PP&L	CALCULATION COVER SHEET	CALC. NO. M-SLD-001	SAFETY-RELATED [X]
		FILE NO. R2-1	ASME III OR XI [ ]
			OTHER QUALITY [ ]
		SUPERSEDED BY NA	NON QUALITY [ ]

PROJECT STEAM LEAK DETECTION PROJECT ER/CTN NO. NA

DESIGN ACTIVITY/PMR NUMBER EWR # M81000 PAGE 1 OF 16

TITLE/DESCRIPTION STEAM LEAK DETECTION CALC - HPCI PUMP ROOM (UNIT 1 ONLY)

SYSTEMS AFFECTED S083G, S052

STATEMENT OF PROBLEM

REFER TO PAGE 3 FOR STATEMENT OF PROBLEM.

DESIGN BASIS (EPM-QA-208 OR EPM-QA-400)

REFER TO ATTACHED DESIGN INPUTS GENERATED FOR THIS CALCULATION.

REFERENCES/FORMULAE

REFER TO PAGE 4 FOR REFERENCES.

SUMMARY/CONCLUSIONS

REFER TO PAGE 12 FOR SUMMARY/CONCLUSIONS.

ENGINEERING TURNOVER
(ETO) BINDER AFFECTED? [ ] YES-If Yes enter: Binder # ______ Vol. ______
Calc. File ______ Pgs. ______
[X] NO

REV. NO.	DATE	PREPARED BY	REVIEWED/CHECKED BY	DATE	APPROVED BY	DATE
0	6/9/89	Mark R. Mjaatvedt	[signature]	6/27/89	[signature]	6/29/89

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PDR ADOCK 05000387
P PDR

FORM EPM-QA-216A REV.1

mls/frb006i(12)

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this calculation is to predict the room temperature profile expected when a small steam leak is introduced in the Unit 1 HPCI Pump Room. The results of this calculation will be used as a basis for development of Steam Leak Detection System setpoints.

2.0 REFERENCES

2.1 Calc # M-RAF-024, Rev. 0 "RB Post DBA Transient Temperature Analysis".

2.2 Bechtel Calc # 176-18, Rev. 5 "RB Cooling Modes"

2.3 SEA-EE-129, Rev. 0 "SSES Unit 1 and Unit 2 Reactor Building Heat Loads"

2.4 Drawings :

P&ID M-176, Rev. 20
P&ID M-155, Rev. 27
V-25-1, Rev. 9
V-25-2, Rev. 14
V-25-3, Rev. 5
V-28-1, Rev. 15
V-28-2, Rev. 14
V-28-3, Rev. 17
C-103, Rev. 19
C-105, Rev. 20
C-132, Rev. 17
C-134, Rev. 15
C-154, Rev. 12
C-156, Rev. 12
C-111, Rev. 15
C-117, Rev. 17
DBB-114-1, Rev. 6
GBD-112-1, Rev. 3
GBD-2-5, Rev. 6
GBD-135-1, Rev. 3

2.5 M-199 Piping Class Sheets

2.6 SEIS Pipeline General Index

2.7 Crane Technical Paper No. 410, 23rd Printing

2.8 ASHRAE 1985 Fundamentals Handbook

2.9 FSAR Table 3.11-6

2.10 FSAR Section 5.2.5.1.3

2.11 Calc # M-PAF-001, Rev. 1 "HVAC Environmental Analysis - Reactor Buildings & Control Structure"

2.12 COTTAP-2 Theory and Input Description Manual (User's Manual), Rev. 1, dated 1/27/89.

2.13 Shipp, P.H. 1982. Basement, Crawlspace, and Slab-on-grade Thermal Performance. Proceedings of ASHRAE/DOE thermal performance of the exterior envelopes of buildings II, Las Vegas, NV. December.

3.0 ASSUMPTIONS

1) Plant is operating under normal conditions prior to introducing a steam leak.

2) All adjacent rooms will be maintained at their design maximum temperature for summer conditions and at the average temperature for the month of January (if blue-box data is available) for winter conditions. Where winter temperature data is not available, the design minimum temperature of 60 F will be used.

3) The room under consideration will not be allowed to pressurize, as the blowout panel will relieve at approximately 0.5 psid. Therefore, a leakage path out of the room will be used to maintain pressure as close to 14.7 psia as possible. The temperature effects due to slight room pressurization are assumed to be negligeble.

