VOLUME I

EXECUTIVE SUMMARY

ENERGY ENGINEERING ANALYSIS PROGRAM

UMATILLA ARMY DEPOT, OREGON

FINAL REPORT

Prepared Under the Direction of
Department of the Army
Sacramento District, Corps of Engineers
Sacramento, California

28 December 1983

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1.0 INTRODUCTION

1.1 CONTRACT OBJECTIVE

This report is submitted in accordance with the Phase III requirements of Contract No. DACA05-81-C-0138 for the Energy Engineering Analysis Program for the Umatilla Depot Activity (UMDA) near Hermiston, Oregon. This study was performed in accordance with the Energy Conservation Investment Program (ECIP) Guidance issued by the Department of the Army, Office of the Chief of Engineers dated revised 31 December 1982. The governing Supplemental Scope of Work was revised by the Sacramento District Corps of Engineers as of 11 June 1982, 9 July 1982, 14 January 1983 and 8 April 1983. The contract objective is to develop a systematic plan of projects that will result in the reduction of energy consumption in compliance with the objectives set forth in the Army Facilities Plan (dated 26 October 1981) without decreasing the readiness posture of the Army.

1.2 PHASES

The contract is structured into three phases:

PHASE I: Data Gathering and Field Trips

PHASE II: Analysis of Data, Identification of Energy Conservation Measures, feasibility and economic evaluations and preparation of first pages of DD Forms 1391.

PHASE III: Preparation of complete DD Forms 1391, Project Development Brochures and documentation of final results and recommendations.

1.3 WORK INCREMENTS

The original scope of work included only Increments A, B, and G of the General Scope of Work. However, the scope was subsequently expanded to include Increment F, which was accomplished between Phases II and III. Increment A projects involve modifying, improving or retrofitting existing buildings. Increment B conservation projects involve utilities and energy distribution systems, Energy Monitoring and Control Systems for building and distribution systems, and existing energy plants. Increment G conservation projects are those projects identified under Increments A and B, which qualify under ECIP economic criteria, but which do not meet the minimum ECIP funding limit ($200,000). Increment F projects are those no cost/low cost recommendations for modifications in equipment and facilities which are within the Facilities Engineer funding authority and management control.

1.4 REPORT OVERVIEW

This report is a Basewide Energy Study and represents all work completed under the above referenced contract. It includes a narrative summary of conclusions and recommendations together with all raw and supporting data, methods used and sources of information. DD Forms 1391 and Project Development Brochures (PDB's) are included for individual projects or aggregate projects as directed by the Corps of Engineers Project Manager. The program documents are complete and ready for signature by the UMDA commander. Due to the volume of data involved, separately bound volumes are included for the following report sections.

Volume I---Executive Summary
Volume II--Narrative Report
Volume III-Appendices
Volume IV--Programming Documents
Volume V---Increment F Report
Volume VI--Increment F Report Appendices
Volume VII-Survey Data Forms

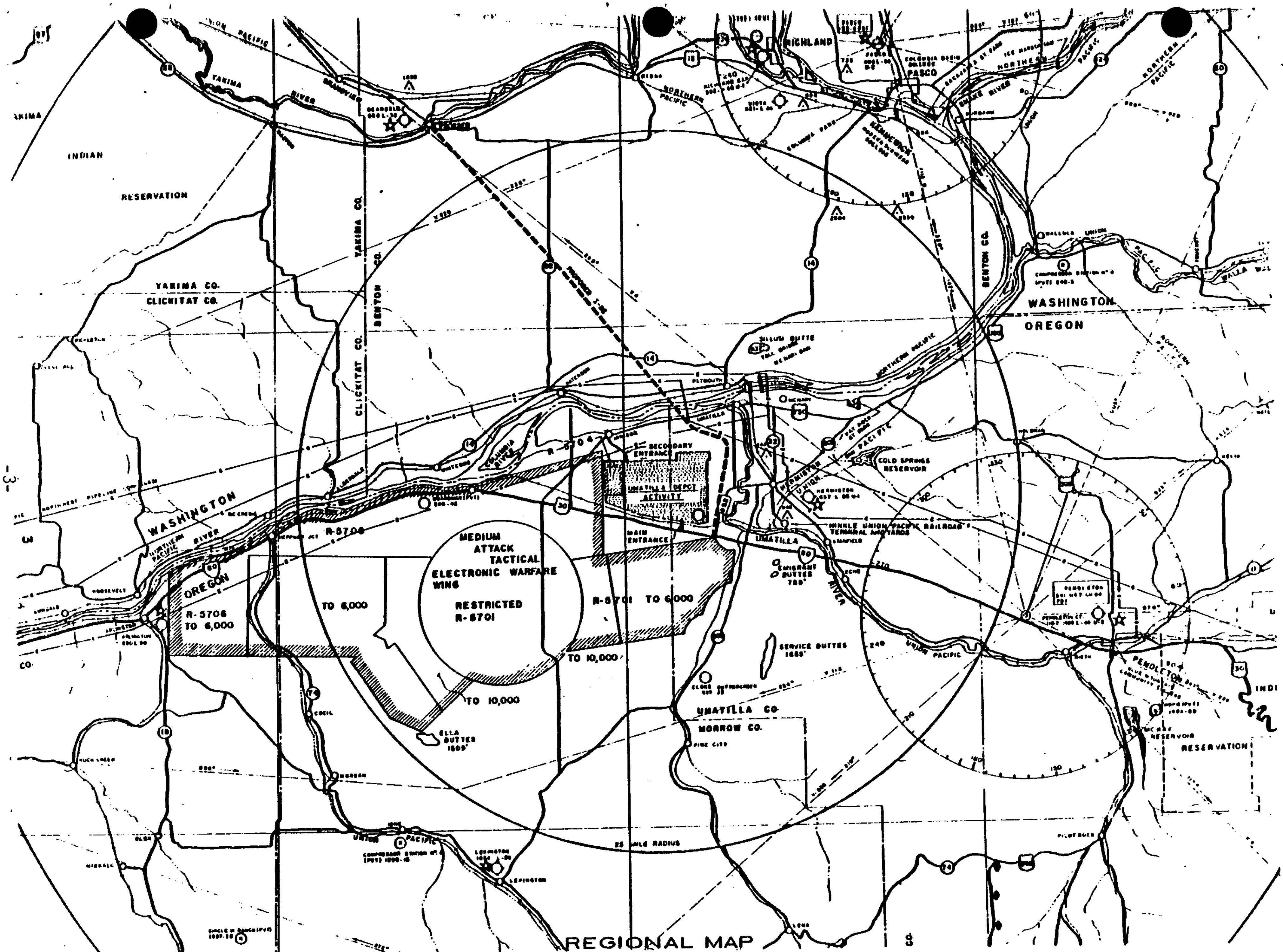
2.0 BACKGROUND

2.1 UMDA MISSION

The mission of the UMDA is to operate a reserve storage depot activity under the command of Tooele Army Depot providing for care, preservation, and minor maintenance of assigned commodities. To provide limited maintenance to preclude deterioration of activity facilities and to retain shipping and receiving capabilities for assigned commodities.

2.2 UMDA HISTORY

In 1940 the Office of Chief of Ordinance initially acquired 16,000 acres of semi-arid desert near the south shore of the Columbia River approximately 280 miles inland from the Pacific Ocean. A regional map showing location of the UMDA (45° 50'N, 119° 30' W) is shown as Figure 2.1. Construction work began in January 1941 which included the first increment of an eventual total of 1,016 ammunition storage magazine. Demands placed upon the Depot were high during World War II, the Korean conflict and the Vietnam War, requiring round the clock work shifts. Between 1957 and 1960 4,000 acres of land were acquired for



REGIONAL MAP

FIGURE 2.1

safety zones, bringing it to its present size of nearly 20,000 acres. A general site map of the UMDA is shown as Figure 2.2 In 1962 a new mission of receipt, storage, issue and normal maintenance of chemical toxic munitions was added to Depot activities. In August of 1973 the installation was assigned as an activity of Tooele Army Depot. Over the years, UMDA's missions have remained essentially the same, although recent reductions in personnel and funding have caused reductions in scope. During World War II its peak civilian population reached 2,037 workers compared to recent work forces of approximately 300.

2.3 ENERGY PERSPECTIVE

Recent UMDA annual facility energy consumption has been relatively small compared to other large DOD installations. For example, its current annual energy consumption is only approximately 7% of that of its parent organization, Tooele Army Depot in Tooele, Utah (Reference 1). Indeed, many large commercial or institutional buildings use more energy than does the entire UMDA.

The baseline year (FY75) energy consumption was approximately 58,115 MBTU which corresponded to 26,380 MBTU/GSF. Compared to the baseline year, FY81 energy consumption dropped by only approximately 5.8%. However, no major energy conservation projects had been accomplished at UMDA until an "Insulate Buildings" project was implemented at the end of FY81. Also, the manning level in FY81 was 56% higher than in FY75, indicating increased activity. Therefore, the 5.8% decrease does reflect the effects of small conservation measures resulting from heightened energy conservation awareness at UMDA over the period.

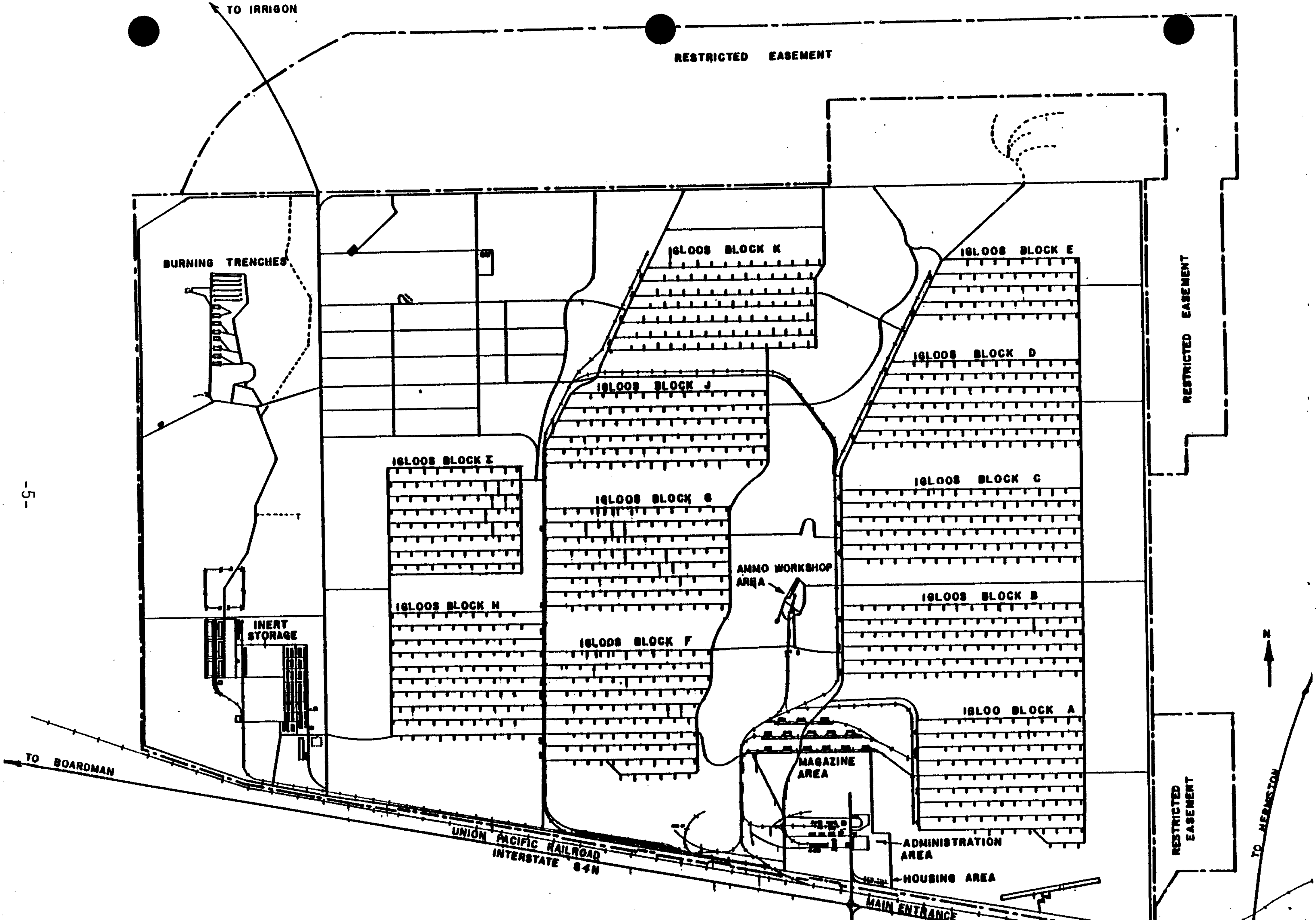
2.4 ENERGY GOALS

This study is designed to help reduce the UMDA energy consumption in accordance with the goals set forth in the Army Facilities Energy Plan dated 26 October 1981. The goals set forth in this plan are (1) reduce baseline FY75 total facilities energy consumption (BTU) 20 percent by FY85 and 40 percent by FY2000, (2) develop the capability to use synthetic gases by FY2000, and (3) reduce heating oil consumption 75 percent by FY2000. However, the previous edition of the Army Facilities Energy Plan (dated 1 October 1978) also set energy reduction goals in terms of BTU's per gross square foot of active building floor space. This report considers both perspectives.

3.0 ENERGY CONSUMPTION

3.1 HISTORICAL ENERGY USE

Table 3.1 shows the usage history of the three principal energy types consumed at the UMDA since FY75. As stated previously, annual facility energy consumption at the depot is rather small when compared to other DOD installations of its size or even compared to large commercial buildings. Total energy costs have been on the order of only $250,000 per year.



UMATILLA DEPOT ACTIVITY

SITE MAP

Figure 2.2

In the baseline year FY75, the total active facility area was 2,203,000 GSF (Reference 2) which implies a total energy consumption for that year of 26,380 BTU/GSF. FY81 total active facility area (including storage igloos) was 2,988,325 GSF (Reference 3) which implies an energy consumption rate of 18,311 BTU/GSF. On this basis, FY81 energy consumption was down by 30.6 percent from FY75.

Total energy consumption in FY81 was 5.8 percent less than that of the baseline year FY75. Although FY82 is not yet complete at this writing, FY82 energy usage is estimated from the most current energy records (Reference 4) to be approximately 53,705 MBTU's (± 1.8%). This reflects a decrease of approximately 7.6 percent from the FY75 baseline year.

TABLE 3.1

Historical Energy Consumption at UMDA Since FY75

	#2 Oil (MBTU)	#5 Oil (MBTU)	Electricity (KWH)	Electricity (MBTU*)	Total (MBTU)
FY75	20,242	13,945	2,062,800	23,928	58,115
FY76	11,447	8,961	2,033,800	23,592	44,000
FY77	14,558	9,795	2,248,200	26,079	50,432
FY78	18,854	9,202	2,264,400	26,267	54,323
FY79	16,651	18,229	2,616,600	30,353	65,233
FY80	15,564	13,578	2,475,000	28,710	57,852
FY81	14,396	12,542	2,395,000	27,782	54,720
FY82**	11,848	13,163	2,473,600	28,694	53,705

*Assuming 11,600 BTU/KWH conversion factor

**(July, August and September values are projected estimates only)

3.2 ENERGY PROFILES

The following breaks down FY81 energy consumption by energy source and application in order to provide a quick perspective on usage patterns and to provide a tool for future energy planning.

The three principal energy sources currently used at the UMDA are electricity and #2 and #5 oil. Electricity is used primarily for lighting, auxiliary heating pumps, fans and controls, process applications, housing appliances, and domestic water heating. Oil is used almost exclusively for space heating--no process steam is currently used, with the exception of occasional asphalt storage tank heating. Propane use is negligible and ground fuel is not included in this study.

Figures 3.1 and 3.2 provide three year monthly energy use profiles for the primary fuels consumed, i.e., oil and electricity. The electrical energy consumption profile is given in terms of MBTU's as converted by the factor 11,600 BTU/KWH in keeping with U.S. Army policy.

Annual oil and electricity use data was obtained from UMDA records. Also, available oil use records by buildings were used in the analysis. However, because very little electric energy metering occurs at UMDA, electrical load breakdown by building and by application was derived by carefully analyzing all electrical loads discovered during the survey and estimating hours of operation for each. Where electrical energy consumption was metered, e.g., in the case of ground water pumps, available data was incorporated. A large building/application electrical load matrix was thus developed which formed the basis for the following.

3.2.1 Basewide Energy Usage

Figure 3.3 displays FY81 energy use percentages by source and by application on an MBTU basis. Electrical KWH hours consumed were converted by 11,600 BTU/KWH (which takes into account electric power plant conversion efficiency of fuel input to electrical energy output) as per Army directive, even though all electrical energy purchased by the UMDA is either hydro-electric or nuclear generated.

As shown in Figure 3.3b heating is by far the largest single load. Although lighting levels are moderate and closely controlled, lighting is the second largest load since it is virtually a constant year-round demand. The housing load is an estimate which does not include oil furnace firing but includes all other electrical loads.

