FINAL SUBMISSION

EXECUTIVE SUMMARY

INDIANA ARMY AMMUNITION PLANT ENERGY ENGINEERING ANALYSIS

Prepared for

The Department of the Army
Omaha District
Corps of Engineers
Contract No. DACA45-80-C-0090

By

Sanders & Thomas, Inc.
An STV Engineers Professional Firm
Consulting Engineers

DEPARTMENT OF THE ARMY
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July 14, 1983

U. S. Army Corps of Engineers
Omaha District
6014 U. S. Post Office and Court House
Omaha, NE 68012

Attention: MROED-MC

Reference: Energy Engineering Analysis
Indiana Army Ammunition Plant
Charlestown, Indiana

Subject: Final Submission - Increment F

Contract No.: DACA45-80-C-0090

Our Project No.: 05-4660

Gentlemen:

This letter transmits the Final Submission of the Executive Summary of the Army Engineering Analysis for the Indiana Army Ammunition Plant. The Executive Summary, last submitted 29 April 1983, has been revised to incorporate the findings of the Increment F Study (Final Submission).

We appreciate this opportunity to be of service and extend our thanks to COE and plant personnel for their invaluable assistance.

Very truly yours,

SANDERS & THOMAS, INC.

David M. Jonik, P.E.
Project Manager

DMJ:mat

Enclosure

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PROJECT ABSTRACT

ENERGY ENGINEERING ANALYSIS
INDIANA ARMY AMMUNITION PLANT

This analysis is undertaken to assist the Indiana Army Ammunition Plant (INAAP) in meeting the goals established in the Army Facilities Energy Plan, in effect at the time of our contract, to reduce energy consumption by 25 percent by FY 85.

Projects selected for implementation as a result of this analysis will enable INAAP to achieve the FY 85 goal. Source energy consumed in 1975 was 508.000 MBTU's. This was reduced by INAAP to 346,000 in 1980 for a 32 percent savings. By combining INAAP's conservation effort with the projects described in this report, FY 1985 source energy consumption will be 218,000 MBTU's or a 57 percent reduction. See Figure 1: Projected Energy Consumption as a Result of Energy Project Implementation.

Projects are divided into Standby and Mobilization Status. Standby status and Increment F projects will save approximately 54,000 MBTU's. Total energy reduction from FY 80 to the end of FY 85 will be approximately 128,000 MBTU's including 74,000 MBTU's from INAAP's energy conservation effort. The total installed cost of the Standby and Increment F projects is estimated at approximately $2.1 million. If Mobilization status projects are implemented, source energy consumption can be reduced by 3,365,000 MBTU's during periods of full mobilization. The cost of implementing the Mobilization projects is approximately $21 million.