4) The effects of adjacent room heatup are not considered in this analysis (i.e. adjacent room temperatures are held constant). This results in a conservative temperature profile for the room under consideration. The actual adjacent room heatup due to the steam leak is expected to be minimal (when considering conductive heat losses).

5) The COTTAP model assumes perfect mixing of the air and steam in the room under consideration.

4.0 METHODOLOGY

The Compartment Transient Temperature Analysis Program (COTTAP) was used to analyze the affects of a steam leak in various rooms within the plant. The program predicted temperature profiles for the room under consideration with the following set of conditions :

1) 5 gpm water equivalent steam leak (Summer)
2) 5 gpm water equivalent steam leak (Winter)
3) 25 gpm water equivalent steam leak (Summer)
4) 25 gpm water equivalent steam leak (Winter)

The individual room models were developed from various sources of information, as identified in Section 2.0 References. The results will consist of the COTTAP output and the plots of various profiles for the conditions stated above. The following discussion is provided to outline the steps used in developing the individual room models.

4.1 General Data For Rooms

Room Volumes : The room volume was taken from Reference 2.1 for the room under consideration. Adjacent room volumes were set to a large value (i.e. 1.0 EE15 cu. ft.) to maintain constant properties such as temperature, pressure and relative humidity.

Initial Pressure : All rooms were assumed to be at an initial pressure of 14.7 psia.

Initial Temperature : All rooms were assumed to be at their maximum normal design temperature initially for summer conditions. Actual winter data was used, where available, as a starting point for the winter runs. The winter data was taken as the "blue-box" average temperature for January 1988. The January data was considered to be more conservative than February data. Where actual winter data was not available, the design minimum room temperature of 60 F was used. Where winter data was not available for the room in question, the room was started at a temperature which allows it to reach a steady-state with its adjacent rooms.

The outside ambient temperature was taken as 79 F (summer) and 26 F (winter). The summer ambient was taken from Reference 2.8 as the 24 hour daily average temperature, based upon the 1% ASHRAE design value for the Wilkes-Barre/ Scranton area. The winter value was taken as the actual monthly average for January over the years 1986 thru 1989. This average was based upon SSES Meteorological Data taken from the plant computer. A comparison of February data over this same time period indicated that the January data was more conservative.

Relative Humidity : The relative humidity for all rooms connected by ventilation or leakage paths is based upon supply air temperatures of 85 F (summer) and 60 F (winter) at 90% RH. Air at these conditions was then allowed to heat up (sensible heating only) to the initial room temperature, and the corresponding RH value was calculated or read from the psychrometric chart.

Room Height : This value is no longer used by COTTAP. It's original purpose was associated with the wall condensation calculation used within COTTAP. COTTAP has been revised and no longer uses this information. Therefore, a value of 10.0 ft was inputted for each room. This value has no significance to the calculation. Note that the actual room height was used in the calculation of room volume.

4.2 Airflow and Leakage Path Data

Airflow Data : The design airflow is provided for the room under consideration. All flow paths are identified (i.e. supply, exhaust and transfer air). The source of the airflow data is the P&ID associated with the particular ventilation system for that room. The data identifies the room from which the air comes, and the room to which the air goes.

Since air flows are balanced to ± 10% accuracy, a conservative value of 2090 cfm was used for this room (1900 cfm x 1.1).

Leakage Path Data : As with the airflow data, all rooms connected to the leakage path are identified. The leakage path area is only used to scale the leakage flowrates for the entire compartment under consideration. The intent of the leakage path is to prevent compartment pressurization. For most rooms (except RWCU), only one leakage path is used, and a value of 1.0 sq. ft. is inputted for the leakage path area. When more than one leakage path exists, actual leakage areas can be inputted to better understand leakage flows between adjacent compartments.

4.3 Heat Load Data

Heat Load Type : The type of heat load was identified using the following nomenclature :

Type	Description
1	Lighting
2	Electrical Panels
3	Motors
4	Unit Coolers
5	Piping
8	Misc. Mechanical Equipment

Heat Input Rate : The heat rate input in Btu/hr for the associated heat load.