"Process" energy is that electrical energy which explicity satisfies a mission requirement, e.g., air compressors, conveyor motors, other miscellaneous motors, etc. Lighting, domestic hot water heating or water pumping associated with mission buildings are not included in the "process" energy category. Therefore, "process" energy used exclusively for mission purposes such as ammunition maintenance is a rather small percentage of the total.

The cooling load includes operation of several small air conditioners and many evaporative coolers. It is clearly not a major consideration at UMDA. This is largely responsible

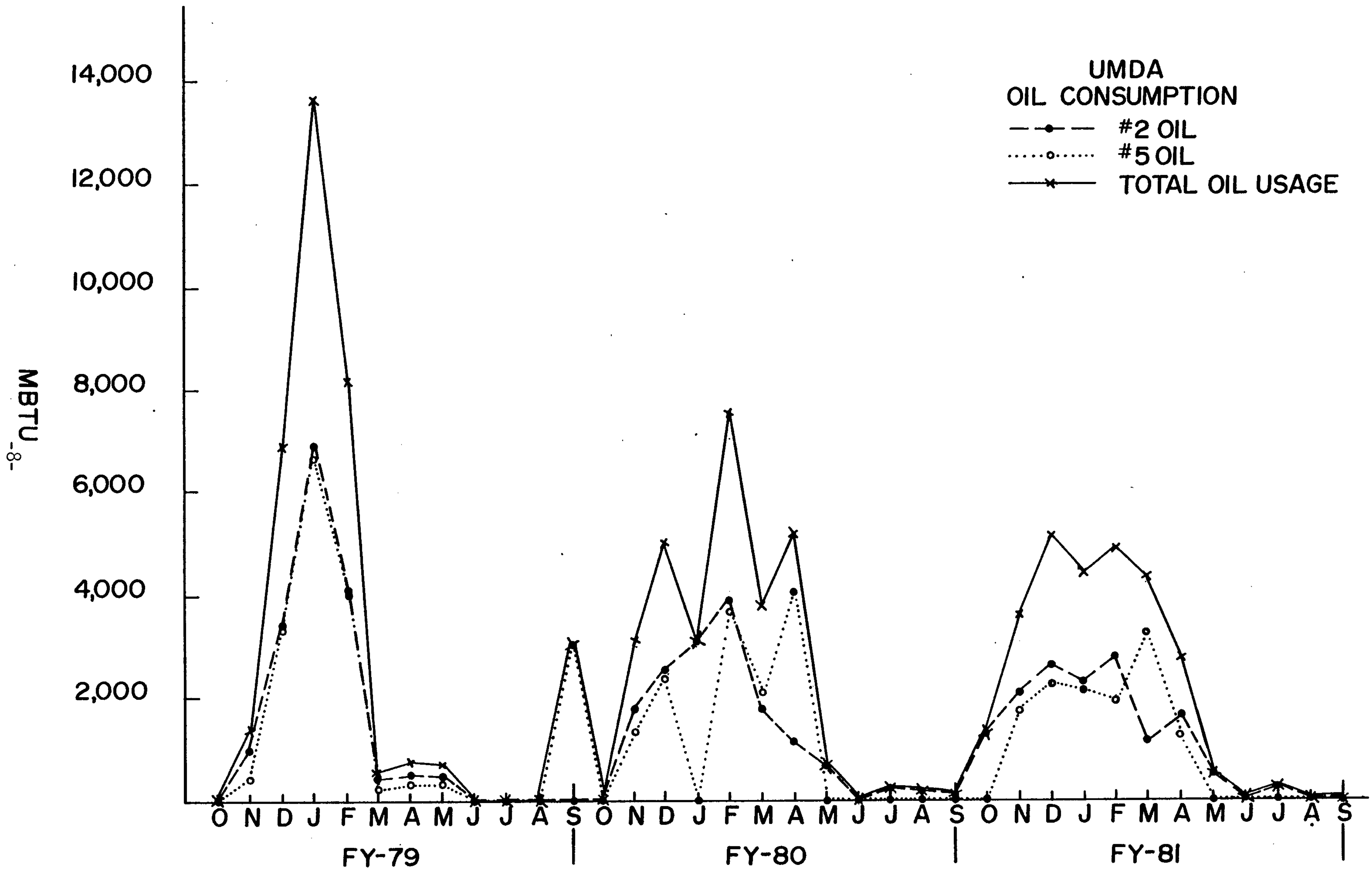


Figure 3.1 OIL CONSUMPTION PROFILE

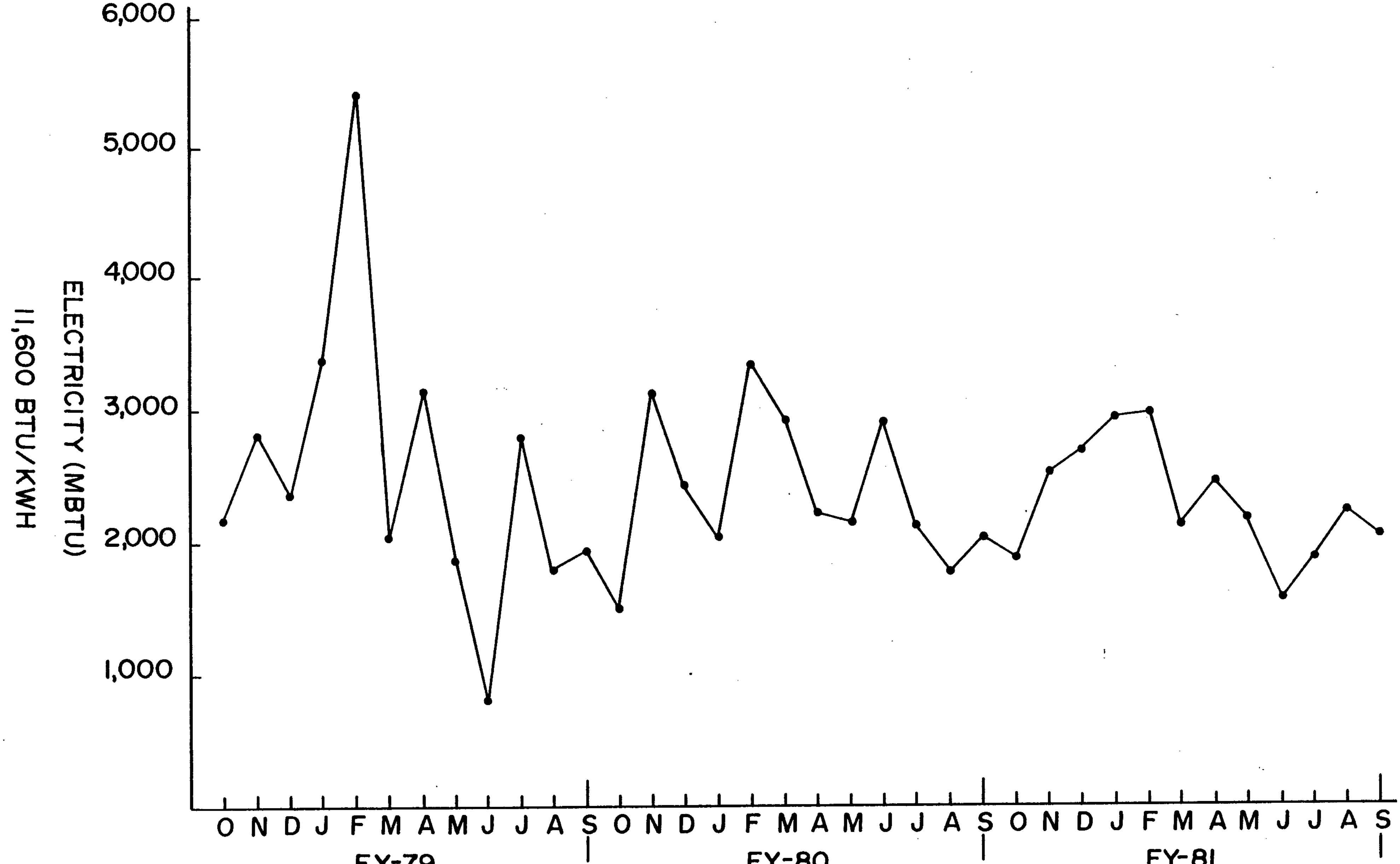


Figure 3.2 ELECTRICAL ENERGY CONSUMPTION PROFILE

Figure 3.3 Basewide FY-81 Relative Energy Consumption Profiles

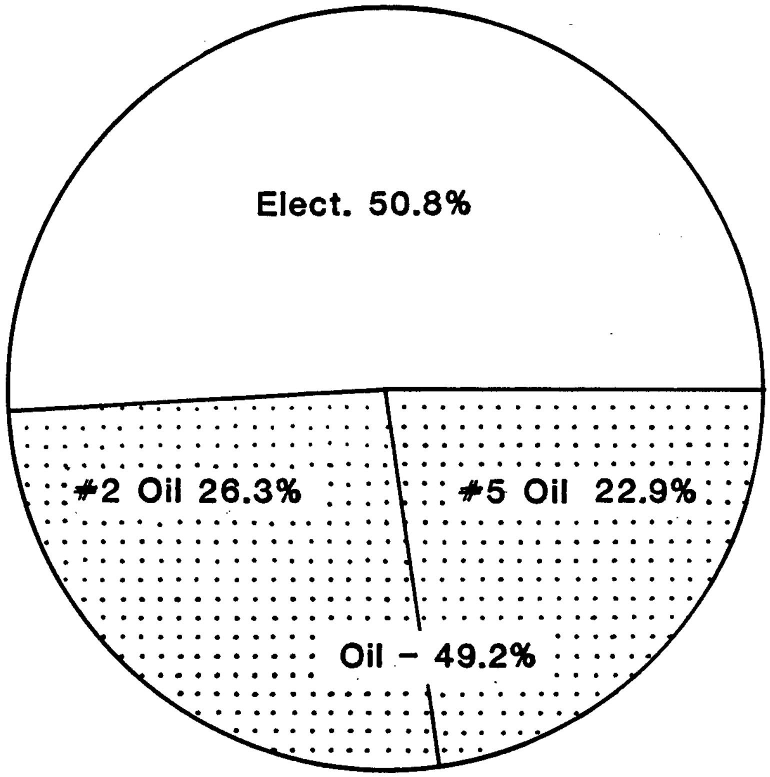


Figure 3.3a:

Energy Source

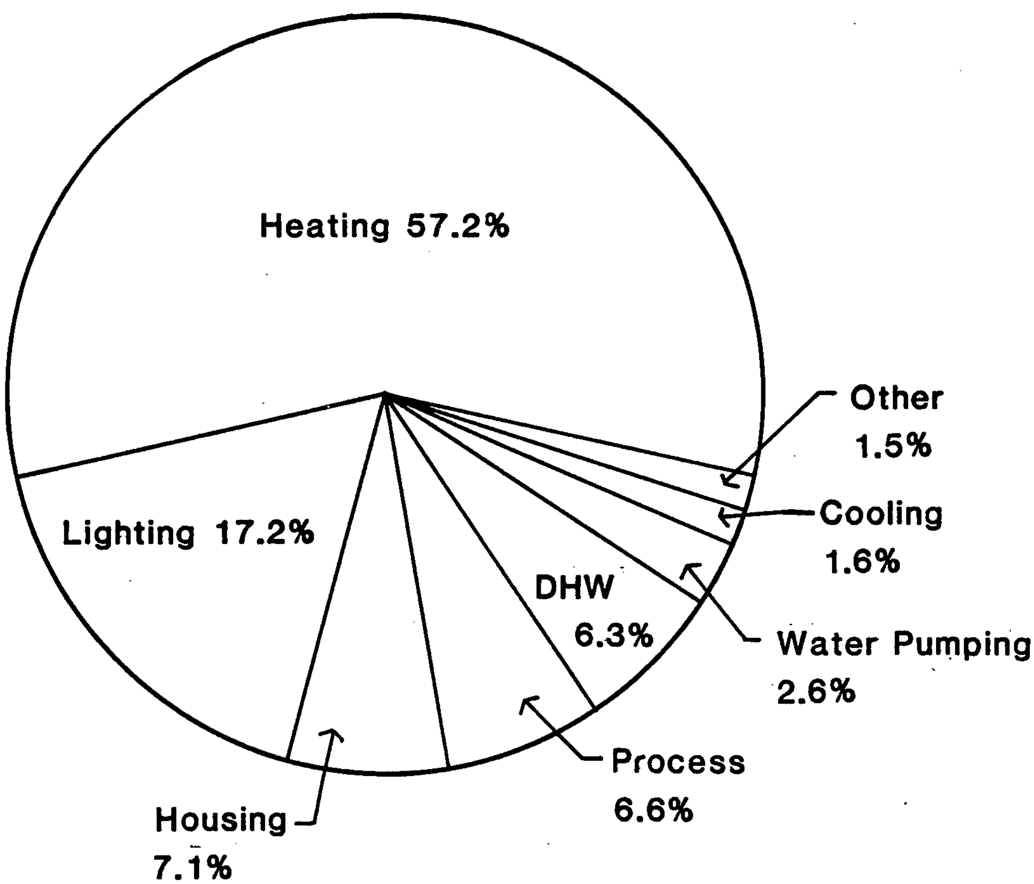


Figure 3.3b:

Load Type

for the overall low annual energy requirement of the depot.

Approximately 55 separate domestic water heaters were found scattered throughout the depot, all of which are electric. High thermostat settings and poorly insulated tanks result in fairly high year-round load percentages for domestic hot water (DHW).

Water pumping electric energy usage includes metered water well pumps plus estimates for booster pumps (e.g., fire water pumps) and a swimming pool pump.

3.2.2 Electrical Energy Usage

As mentioned in the previous section, specific electrical energy usage was estimated for each load device based upon power requirement and estimated hours of operation, due to the fact that very few loads are separately metered at UMDA. Total KWH's for all electrical loads surveyed were summed and resulted in an overall estimate equal to 85 percent of the FY81 total. This is considered to be a reasonably close estimate considering the large uncertainties in building usage and device operating hours during a given year. Also, not all electrical loads were included in the building survey list and were therefore not considered here. Table 3.2 and Figure 3.4 show the relative electrical loads as esimated.

TABLE 3.2

BASEWIDE ANNUAL ELECTRICITY USAGE

Electric Load Type		Estimated KWH/YR	% Total
	Day Night		
Lighting	357,679 + 325,758 =	683,000	33.8
Housing		282,000	13.9
Process & Misc. Motors		260,000	12.9
DWH		251,000	12.4
Water Pumping (Cold)		106,000	5.2
Heating			
Elect. Heat		164,000	8.1
Boiler Pumps and Blowers		101,000	5.0
Unit Heater Fans		52,000	2.6
Cooling			
Evap. Cooling		51,000	2.5

TABLE 3.2

BASEWIDE ANNUAL ELECTRICITY USAGE

(continued)

Electric Load Type	Estimated KWH/YR	% Total
A/C	14,000	0.7
Other	59,000	2.9
Total	2,023,000	

3.2.3 Representative Building Energy Profiles

For survey purposes, building types were broken down into seven categories: (1) administrative, (2) mission, (3) support, (4) housing, (5) warehouse, (6) power/utility, and (7) water. From the electrical energy use matrix mentioned previously and FY81 (before insulation project) oil use records for each building, energy use profiles for representative buildings in each of these categories were developed. Figure 3.5 displays these profiles on an MBTU basis. Again, space heating is shown to be the largest load in heated buildings. Heating loads have been somewhat reduced since the "Insulate Buildings" project accomplished at the very end of FY81. Building envelope heat loss data is given in Volume III.

3.3 ENERGY COSTS

Energy costs at UMDA have changed within the last two years as predicted in the "Preliminary Report" submitted November 13, 1981. The cost of #4 oil dropped from $0.90/gallon to $0.80/gallon as of June 25, 1982, while the cost of #2 oil did not change from $1.37/gallon.

Electricity costs increased by approximately 30 percent in January 1982 due to the Bonneville Power Association's cost of mothballing an incomplete nuclear reactor. Another increase of approximately 50 percent occurred in October 1982 in order for the utility to pay loan interest due on funds borrowed for nuclear reactors presently under construction. Table 3.3 shows UMDA's current electricity rate schedule.