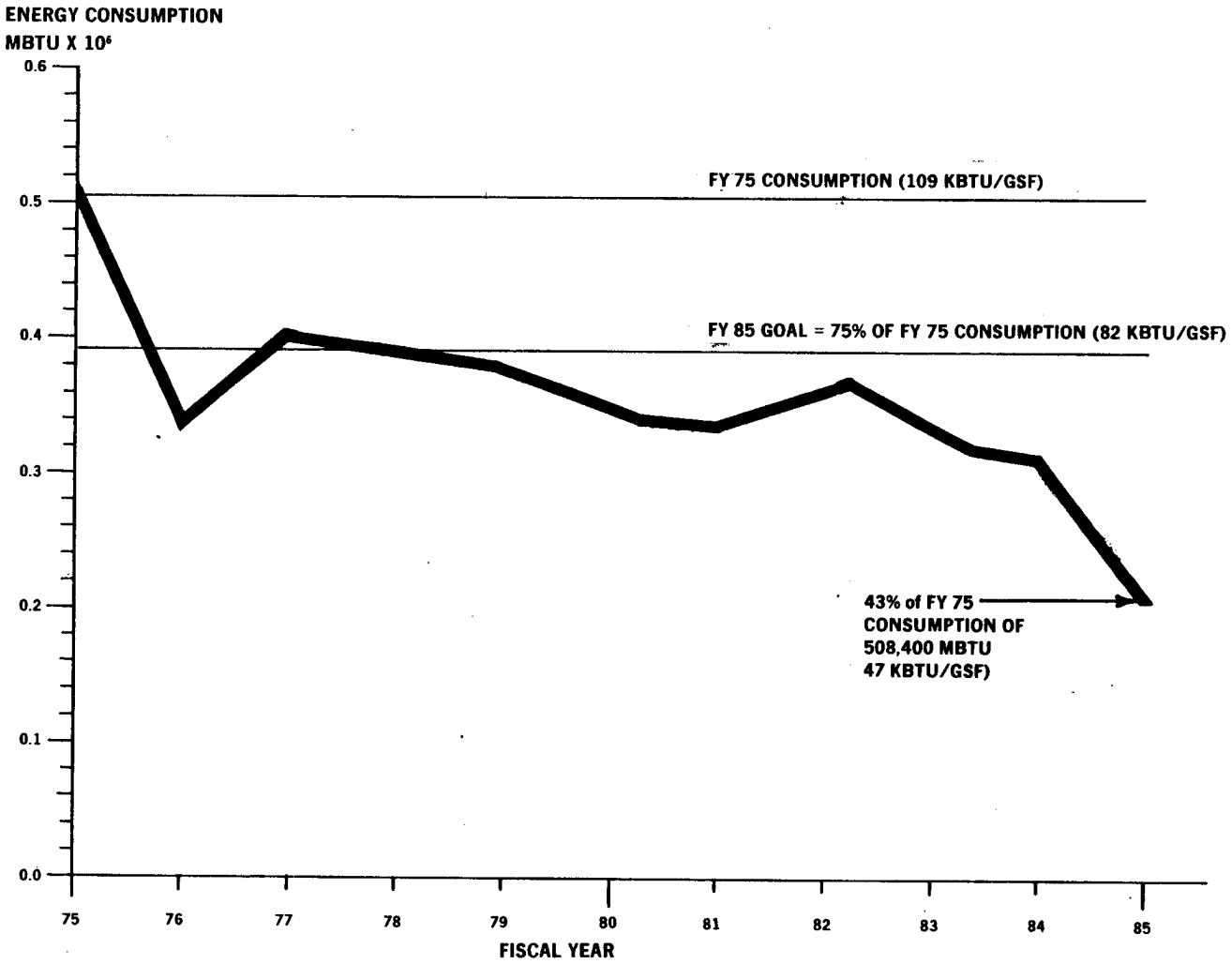

FIGURE 1
PROJECTED ENERGY CONSUMPTION
AS A RESULT OF
ENERGY PROJECT IMPLEMENTATION

SANDERS & THOMAS.
AN STV ENGINEERS PROFESSIONAL FIRM

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DEFINITION OF TERMS

BENEFICIAL OCCUPANCY DATE (BOD)

The date a facility begins to operate.

BENEFITS

The dollar savings realized over the life of the project.

BENEFIT-TO-COST RATIO (BCR)

The dollar savings realized over the life of the project divided by the non-recurring capital investment (including design). BCR is a measure of project payback. A BCR of 1.0, for example, means that the project's initial capital investment will be recovered over its lifetime.

CURRENT WORKING ESTIMATE (CWE)

The project installation cost escalated to the year the project is programmed for implementation. Installation costs are non-recurring and include all labor and material, contractor costs, bond, contingency, SIOH, and escalation. Design costs are not included and must be added to the CWE to develop the total project cost.

ENERGY-TO-COST RATIO (ECR)

The MBTU's per year saved divided by the non-recurring capital investment (excluding design). ECR is a measure of the amount of energy savings related to the required capital investment. Acceptable ECR's should be lower each year since energy costs escalate faster than capital investment costs.

MOBILIZATION STATUS

Period when the plant is operating at full production level.

SAVINGS-TO-INVESTMENT RATIO (SIR)

The total net dicounted savings divided by the total investment, in accordance with ECIP Guidance, dated 6 August 1982.

SIMPLE AMORTIZATION PERIOD (SAP)

The project capital investment divided by the yearly savings. This yields the period of time required to recover the initial capital investment.