The values for heat load types 1 thru 3 were obtained from References 2.2 & 2.3. The heat rate inputs for type 4 heat loads are inputted as negative values since the unit coolers remove heat from the room. The heat input rate for type 5 heat loads were input as -1. This value directs COTTAP to obtain piping information necessary to calculate the piping heat loads. The heat input rate for type 8 heat loads was obtained from References 2.2 & 2.3, as necessary for the appropriate room.

To achieve an initial steady-state condition, a miscellaneous heat load (positive or negative) was added to the main room to balance all other time zero heat loads. This heat load was inputted as type 8.

Note that COTTAP neglects cold pipe and equipment as heat sinks. This represents non-conservatism in this calculation. A sample run made to determine the effects of these heat sinks indicated that resultant temperatures were only slightly lower than the values predicted when neglecting these heat sinks. Therefore, this calculation assumes the effects of these heat sinks are negligable.

For walls and floors in contact with ground, the model predicts a conservative value of heat loss to ground. The slabs are assumed to be in contact with soil at a temperature of 55 F. To model the heat loss to ground, a large value of surface film convective heat transfer coefficient (100 Btu/hr-sq ft- F) has been introduced on the ground side of the floors and walls to achieve a ground contact temperature of 55 F.

4.4 Piping Input Data

Only piping with a design temperature greater than that of the normal room design temperature was included, since COTTAP ignores cold pipe as a heat sink. This generally meant that piping at or close to Reactor conditions was included. Also note that this calculation neglects heat loss from small pipe (i.e. less than 2" OD).

Pipe OD : The outside diameter of the pipe was obtained from Reference 2.4 .

Pipe ID : The pipe schedule was obtained from Reference 2.5 . Knowing the schedule, the inside diameter was obtained from Reference 2.7 .

Insulation OD : The insulation OD was obtained from Reference 2.11 .

Pipe Length : The pipe length was obtained from Reference 2.4 .

Emmisivity : The emmisivity was obtained from Reference 2.11 .

Insulation k Value : The insulation thermal conductivity (k) was obtained from Reference 2.11 .

Pipe Fluid Temperature : The design fluid temperature was obtained from Reference 2.6 .

Fluid Phase : The state of the fluid was determined by reviewing the system P&ID's and design temperatures/pressures. If a particular line could carry steam or water, it was assumed to be liquid for conservatism.

4.5 General Data For Thick Slabs

Room ID # on Side 1 : The room number on one side of the slab.

Room ID # on Side 2 : The room number on the other side of the slab. When slab is adjacent to ground, a room # of "0" is used.

Thickness : The thickness of the slab was obtained from Reference 2.4 .

Heat Transfer Area : The area of the slab was obtained from Reference 2.4 . The dimensions were scaled from plant ventilation drawings. The slab areas are calculated in the Data Input Section (Refer to Appendix A).

Thermal Conductivity : The thermal conductivity of the concrete slabs were obtained from Reference 2.8 , Chapter 23 Table 3A. A value of 1.0 Btu/hr ft F was used for all concrete slabs.

Density : The density of all concrete slabs is assumed to be 140 lbm/cu ft. This value was obtained from Reference 2.8 , Chapter 23 Table 3A.

Specific Heat : The specific heat for all concrete slabs was assumed to be 0.22 Btu/lbm F as obtained from Reference 2.8 , Chapter 23 Table 3A.

4.6 Film Coefficient Data For Thick Slabs

Type w/r to Room on Side 1 : The type of slab with respect to the room on Side 1 was defined using the following codes :

Type 1	Vertical Wall
Type 2	Floor
Type 3	Ceiling

h1 & h2 : All film coefficients (h) for inside walls were calculated by COTTAP. The film coefficient for walls in contact with outside air were inputted as :

Summer	4.0	Btu/hr-sq ft- F
Winter	6.0	Btu/hr-sq ft- F

(Per Reference 2.8 , Chapter 23, Table 1)

A value of 100 Btu/hr-sq ft- F was inputted for walls in contact with ground. This value helps to simulate a wall (or floor) in contact with soil at 55 F. This will result in a conservative prediction of the heat loss to ground.

4.7 Pipe Break Data

Fluid Pressure : The fluid pressure within the pipe (psia). All rooms (except RWCU) used a fluid pressure of 1000 psia, which was considered representative of normal Reactor conditions.

