SUMMARY

The purpose of this study is to evaluate all forced air type heating and ventilating systems at the Test Reactor Area (TRA) and determine the optimum amount of recirculation air that can be cost effectively provided for maximum energy conservation. This study determined that two of the systems are candidates for modification, the main heating and ventilating system serving the Materials Test Reactor (MTR) complex and the HVS-1 system at the Advanced Test Reactor (ATR).

The proposed modification to these two system will result in an annual energy savings of 13, 500 million Btu per year for the first three years of operation (prior to installation of the Waste Heat Recovery System) and 6,200 million Btu per year afterwards. The energy cost savings resulting from this project will be a total of $300,000 for the first three years, and $60,000 per year afterwards. The capital cost of this project is estimated to be $56,900 and discounted payback period, using the DOE life cycle costing method, is 1.3 years.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 General

A project to upgrade the heating and ventilating (H&V) systems at the Test Reactor Area (TRA) titled TRA Heating System Upgrade with Waste Heat Recovery( ) has been previously submitted and the first phase funded. This project will replace the existing steam heating system with an electric resistance heating system. As stated in the conceputal design report, several of the individual H&V systems may not be properly balanced with respect to the percentage split between outside air and recirculation air to meet present occupancy requirements.

The largest H&V systems at TRA are the forced units serving the three reactor building complexes, the Advanced Test Reactor (ATR), the Materials Test Reactor (MTR), and the Engineering Test Reactor (ETR). These three systems account for approximately 70 percent of the total annual H&V energy consumption at TRA. The design of these systems is such that during the heating season the air supplied to the buildings is made up of a percentage split of fresh outside air and building recirculation air. This percentage split and the total system air flow rate determines the amount of energy consumption. Therefore, raising the percentage of warmer recirculation air used by the system will reduce energy consumption.

1.2 Objective

The objective of this study is to evaluate all force air heating systems at TRA and determine the maximum amount of recirculation air that can be cost effectively provided within the design criteria discussed below, to describe the plant modifications required to achieve the optimum recirculation balance, and to estimate both the capital costs and the life cycle cost savings of the project.

1.3 Design Criteria

1. The H&V systems must be designed to prevent the spread of airborne radioactive contamination. Air flows will be directed from the least potentially contaminated areas thru the most potentially contaminated areas then to the exhaust stack.

2. Relative internal building pressures shall remain essentially unchanged.

3. A minimum of 15% outside shall be used for normally occupied areas.

4. Fusible link type fire dampers shall be installed in all wall penetrations where required by the Fire Code.

2.0 ENGINEERING EVALUATION

2.1 MTR Complex

The MTR reactor building (MTR 603), wing building (MTR 604) and service building (MTR 635) are served by two main H&V systems. The original MTR design criteria required 100% outside air. Since the decommissioning of the MTR this requirement no longer exists. The two H&V systems supply a total of 99,000 CFM to the three buildings. The air flow is distributed as follows: 32,700 CFM to the reactor building main floor, 28,000 CFM to the reactor building basement, 20,300 CFM to the wing building main floor, 4,000 CFM to the wing building basement, and 14,000 CFM to the service building. Figure 1 shows the air distribution and exhaust flows for these buildings. As shown, the air supplied to the reactor building basement presently flows up through the roof into the main floor. From there the air is exhausted outside through the reactor exhaust header, leaks, open doors, etc. The MTR exhaust fans were originally designed to draw air from the reactor building main floor down through the reactor shielding, for cooling, then exhaust it to the stack. Since the decommissioning of the MTR, the exhaust fans have been shut down. Installation of the PBF Test Train Assembly Facility in the reactor building basement and their associated storage of irradiated test assemblies poses the potential of releasing airborne radioactive contamination. To preclude this from migrating into other areas of the MTR complex, the Test Train Assembly group plans to reactivate a portion of the MTR exhaust system. The air supply to the basement will be reduced to 10,000 CFM and the exhaust system will exhaust it to the stack. This air flow cannot be recirculated. The wing building main floor consists of many offices and laboratories. The six laboratories located on the south end of the building each contain exhaust hoods which exhaust a maximum of 6,500 CFM. This air flow cannot be recirculated. The remaining 64,500 CFM will be recirculated reducing outside air requirements to 20 percent. Figure 1 also shows the new air flows after the recirculation modification.

2.2 ETR Complex

The ETR reactor building (TRA 642) and ETR office building (MTR 647) are served by five main H&V systems. Each of these systems are controlled by a single Supervisory Data Center (SDC). The percentage split of outside air is adjustable from 0 to 100 percent at the SDC. Therefore, no construction project for rebalancing of these systems is required.