DEFINITION OF TERMS (Continued)

STANDBY STATUS

Active or laid-away buildings or equipment used to maintain the plant at a reduced production level in readiness for mobilization.

TOTAL INSTALLED COST (TIC)

The sum of the CWE and the design costs.

EXECUTIVE SUMMARY

1.1 PROJECT REQUIREMENT

This engineering analysis is undertaken in order to develop a systematic program of projects that will lead to energy consumption reductions at the Indiana Army Ammunition Plant (INAAP) without compromising the mission of the plant, and in compliance with all applicable environmental and Occupational Safety and Health Administration regulations. Reduced energy consumption is a stated goal of the Army Facilities Energy Plan.

The projects included in this analysis are grouped into increments: A - Energy Conservation and Management Program (ECAM) projects for buildings and processes, B - ECAM projects for utilities and energy distribution systems, E - Feasibility of central boiler plants, F - Recommendations for energy saving modifications and changes in building and system operation which are within the funding authority and management control of the Facilities Engineer, and G - Minor construction, maintenance and repair projects.

2.1 PLANT DESCRIPTION

INAAP is a Government-owned, Contractor-operated military industrial installation. ICI Americas, Inc. serves as the plant operator.

INAAP is located near Charlestown, Indiana in close proximity to Louisville, Kentucky. The plant is bounded on the west by Indiana Highway 62 and on the east by the Ohio River. The plant's location in relation to Charlestown and Louisville is shown in Figure 2: Location Map.

INAAP consists of approximately 10,500 acres with over 1,700 buildings, 90 miles of roads, and 84 miles of railroad track. The plant is divided into four sections: Load, Assemble, and Pack (LAP): Propellant and Explosives (P&E); Administrative; and Black Powder. Figures 3 and 4 show the key features of the plant.

The INAAP mission is to manufacture finished propelling charges and bore wear reducing jackets for artillery and to maintain facilities and equipment in support of mobilization requirements.

3.1 ARMY FACILITIES ENERGY PLAN

The Army Facilities Energy Plan sets short and long range energy goals for the Army and provides policy and planning guidance for the development of detailed facility energy plans. The Army's energy goals in effect at the time of our scope of work, compared to present goals, are shown in Table 1: Comparison of Army Facilities Energy Plan Goals.

The program recommended in this EEA report is consistent with revised Army Facilities Energy Plan goals as stated in the plan's 26 October 1981 version.