Figure 3.4 Basewide Electricity Usage Profile

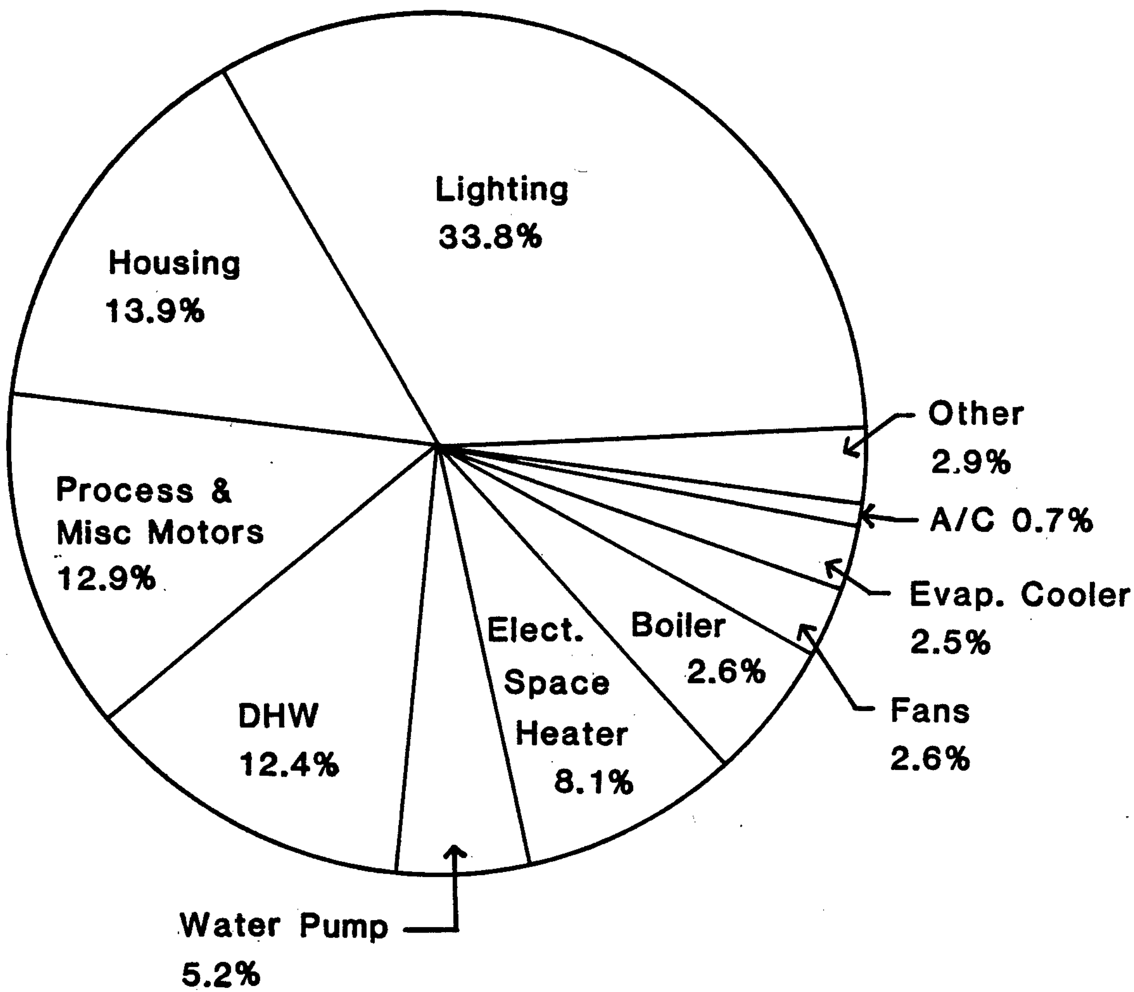


Figure 3.5 Representative Building Energy Use Profiles

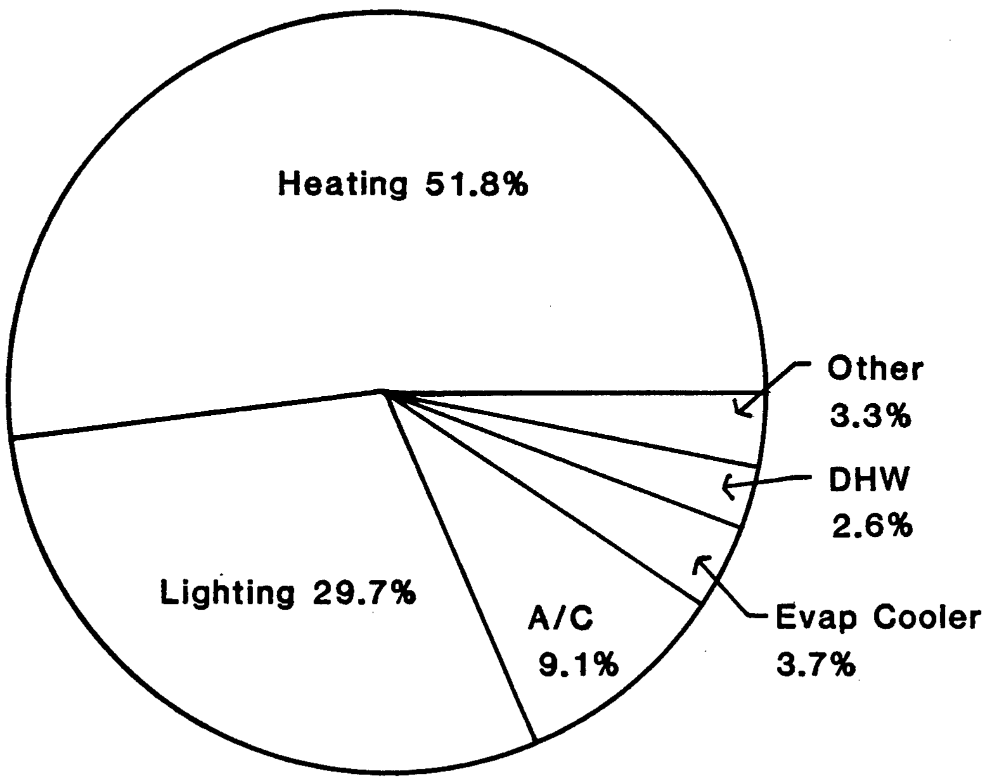


Figure 3.5a: Administrative - Building 1

Figure 3.5b:

Support - Building 4

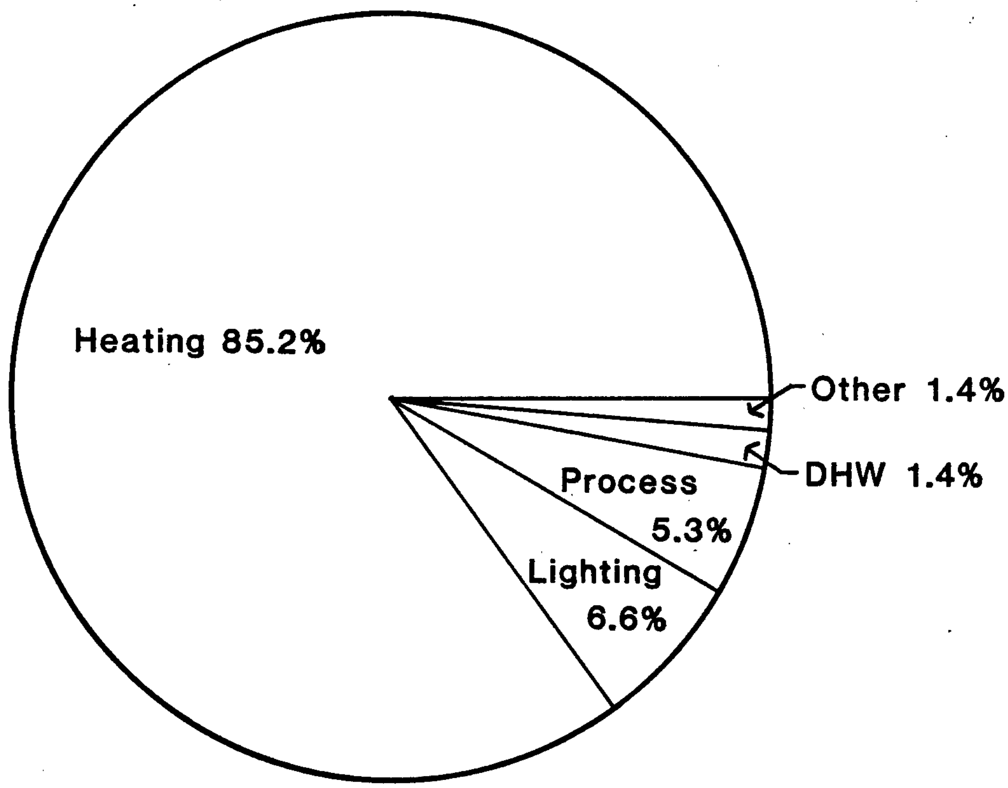
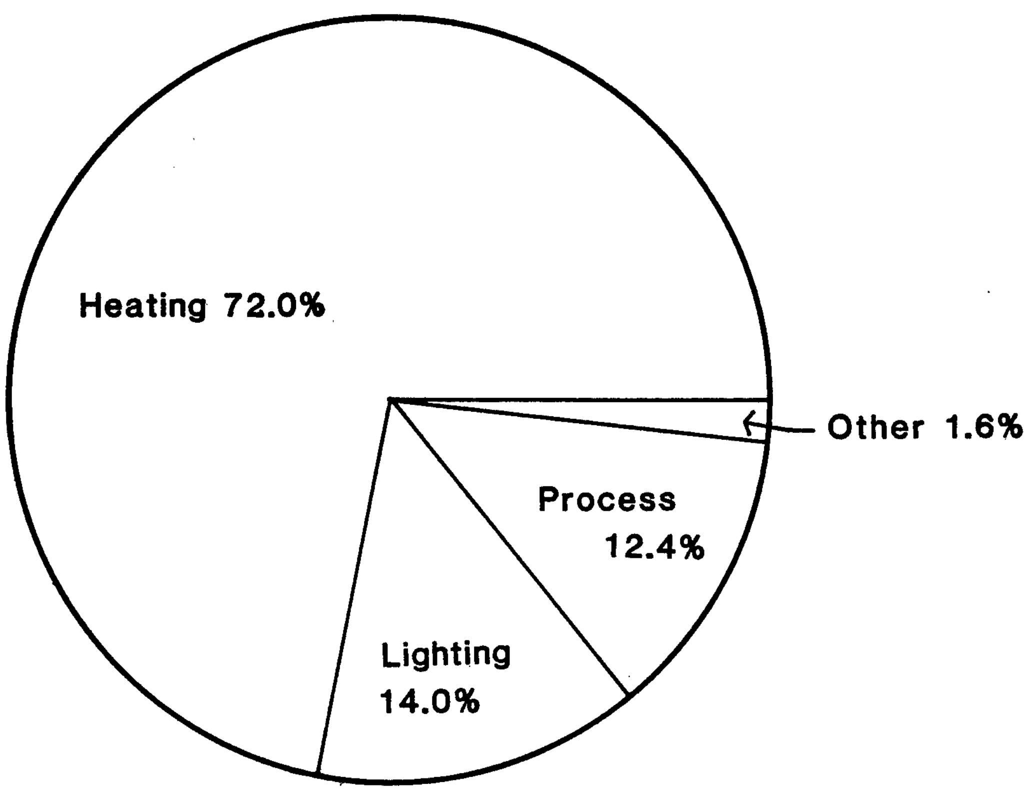


Figure 3.5c:

Mission - Building 608



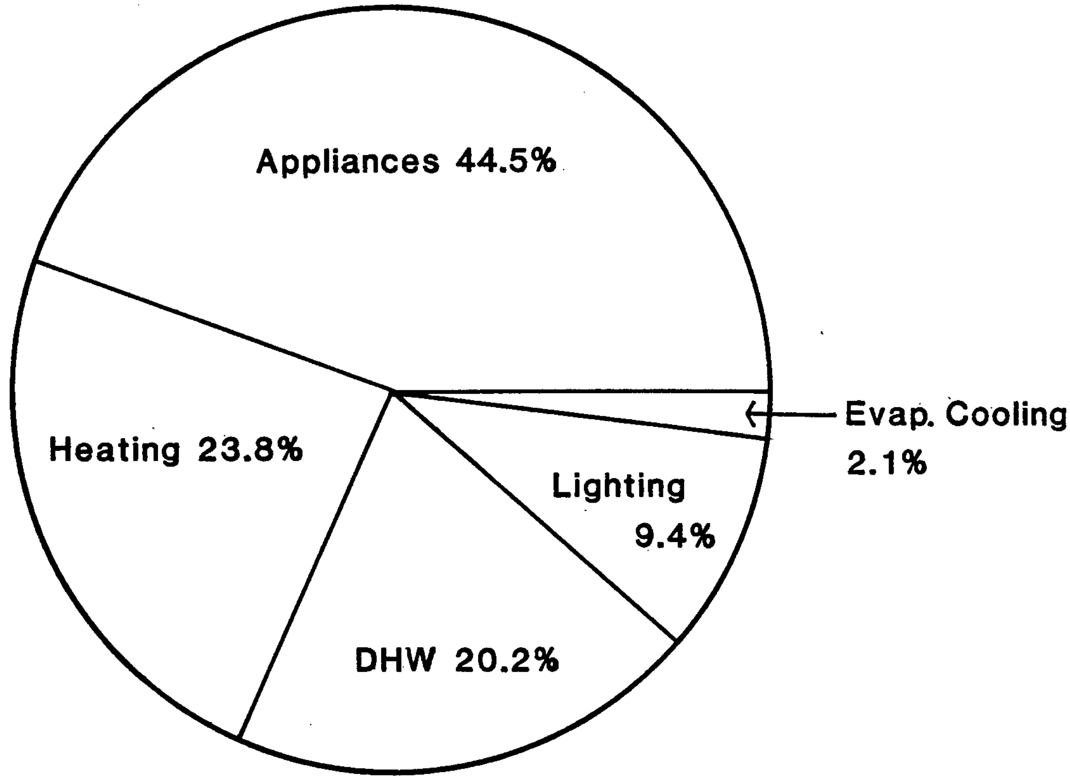


Figure 3.5d:

Housing -
Building 55

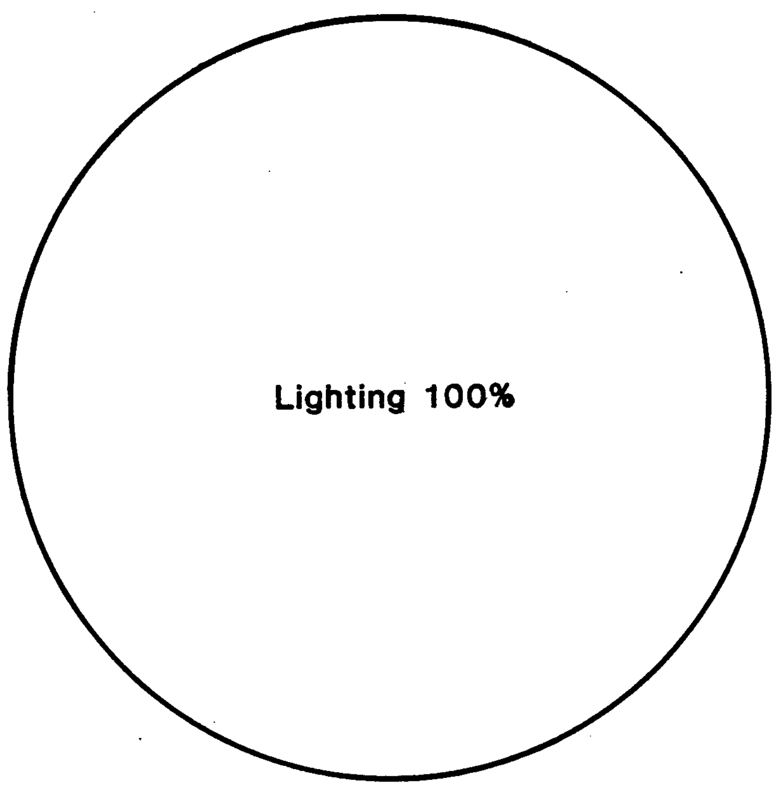


Figure 3.5e:

Warehouse -
Building 101

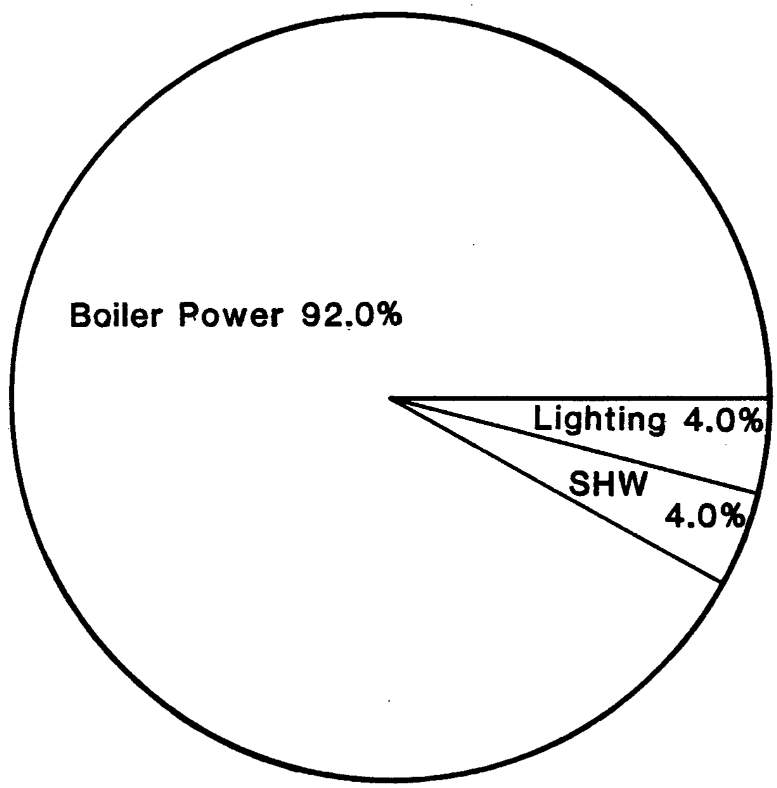


Figure 3.5f:

Power/Utility - Building 37

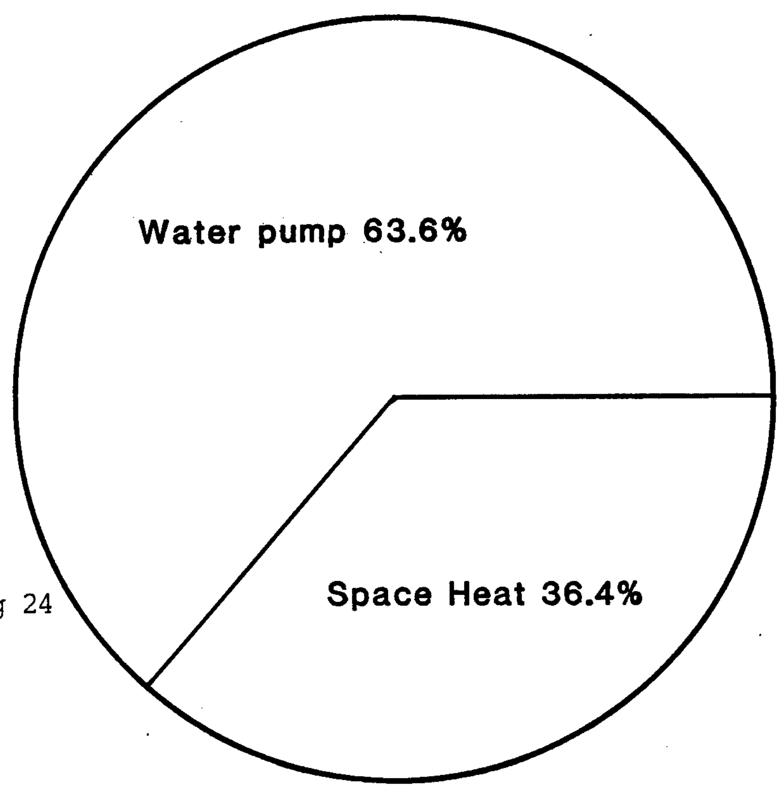


Figure 3.5g:

Water - Building 24

The following compares the current costs of the three primary energy sources on a per unit "burnable" energy basis:*

Source	$/MBTU
Elect.	7.24 = $ 0.0247/KWH
#5	5.34 = $0.80/gal
#2	9.88 = $1.37/gal

It is again noted that electric power purchased by UMDA is largely hydro-electric with some nuclear supplied power. Consequently, the Army conversion factor of 11,600 BTU/KWH is not applicable here. However, as directed in the Phase I Review Comments, this conversion factor is used in the economic analyses where appropriate.

TABLE 3.3

Current Electricity Rate Schedule for UMDA

(as of October 1982)

MONTHLY CUSTOMER CHARGE: Single phase: $ 8.00 per meter
Three phase: $12.00 per meter

ENERGY CHARGES:

First	5,000 KWH per month @ 4.25¢ per KWH
Next	10,000 KWH per month @ 3.25¢ per KWH
Next	50,000 KWH per month @ 3.25¢ per KWH
Over	65,000 KWH per month @ 2.47¢ per KWH

DEMAND CHARGE: First 20 KW of billing demand per month - no charge

Over 20 KW of billing demand per month @
$2.91/KW June-Nov.
$5.21/KW Dec.-May

POWER FACTOR: The consumer agrees to maintain unity power factor as nearly as practicable. The association reserves the right to measure such power factor at any time. Should such measurements indicate that the average power factor is less than 95 percent, the demand for billing purposes shall be increased 1 percent for each 1 percent or major fraction thereof by which the average power factor is less than 95 percent lagging.

*Last purchased electric KWH converted by the factor 3410 BTU/KWH for point of use comparison.

Beginning in February 1983 the Umatilla Electric Cooperative Association (UECA) began reducing the above energy rates by 0.85¢/KWH on a temporary basis. This represents a decrease of approximately 30%, however, how long this will last no one knows. A decision is made each month by the UECA as to whether or not the reduction should continue.

Future rate schedules are impossible to predict with any certainty due to uncertainties in the costs associated with mothballing nuclear power plants in Washington. Who will be charged the nuclear plant costs is a matter of continuing litigation. However, present projections are that a 20% rate increase will go into effect in November 1983. Beyond that, a nominal 10% increase per year is probably a reasonable projection.

Such an electric rate increase along with an estimated 14% per year fuel oil increase (Reference ECIP Guidance) would result in the following energy costs by the end of FY86 (more than three years from now):

Source	$/MBTU
Elect.	$11.56 = $0.039/KWH
#5 Oil	$ 8.19 = $1.27/gal
#2 Oil	$15.15 = $2.10/gal

4.0 ENERGY CONSERVATION MEASURES DEVELOPED

4.1 PROJECTS INVESTIGATED

A total of 19 projects were considered as potential energy conservation measures under Work Increments A, B, and G. Another 33 measures were investigated as Increment F projects which are summarized separately in section 6.0 of the EXECUTIVE SUMMARY and are described thoroughly in Volumes V and VI. Minor maintenance and repair projects discovered during Phase I were listed and submitted to the Corps of Engineers for immediate consideration by Depot personnel.

Energy conservation measures were investigated for all building types at the UMDA: active, inactive, permanent and temporary. The A/E visited and surveyed 103 buildings during Phase I and relevant characteristics were noted on survey data forms. These completed forms are included as Volume VII for Depot information.

Major energy conservation projects were identified for analysis based upon survey data gathered. Table 4.1 lists those projects investigated along with the buildings considered. Each of these potential projects were scrutinized to determine their practicability and their compliance with ECIP economic criteria.

TABLE 4.1

Energy Conservation Projects Investigated

(Increments A, B and G)

PROJECT DESCRIPTION	BUILDINGS INCLUDED
1. Roof Insulation	Active - 5, 11, 24, 25, 31 33, 36, 58, 133, 135, 160, 161, 208, 422, 478, 613, 660
	Inactive - 27, 52, 53, 54, 75, 104, 105, 112, 113, 117, 118, 127, 128, 130, 131, 115, 154, 155, 417, 418
2. Wall Insulation	Active - 1, 2, 3, 5, 7, 10, 11, 15, 16, 18, 24, 25, 30, 31, 32, 33, 51, 55, 58, 116, 133, 135, 160, 161, 208, 415, 422, 434, 478, 501-517, 608, 613, 614, 619
	Inactive - 27, 36, 52, 54, 53, 75, 104, 105, 112, 113, 117, 118, 127, 128, 130, 115, 131, 154, 155, 417, 418, 431
3. Interior Partition Insulation	Active - 11, 18, 31
4. Floor Insulation	Active - 32, 33, 34
	Inactive - 27, 52, 53, 54, 75
5. Reduce Window Area	Active - 1, 2, 5, 7, 11, 10, 30, 31, 32, 33, 36, 116, 208, 415, 608, 614
	Inactive - 27, 130, 417
6. Seal Overhead Doors	Active - 5, 11, 18, 30, 31, 422

TABLE 4.1

Energy Conservation Projects Investigated

(Increments A, B and G) (continued)

PROJECT DESCRIPTION	BUILDINGS INCLUDED
7. Weatherstrip Windows and Doors	Active - 5, 11, 24, 25, 31, 33, 34, 36, 58, 133, 135, 160, 161, 208, 422, 455, 478, 613
	Inactive - 104, 105, 112, 113, 117, 118, 127, 128, 130, 54, 418, 131, 115, 154, 155, 27, 52, 53, 417, 75
8. Night Set-Back T-Stats	Active - 1, 4, 5, 6, 7, 10, 11, 18, 30, 32, 33, 208, 415, 419, 420, 434, 608, 614, 660
	Inactive - 27, 52, 53, 54, 75, 104, 105, 112, 113, 117, 118, 127, 128, 130, 131, 115, 154, 155, 417, 418, 431
9. Replace Oversized Boilers	Active - 1, 2, 7, 18, 28, 30, 32, 33, 37, 416, 433, 612, 617
10. Lighting Source Change	Active - 30, 2, 3, 4, 5, 31, 76, 161, 415, 457, 613,6
	Inactive - 130, 131, 127, 128, 104-114, 52, 53, 75, 27, 102, 117-126, 207, 208, 209, 801-838
11. Storm Windows	Active - 30, 7, 10, 11, 5, 33, 36, 32, 422, 35, 508, 3, 419
	Inactive - 417, 104, 52, 54, 75, 27
12. Replace Overhead Doors	Active - 18, 30, 7, 10, 116, 11, 58, 8, 9
	Inactive - 130, 131, 115, 112, 113, 117, 118, 127, 128, 105, 104

TABLE 4.1

Energy Conservation Projects Investigated

(Increments A, B and G) (continued)

	PROJECT DESCRIPTION	BUILDINGS INCLUDED
13.	Replace Personnel Doors	Active - 415, 608, 614, 434
		Inactive - 417, 431, 493
14.	Conditioned Air Reclaim	Active - 608, 434
15.	Energy Monitoring and Control System	Basewide
16.	Replace 5th Avenue Housing Furnaces	Active - 501-517
17.	Insulated Siding - Family Housing	Active - 501-517, 51, 35, 34, 55
18.	High Efficiency Motor Replacement	Active - 433, 612, 617, 24, 25, 135, 133, 160, 161, 478, 613, 495, 621, 116
19.	DHW Tank Insulation	Active - 1, 2, 18, 32, 33, 116, 208, 419, 55, 420, 619, 660, 4, 5, 6, 7, 10, 11, 422, 15, 16, 30, 415, 608, 34, 35, 501-517, 28, 37, 38

Several were discarded as infeasible after only preliminary consideration although most were analyzed in detail and were tested against the ECIP economic criteria for qualification. Table 4.2 is a comprehensive tabulation of all projects (Increments A, B and G) considered along with their associated economic parameters. Projects for which Savings to Investment Ratios (SIR) are less than 1.0 do not qualify for ECIP funding.

4.2 ECIP PROJECTS

Qualifying projects were grouped into ECIP projects, i.e., those which cost $200,000 or more and/or family housing projects. Complete programming documents were developed for ECIP projects and are included as Volume IV of this report. Additional non-ECIP (i.e., less than $200,000) aggregate projects were developed from other qualifying projects to aid the Facilities Engineer in applying for funding. The first pages of the DD Forms 1391 were completed for these projects and are also included in Volume IV. Table 4.3 summarizes these aggregate projects. Note that several Increment F

TABLE 4.2

INCREMENT A, B, AND G PROJECT LIST

Active Buildings

No.	Project	SIR	Capital Cost ($)	Annual Energy Savings (10^6BTU/YR)	Dollar Savings ($/YR)
*1. G	Night Set-Back Thermostats	6.8	13,052	813	6,584
2.	Interior Partition Insulation	5.9	4,178	278	1,603
3.	Reduce Window Area	4.4	32,742	1,444	10,231
4.	Roof Insulation	4.2	38,031	1,986	10,359
5.	Seal Overhead Doors	3.7	10,139	386	2,620
6.	Family Housing Insulation	3.3	26,032	673	6,649
7.	Replace Oversized Boilers	2.1	86,132	1,675	13,330
8.	Floor Insulation	2.1	11,135	183	1,808
9.	Weatherstrip Windows and Doors	1.6	16,065	265	1,899
10.	Wall Insulation	1.1	216,531	2,590	17,824
11.	Replace 5th Avenue Furnaces	0.9	39,510	-1,005	2,574
12.	Insulated Siding - Family Housing	0.9	73,474	521	5,147
13.	Lighting Source Change	0.8	14,128	289	845
14.	Storm Windows	0.7	72,314	466	3,328
15.	Replace Personnel Doors	0.7	17,083	104	860
16.	Replace Overhead Doors	0.7	33,407	192	1,680

*Note: This project has already been implemented as a result of its identification during the early phases of this study.

TABLE 4.2 (continued)

INCREMENT A, B, AND G PROJECT LIST

Inactive Buildings

No.	Project	SIR	Capital Cost ($)	Annual Energy Savings (10^6BTU/YR)	Dollar Savings ($/YR)
1.	Night Set-Back Thermostats	18.5	6,203	1,026	8,557
2.	Reduce Window Area	6.8	27,597	1,544	14,687
3.	Lighting Source Change-Outdoor	6.0	35,768	1,716	16,829
4.	Insulate Roofs/Ceilings	4.5	122,253	5,121	40,575
5.	Insulate Walls	3.8	313,957	10,083	91,555
6.	Lighting Source Change Indoor	2.1	69,775	4,730	19,673
7.	Insulate Floors	1.5	17,954	319	1,703
8.	Storm Windows	1.3	22,441	335	1,948
9.	Replace Overhead Doors	0.9	152,084	1,134	11,204
10.	Weatherstrip Doors and Windows	0.7	62,426	405	3,366
11.	Replace Personnel Doors	0.5	5,962	36	192

TABLE 4.3

ECIP AND OTHER AGGREGATE PROJECTS

ECIP	PROJECT	SIR	Capital Cost ($)	Energy Savings (10^6 BTU/YR)	Dollar Savings ($/YR)
Yes	Buildings Envelope Modifications	2.0	$326,674	7,198	$46,486
	Roof Insulation Wall Insulation Interior Partition Insulation Reduce Window Area Seal Overhead Doors Floor Insulation Weatherstrip Windows and Doors				
Yes	Family Housing Insulation	3.3	$ 26,032	673	$ 6,649
	Wall Insulation				
No	Replace Oversized Boilers	2.1	$ 86,132	1,675	$13,330
No	Heat Loss Control Modifications	19.7	$ 33,973	7,398	$45,055
	*Thermostat Modifications *Thermostat Radiator Valves *Hot Water Boiler Control *Insulate Steam and Condensate Piping *Insulate Deactivate Furnace Cylinder				
No	Electrical Modifications *Lighting Timers *Ceiling Fans	4.3	$ 16,969**	715	$ 5,009

*Project developed under Increment F

**This project originally exceeded $25,000 when submitted in Pre-Final Report, however, power factor correction project is dropped here (because project is being implemented) which reduces capital cost.

projects are included in two of the Aggregate Projects. Supporting documentation for these Increment F projects are included in Volume III as well as in Volume VI.

5.0 ENERGY AND COST SAVINGS

Of all the energy conservation measures considered in detail, listed in Table 4.2, 11 active building and 8 inactive building projects qualified under the most recent ECIP criteria. The total annual savings for the 11 active building projects is approximately 10,582 x 10^6 BTU/YR and $73,752/YR. This savings represents approximately 18% of the total energy consumption of FY75, or approximately 30% of the FY81 energy consumption.

Figure 5.1 profiles past and projects future energy use at the UMDA. The recent "Insulate Buildings" project was a major project accomplished during the summer of FY81 which insulated and weatherstripped many active buildings and which should result in an approximately 10% energy reduction in FY82 compared to FY81. However an overall energy use decrease of only approximately 2% is estimated in FY82 due to the effects of an anticipated 10% manning level increase and activation of several new buildings.

The conservation measures recommended under Increments A, B and G of this study are not expected to be implemented until the end of FY87. However, Increment F projects may well be implemented by FY84. Therefore, the potential effect of these projects are shown in FY85. As is detailed in Section 6.0 the total savings possible from qualifying Increment F active building projects is approximately (not including projects which "overlap" Increment A, B and G projects) 12,230 x 10^6 BTU/YR and $66,700/YR. This savings represents approximately 21% of the total FY75 energy consumption.

As shown in Figure 5.1, if both the Increment F and Increments A, B and G projects are implemented in FY84 and FY87, then it is possible for the UMDA to meet both the FY75 and FY2000 energy goals.