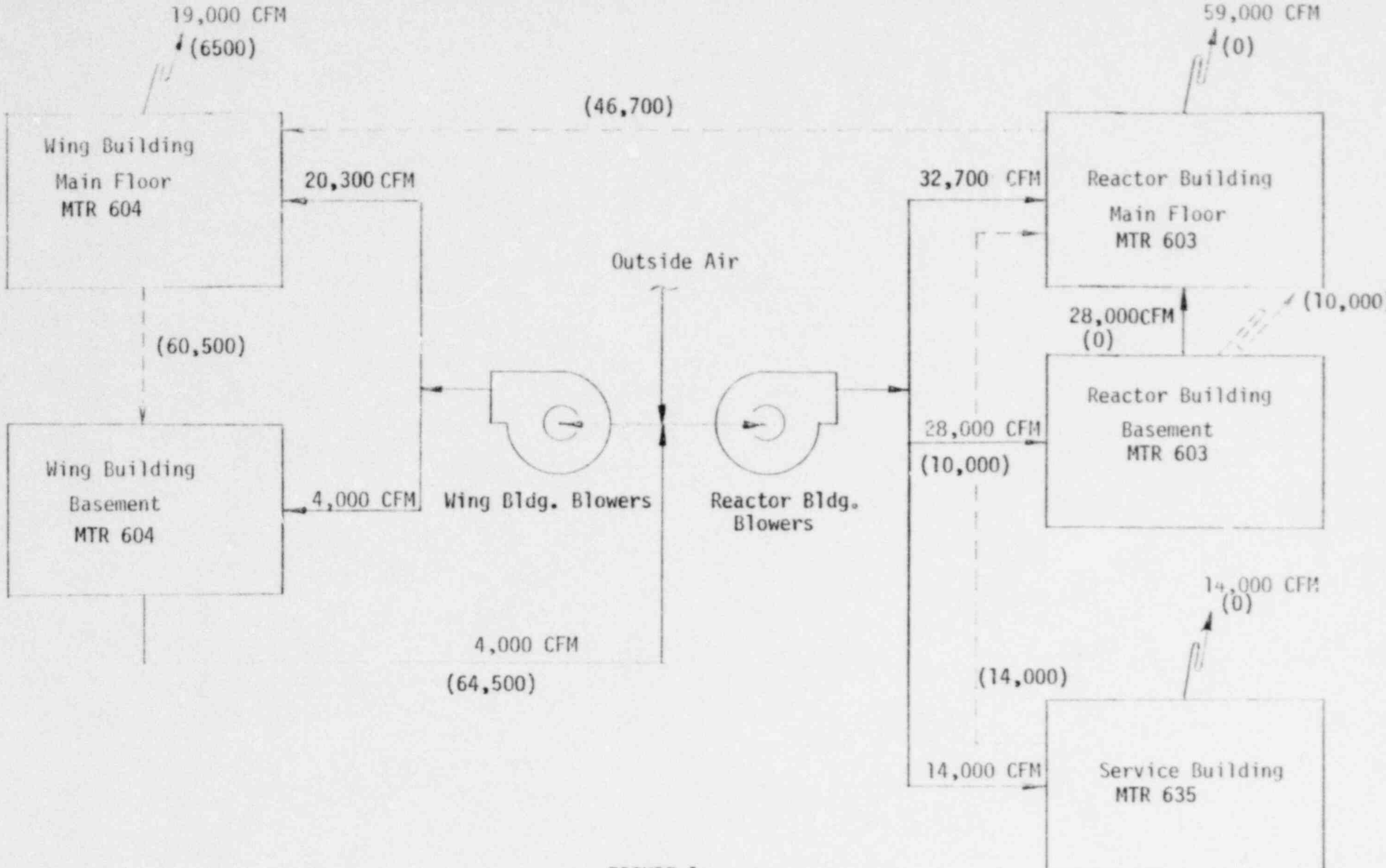


FIGURE 1
MTR COMPLEX
HEATING AND VENTILATING
AIR FLOWS

Numbers in paranthesis indicates new air flows after recirculation modification

2.3 ATR Reactor Building

The ATR reactor building (MTR 670) is served by five main H&V systems. Table 1 presents the design details for each system. Only the HVS-1 system, which draws 85 percent outside air during the heating season, would result in a significant energy savings by increasing the amount of recirculation air. This is, therefore, the only system at ATR evaluated in detail in this study. The HVS-1 system supplies a total of 64,800 CFM to the reactor building, distributed as follows: 35,000 CFM to the reactor operating area, 15,600 CFM to the first basement, and 14,200 CFM to the second basement. Figure 2 shows the air distribution and exhaust flows for this system. The operating area is the least potentially contaminated area served by the HVS-1 system. This area is therefore the only area considered for recirulation. Of the 35,000 CFM supplied to this area 10,000 CFM is presently recirculated back to the HVS-1 system, 10,000 CFM is drawn down around the reactor for cooling of the shielding concrete, and 15,000 CFM is transferred down to the primary coolant pump motor room for cooling. These two heating air flows that are presently used for cooling will be recirculated back to the HVS-1 system and their cooling function provided by outside air. The outside air requirements during the heating season will be reduced to 46 percent.

2.4 Hot Cell and Alpha Wing

The hot cell (MTR 632) and the MTR Alpha Wing (MTR 661) both require 100 percent outside air because of potential airborne radioactive contamination. These buildings will not be modified.

2.5 Outlying Buildings

Buildings MTR 605, 607, 608, 609, 610, 614, 616, 641, 643, 645, 648, 653, 656, and 669 all have forced air units with manually adjustable louvers capable of varying outside air flows from 0 to 100 percent. A construction project is therefore not required for these buildings.

The remaining buildings at TRA have either baseboard heaters or propeller type unit heaters that do not draw any outside air.

2.6 Airborne Contamination

Prevention of the spread of airborne radioactive contamination is of primary importance in the design of this project. To this end, recirculation air will not be drawn from areas that have even a moderate potential for airborne contamination. In addition, internal building pressures will not be altered where this could lead to unwanted migration of contamination.