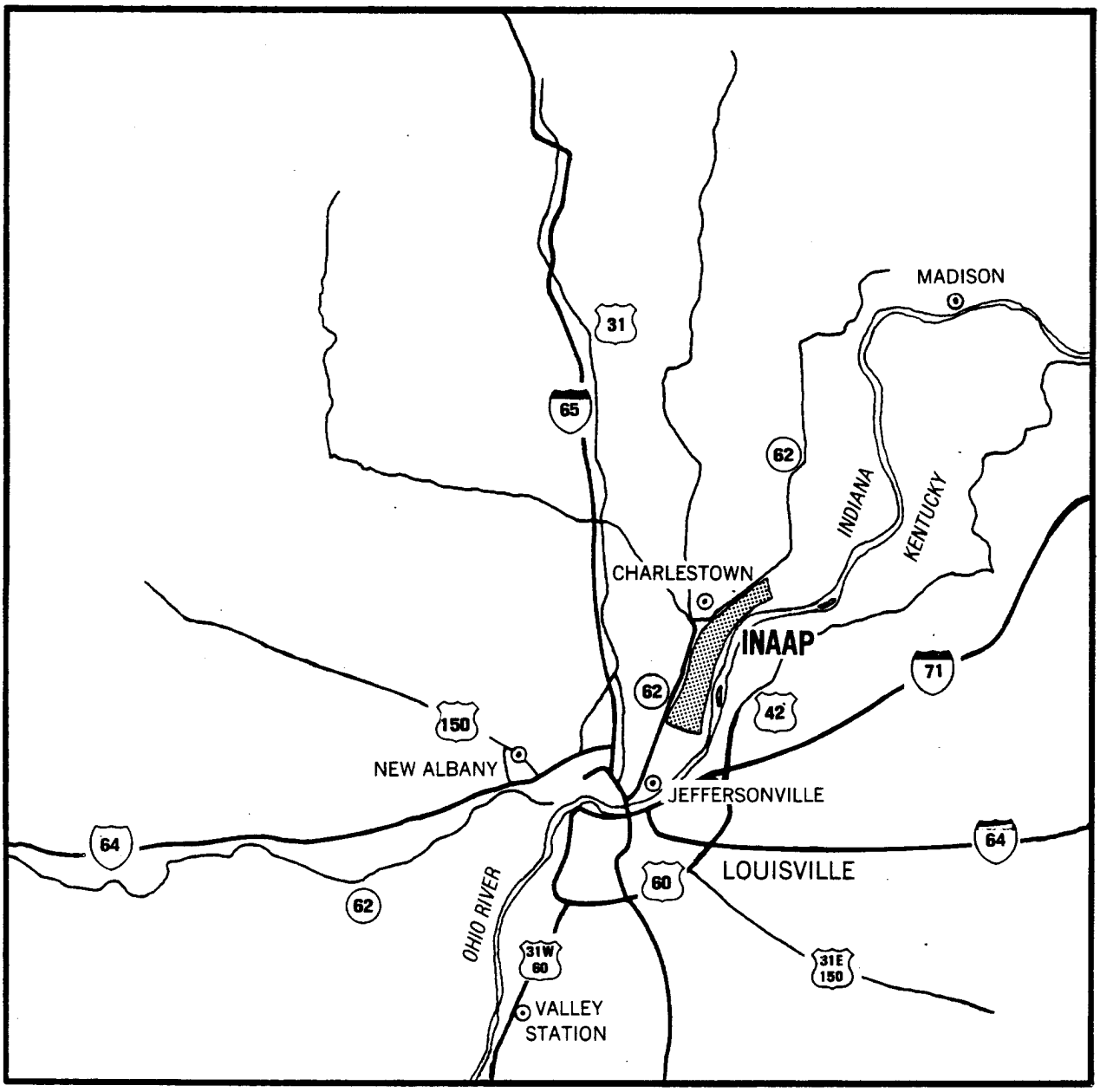