Mass Flow : The total mass flow exiting the pipe break (lbm/hr) was inputted as follows :

for 5 gpm water equivalent steam leak :

5 gal/min x 1 cu ft/7.48 gal x 60 min/hr x .02159 cu ft/lbm = 1860 lbm/hr

vf = 0.02159 cu ft/lbm @ 1000 psia
(per ASME Steam Tables)

for 25 gpm water equivalent steam leak :

5 x 1860 lbm/hr = 9300 lbm/hr

The break occurs at t=0.5 hrs. This allows the room to reach equilibrium conditions prior to initiation of the break. In all room models, the break mass flow is allowed to increase linearly (ramp) from 0 lbm/hr to its maximum value over 0.1 hrs.

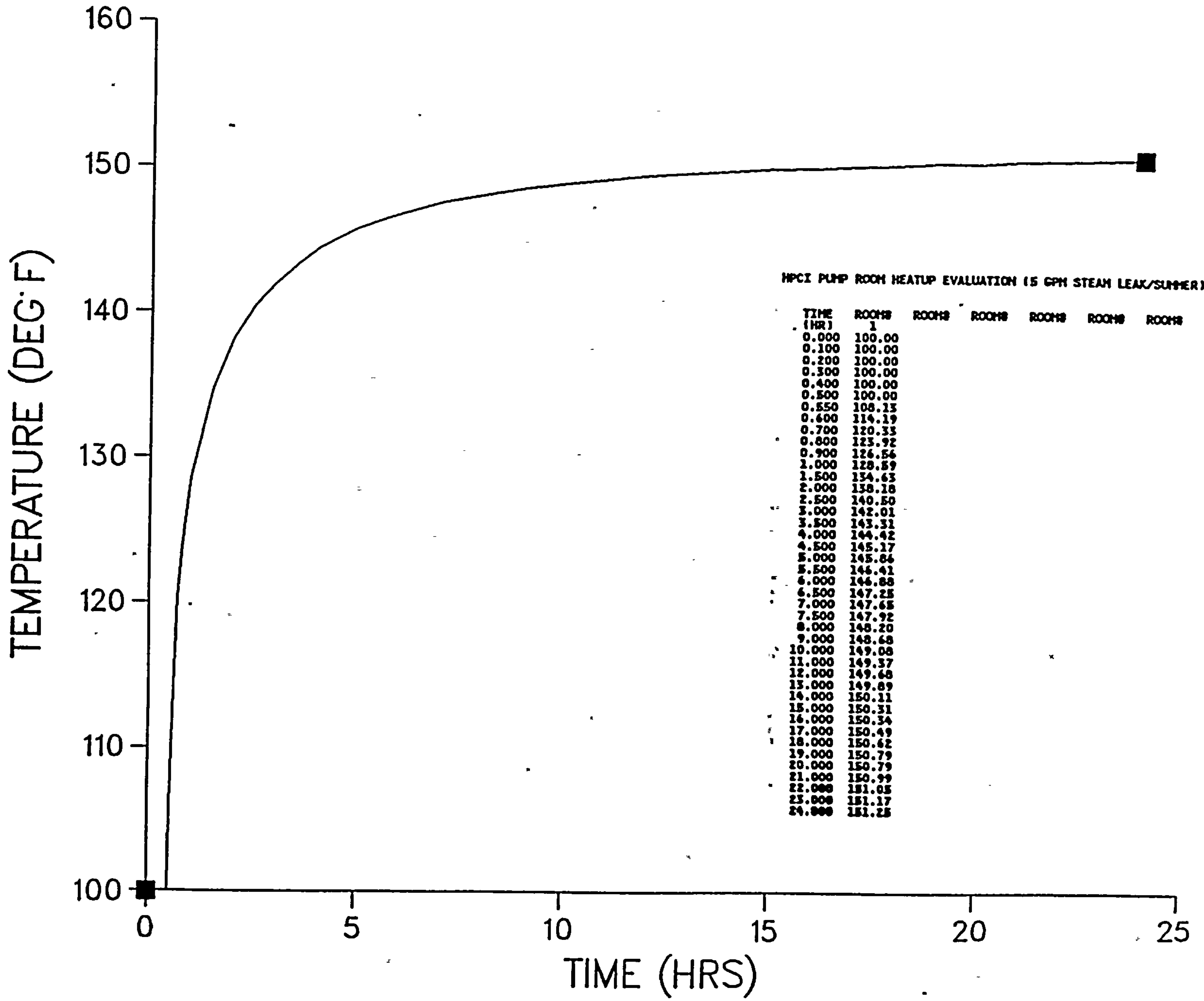
5.0 RESULTS/CONCLUSIONS

The following pages provide the temperature profiles resulting from the HPCI Pump Room model for the conditions stated below :