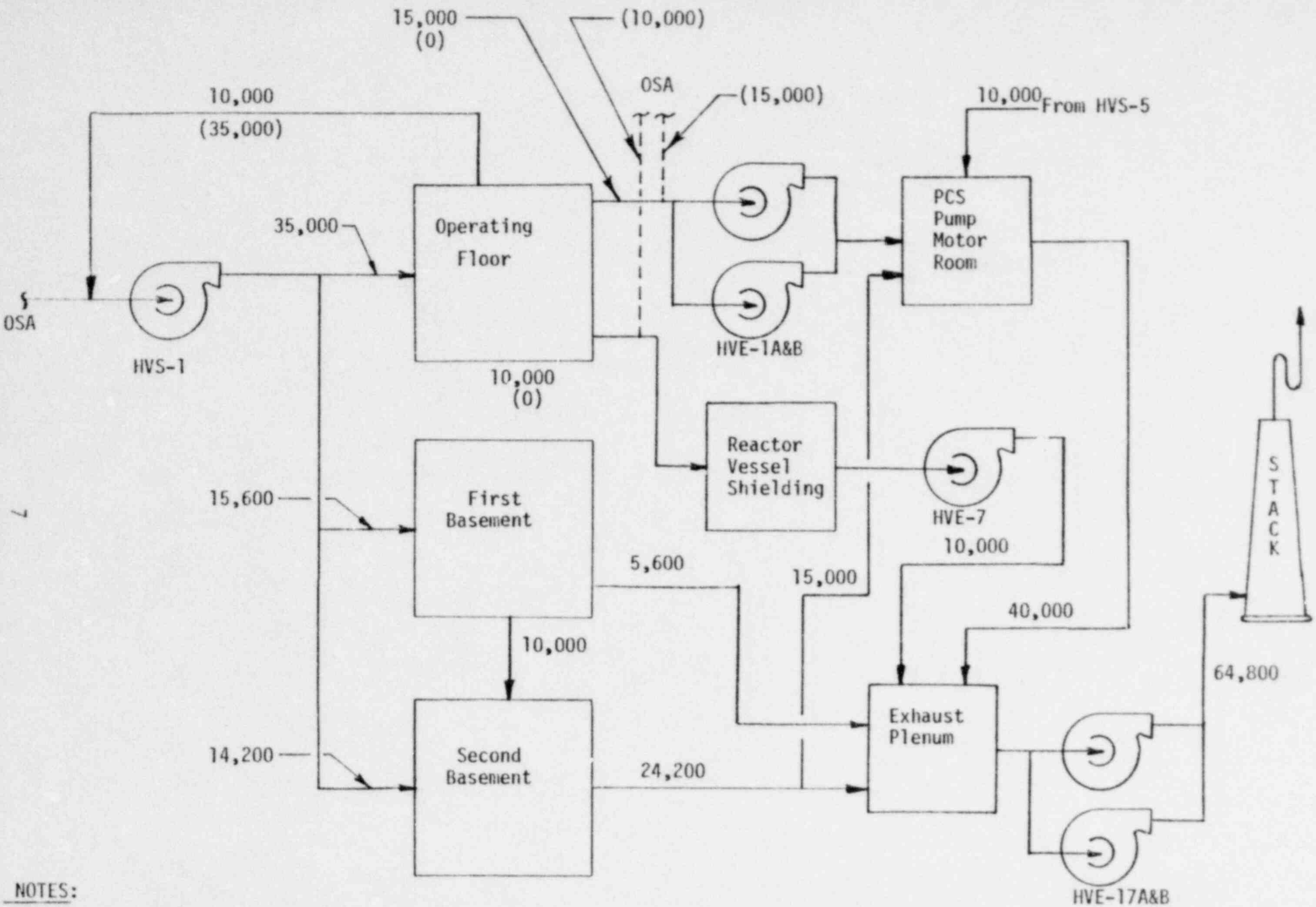
TABLE 1

ATR HEATING AND VENTILATING SYSTEMS DESIGN DETAILS[1]

SYSTEM	AIR FLOW (CFM)	PERCENT OUTSIDE AIR	DESIGN HEAT LOAD (10^6 Btu/hr)	MAXIMUM HEAT LOAD REDUCTION[2] (10^6 Btu/hr)
HVS-1	64,800	85	5.70	3.4
HVS-2	12,500	11	0.31	0
HVS-3	23,500	32	0.95	0.3
HVS-4	13,500	22	0.44	0.07
HVS-5	79,500	25	2.90	0.6

(1) Based upon a design ambient temperature of -9°F and a design discharge temperature of 85°F

(2) Assuming that outside air requirements can be reduced to 15 percent



NOTES:

1. OSA means outside air
2. All values in CFM
3. All numbers in parenthesis indicate new air flows after recirculation modification

FIGURE 2
ATR HVS-1
HEATING AND VENTILATING AIR FLOWS

2.6.1 MTR Complex

The recirculation air supply for the MTR system will come from the reactor building main floor, the service building and the wing building main floor and basement. There are presently no sources of airborne contamination in these areas. In the unlikely event that high air activity is detected, the system can be manually returned to the present condition.

2.6.2 ATR Reactor Building

The reactor operating area is the least potentially contaminated area served by the HVS-1 system. As such, this is the only area presently used as the source of recirculation air. The ATR modification will increase the recirculation air drawn from this area from 10,000 CFM to 35,000 CFM during the heating season. The additional 25,000 CFM presently used for cooling will be replaced with outside air so as not to alter internal building pressures. The new system will be designed such that it can be manually returned to the present condition in the event of high air activity. In addition, the system will be connected to the radiation monitoring system (RMS) to automatically return the system to the present condition in the event of an RMS-1 or RMS-2 signal.

2.7 Fire Protection

The integrity of the fire protection system will be maintained. All louvers or ducts penetrating a fire wall will contain fusible link type fire dampers or an equivalent.

2.8 Energy Conservation

This section discusses the reduction in the design heat load, the annual energy conservation, and annual energy cost savings as a result of this modification.

Figure 3 presents a diagram of a typical heating and ventilating system. The study in Reference (1) proposed to convert the existing steam heating system to an electric resistance heating system plus install a waste heat recovery system (WHRS) with the project to be completed in two phases. Phase 1 will convert the MTR and ETR areas to electric heating and Phase 2 will convert ATR to electric heating plus install the WHRS. Phase 1 is scheduled to be completed in 1981 and Phase 2 is scheduled to be completed in 1984. This recirculation project is scheduled for completion in 1981, concurrent with Phase 1 of the heating system upgrade. Therefore, energy savings are calculated both before and after the WHRS is installed. Since the ATR electric heating system will be installed in Phase 2 of the heating system upgrade, energy cost savings for ATR before installation of the WHRS are based upon fuel oil prices and savings afterwards are based upon electric rates. Energy cost savings for MTR are based upon electric rates only.

As shown in Figure 3 the outside air and recirculation air are combined in the inlet plenum and the resulting temperature is called the mixed air temperature. This temperature is determined from the following equation:

$$Tm = K + Tr\ (1-K)$$

Where: Tm = Mixed Air Temperature, °F

To = Outside Air Temperature, °F

Tr = Recirculation Air Temperature, °F

K = Percent Outside Air, %

The total air flow is then heated from the mixed air temperature to the discharge air temperature. The energy required to do this is determined from the following equation:

$$q = 1.09\ F\ (Td - Tm)$$

Where: q = Heat Load, Btu/hr

F = Air Flow, CFM

Td = Discharge Air Temperature, °F

The annual energy consumption is the sum of the above heat loads calculated aat all ambient temperatures from the design minimum of -9°F to the design maximum of 65°F times the annual frequency of each temperature. The annual ambient temperature frequency distribution for the INEL site is presented in Figure 4.

$$Q = \sum_{t=-9}^{65} (1.09)\ F\ (Td - Tm)\ H_t$$

Where: Q = Annual Energy Consumption, Btu/yr.

H_t= Ambient Temperature Frequency, Hrs/yr.