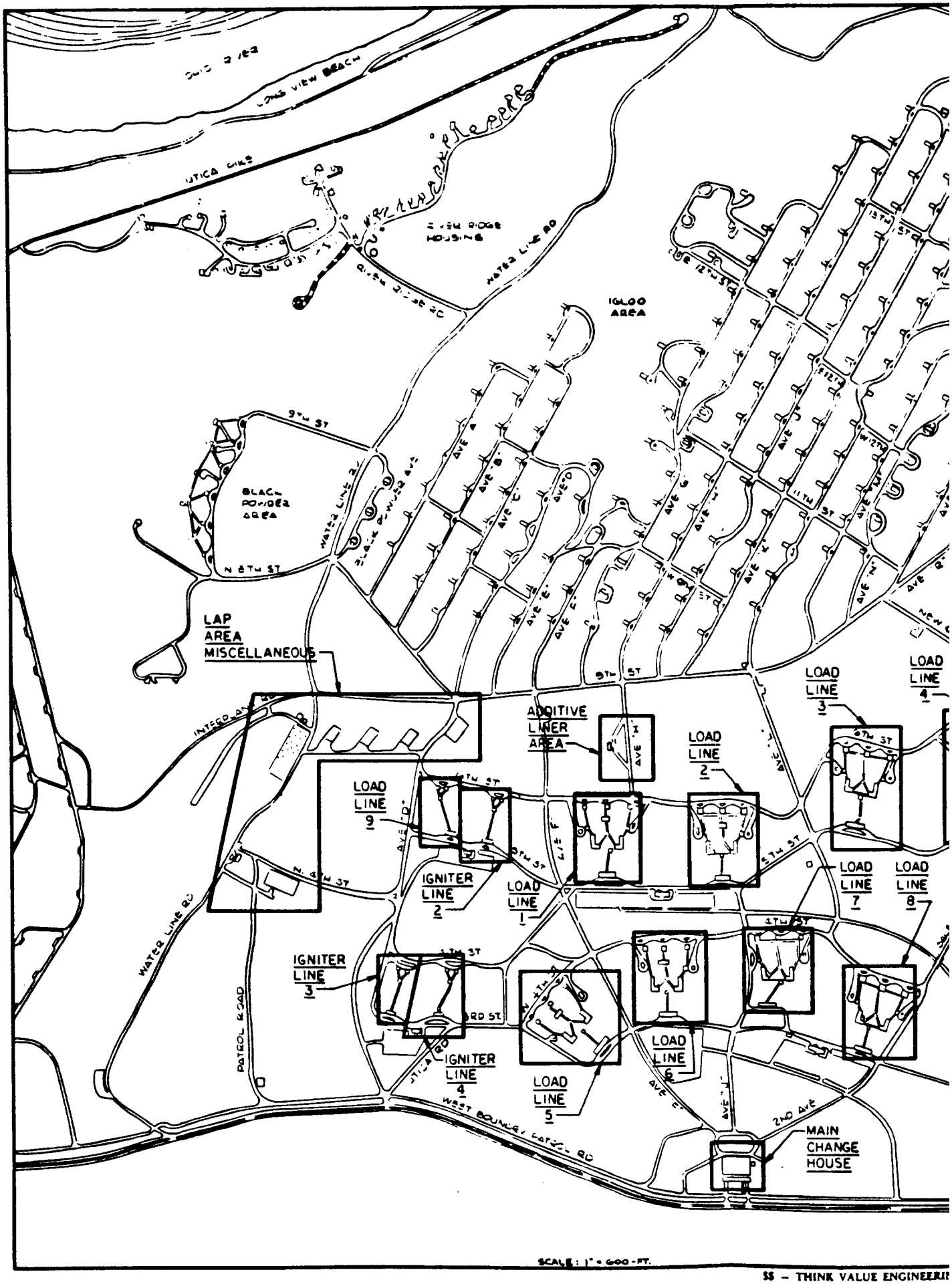