6.0 INCREMENT "F"

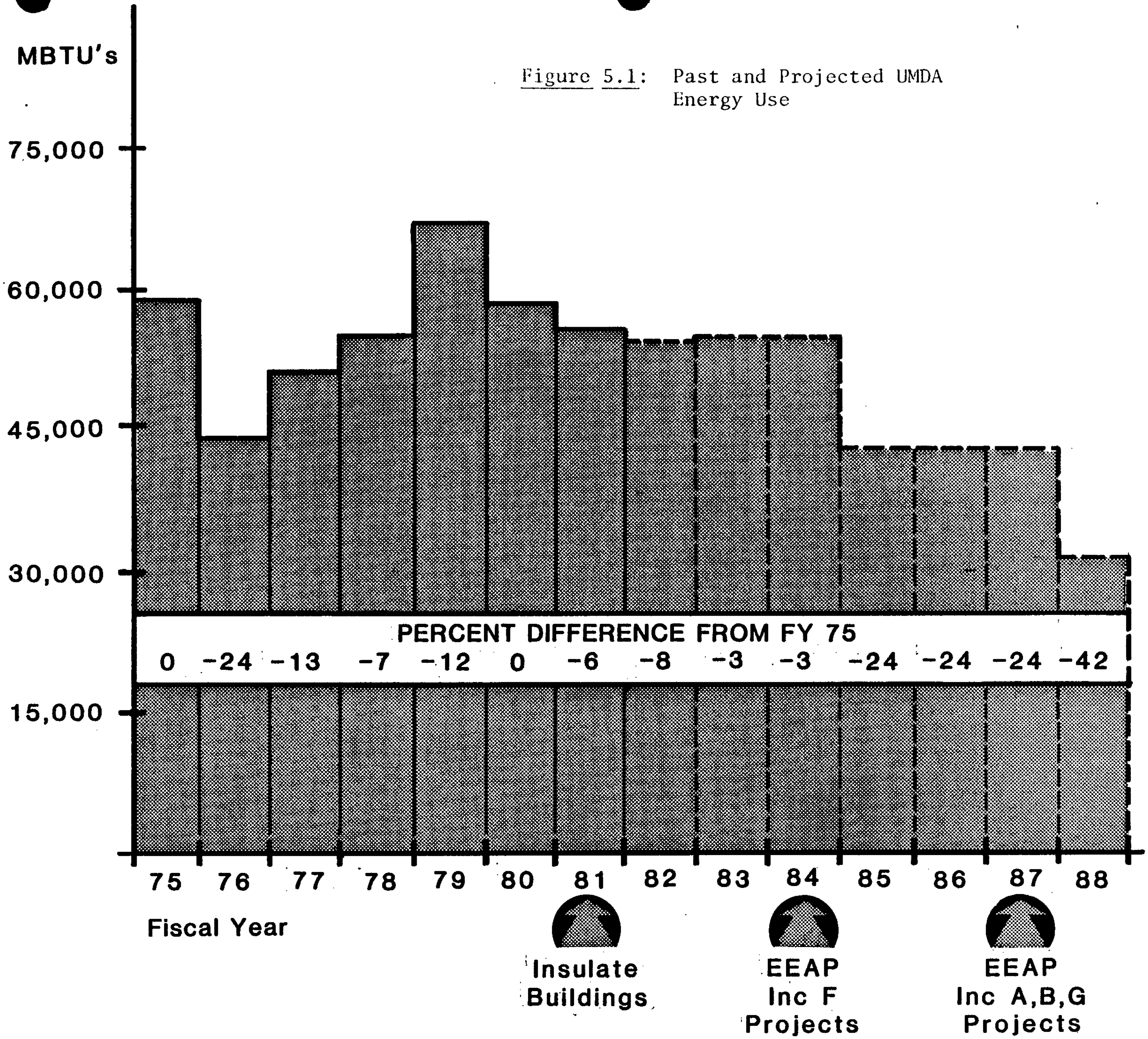
6.1 OBJECTIVES

The objectives of the work performed under Increment F of the contract were to:

- --provide recommendations for modifications and changes in system operation which shall result in energy conservation and which are within the Facilities Engineer funding authority and management control

- --summarize and prioritize all energy conservation measures and projects from Increments A, B, F and G for the use of the Installation Commander and Facilities Engineer in developing their energy management plans

Figure 5.1: Past and Projected UMDA Energy Use



--list energy conservation projects accomplished since FY75

--list energy conservation projects planned

--list planned facilities changes

--recommend personnel training to enhance energy conservation

--recommend replacement energy saving equipment

6.2 SITE SURVEY

A separate site survey was performed which served as the basis from which energy conservation measures were conceived and analyzed for cost effectiveness. Work previously accomplished under Increments A, B and G was not duplicated. The survey building list used was virtually the same as the original list updated to eliminate buildings recently scheduled for demolition.

6.3 INCREMENT F PROJECTS SUMMARY

Table 6.1 lists each project considered for active and inactive buildings. The projects are listed from highest to lowest SIR for active building projects, with inactive building projects listed immediately below the same active building project. Inactive building project numbers are designated with the letter "I" suffix. The total implementation cost for all qualifying (i.e. SIR greater than or equal to 1.0) active building projects listed is approximately $170,000 which would return approximately $91,000 per year in savings or approximately 15,200 MBTU per year. This energy savings represents approximately 25% of the total FY75 (baseline year) facility energy consumption.

6.4 AGGREGATE PROJECTS

To aid the Facilities Engineer in obtaining funding for projects identified under Increment F, aggregate projects costing greater than or equal to $25,000, made up of one or more discrete projects, were developed. Coversheet DD Forms 1391 were therefore developed for these aggregate projects and are included in Volume V. Several of the discrete Increment F projects used to form the aggregate projects are also combined with Increment A, B or G projects to form similar aggregate projects which were summarized in Table 4.3 The Facilities Engineer therefore has several project funding options.

TABLE 6.1

INCREMENT F PROJECTS SUMMARY

No.	Project	SIR	First Annual Energy Savings (10^6 BTU/YR)	First Annual Dollar Savings ($/YR)	Implementation Cost ($)	Simple Payback Period (Years)
1F	Deactivate Bldg.33	246.5	502	4960	256	0.05
2F	Shower Flow Restrictors	81.8	1353	2882	496	0.17
3F	Reduce Lighting	66.8	23	49	12	0.24
4F	Seal Air Vents	65.9	1016	3965	924	0.23
5F	Reduce DHW Set Point Temp.	49.6	401	855	243	0.28
5FI	Reduce DHW Set Point Temp. (Inactive Bldgs)	64.0	4	136	30	0.22
6F	Thermostat Modifications	45.6	732	3738	1183	0.32
6FI	Thermostat Modifications (Inactive Bldgs).	30.6	643	3434	1768	0.51
7F	Swimming Pool Cover	30.0	320	682	320	0.47
8F	Insulate Hot Water Pipes	30.0	26	55	26	0.47
9F	Insulate Steam & Condensate Piping	27.2	6533	38,895	21,570	0.55

TABLE 6.1 (continued)

INCREMENT F PROJECTS SUMMARY

No.	Project	SIR	First Annual Energy Savings (10^6 BTU/YR)	First Annual Dollar Savings ($/YR)	Implementation Cost ($)	Simple Payback Period (Years)
9FI	Insulate Steam & Condensate Piping (Inactive Bldgs)	32.1	3727	34,616	13,947	0.40
10F	Lighting Timers	14.7	127	271	260	1.0
10FI	Lighting Timers (Inactive Bldgs)	11.4	42	90	111	1.2
11F	Turn Off DHW Tank	12.8	39	82	91	1.1
12F	Insulate Deactivation Furnace cyl.	7.4	230	2272	2272	1.7
13F	Hot Water Boiler Control	5.8	108	1067	2336	2.2
14F	Install Thermostatic Radiator Valves	4.3	177	1660	4964	3.1
15F	Install Ceiling Fans	4.2	588	4738	16609	3.5
15FI	Install Ceiling Fans (Inactive Bldgs)	7.8	1420	13577	23,328	1.7
16F	Construct Vestibule	3.9	61	603	1945	3.2
17F	Boiler/Burner Modifications	2.7	2960	21,622	113,165	5.2

TABLE 6.1 (continued)

INCREMENT F PROJECTS SUMMARY

No.	Project	SIR	First Annual Energy Savings (10^6 BTU/YR)	First Annual Dollar Savings ($/YR)	Implementation Cost ($)	Simple Payback Period (Years)
17FI	Boiler/Burner Modifications (Inactive Bldgs)	23.3	12637	68321	46034	0.67
18F	Close Off East Work Boy in Bldg. 30	2.4	36	356	1915	5.4
19F	Turn Off Water Coolers-Bldg. 614	1.5	1	2	1	NA
20F	Repair Broken Steam Pipe Insulation	1.4	1	3	31	10.3
21FI	Repair Siding (Inactive Bldgs)	1.1	4	34	411	12.1
22FI	Replace Windows (Inactive Bldgs)	1.1	4	40	477	11.9
23F	Replace Defective Air Relief Valve - Wall No. 5	0.6	1	1	27	27
24F	Door Repair Bldg. 614	0.38	1	15	489	32.6
25F	Disconnect Bldg. 10 Boiler	0.26	23	227	11,100	48.9
26F	Domestic Hot Water Time Clock	0.22	10	20	1278	63.9
26FI	Domestic Hot Water Time Clock (Inactive Bldgs)	0.7	1	2	355	177.5

TABLE 6.1 (continued)

INCREMENT F PROJECTS SUMMARY

No.	Project	SIR	First Annual Energy Savings (10^6 BTU/YR)	First Annual Dollar Savings ($/YR)	Implementation Cost ($)	Simple Payback Period (Years)
27F	Replace Incandescent Lighting	0.20	34	72	5167	71.8
28F	Water Cooler Time Clocks	0.18	2	5	367	73.4
29F	Repair Louvres	0.18	0.45	1	101	101
30F	Insulate Hot Oil Pipes	0.15	1	9	780	87
31F	Replace Broken Windows	0.13	0.06	0.32	33	103
32F	Operate Lawn Sprinklers at Night	NA	0	1151	0	NA
33F	Power Factor Correction	NA	0	2568	2220	0.8

6.5 ENERGY CONSERVATION PROJECTS SINCE FY75

Few energy conservation projects have been funded at the UMDA since FY75. Those that have been accomplished are listed below and their impact described where possible.

6.5.1 Insulate Buildings - FY81

During the summer of FY81 a large building improvement project was accomplished which included adding insulation, weatherstripping, storm windows, and replacing doors on 24 of the most important buildings. This project will have a very significant effect on future building energy consumption. Calculations show a resultant decreased building heat loss rate of approximately 3 MBTU/HR, or an annual energy savings of approximately 5500 MBTU. This would represent a decrease by approximately 10 percent below FY81 total energy consumption in FY82.

6.5.2 Replace Steam and Condensate Lines, Building 28 to and from Buildings 36, 52, 53, 54 - FY82

This project was accomplished in the early fall of FY81. It will reduce future energy waste; however, buildings 52, 53, and 54 are currently inactive and building 36 has only recently been reactivated to occasional use.

6.5.3 Replace Heating System, Building 34 - FY81

The steam boiler in Building 34 was deactivated in mid-November, FY82 in favor of a new electric baseboard system. The previous system was extremely wasteful. Metering of the new system through the winter of FY82 showed an energy savings of 256 MBTU (11,600 BTU/KWH) over the previous year.

6.5.4 Upgrade Electrical Distribution System in Administrative Area - FY82

The primary electrical distribution system within the administrative area has been upgraded during the last year. It included replacement of underground transformers and wiring as well as street light conversion to HPS luminaires. The effect which the project will have upon energy waste should be favorable.

6.5.5 DHW Tank Insulation Jackets - FY82

During the summer of FY82 the Umatilla Electric Cooperative Association undertook a program wherein they insulated, free of charge, all of their residential customers' electric domestic hot water (DHW) tanks. Residential DHW tanks at the UMDA were included and, therefore, each was insulated with 3.5 inch thick fiberglass insulation blankets. The DHW tank insulation project originally recommended under this EEAP study was therefore dropped.

6.5.6 Repair Million Gallon Reservoir Leak - FY82

The leaking 1,000,000 gallon earthen water reservoir located in the "100 area" was repaired during the summer of FY82. Water "repumping" costs caused by the large leak were estimated at 20,000 KWH per year. Repairing the leak will therefore save approximately $500 per year at current (effective October 1982) electric rates.

6.6 CONSERVATION PROJECTS PLANNED

Several projects are currently in various levels of the planning process at the UMDA which would result either directly or indirectly in energy savings. These are listed below.

- Replace Condensate Line and Heaters in Building 415, and Condensate Line from Building 415 to 416.
- Replace Condensate Line and Heaters in Building 5 and Condensate Line from Building 5 to Building 37.
- Replace Storm Windows in Buildings 501-517, 35, 51, 55.
- Electrical Transmission and Substation Upgrade.
- Install Fireplace Inserts in Six FH Quarters.

6.7 PLANNED FACILITIES CHANGES

The purpose of this section is to summarize future planned facilities changes included on the installation master plan and estimate the annual energy consumption of each. Other planned facilty changes, which are being considered under the Facilities Engineer funding authority which effect basewide energy consumption are also listed. However, quantitative energy use estimates for the latter projects are not calculated. The following information is provided to further assist command personnel in planning for future installation energy consumption.

6.7.1 Master Plan Facilities Changes

Ammunition Storage Pad - FY86

A 30,000 SF container loading pad is planned to provide a facility for load/unloading all types of rail car shipping containers. The only energy consuming load will be perimeter lighting for nighttime operation. Assuming that high pressure sodium luminaires shall provide approximately 10 foot candles of illumination, and that under mobilization one 8 hour night shift per week is operational, the total annual load will be approximately 120 KWH/YR or 14,5 MBTU/YR. However, lighting usage will be far less under current activity levels.

- Ammunition Handling Building - FY87

A 12,000 SF masonry building shall be constructed to replace Buildings 431 and 434 as bundle buildings. Only Building 434 is presently active, however, neither comply with safety regulations allowing for sufficient munition segregation or overnight storage resulting in excess transportation costs. The new building will probably be equipped with a small paint booth and small portable woodworking tools. An oil heating plant and electric lighting will be the primary loads. Assuming that the new building and heat plant are properly designed, this facility change will probably result in a net energy usage decrease because of the high heat loss from the present building envelopes and heating system. Total energy consumption in FY81 by Building 434 is estimated at 1508 MBTU compared to the target energy budget for new construction of this type of 75-90 x 10^3 BTU/SF/YR (Reference: DOD Manual 4270.1-M, ETL 1110-3-295) or approximately 1000 MBTU/YR.

- Vehicle Wash/Paint Facility - FY87

A 3000 SF prefabricated metal building is planned for construction on a concrete slab to provide a vehicle wash and paint facility on base. These functions are currently contracted for off base. The new facility would increase installation direct energy consumption (but would decrease indirect consumption, i.e., that used by the contractor in servicing Army vehicles) via building heating, evaporative cooling, water heating, lighting and miscellaneous equipment use. Target design energy budget would be approximately 270 MBTU/YR.

- Surveillance Workshop - FY87

A 17,171 SF permanent pre-engineered metal building with substantial quantities of reinforced concrete forming dividers and protective blast walls to replace the existing Surveillance Workshop in Building 415. This change could result in reduced installation energy consumption due to the energy inefficient design of the presently used 40 year old building even though the new building would be 3.7 times larger. The existing structure uses approximately 1170 MBTU/YR compared to the new construction target of 1030 MBTU/YR.

- Heating System Upgrade - FY88

A new 3.5 MBH boiler located in an existing boiler plant (Building 37) would be constructed to centralize the Administration Area heating system. The new steam distribution system would also be tied into the boiler plant in Building 28. Six smaller boilers located in individual buildings are currently in use but are 40 years old. Design details for this project are not yet clearly defined. Its impact on the installations overall heating oil consumption cannot be determined without basic design data. Almost certainly, labor costs would be reduced due to the reduced number of boilers which are manually operated. However, steam distribution losses would increase considerably due to the long steam and condensate runs required. Boiler radiation and convention losses would decrease, however. Location and control of steam shut-off valves to individual buildings as well as boiler control senarios are examples of design considerations which must be worked out before a quantitative energy use impact estimate can be made.

- <u>Security Upgrade for Sensitive Arms and Ammunition - FY90</u>

This project is designed to bring the protection for sensitive arms and ammunition up to the level required by current regulations. Two electrical loads are the only energy consumers included in the project: igloo lighting and an intrusion detection system (IDS). The IDS load characteristics are not known but will probably be minimal. The lighting system would consist of 80 each 40 watt fluorescent plus 6 each roadway luminaires. Assuming 250 watt high pressure sodium lamps are used for roadway lighting, the total annual energy consumption resulting from this project would be approximately 300 MBTU.

- <u>Administrations/Operations Building - FY90</u>

A new 18,005 SF administrative building would be constructed to provide office space for headquarters, mission, surveillance, family housing, and emergency operations center. The building would include two levels, one above and one below ground. This facility change would also result in energy conservation assuming that the new building meets the design energy budget target of 990 MBTU/YR. The new facility would completely replace the use of Building 1 and partially replace the use of Building 18. Assuming that energy consumption in Building 1 is eliminated and consumption in Building 18 is reduced by one half, the change would eliminate approximately 1600 MBTU/YR in oil and electricity consumption. An annual savings of approximately 600 MBTU would result.

- <u>New Railroad Storage Yard - FY90</u>

Work planned is the construction of four 1000 FT railroad sidings with a combined capacity of 16 munition laden freight cars. Each siding would be separated by earth barricades. No lighting or other energy loads are anticipated.

6.7.2 Facilities Engineer Changes

Many facilities improvement projects have been submitted for funding which are not MCA projects. Many of these will not impact facility energy usage. Those that may impact energy usage either positively or negatively are listed below.