The annual energy savings as a result of this project is the difference between the present annual energy consumption and the consumption after this recirculation modification.

2.8.1 <u>MTR Complex</u>

Using equations (1) and (2) above and the following design data:

To = -9°F

Td = 85°F

K = 100%

F = 99,000 CFM

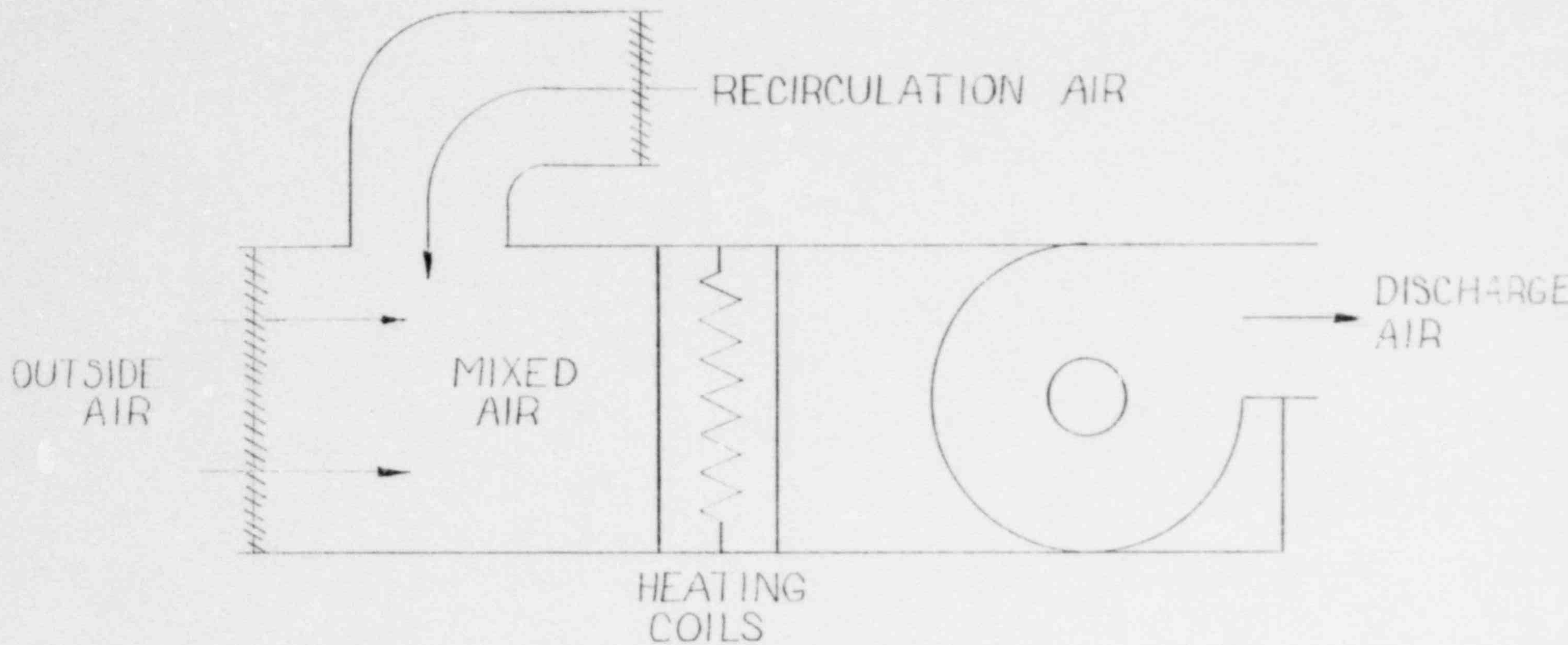
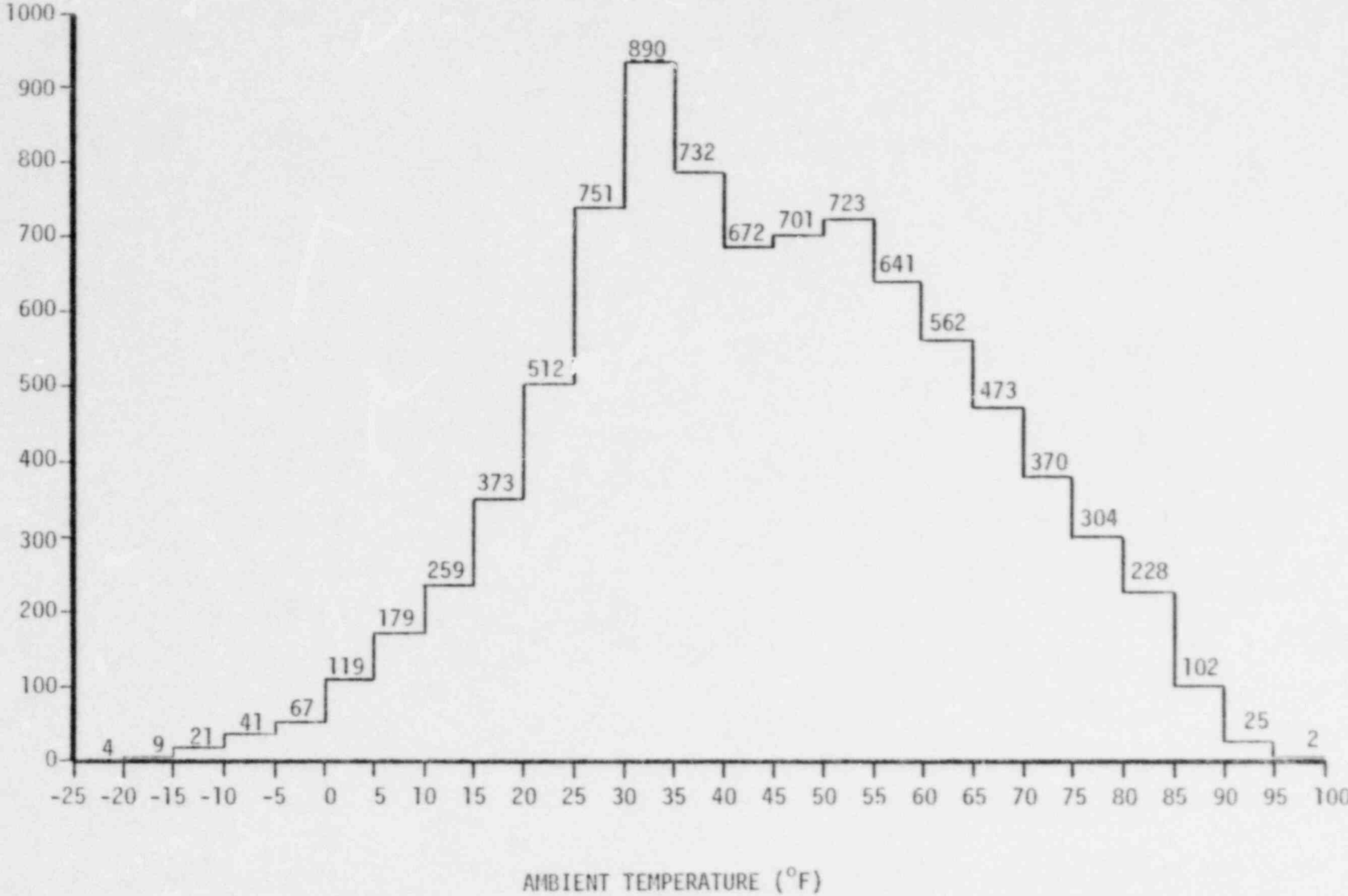