Figure 2
Indiana Army Ammunition Plant
Location Map



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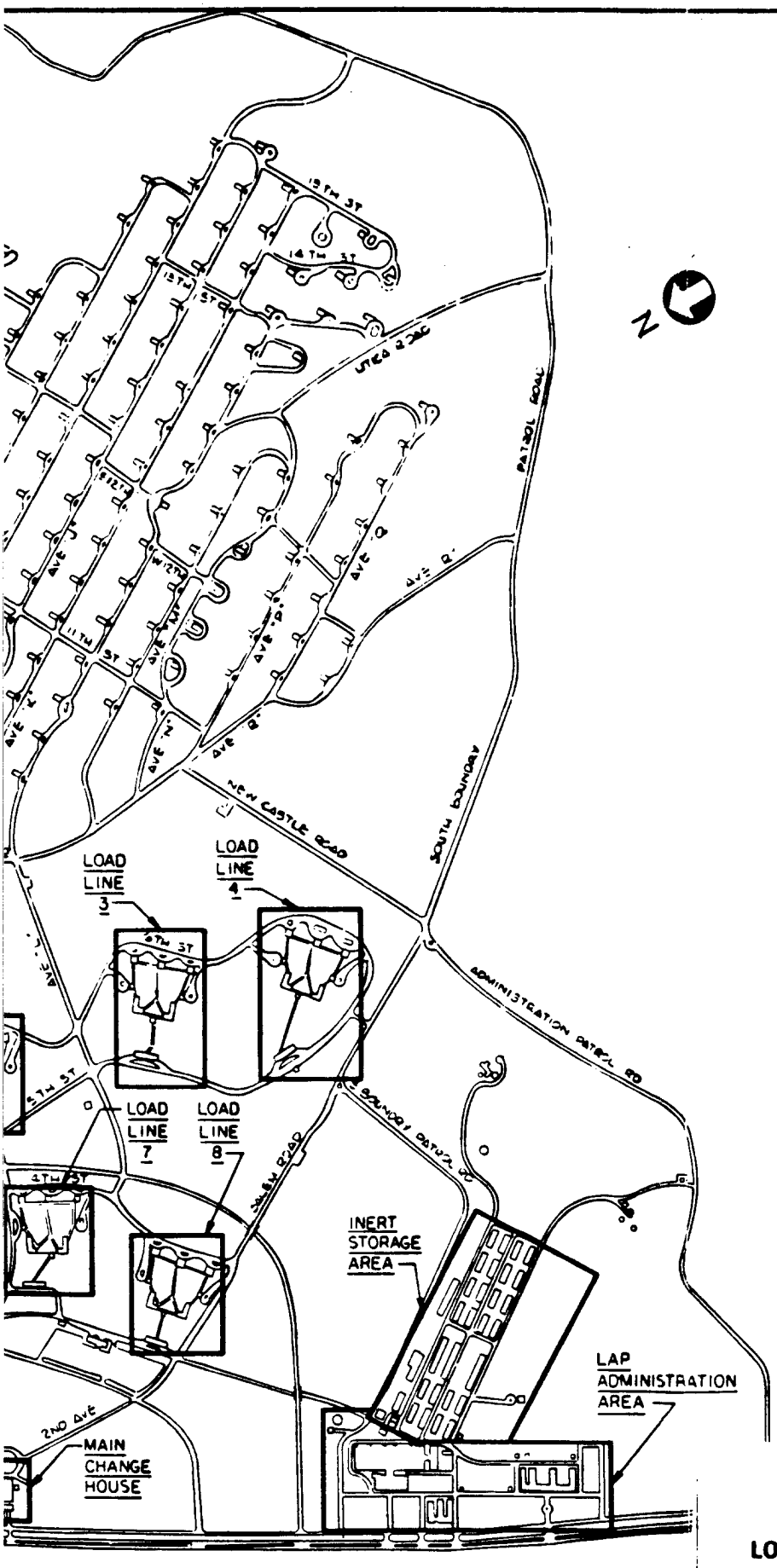