1) 5 gpm water equivalent steam leak (Summer)
2) 5 gpm water equivalent steam leak (Winter)
3) 25 gpm water equivalent steam leak (Summer)
4) 25 gpm water equivalent steam leak (Winter)

The COTTAP output for each case above can be found as Attachments 1 thru 4, respectively. Each output provides a summary of the data input, and the results of each time step within the 24 hour run time. At the end of each COTTAP output, a summary table of Temp vs Time information is also provided.

HPCI PUMP ROOM HEATUP EVALUATION (5 GPM STEAM LEAK/SUMMER)

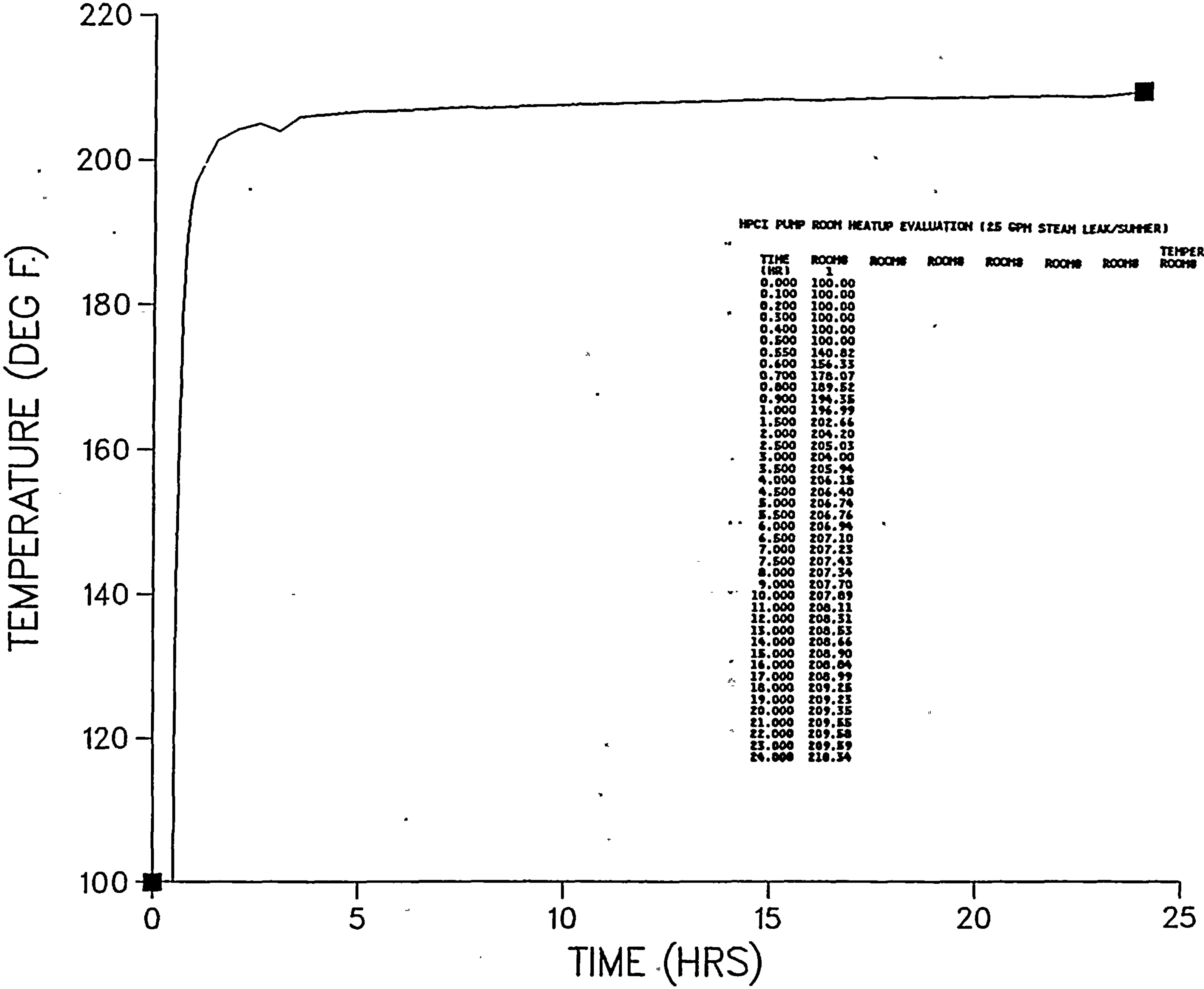


HPCI PUMP ROOM HEATUP EVALUATION (5 GPM STEAM LEAK/SUMMER)

TIME (HR)	ROOM# 1	ROOM#	ROOM#	ROOM#	ROOM#	ROOM#	TEMPERATURE (DEG F) ROOM#	ROOM#	ROOM#
0.000	100.00								
0.100	100.00								
0.200	100.00								
0.300	100.00								
0.400	100.00								
0.500	100.00								
0.550	108.13								
0.600	114.19								
0.700	120.33								
0.800	123.92								
0.900	126.56								
1.000	128.59								
1.500	134.63								
2.000	138.18								
2.500	140.50								
3.000	142.01								
3.500	143.31								
4.000	144.42								
4.500	145.17								
5.000	145.86								
5.500	146.41								
6.000	146.88								
6.500	147.25								
7.000	147.65								
7.500	147.92								
8.000	148.20								
9.000	148.68								
10.000	149.08								
11.000	149.37								
12.000	149.68								