FIGURE 3

TYPICAL HEATING AND VENTILATING SYSTEM

FIGURE 4

AVERAGE YEARLY TEMPERATURE FREQUENCY
DISTRIBUTION FOR IDAHO FALLS ADJUSTED
TO REFLECT THE INEL



the design heat load prior to this modification is:

$$q = 10.15 \times 10^6 \text{ Btu/hr.}$$

After this modification outside air requirements will be reduced to 20 percent and the design heat load will be reduced to:

$$q = 4.20 \times 10^6 \text{ Btu/hr.}$$

Thus, this modification will reduce the design heat load by 5.95×10^6 Btu/hr. which is equivalent to approximately 1700 KW with the electric heating system.

Using equation (3) above the annual energy savings as a result of this project prior to installation of the WHRS is:

$$Q = 8{,}900 \times 10^6 \text{ Btu/yr.} = 2.6 \times 10^6 \text{ KWH/yr.}$$

When installed, the WHRS will supply significant percentage of the total heat load. Factoring this into the above energy savings calculations the net savins is:

$$Q = 3{,}300 \times 10^6 \text{ Btu/yr.} = 1.0 \times 10^6 \text{ KWH/yr.}$$

At the expected 1981 electric cost of 24 mils per KWH the annual savings from this system before the WHRS becomes operational is:

Savings = $62,000/yr.

The savings in 1984 when the WHRS become operational is:

Savings = $32,000

2.8.2 ATR Reactor Building

Using equations (1) and (2) above and teh following design data:

To = -9°F

Td = 85°F

K = 85%

F = 64,800 CFM

the design heat load prior to this modification is:

$$q = 5.69 \times 10^6 \text{ Btu/hr.}$$

After this modification outside air requirements will be reduced to 46 percent and the design heat load will be reduced to:

$$q = 4.01 \times 10^6 \text{ Btu/hr.}$$

Thus, this modification will reduce the design heat load by 1.68×10^6 Btu/hr which is equivalent to approximately 500 KW with the electric heating system.

Using equation (3) above the annual energy savings as a result of this project prior to installation of the WHRS is:

$$Q = 4{,}600 \times 10^6 \text{ Btu/yr.} = 54{,}000 \text{ gal fuel oil/yr.}$$

At the expected 1981 fuel oil cost of $0.52 per gallon the annual savings from this system, before the WHRS becomes operational is:

Savings = $28,000/yr.

When the WHRS begins operation the annual energy savings is reduced to:

$$Q = 2{,}900 \times 10^6 \text{ Btu/yr.} = 0.9 \times 10^6 \text{ KWH/yr.}$$

The savings in 1984 when the WHRS and ATR electric heating system become operational is:

Savings = 28,000/yr.

3.0 DESIGN DESCRIPTION

3.1 MTR Complex

3.1.1 System Function

The function of the MTR complex recirculation modification is to conserve energy by recirculating approximately 64,500 CFM of heating and ventilating air, that is presently exhausted, back to the inlet of the MTR reactor building and wing building H&V systems.

3.1.2 Engineering Description

This system will recirculate all of the air from the reactor building main floor, the service building and the wing building basement and most of the air from the wing building main floor back to the common reactor building and wing building H&V systems.

The recirculation air flow consists of 32,700 CFM from the reactor building main floor, 14,000 CFM from the service building, 13,800 CFM from the wing building main floor and 4000 CFM from the wing building basement. Air from the reactor building basement is not recirculated because of potential airborne contamination.

The new air flow paths are shown on Figure 1. Air from the service building will flow thru the always open truck door into the reactor building main floor. Approximately 50 ft^2 of louvered openings will be installed in the wall between the reactor building main floor and the wing building main floor. Approximately 60 ft^2 of louvered openings will be installed in the wing building floor to pass the air from the main floor into the basement. Fusible link type fire dampers will be installed in these louvers to prevent the migration of fire from one building or room to another. A new duct will be installed inside the inlet air plenum. The duct will run the length of the plenum to provide even air distribution and mixing with the outside air. Manually adjustable louvers will be provided on the inlet of this duct and the outside air duct.

3.2 ATR Reactor Building

3.2.1 System Function

The function of the ATR recirculation modification project is to conserve energy by recirculating an additional 25,000 CFM of heating and ventilating air back to the inlet of the HVS-1 system.

3.2.2 Engineering Description

THE HVS-1 system supplies 35,000 CFM to the reactor operating area. Of this, 10,000 CFM is drawn down between the reactor vessel and the high density concrete by the HVE-7 transfer fan for cooling of the concrete and 15,000 CFM is transferred to the primary coolant pump motor room by either of the redundant HVE-1A or 1B transfer fans for cooling of the motor room. Both of these air flows will be recirculated back to the HVS-1 system.