- Install Lights in Building 659 - 95% designed. Electrical energy increase for lighting.
- Illuminate Sally Port in Building 660 - 25% designed. Electrical energy increase for lighting.
- Electrical Service to MET Site - 70% designed. Electrical energy increase for instrumentation.
- Construction of Breatheable Air Bottle Facility - unknown energy usage impact.
- Ventilation System in Buildings 4, 5, 7, 30 - Building 4 in design. Electrical energy increase for fans. Heating oil increase due to increased ventilation.
- Install Overriding Thermostats/14 Buildings - 0% designed Heating oil decrease due to reduced t-stat set points.
- Replace Battery Exhaust Fan with Larger Capacity/Building 31 - 0% designed. Electrical energy increase for larger fan. Heating oil increase due to excess ventilation.
- Renovate Inactive Buildings 36, 52, 53 - 0% designed. Electrical and heating oil increase due to building reactivation.
- Replace Condensate Line and Heaters, Building 415 and Condensate Line from Buildings 415 to 416 - In design. Heating oil decrease due to decreased steam losses.
- Remodel Building 33 to Activities Center - 0% designed. Electrical and heating oil increase due to increased building activity.

6.8 PERSONNEL TRAINING

The UMDA is a depot activity to the Tooele Army Depot in Utah. As such, it does not have a resident engineering division but relies on engineering support from Tooele. Mechanical and structural systems are operated and maintained by systems maintenance personnel and a small carpentry shop. Therefore, training courses available through the Department of the Army PROSPECT program and others which require engineering background are of marginal use for UMDA maintenance personnel. Air conditioning units at UMDA are few and very small. Therefore, boiler operation and maintenance is the only major area in which significant technical expertise is required and in which significant energy conservation could be realized.

6.8.1 Boiler O&M Training

Several boiler firemen at the UMDA have knowledge and experience with boiler operation and maintenance, however, training in new technologies and techniques which can effect energy consumption would be very beneficial. Unfortunately, no PROSPECT courses in boiler operation or maintenance are available. The only short seminars which provide boiler operation, maintenance, controls and energy conservation available in the area, are those held by manufacturer's representative companies in Portland. Approximately once per quarter some boiler related seminar is held. These can be informative. One such company which holds these seminars is Industrial Controls Company of Portland. Special topic seminars will be given by these companies upon special request also. An effort by UMDA personnel to arrange such a seminar in boiler operation and maintenance may prove benefiical.

Another possible source of short seminars is the Oregon Chapter of the ASHRAE in Portland. They may be holding short courses in energy conservation at a community college in Portland this year.

Mount Hood Community College in Gresham, Oregon holds boiler related courses, which may be instructive. However, these courses run for full sessions and are therefore impractical for UMDA personnel. It may be possible to arrange a special seminar at UMDA taught by knowledgeable instructors from MHCC on a private basis.

A major complaint registered by the Corps Facilities Engineering Support Agency team which tested several of the larger boilers at UMDA in July 1981 was that operation manuals were unavailable on several of the boilers/burners which prevented proper adjustment. The best source of information concerning proper boiler/burner operation details is the manufacturer. Operation and maintenance manuals should be obtained from manufacturers and their procedures followed.

6.8.2 Energy Use Monitoring

An important element in an effective energy conservation program is the ability to accurately monitor energy consumption. An individual should be tasked with keeping track of oil use records and monitoring electrical KWH meters. Umatilla Electric Cooperative Association personnel are available to answer questions regarding electricity use, metering and conservation. Additional electrical metering should be installed as described in the Narrative Report to better monitor electrical energy usage. The existing meterological station at UMDA should be used to record heating and cooling degree data and windspeed data. Weather data should be kept with energy records to be used to correlate energy consumption with meteorological conditions. Future energy conservation measures can then be identified and past ones can be evaluated as to their effectiveness. Engineering personnel at Tooele should be consulted to help conceptualize the monitoring program and to train UMDA personnel in the specific data gathering and reduction techniques.

6.8.3 Energy Economics

Personnel responsible for implementing and monitoring energy conservation measures should have a fundamental acquaintance with DOE methodologies and procedures for conducting economic studies of energy systems. A 40 hour PROSPECT course is offered in Huntsville, Alabama entitled Economic Analysis of Energy Systems (Course No. P4MEAES). This course may be appropriate for upper level management personnel either in the Facilities Branch or in Services and Administration.

6.9 ENERGY SAVING EQUIPMENT REPLACEMENT

The purpose of this section is to recommend common energy efficient equipment which can be routinely procured and installed as replacement parts. These are items which would not cost-effectively replace existing operable equipment but would be cost-effective as a replacement after existing equipment failure or decommission for other reasons.

6.9.1 Electric Water Heaters

Many companies manufacture energy efficient electric water heaters today. These units are simply more heavily insulated than the older designs which were conceived prior to the escalation of energy prices. Heavier insulation reduces stand-by heat losses to surrounding air. Different tanks should be compared by comparing specified insulation "R" or "U" values. Higher "R" values or lower "U" values identify the more efficient tanks. Three manufacturers of energy efficient DHW tanks are:

- A.O. Smith
- Rheem
- Sears

6.9.2 In-Line Water Heaters

When an existing DHW tank fails or when a new hot water requirement arises for which no supply already exists, an alternative to the DHW tank which should be considered is an electric in-line water heater. These are small units (typically 10 inches x 6 inches x 3 inches) and only heat water when water flow is initiated by the opening of a hot water faucet. Water is instantaneously heated as it flows through the unit. They therefore eliminate stand-by energy losses associated with large hot water reservoirs held at a constant temperature. Since they can be located directly beneath a sink, water can be saved due to decreased waiting time between opening of the faucet and arrival of hot water. These should be considered for use whenever hot water storage is not required and required flow rates are small (less than 2 gpm). For example, most of the hot water tanks distributed around the UMDA serve sinks for hand washing only. They could be replaced with an in-line heater and stand-by heat losses eliminated. A manufacturer of these units is:

- Chronomite Laboratories, Inc.

6.9.3 Energy Saver Lamps

Energy efficient lamps are now commonly available both of the incandescent and fluorescent type. Energy "saving" incandescent lamps are nothing more than lower wattage replacement lamps which produces proportionately lower light output. (Some lamps, especially those below 100W, do produce slightly more light per watt than those they replace but high wattage lamps do not). However, whenever lower wattage lamps will adequately do the job they should be used instead of higher wattage lamps. Other higher power (greater than 200W) incandescent lamps are available whose glass enclosures are shaped and are reflective so as to direct their light into a smaller area. These can save energy if used properly by reducing wasted dispersed light.

Energy efficient fluorescent lamps are available which are truly more efficient than their predecessors in that they produce more light with less electrical energy. These replacements are completely compatible with existing fluorescent fixtures unless the existing ballast is more than 5 years old. Retrofitting ballasts which were manufactured prior to 1978 with an "energy saver" lamp, can cause the ballast to burn out prematurely.

Three manufacturers which carry these energy efficient lamps are:

- General Electric
- Westinghouse
- Sylvania

6.9.4 <u>High Efficiency Ballasts</u>

Ballasts for fluorescent lamps are available in energy efficient versions which are compatible with all existing fluorescent systems. Two types of ballasts are currently available: magnetic ballasts and solid state electronic ballasts. The former is similar in design to the standard ballasts which have always been used. The latter, however are relatively new and represent the new state-of-the-art. The solid state ballasts convert 60hz power to greater than 20khz which results in lower energy consumption for equivalent or greater light output. Manufacturers of high efficiency fluorescent lamp ballasts are:

- Magnetic
  - General Electric
  - Westinghouse
  - Sylvania
- Solid State Electronic
  - Triad Utrad
  - Thomas Industries

6.9.5 <u>High Efficiency Motors</u>

Electric motors represent a large fraction of the total electrical energy demand at the UMDA. Special motors are now available which are more efficient than the standard models made in recent years. These new motors are similar to those routinely manufactured twenty or so years ago. They are more expensive due to costs associated with increased material (core steel for example) quantities used. However, in some cases their life cycle costs are lower.

The payback period for high efficiency motors depends upon the cost differential, efficiency differential, and annual run time. Motor replacements in the range of from 1 to 100 hp are of interest to the UMDA. Very few, if any, motors at the UMDA run for more than 2000 hours per year. Therefore, several examples are considered and simple payback periods are determined for high efficiency motors running 2000 hours per year. Table 6.2 shows the results based upon General Electric "Energy Saver" TM, 3 phase, TEFC motors. From the table it is clear that 20 hp motors and larger can be cost effectively replaced with high efficiency versions at 2000 hours per year run time.

Three manufacturers of high efficiency motors are:

- General Electric
- Westinghouse
- Gould

7.0 ENERGY PLAN

7.1 MATRIX OF ACTIONS AND SAVINGS

Located at the end of this section is a fold-out matrix listing all qualifying Increment A, B, G and F projects. Buildings to which the project applies, including inactive buildings, are given as well as the overall project SIR, annual energy savings, annual dollar savings and implementation cost.

Table 7.1 is a prioritized list of all projects analyzed (qualifying and non-qualifying) for active buildings.

7.2 SCHEDULE OF ENERGY CONSERVATION PROJECTS

Funding for Increment A, B, and G projects is not expected to be available until FY86 with BOD in late FY87 (Reference: Sacramento District Corps of Engineers Project Manager). However, Increment F projects may be funded as early as FY84. All qualifying projects for active buildings are recommended for implementation as soon as possible. Non-qualifying projects should be reevaluated periodically to see if they can be re-qualified for any reason. Inactive building projects should be considered whenever buildings are reactivated.

It is important to realize that two projects do "overlap" in that implementation of one project makes unnecessary certain parts or all of another project. Those projects which "overlap" are:

Replace Oversized Boilers -vs- Boiler/Burner Modifications

TABLE 6.2

ENERGY AND COST SAVINGS FOR HIGH EFFICIENCY MOTOR REPLACEMENT

Motor Size (Hp)	Motor Efficiency (%)		Motor Cost ($)		Energy Saved* (KWH/YR)	Dollars Saved ($/YR)	Simple Payback (Years)
	Standard Motor	High Efficiency Motor	Standard Motor	High Efficiency Motor			
1	74.4	84.0	252	334	229	5.66	14.5
2	77.8	84.0	354	434	284	7.00	11.4
5	83.6	86.5	484	581	299	7.39	13.1
10	85.9	90.2	592	780	828	20.50	9.2
25	89.4	92.4	1,325	1,542	1,355	33.45	6.5
50	91.3	94.1	2,658	2,881	2,431	60.05	3.7
75	91.3	94.1	4,633	5,520	3,647	90.08	9.8
100	91.6	95.0	6,251	6,775	5,829	143.99	3.6

* Energy Saved = $\frac{(2000hr)\ (0.746KW/hp)\ (hp)}{} \left(\frac{1}{Efficiency_{Standard}} - \frac{1}{Efficiency_{High}} \right)$

For example, replacement of oversized boilers obviates boiler/burner modifications to the same boilers.

Also important to note is that the aggregate projects "Heat Loss Control Modifications" and "Electrical Modifications" contain seven projects developed under Increment F. And, the seven Increment F projects are used to form aggregate projects within the Increment F portion of the study. These relationships were formed to provide the Facilities Engineer with different funding options only. Obviously, the same project should not be funded twice.

In order to minimize building occupancy disturbances and to ensure project coordination, several discrete projects should be scheduled simultaneously. The aggregate projects recommended are formed to meet this objective. For example the "Building Envelope Modification" project includes sealing unnecessary windows and doors along with wall insulation so that the three projects properly coordinate functionally and architecturally. Weatherstripping should follow door and window sealing to ensure that doors and windows scheduled for sealing are not also weatherstripped.

Many of the no cost/low cost projects will be scheduled for implementation by in-house service crews. Such projects should be scheduled as soon as possible since project funding processes are not necessary in those cases. Internal energy conservation measures implementation will have the dual advantage of conserving energy at the earliest possible date at lower total cost.

7.3 UMDA ENERGY CONSUMPTION BY FY88

As described in Section 5.0 the total energy savings potential of all projects recommended here is approximately 23,000 x 10^6 BTU/YR or a reduction of 39% compared to FY75. An additional 2% net savings resulting from the recent "Insulate Buildings" project is also expected. Therefore, by FY88 a total savings of 41% could be realized which would meet the FY2000 energy reduction goal.

Based upon the anticipated facility changes described in Section 6.7, the total active gross square footage at the UMDA in FY88 is expected to be approximately 3,035,032 SF. Projected energy consumption per square foot is then approximately 11,632 BTU/SF. This is only 44% of the FY75 consumption which was 26,380 BTU/SF.

TABLE 7.1

PRIORITIZED LIST OF ALL

ACTIVE BUILDING PROJECTS

No.	Project	SIR	Capital Cost ($)	Annual Energy Savings (10^6BTU/YR)	Dollar Savings ($/YR)
1	Deactivate Bldg. 33	246.5	256	502	4,960
2	Shower Flow Restrictors	81.8	496	1,353	2,882
3	Reduce Lighting	66.8	12	23	49
4	Seal Air Vents	65.9	924	1,016	3,965
5	Reduce DHW Set Point Temp.	49.6	243	401	855
6	Thermostat Modifications	45.6	1,183	732	3,738
7	Swimming Pool Cover	30.0	320	320	682
8	Insulate Hot Water Pipes	30.0	26	26	55
9	Insulate Steam & Condensate Piping	27.2	21,570	6,533	38,895
10	Lighting Timers	14.7	260	127	271
11	Turn Off DHW Tank	12.8	91	39	82
12	Insulate Deactivation Furnace Cyl.	7.4	2,272	230	2,272
13	Night Set-Back Thermostats	6.8	13,052	813	6,584
14	Interior Partition Insulation	5.9	4,178	278	1,603
15	Hot Water Boiler Control	4.8	1,665	64	630
16	Reduce Window Area	4.4	32,742	1,444	10,231
17	Install Thermostatic Radiator Valves	4.3	4,964	177	1,660
18	Roof Insulation	4.2	38,031	1,986	10,359
19	Install Ceiling Fans	4.2	16,609	588	4,738
20	Construct Vestibule	3.9	1,945	61	603
21	Seal Overhead Doors	3.7	10,139	386	2,620

TABLE 7.1 (continued)

No.	Project	SIR	Capital Cost ($)	Annual Energy Savings (10^6BTU/YR)	Dollar Savings ($/YR)
22	Family Housing Insulation	3.3	26,032	673	6,649
23	Boiler/Burner Modifications	2.7	113,165	2,960	21,622
24	Close Off East Work Bay in Bldg. 30	2.4	1,915	36	356
25	Replace Oversized Boilers	2.1	86,132	1,675	13,330
26	Floor Insulation	2.1	11,135	183	1,808
27	Weatherstrip Windows and Doors	1.6	16,065	265	1,899
28	Turn Off Water Coolers - Bldg. 614	1.5	1	1	2
29	Repair Broken Steam Pipe Insulation	1.4	3	1	3
30	Wall Insulation	1.1	216,531	2,590	17,824
31	Replace 5th Avenue Furnaces	0.9	39,510	-1,005	2,574
32	Insulated Siding - Family Housing	0.9	73,474	521	5,147
33	Lighting Source Change	0.8	14,128	289	845
34	Storm Windows	0.7	72,314	466	3,328
35	Replace Personnel Doors	0.7	17,083	104	860
36	Replace Overhead Doors	0.7	33,407	192	1,680
37	Replace Defective Air Relief Valve - Wall No. 5	0.6	27	1	1
38	Door Repair - Bldg. 614	0.38	489	1	15
39	Disconnect Bldg. 10 Boiler	0.26	11,100	23	227
40	Domestic Hot Water Time Clock	0.22	1,278	10	20

TABLE 7.1 (continued)

No.	Project	SIR	Capital Cost ($)	Annual Energy Savings (10^6BTU/YR	Dollar Savings ($/YR)
41	Replace Incandescent	0.20	5,167	34	72
42	Water Cooler Time Clocks	0.18	367	2	5
43	Repair Louvres	0.18	101	0.45	1
44	Insulate Hot Oil Pipes	0.15	780	1	9
45	Replace Broken Windows	0.13	33	0.06	0.32
46	Operate Lawn Sprinklers at Night	NA	0	0	1,151
47	Power Factor Correction	NA	2,220	0	2,568

(1)