13.000	149.89								
14.000	150.11								
15.000	150.31								
16.000	150.34								
17.000	150.49								
18.000	150.62								
19.000	150.79								
20.000	150.79								
21.000	150.99								
22.000	151.05								
23.000	151.17								
24.000	151.25								

[illegible]

HPCI PUMP ROOM HEATUP EVALUATION (25 GPM STEAM LEAK/SUMMER)



HPCI PUMP ROOM HEATUP EVALUATION (25 GPM STEAM LEAK/SUMMER)

TIME (HR)	ROOM# 1	ROOM#	ROOM#	ROOM#	ROOM#	ROOM#	TEMPERATURE (DEG F) ROOM#	ROOM#	ROOM#
0.000	100.00								
0.100	100.00								
0.200	100.00								
0.300	100.00								
0.400	100.00								
0.500	100.00								
0.550	140.82								
0.600	156.33								
0.700	178.07								
0.800	189.52								
0.900	194.35								
1.000	196.99								
1.500	202.66								
2.000	204.20								
2.500	205.03								
3.000	204.00								
3.500	205.94								
4.000	206.15								
4.500	206.40								
5.000	206.74								
5.500	206.76								
6.000	206.94								
6.500	207.10								
7.000	207.23								
7.500	207.43								
8.000	207.34								
9.000	207.70								
10.000	207.89								
11.000	208.11								
12.000	208.31								
13.000	208.53								
14.000	208.66								
15.000	208.90								
16.000	208.84								
17.000	208.99								
18.000	209.25								
19.000	209.23								
20.000	209.35								
21.000	209.55								
22.000	209.58								
23.000	209.59								
24.000	210.34								