The existing duct returning air from the reactor operating area to the HVS-1 inlet plenum must be enlarged to approximately 30 ft^2 to allow for the increased recirculation air flow and extended the length of the inlet plenum to provide better mixing with the outside air. A new duct of approximately 8 ft^2 must be installed to supply 10,000 CFM of outside air to the nozzle trench area to replace that being recirculated. The duct will run from the south-central wall of the reactor building thru the south nozzle trench wall. Figure 5 presents the layout of this new duct. The duct must contain butterfly dampers connected to the Radiation Monitoring System (RMS) to switch from drawing outside air to reactor operating area air in the event of an RMS-1 or RMS-2 signal. In addition, the existing air flow paths from the reactor operating area into the nozzle trench must be sealed.

A new duct must be installed to supply outside air to the suction of the HVE-1A and 1B exhaust fans. The duct will run from the west wall of the reactor building along the south wall of the canal area and connect to the top of the inlet plenum. Figure 5 also presents the layout of this new duct. Butterfly dampers on both the outside air suction and the reactor operating area suction, connected to the RMS, must also be provided to switch from drawing outside air to reactor operating area air in the event of an RMS-1 or RMS-2 signal. In addition, the discharge ductwork in the pump motor room for this outside air supply must be connected to the four pump motors to duct the cold outside air directly to them for cooling. The four individual HVS-5 ducts that are presently connected to the motors must be disconnected so that this main duct exhausts into the room rather than directly to the motors. Control dampers must be installed on the four individual supply ducts to the motors, and controlled by the motor discharge air temperature. This control system will reduce outside air flow to the motors as motor discharge air temperature falls to prevent a low temperature in the motor bearings. The HVS-5 supply can be shut off during the heating season since the cold outside air will provide adequate cooling for the motors and the room. However, ventilation flow will still be required during the summer months. This would also reduce the heat load in the HVS-5 system but has not been included in the project economics.

FIGURE 5

IN PRINTING

4.0 PROJECT ECONOMICS

The total capital cost of this project is $56,500 as shown in Table 2. Details of the cost estimate are presented in Appendix I. The cost estimate includes escalation to the midpoint of construction at a compound rate of 8 percent. Section 5 presents the procurement and construction schedule.

This project will result in an annual energy cost savings of approximately $90,000 in 1981, $100,000 in 1982, and $113,000 in 1983. In 1984 the waste heat recovery system will come on line and reduce total TRA energy consumption. The energy cost savings as a result of this project will then drop to approximately $60,000 then increase at an estimated rate of 10 to 12 percent per year thereafter. In addition to energy cost savings this project will reduce the size of the electric resistance heating system by approximately 2200 KW. This will result in a capital cost savings for that project of approximately $40,000.

The primary project analysis form for energy conservation projects is contained in Appendix II. The results of this analysis show that the project has a discounted payback period of 1.3 years and a savings to investment ratio of 8.

TRA RECIRCULATION MODIFICATION

CONSTRUCTION PROJECT COST ESTIMATE
SUMMARY

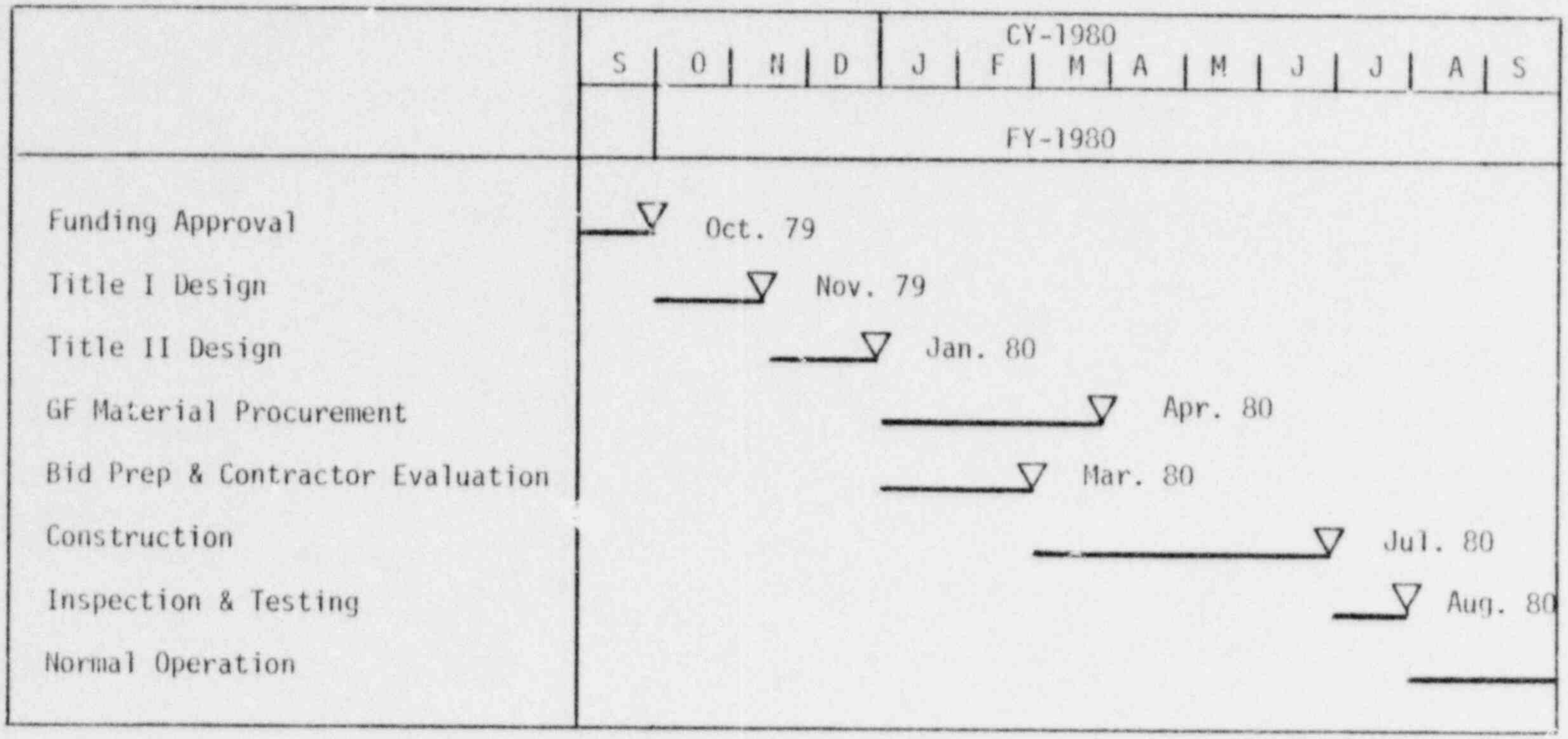
ENGINEERING, DESIGN & INSPECTION			7,000
Title I Design	2,000		
Title II Design	3,000		
Title III Inspection	2,000		
CONSTRUCTION COSTS			40,110
Direct Costs		28,650	
Improvements to Land	0		
Building & Structures (incl. Mods)	0		
Utilities	24,900		
Equipment	3,750		
Demolition & Removal	0		
Indirect Costs		11,460	
PROJECT ADMINISTRATION			3,500
Project Management	1,000		
Construction Management	1,000		
Cost/Schedule Control	200		
Subcontract Administration	400		
Quality Engineering	300		
Health - Safety	600		
CONTINGENCY			5,890
TOTAL PROJECT COST			56,500
ESCALATION (Included in Above)		8,120	
Engineering, Design & Insp.	1,600		
Construction	5,720		
Project Administration	800		