FIGURE 3
INDIANA ARMY AMMUNITION PLANT
LOAD, ASSEMBLE AND PACK AREA SITE PLAN

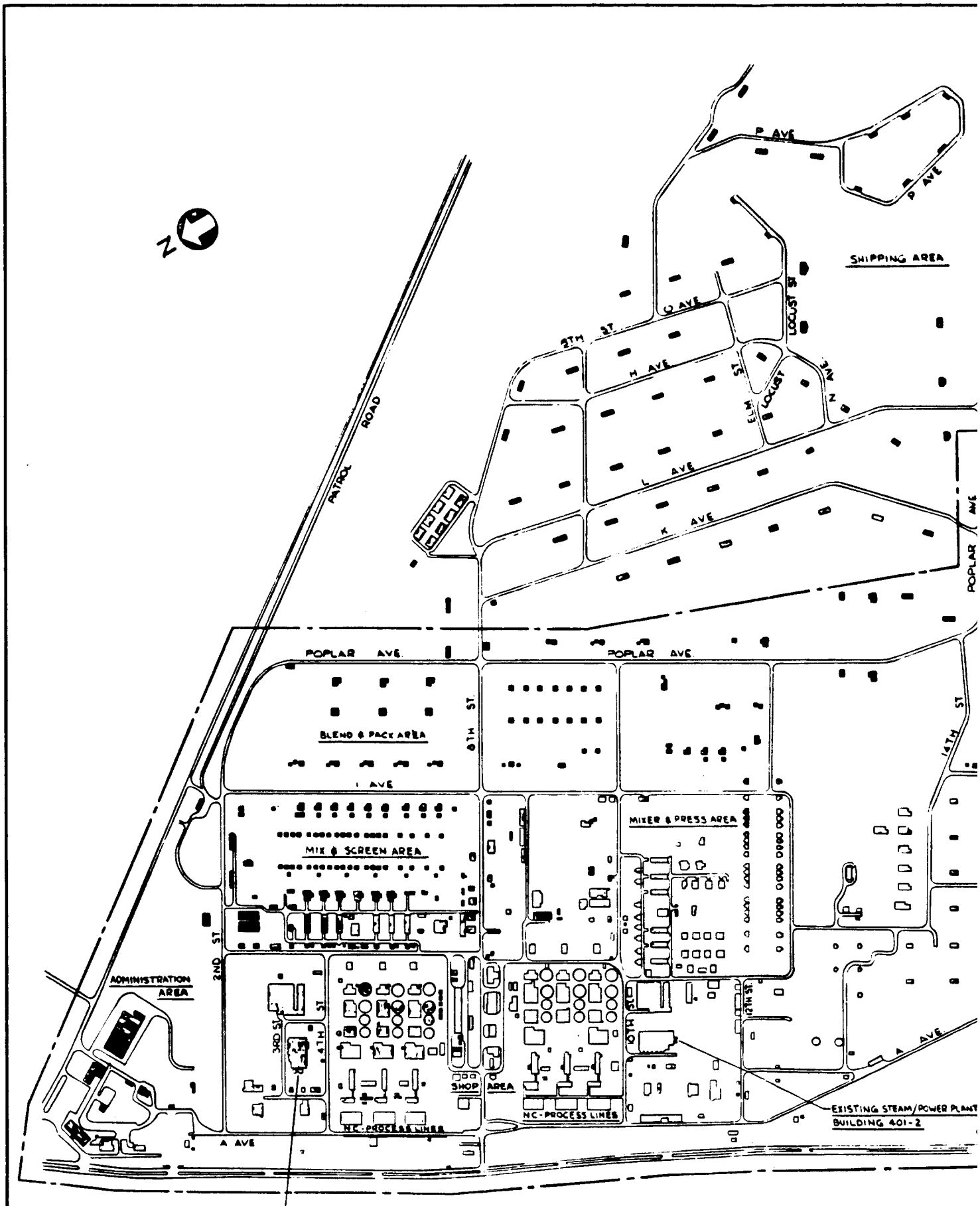

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FIGURE 4
INDIANA ARMY AMMUNITION PLANT
P&E AREA SITE PLAN

=600-FT.

PLANT

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TABLE 1

COMPARISON OF ARMY FACILITIES ENERGY PLAN GOALS

	1 OCT '78	26 OCT '81
Reduce total consumption by:	25% by FY 85 50% by FY 2000	20% by FY 85 40% by FY 2000
Energy from coal and RDF	10% by FY 85	N.M.
Solar energy	1% by FY 85	N.M.
Natural gas	Eliminate use by FY 2000	N.M.
Petroleum fuels	Reduce by 75% by FY 2000	N.M.
Capability for synthetic gases	N.M.	By FY 2000
Heating oil consumption	N.M.	Reduce by 75% by FY 2000

N.M. - Not Mentioned

4.1 SOURCE ENERGY CONSUMPTION

Table 2: Source Energy Consumption compares consumption from FY 1975, the base year for the study, with consumption during FY 1979. Fuel consumption over the period dropped by approximately 33 percent though costs rose 31 percent. Reductions in fuel use can be attributed to plant conservation efforts.

TABLE 2

SOURCE ENERGY CONSUMPTION
FY 1975 AND 1979

	FY 1975		FY 1979	
Source	Cost ($000)	MBTU'S Consumed (000)	Cost ($000)	MBTU'S Consumed (000)
Electricity	$272	221	$ 464	172
Fuel Oil No. 2	553	287	618	208
Natural Gas	0	0	0	0
Propane Gas	3	1	2	0.5
Totals	$828	509	$1,084	381

5.1 PROJECT EXECUTION

This energy engineering analysis was conducted in four phases:

- Field surveys and data gathering
- Analysis of projects
- Review and verification
- Preparation of Project Programming Documents

5.1.1 Field Surveys and Data Gathering

The field surveys included buildings and process surveys. The surveys were conducted in four areas:

- Architectural - to evaluate such items as wall and roof types and levels of insulation
- Mechanical - to evaluate heating, ventilating, and air conditioning systems
- Electrical - to evaluate lighting and building electrical systems
- Distribution - to evaluate plant utility systems

The process surveys addressed the processes conducted at the plant and the various recovery systems in operation.