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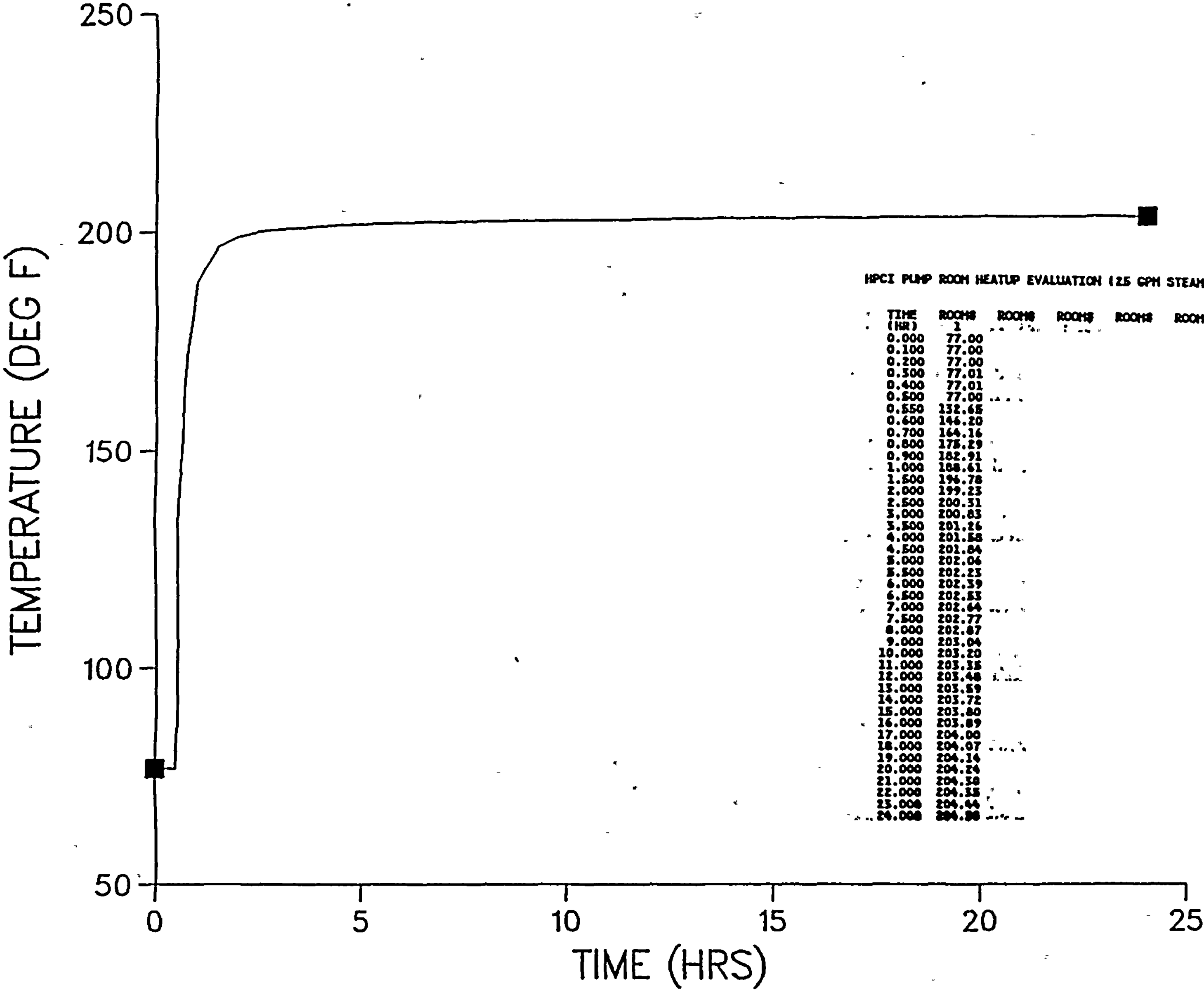
HPCI PUMP ROOM HEATUP EVALUATION (25 GPM STEAM LEAK/WINTER)



HPCI PUMP ROOM HEATUP EVALUATION (25 GPM STEAM LEAK/WINTER)

TEMPERATURE (DEG F)

TIME (HR)	ROOM# 1	ROOM#	ROOM#	ROOM#	ROOM#	ROOM#	ROOM#	ROOM#	ROOM#
0.000	77.00								
0.100	77.00								
0.200	77.00								
0.300	77.01								
0.400	77.01								
0.500	77.00								
0.550	132.65								
0.600	146.20								
0.700	164.16								
0.800	175.29								
0.900	182.91								
1.000	188.61								
1.500	196.78								
2.000	199.23								
2.500	200.31								
3.000	200.83								
3.500	201.26								
4.000	201.58								
4.500	201.84								
5.000	202.06								
5.500	202.23								
6.000	202.39								
6.500	202.53								
7.000	202.64								
7.500	202.77								
8.000	202.87								
9.000	203.04								
10.000	203.20								
11.000	203.35								
12.000	203.48								
13.000	203.59								
14.000	203.72								
15.000	203.80								
16.000	203.89								
17.000	204.00								
18.000	204.07								
19.000	204.14								
20.000	204.24								
21.000	204.30								
22.000	204.35								
23.000	204.44								
24.000	[illegible]								

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