5.0 PROCUREMENT AND CONSTRUCTION SCHEDULE

This project will span a period of approximately 10 months starting from Title I design in October 1979 thru completion of construction and testing in August 1980. Construction is expected to last approximately 4 months. Figure 8 presents a bar chart showing the procurement and construction schedule.

FIGURE 8

PROCUREMENT AND CONSTRUCTION SCHEDULE



6.0 CONCLUSIONS AND RECOMMENDATIONS

This project, which consists of separate systems for the MTR complex and the ATR reactor building, will result in an annual energy savings of 13,500 million Btu/yr prior to installation of the Waste Heat Recovery System and 6,200 million Btu/yr afterwards. This project is scheduled to be completed in 1981, concurrent with the electric resistance heating system at MTR. The electric resistance heating system at ATR along with the WHRS at both ATR and MTR is scheduled to be completed in 1984. This project will conserve 162,000 gallons of fuel oil plus 7.8 million KWH in the first three years of operation. This energy savings results in a real cost savings of $300,000 for the first three years. After 1984 this project will conserve 1.8 million KWH per year, resulting in a real annual energy cost savings of $60,000 per year in 1984 and increasing by an estimated 10 to 12 percent per year thereafter.

The capital cost of this project is $56,500. The discounted payback period is 1.3 years. In addition, this project will result in a capital cost savings on the TRA electric resistance heating system of approximately $40,000 by reducing the heating coil sizes by 2200 KW.

It is recommended that this project be implemented.

REFERENCES

1. Conceptual Design Report for TRA Heating System Upgrade with Waste Heat Recovery, Technical Report No. RE-D-77-212, Rev. 1, January 1978

APPENDIX I

COST ESTIMATE DETAILS

EG&G Idaho, Inc.

Detailed Cost Estimate: Feasibility
(Type of estimate, ie., conceptual, Title I, etc.)

Date: 9-29-78
Page 1 of 5

Project or Description: MTR Complex Recirculation

Location: TRA   Requested By: R. L. Pierce

Prep By: R. D. Bremm
Chk'd/Appr'd By: M. J. Schell

SOURCE OF ESTIMATE
(E) Engr. Est.
(V) Vendor
(P) Pur. Order
(H) Handbook Ref.

FORM EG&G-588
(Rev. 12-76)

Acct. No.	Description	Source	Material Quantity & Units	Mat'l Unit Cost	Unit Labor Hours	Total Labor Hours	Labor Rate	Labor Cost	Material Cost	Other Cost	Total Cost
	603 to 604 louver	E	$50 ft^2$			40	14	560	200		760
	604 main floor to bsmt. louver	E	4 ea						400	2,000	2,400
	Fusible link fire dampers	E	8 ea	100	4	32	14	450	800		1,250
	Duct	H	50ft	10	2	100	14	1,400	500		1,900
	Dampers	H	2	375	10	20	14	280	750		1,030
	Diffusers	H	6	70	1	6	14	85	420		505
	Totals							2,770	3.070	2,000	7,845

EG&G Idaho, Inc.

Detailed Cost Estimate: Feasibility
(Type of estimate, ie., conceptual, Title I, etc.)

Date: 9-29-78
Page 2 of 5
Prep. By: R. Bromm
Chk'd/Appr'd. By: M. J. Schell

Project or Description: Recirculation Upgrade
Location: ATR
Requested By:

SOURCE OF ESTIMATE
(E) Engr. Est.
(V) Vendor
(P) Pur. Order
(H) Handbook Ref.

FORM EG&G-588
(Rev. 12-76)

Acct. No.	Description	Source	Material Quantity & Units	Mat'l Unit Cost	Unit Labor Hours	Total Labor Hours	Labor Rate	Labor Cost	Material Cost	Other Cost	Total Cost
	ATR SUMMARY										
	Ductwork							3150	1180		4330
	Fittings							340	135		475
	Dampers							1050	1005		2055
	Diffusers							90	305		395
	Controls							1350	350	3000	4700
	Miscellaneous							1500	-	2000	3500
	Total Direct Cost							7480	2975	5000	15,455

EG&G Idaho, Inc.

Detailed Cost Estimate: Feasibility
(Type of estimate, ie., conceptual, Title I, etc.)

Date: 9-29-78

Prep. By: R. Bromm

Chk'd/Appr'd By: M. J. Schell

Project or Description: Recirculation Upgrade

Location: ATR   Requested By:

SOURCE OF ESTIMATE
(E) Engr. Est.
(V) Vendor
(P) Pur. Order
(H) Handbook Ref.

FORM EG&G-588
(Rev. 12-76)

Acct No.	Description	Source	Material Quantity & Units	Mat'l Unit Cost	Unit Labor Hours	Total Labor Hours	Labor Rate	Labor Cost	Material Cost	Other Cost	Total Cost
15-9	DUCTWORK										
	36 x 51 x 24 Ga	H	35 ft	5.66	1	35	15	525	200		725
	33 x 36 x 24 Ga	H	105 ft	4.49	0.8	85	15	1275	470		1745
	60 x 72 x 22 Ga	H	50 ft	10.12	1.8	90	15	1350	510		1860
15-9	FITTINGS										
	33 x 36 90° Elbows	H	7 ea	13.5	2.4	17	15	250	100		350
	36 x 51 90° Elbows	H	2 ea	17.0	3.0	6	15	90	35		125
15-9	DAMPERS										
	33 x 36	H	1 ea	112	10	10	15	150	110		260
	36 x 51	E	1 ea	253	10	10	15	150	255		405
	36 x 72	E	1 ea	374	10	10	15	150	375		525
	12 x 24	E	4 ea	66	10	40	15	600	265		865

EG&G Idaho, Inc.