UMATILLA DEPOT ACTIVITY

HERMISTON, OREGON

FINICAL & DOMBROWSKI
ARCHITECTS & ENGINEERS
TUCSON ARIZONA

QUALIFYING

		HEADQUARTERS	FIRESTATION / SECURITY	SECURITY SENTRY	MAINTENANCE SHOP	VEHICLE REPAIR	GASOLINE STATION	CARPENTRY SHOP	INFLAMMABLE STORAGE	RAILROAD ENGINE SHOP	DISPENSARY / TOOL CRIB	ELECT TRANSFORMER STATION	FAMILY HOUSING	WAREHOUSE	DIESEL STATION	WATER WELL #1	WATER WELL #2	SCALE HOUSE	ADMIN GEN PURPOSE	OIL HEAT PLANT	BOX & CRATE SHOP
		1	2	3	4	5	6	7	8	10	11	14	16	17	23	24	25	26	27	28	30
BUILDING TYPE	ADMIN	●	●	●										●					●		
	MISSION																				●
	SUPPORT				●	●	●	●	●	●	●				●			●			
	WAREHOUSE / STORAGE																				
	HOUSING												●								
	POWER / UTILITY											●								●	
	WATER															●	●				
	MISCELLANEOUS																				
USAGE	YEAR ROUND	●	●	●	●	●	●	●	●	●	●	●	●			●	●				●
	INTERMITTENT													●	●			●		●	
	INACTIVE																		●		
	NUMBER OF DUPLICATE BLDGS								–				–								
	STRUCTURE TYPE																				
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	TEMPORARY																		●		●
WORK INCREMENT A, B & G	ROOF INSULATION (ACTIVE BLDGS)					●					●					●	●				
	INACTIVE BLDGS																		●		
	WALL INSULATION (ACTIVE BLDGS)	●	●	●		●		●		●	●		●			●	●				●
	INACTIVE BLDGS																		●		
	INTERIOR PARTITION INSUL (ACTIVE BLDGS)										●										
	FLOOR INSULATION (ACTIVE BLDGS)																				
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	REDUCE WINDOW AREA (ACTIVE BLDGS)	●	●			●		●		●	●										●
	INACTIVE BLDGS																		●		
	SEAL OVERHEAD DOOR (ACTIVE BLDGS)					●					●										●
	NIGHT SET-BACK T-STATS (ACTIVE BLDGS)	●			●	●	●	●		●	●										●
	INACTIVE BLDGS																		●		
	REPLACE OVERSIZED BOILERS (ACTIVE BLDGS)	●	●					●												●	●
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	SHOWER FLOW RESTRICTORS		●										●								
	REDUCE LIGHTING	●									●										●
	SEAL AIR VENTS								●		●					●	●				

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ALIFYING ENERGY CONSERVATION MEASURE

16 FAMILY HOUSING	17 WAREHOUSE	23 DIESEL STATION	24 WATER WELL #1	25 WATER WELL #2	26 SCALE HOUSE	27 ADMIN GEN PURPOSE	28 OIL HEAT PLANT	30 BOX & CRATE SHOP	31 MOTORPOOL / BATTERY	32 PX / THEATER	33 SECURITY TRAINING	34 BACHELOR APARTMENT	35 FAMILY HOSING	36 CAFETERIA	37 OIL HEAT PLANT	38 BATH HOUSE	40 SWIMMING POOL	41 STANDBY GEN PLANT	44 PRIMARY ELECT SUBSTATION	51 FAMILY HOUSING	52 ADMIN GEN PURPOSE	54 ADMIN GEN PURPOSE	55 FAMILY HOUING	57 GASOLINE PUMP	58 STANDBY GENERATOR	61 TENNIS COURT	62 WADING POOL	64 DIESEL STATION	67 MULTIPLE COURTS	75 FACILITIES ENGINEER	80 ASPHALT TANK	81 ASPHALT TANK	82 STORAGE	100 STORAGE	101 WAREHOUSE	102 WAREHOUSE	104 FIRE STATION	105 WAREHOUSE	106 WAREHOUSE	112 WAREHOUSE	115 SHOP / STORAGE	116 BREAKROOM / ADMIN	130 AMMO DEMOLITION	133 PUMP STATION, FIRE	[illegible] PUMP STATION, FIRE
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N MEASURES - ENERGY ENGINEERING ANALYS

100 STORAGE	101 WAREHOUSE	102 WAREHOUSE	104 FIRE STATION	105 WAREHOUSE	106 WAREHOUSE	112 WAREHOUSE	115 SHOP / STORAGE	116 BREAKROOM / ADMIN	130 AMMO DEMOLITION	133 PUMP STATION, FIRE	135 PUMP STATION, FIRE	136 VACUUM MOTOR	154 PUBLIC TOILET	160 WATER WELL #4	161 WATER WELL #5	200 WAREHOUSE	206 DEACTIVATING FURNACE	207 LOADING DOCKS	208 BREAKROOM	209 LOADING DOCKS	210 LOADING DOCKS	328 STORAGE	343 SEWAGE TREATMENT	344 SEWAGE TREATMENT	345 RAILROAD INSPECT PIT	346 RAILROAD SCALES	401 MAGAZINE	415 SURVEILLANCE WORKSHOP	416 OIL HEAT PLANT	417 AMMO RENOVATION SHOP	418 PUBLIC TOILET	419 TOXIC CHANGE ROOM	420 BREAKROOM	422 DUNNAGE (ONLY 422 HEATED)	433 OIL HEAT PLANT	434 BUNDLE BUILDING	447 TRANSMITTER	449 STANDBY GENERATOR	455 WATER WELL #3	478 BOOSTER PUMP	481 SHIPPING & RECIEVING	486 OIL HEAT PLANT	489 WASHOUT & FLAKER BLDG.	493 CLEAN & PAINT SHOP
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:ERING ANALYSIS PROGRAM

417 AMMO RENOVATION SHOP	418 PUBLIC TOILET	419 TOXIC CHANGE ROOM	420 BREAKROOM	422 DUNNAGE (ONLY 422 HEATED)	433 OIL HEAT PLANT	434 BUNDLE BUILDING	447 TRANSMITTER	449 STANDBY GENERATOR	455 WATER WELL #3	478 BOOSTER PUMP	481 SHIPPING & RECIEVING	486 OIL HEAT PLANT	489 WASHOUT & FLAKER BLDG.	493 CLEAN & PAINT SHOP	495 COMPRESSED AIR PLANT	508 FAMILY HOUSING	608 AMMO NORMAL MAINT	612 OIL HEAT PLANT	613 WATER WELL #6	614 AMMO RENOVATION	617 OIL HEAT PLANT	619 LUNCH ROOM	660 SENTRY STATION	802 LOADING DOCK	839 LOADING DOCK	18 ADMIN BUILDING	19 WAREHOUSE	SIR - SAVINGS TO INVESTMENT RATIO	ANNUAL ENERGY SAVED, MBTU	ANNUAL $ SAVED, $/YR	IMPLEMENTATION COST, $
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																												247	502	4,960	256
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																												66.8	23	49	12
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	TEMPORARY																		●		●
WORK INCREMENT A, B & G	ROOF INSULATION (ACTIVE BLDGS)					●					●					●	●				
	INACTIVE BLDGS																		●		
	WALL INSULATION (ACTIVE BLDGS)	●	●	●		●		●		●	●		●			●	●				●
	INACTIVE BLDGS																		●		
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	FLOOR INSULATION (ACTIVE BLDGS)																				
	INACTIVE BLDGS																		●		
	REDUCE WINDOW AREA (ACTIVE BLDGS)	●	●			●		●		●	●										●
	INACTIVE BLDGS																		●		
	SEAL OVERHEAD DOOR (ACTIVE BLDGS)					●					●										●
	NIGHT SET-BACK T-STATS (ACTIVE BLDGS)	●			●	●	●	●		●	●										●
	INACTIVE BLDGS																		●		
	REPLACE OVERSIZED BOILERS (ACTIVE BLDGS)	●	●					●												●	●
	WEATHERSTRIP WINDOWS & DOORS (ACT BLDGS)					●					●					●	●				
	INACTIVE BLDGS																		●		
WORK INCREMENT F	DEACTIVATE BLDG 33																				
	SHOWER FLOW RESTRICTORS		●										●								
	REDUCE LIGHTING	●									●										●
	SEAL AIR VENTS								●		●					●	●				
	REDUCE DHW SET POINT TEMP (ACTIVE BLDGS)	●	●	●	●	●		●		●	●										●
	INACTIVE BLDGS																				
	THERMOSTAT MODIFICATIONS (ACTIVE BLDGS)								●		●					●	●				
	INACTIVE BLDGS																				
	SWIMMING POOL COVER																				
	INSULATE HOT WATER PIPES																				
	INSULATE STEAM & COND PIPING (ACTIVE BLDGS)	●	●		●	●	●	●	●	●	●									●	●
	INACTIVE BLDGS																				
	LIGHTING TIMERS (ACTIVE BLDGS)																				
	INACTIVE BLDGS																				
	TURN OFF DHW TANK										●										
	INSULATE DEACTIVATION FURNACE CYL																				
	HOT WATER BOILER CONTROL		●										●								
	INSTALL THERMOSTATIC RADIATOR VALVES		●	●									●								●
	INSTALL CEILING FANS (ACTIVE BLDGS)				●	●		●		●											●
	INACTIVE BLDGS																				
	CONSTRUCT VESTIBULE	●																			
	BOILER / BURNER MODIFICATIONS (ACTIVE BLDGS)	●	●					●		●			●							●	●
	INACTIVE BLDGS																				
	CLOSE OFF EAST WORK BAY IN BLDG 30																				●
	TURN OFF WATER COOLERS - BLDG 614																				
	REPAIR BROKEN STEAM PIPE INSULATION					●															
	REPAIR SIDING (INACTIVE BLDGS)																				
	REPLACE WINDOWS (INACTIVE BLDGS)																				
	OPERATE LAWN SPRINKLERS AT NIGHT																				
	POWER FACTOR CORRECTION																				

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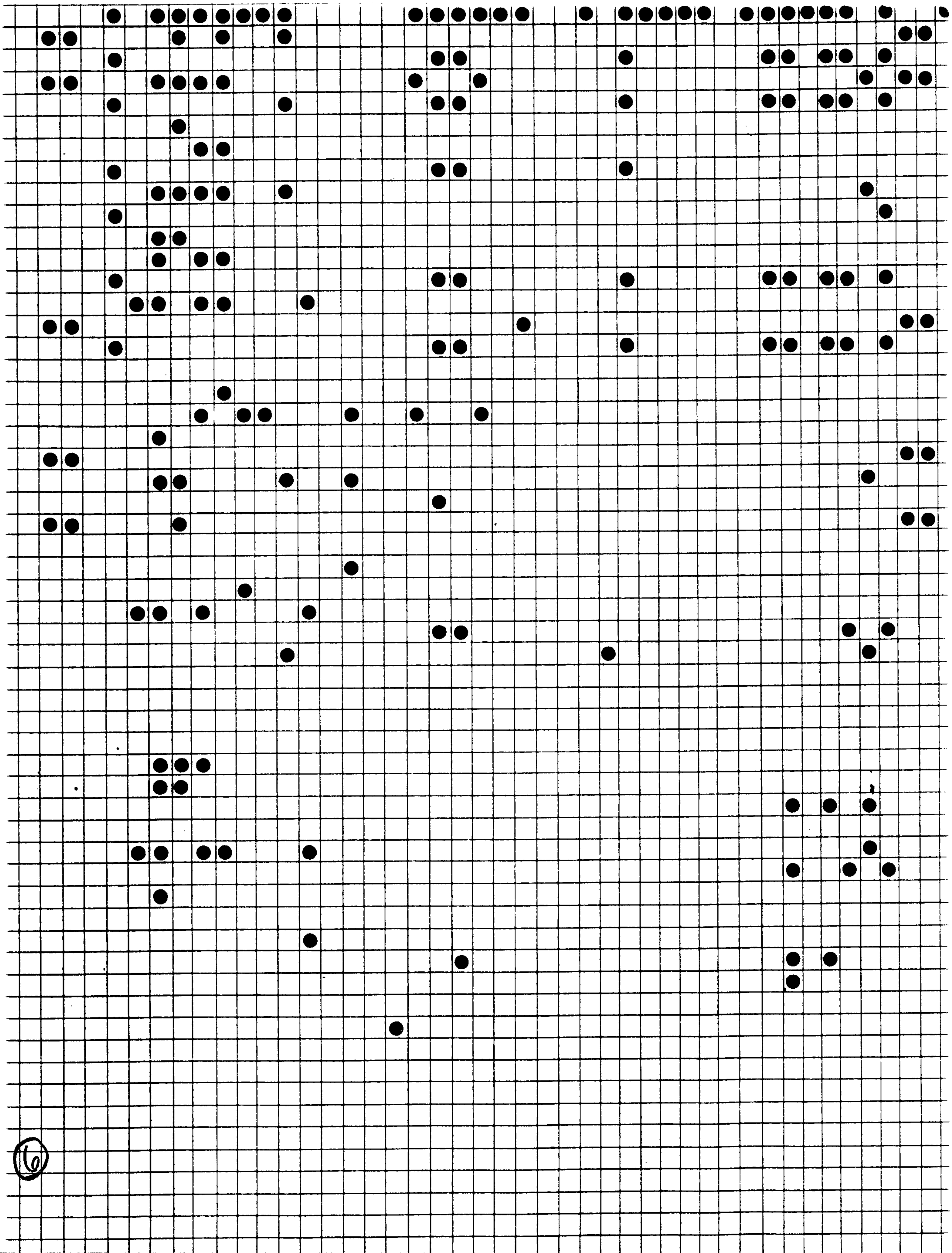

