTATION (Continued)

INSTRUMENTATION REQUIREMENTS for Scattergood School (POH ?249)

Page 4 of 5

DATE: February 16, 1977

Measurement					Phase	Configuration (3 or 4 wire)	Full Scale Inputs			Model No.
gnation	Number J-Box	Number SDAS	Justification	Name			Volts	Amps	Power (Kilowatts)	
01			Q102	Circulating Air Fan Power	1		240	9	3 HP	PC5-20
01			Q303	DHW Circulating Pump Power	1		240	1	1/20 HP	
02			Q403	Space Heater Fan Power (4)	1		115	9	1/2 HP	PC5-28
02			Q403	Locker and Utility Room Heater Fan Power	1		115	1	1/6 HP	
00			Q305	DHW Electric Power	1		220		5000 watts	PC5-29

TABLE 3-1. INSTRUMENTATION (Continued)

INSTRUMENTATION REQUIREMENTS for Scattergood School (PON 2249)

Page 5 of 5

DATE: February 16, 197

Measurement					Model No.	Comments
signation	Number		Justi-fication	Name		
	J-Box	SDAS				
01			Q001	Solar Flux (Total Solar Radiation)	Eppley PSP	
01				Wind Velocity	Skyvane I	W101-P-DC/540
01				Wind Direction	Skyvane I	W101-P-DC/540
001				Outside Relative Humidity	HM 111-P	

TABLE 3-3 PERFORMANCE FACTORS FOR SCATTERGOOD SCHOOL

SYMBOL	NBS Factor IDENT.*	FACTOR NAME
SYSL	Q602	System Load
SFR	N601	Solar Fraction of System Load
SYSPF	N602	System Performance Factor
SEL	Q203	Solar Energy to Load
AXE	-	Auxiliary Electrical Energy to Load
AXF	-	Auxiliary Fossil Energy to Load
SYSOPE	Q601	System Operating Energy
TECSM	Q603	Total Energy Consumed by System
TSVE	Q604	Total Electrical Energy Savings
TSVF	Q605	Total Fossil Energy Savings
TSW	N305	Supply Water Temperature
THW	N307	Service Hot Water Temperature
TB	N406	Building Temperature
TDA	-	Daytime Average Ambient Temperature
TA	N113	Ambient Temperature
SE	Q001	Incident Solar Energy
SEA	-	Incident Solar Energy on Array
SEOP	-	Operational Incident Solar Energy
SEC	Q100	Collected Solar Energy
SECA	-	Collected Solar Energy by Array
CAREF	N100	Collector Array Efficiency
TST	-	ECSS Storage Temperature
STEI	Q200	Energy Delivered to ECSS Storage
STEO	Q201	Energy Supplied by ECSS Storage
STECH	Q202	Change in ECSS Stored Energy
STEFF	N108	ECSS Storage Efficiency
CSEO	-	Energy Delivered from ECSS to Load
CSOPE	Q102	ECSS Operating Energy
CSCEF	N111	ECSS Solar Conversion Efficiency
HWCSM	N308	Service Hot Water Consumption
HWL	Q302	Hot Water Load
HWSFR	N300	HWS Solar Fraction
HWSE	Q300	Solar Energy to HWS
HWOPE	Q303	HWS Operating Energy
HWAE	Q305	HWS Auxiliary Electrical Energy
HWAF	Q306	HWS Auxiliary Fossil Energy
HWSVE	Q311	HWS Electrical Energy Savings
HWSVF	W313	HWS Fossil Energy Savings
HL	Q402	Space Heating Load
HSFR	N400	SHS Solar Fraction
HSE	Q400	Solar Energy to SHS
HOPE	Q403	SHS Operating Energy
HAE	Q404/Q409	SHS Auxiliary Electrical Energy
HAF	Q410	SHS Auxiliary Fossil Energy
HSVE	Q415	SHS Electrical Energy Savings
HSVF	Q417	SHS Fossil Energy Savings

*NBS Factor Identification defined in National Bureau of Standards Document NBSIR 76-1137.