Detailed Cost Estimate: Feasibility
(Type of estimate, ie., conceptual, Title I, etc.)

Date: 9-29-78

Project or Description: Recirculation Upgrade

Location: ATR

Requested By:

Prep By: R. Bromm

Chk'd/Appr'd By: M. J. Schell

SOURCE OF ESTIMATE

(E) Engr. Est.
(V) Vendor
(P) Pur. Order
(H) Handbook Ref.

FORM EG&G-588
(Rev. 12-76)

Acct No.	Description	Source	Material Quantity & Units	Mat'l Unit Cost	Unit Labor Hours	Total Labor Hours	Labor Rate	Labor Cost	Material Cost	Other Cost	Total Cost
15-9	DIFFUSERS										
	33 x 36	H	2 ea	70.50	1	2	15	30	140		170
	36 x 51	E	1 ea	90.00	1	1	15	15	90		105
	12 x 24	H	4 ea	19.50	0.75	3	15	45	75		120
	CONTROLS										
15-11	Control System	H	6 ea							3000	3000
16-10	Wiring 2/c #14	H	1000 ft	0.11	.01	10	15	150	110		260
15-66	Pneumatic Tubing	H	1000 ft	0.24	.08	80	15	1200	240		1440
	MISCELLANEOUS										
	Rework PCS Motor Ducts	E	4 ea	-0-	20	80	15	1200			1200
	Seal Nozzle Trench Holes	E	Lot	-0-	20	20	15	300			300
	Concrete Coring	E	1							2000	2000

EG&G Idaho, Inc.

Detailed Cost Estimate: Feasibility
(Type of estimate, ie., conceptual, Title I, etc.)

Date: 9-29-78

Page 5 of 5

Project or Description: Recirculation Upgrade

Prep. By: R. Bromm

Location: MTR

Requested By:

Chk'd/Appr'd. By: M. J. Schell

SOURCE OF ESTIMATE
(E) Engr. Est.
(V) Vendor
(P) Pur. Order
(H) Handbook Ref.

FORM EG&G-588
(Rev. 12-76)

Acct. No.	Description	Source	Material Quantity & Units	Mat'l Unit Cost	Unit Labor Hours	Total Labor Hours	Labor Rate	Labor Cost	Material Cost	Other Cost	Total Cost
15-9	DUCTWORK 60x90x18 ga.	H	235 ft	17	2.3	540	15	8100	4000		12100
15-9	FITTINGS, 90° Elbows	H	6	51	1.92	11-1/2	15	180	300		480
15-9	DAMPERS										
	36x36 Face	H	8	136.				incl.	1100		1100
	96x96 Face	E	1	500				incl.	500		500
15-9	DIFFUSERS	E	8	70.5	1	8	15	120	565		685
15-9	CONTROLS	H	Lot							500	500
	CONCRETE CORING	E	2							4000	4000

APPENDIX II

PRIMARY PROJECT ANALYSIS FORM

APPENDIX II

PRIMARY PROJECT ANALYSIS FORM

ENERGY CONSERVATION PROJECTS

Project Title TRA RECIRCULATION MODIFICATION Date September 29, 1978

Plant/Lab/or Energy Research Center INEL

Building(s) Affected MTR 603, 604, 635, 670

Conducted By R. D. Bromm Approved By

Description of Baseline Condition:	Description of ENCOP:
Existing Heating and Ventilating System	Increase recirculation air flows to affected buildings H&V systems

INVESTMENT ANALYSIS SUMMARY

Incremental Present Value of Investment	62,200
Present Value of Life Cycle Cost Savings	500,500
Amount of Budget Request in FY 80	62,500
Billions of BTUs Saved Per Year	0.135
Savings/Investment Ratio	8.05
Discounted Payback Period	1.3 yrs
Annual BTU Savings/Annual Discounted Investment Dollar	520,260

SENSITIVITY ANALYSIS SUMMARY

Category Subject to Sensitivity Test ______________________

Sensitivity Condition ______________________

EFFECT	System	Present Value of Variable		Change In LCC Savings	Resultant Savings/ Investment Ratio
		Before Sensitivity	After Sensitivity		
	ENCOP				

MEASUREMENT STATISTICS

INEL ENCOP

A. Savings/Investment Ratio

Net Present Value of LCC Savings		Incremental Present Value of Investment		Savings/Investment Ratio
$500,500	÷	62,200	=	8.05

B. Annual BTU Savings Per Annual Discounted Investment Dollar

Step 1.

Present Value of Investment		Economic Life of Investment		Annual Discounted Investment Dollar
62,200	÷	25	=	2488

Step 2.

Annual BTU Savings		Annual Discounted Investment Dollar		Annual BTU Savings/ Annual Discounted Investment Dollar
13,500,000,000	÷	2488	=	520,260

Page 1 of Work Sheet 4

Calculate Energy *Savings* of the Baseline

Year	Energy Source A Fuel Oil Consumption in 10^6 BTUS	Cost Per 10^6 BTU	Total 1000 $	Differential Escalation Factor	Present Value $	Energy Source B Electricity Consumption in 10^6 BTUS	Cost Per 10^6 BTU	Total 1000 $	Differential Escalation Factor	Present Value 6000 $
1	4600	3.33	15.3	0.982	15.0	8900	4.40	39.2	0.961	37.7
2	4600	3.33	15.3	0.964	14.8	8900		39.2	0.923	36.2
3	4600	3.33	15.3	0.946	14.5	8900		39.2	0.887	34.8
4						6200		27.3		
5										
6										
7										
8										
9										
10										
11										
12										
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14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25						6200	4.40	27.3	12.74	347.8
Total					44.3					456.5

Page 1 of Work Sheet 2

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