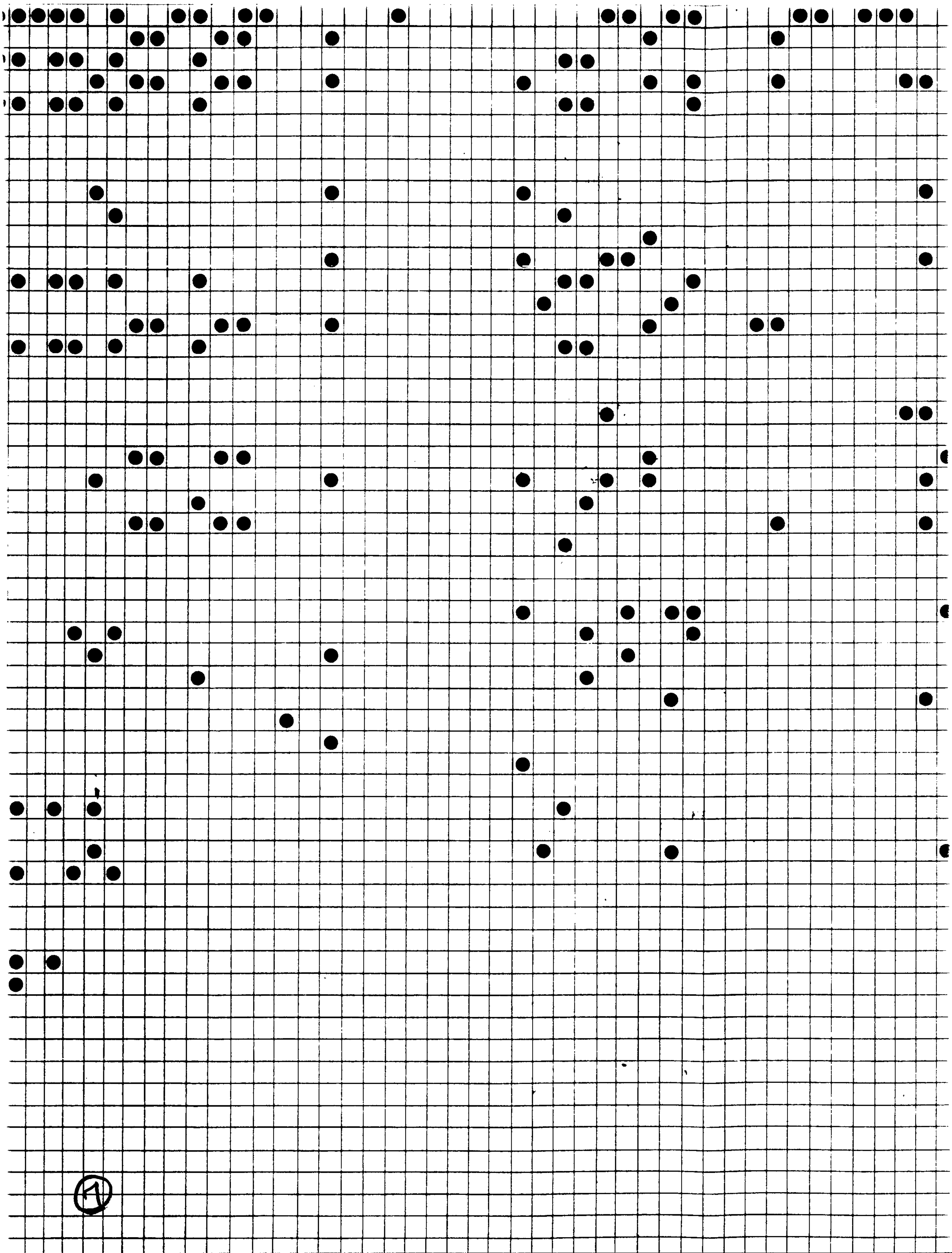
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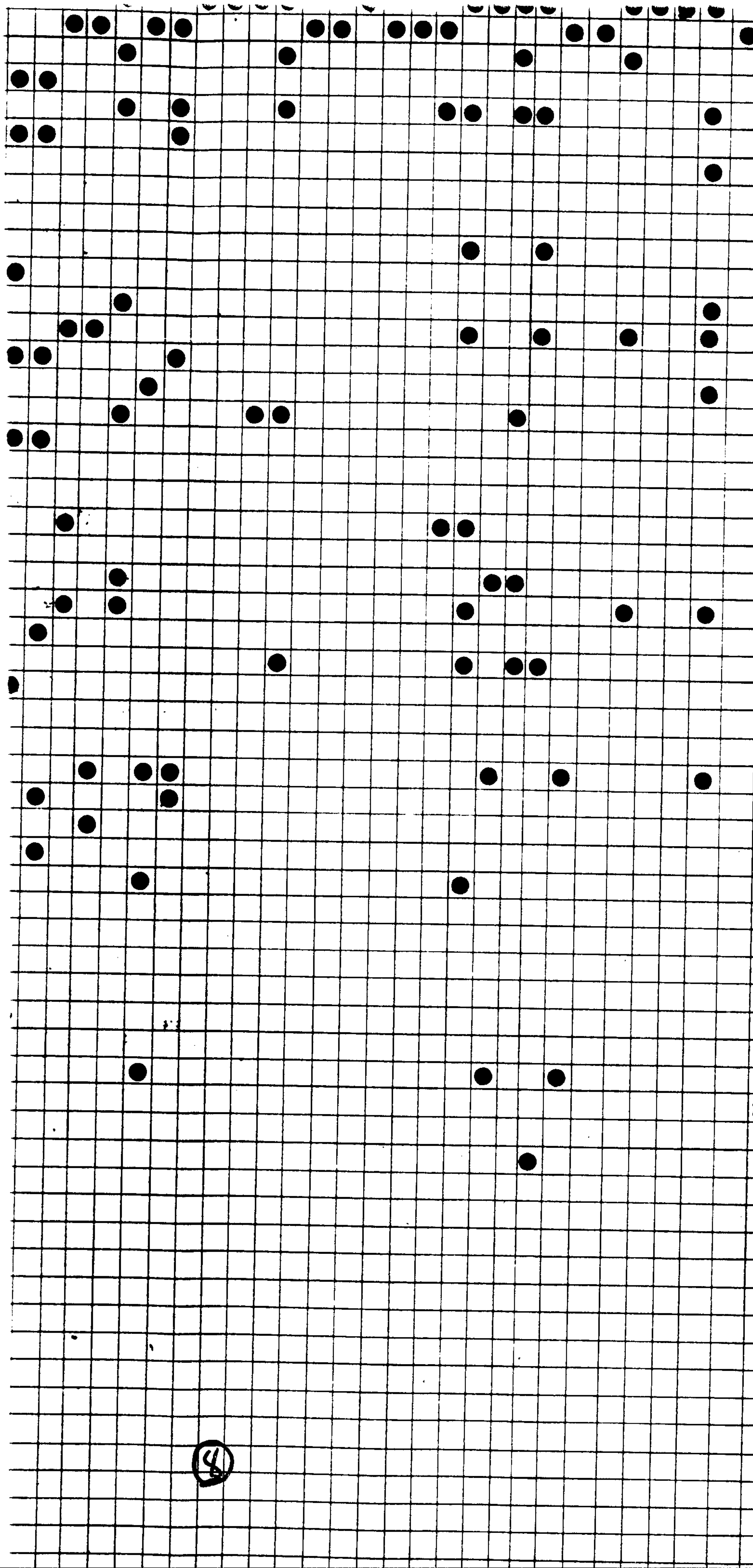
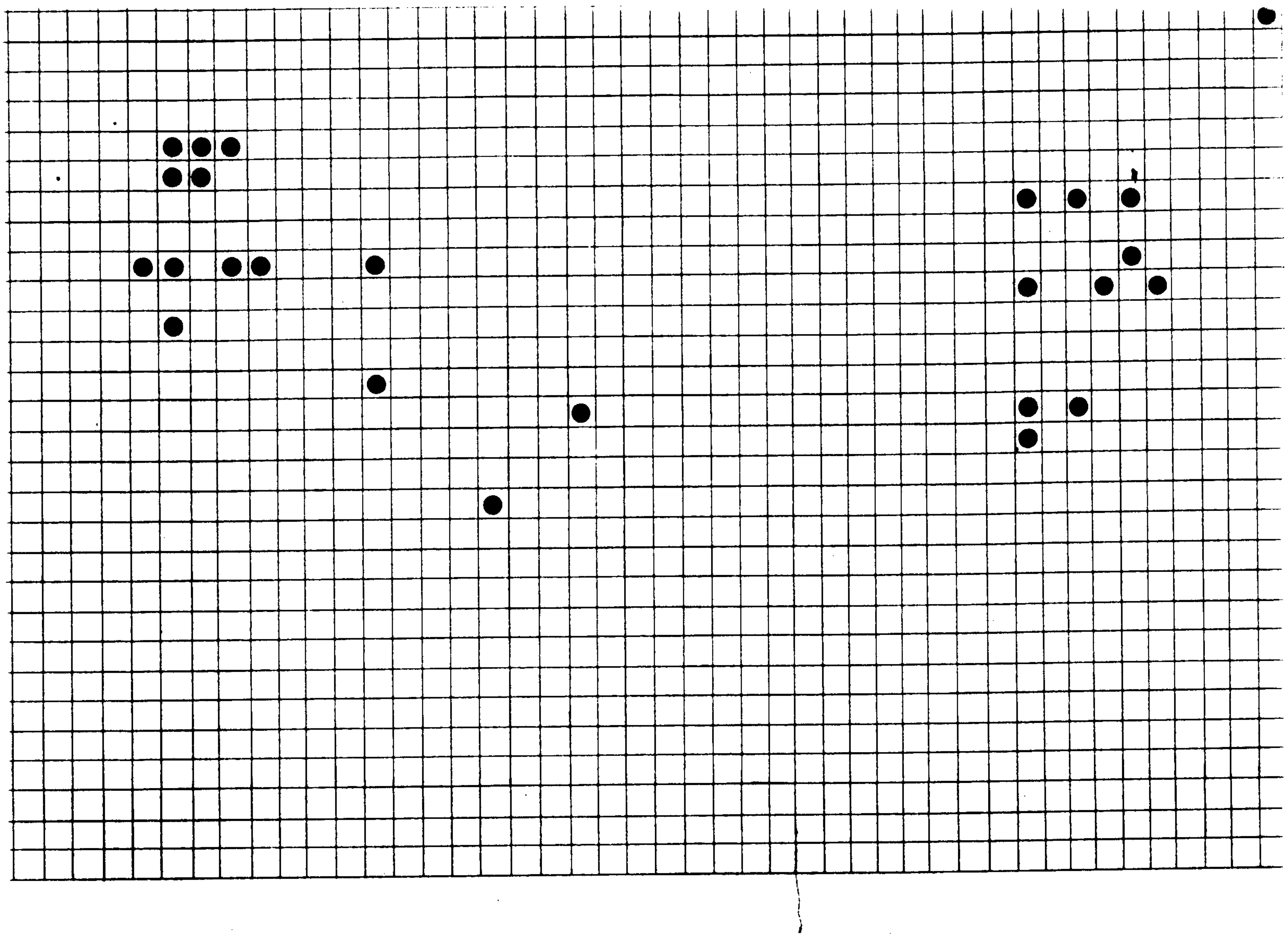
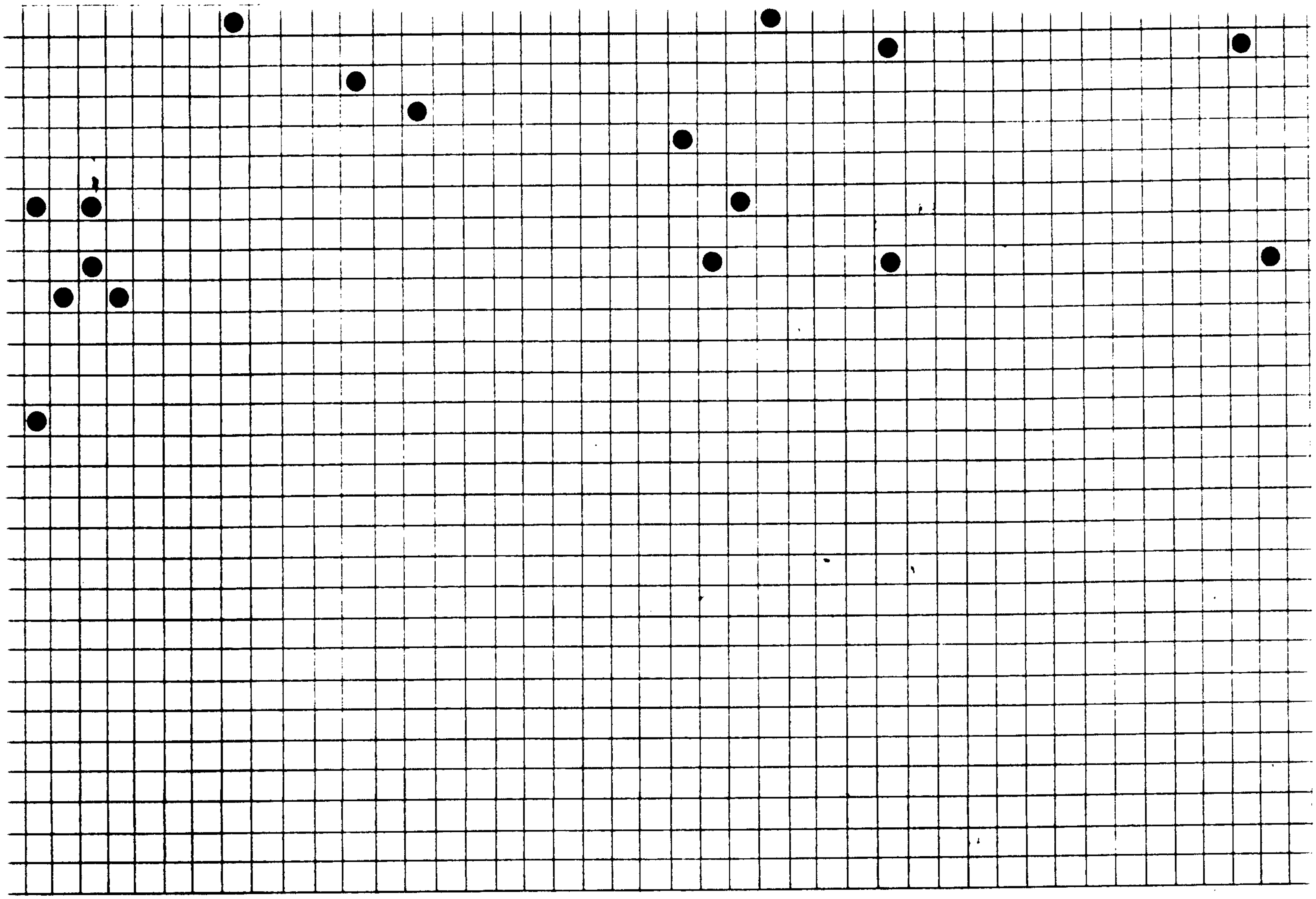


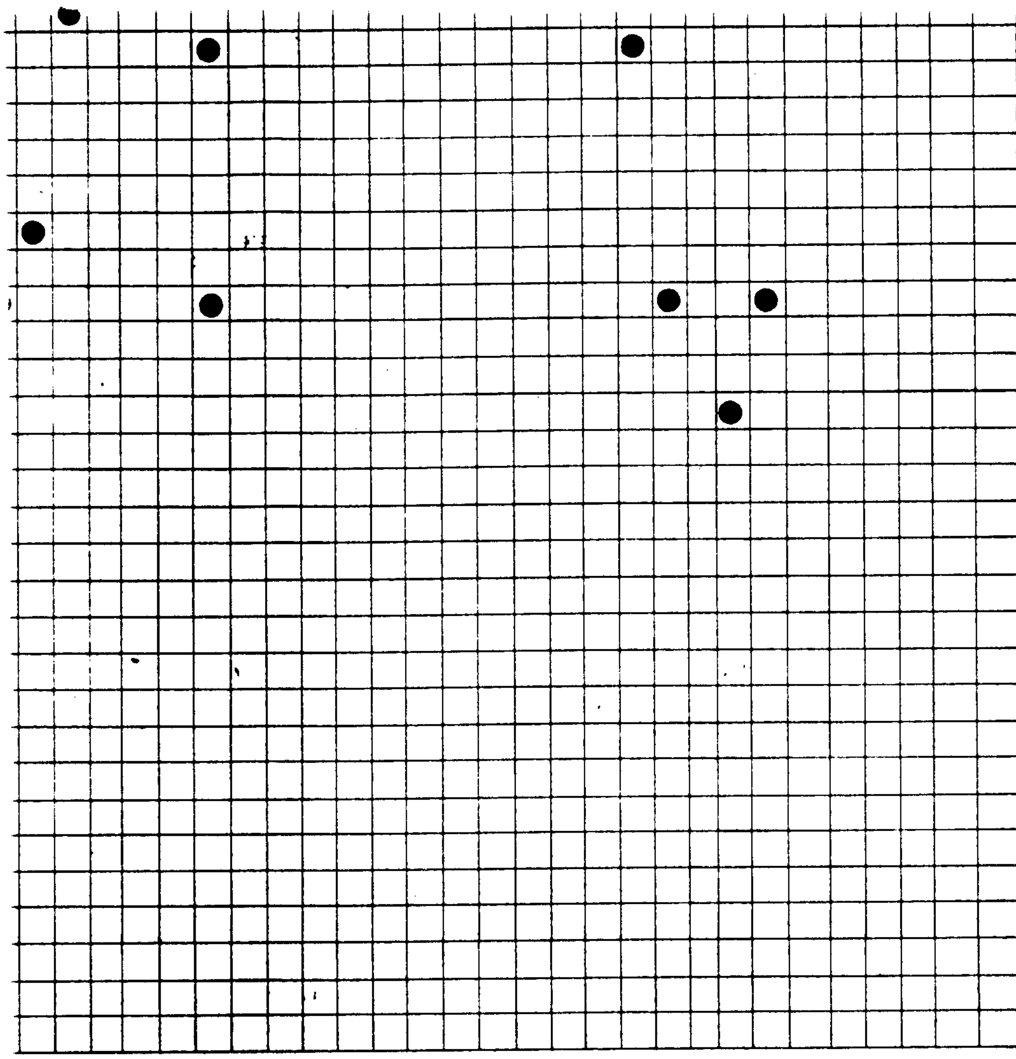
4.2	1,986	10,359	38,031
4.5	5,121	40,575	122,253
1.1	2,590	17,824	216,531
3.8	10,083	91,555	313,957
5.9	278	1,603	4,178
2.1	183	1,808	11,135
1.5	319	1,703	17,954
4.4	1,444	10,231	32,742
6.8	1,544	14,687	27,597
3.7	386	2,620	10,139
6.8	813	6,584	13,052
18.5	1,026	8,557	6,203
2.1	1,675	13,330	86,132
1.6	265	1,899	16,065
0.7	405	3,366	62,426
247	502	4,960	256
81.8	1,353	2,882	496
66.8	23	49	12
65.9	1,016	3,965	924
49.6	401	855	243
64.0	4	136	30
45.6	732	3,738	1,183
30.6	643	3,434	1,768
30.0	320	682	320
30.0	26	55	26
27.2	6,533	38,895	21,570
32.1	3,727	34,616	13,947
14.7	127	271	260
11.4	42	90	111
12.8	39	82	91
7.4	230	2,272	2,272
4.8	64	630	1,665
4.3	177	1,660	4,964
4.2	588	4,738	16,609
7.8	1,420	13,577	23,328
3.9	61	603	1,945
2.7	2,960	21,622	113,165
23.3	12,637	68,321	36,034
2.4	36	356	1,915
1.5	1	2	1
1.4	1	3	31
1.1	4	34	411
1.1	4	40	477
NA	0	1,151	0
NA	0	2,568	2,220

WORK INCREMENT F

LIGHTING TIMERS (ACTIVE BLDGS)																					
INACTIVE BLDGS																					
TURN OFF DHW TANK										●											
INSULATE DEACTIVATION FURNACE CYL																					
HOT WATER BOILER CONTROL		●										●									
INSTALL THERMOSTATIC RADIATOR VALVES		●	●									●								●	●
INSTALL CEILING FANS (ACTIVE BLDGS)				●	●		●		●											●	●
INACTIVE BLDGS																					
CONSTRUCT VESTIBULE	●																				
BOILER / BURNER MODIFICATIONS (ACTIVE BLDGS)	●	●					●		●			●							●	●	
INACTIVE BLDGS																				●	
CLOSE OFF EAST WORK BAY IN BLDG 30																					
TURN OFF WATER COOLERS - BLDG 614																					
REPAIR BROKEN STEAM PIPE INSULATION					●																
REPAIR SIDING (INACTIVE BLDGS)																					
REPLACE WINDOWS (INACTIVE BLDGS)																					
OPERATE LAWN SPRINKLERS AT NIGHT																					
POWER FACTOR CORRECTION																					







11.4	42	[illegible]	[illegible]
12.8	39	82	91
7.4	230	2,272	2,272
4.8	64	630	1,665
4.3	177	1,660	4,964
4.2	588	4,738	16,609
7.8	1,420	13,577	23,328
3.9	61	603	1,945
2.7	2,960	21,622	113,165
23.3	12,637	68,321	36,034
2.4	36	356	1,915
1.5	1	2	1
1.4	1	3	31
1.1	4	34	411
1.1	4	40	477
NA	0	1,151	0
NA	0	2,568	2,220

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