The distribution surveys covered all plant utility systems including steam, hot water, electrical, potable water, and sewage.

The survey phase enabled the identification of energy conservation opportunities and the applicability of energy conservation measures to INAAP.

5.1.2 Analysis of Projects

After the data gathering phase it was possible to identify potential projects for analysis. These projects were analyzed for applicability to INAAP and their potential to save energy in relation to their implementation cost.

5.1.3 Review and Verification

INAAP personnel assisted in the selection of those projects which should be implemented and developed project priorities. All projects were reviewed and verified at the plant in consultation with INAAP personnel.

6.1 ENERGY CONSERVATION OPPORTUNITIES

The following energy conservation opportunities were investigated and found to be viable:

Insulation
Storm Windows
Caulking
Weatherstripping
Solar Films
Load Dock Seals
Reduce Glass Area
Modify Hot Water Heater Controls
Install Shower Flow Restrictors
Reduce Ventilation Requirements
Prevent Air Stratification
Oxygen Control for Boilers
Blowdown Heat Recovery
Revise Boiler Controls

Reduce Lighting Levels
Replace Incandescent Fixtures
Install Fluorescent Fixtures
Install High-Efficiency Fixtures
Night Setback Controls
Install Economizers
Install New Burners
Reduce Street Lighting
Insulate Steam Lines
Return Condensate

The following conservation opportunities were studied but found not viable because of low ECR or lack of conservation opportunity at the plant:

- Replace kitchen lighting fixtures
- Improve power factor
- High-efficiency motor replacement
- FM radio controls
- Decentralize domestic hot water heaters
- Reclaim heat from hot refrigerant gas
- Install chiller controls
- Replace chillers

7.1 ECAM PROJECTS SELECTED FOR IMPLEMENTATION

Selected ECAM projects are shown in Table 3: ECAM Projects Selected for Implementation.

TABLE 3

ECAM PROJECTS SELECTED FOR IMPLEMENTATION

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings ($000)	Benefits ($000)	CWE ($000)	TIC ($000)	SAP	BCR	ECR
	FY 85 Standby Status								
5-1	Misc. Building Insulation	12,900	137	2,699	444	468	3	6	29
6-3	Disconnect Transformers	3,200	13	250	201	212	16	1	16
8-1	Install Small Air Compressors	6,900	33	589	478	503	15	1	14
11-1	EMCS Expansion	6,400	74	1,070	524	553	7	2	12
	SUBTOTAL	29,400	257	4,608	1,647	1,736			

8.1 VIABLE PROJECTS NOT SELECTED FOR IMPLEMENTATION

Table 4: Viable Projects Not Selected for Implementation, shows those projects which meet ECAM guidelines but were not selected by INAAP personnel.

TABLE 4

VIABLE PROJECTS NOT SELECTED FOR IMPLEMENTATION

Project No.	Project Title	Annual Energy Savings MBTU's	CWE ($000)	TIC ($000)	SAP	BCR	ECR	Status*
9-1	Reclaim Heat from Poaching Tanks	2,565,000	5,380	5,665	1	19	477	M
6-5	Repair and Replace Steam Traps	389,000	2,444	2,574	1	40	159	M
6-7	Repair Damaged Insulation	10,800	102	108	1	26	105	S
9-2	Reclaim Heat from Boiling Tubs	282,000	5,325	5,605	7	2	53	M
5-4	Selected Bldg. Weatherization	13,000	449	473	3	6	30	S
6-4	Replace Insulation P&E Area	123,000	6,695	7,050	4	5	18	M
6-2	Replace Exterior Lighting	1,800	133	140	3	4	13	M
6-1	Replace Fence Lighting	4,200	347	363	14	1	12	M
	SUBTOTAL (Standby)	23,800	551	581				
	SUBTOTAL (Mobilization)	3,365,000	20,324	21,397				

*Status: S - Standby
M - Mobilization

9.1 INCREMENT F PROJECTS

Increment F projects present recommendations for energy saving modifications and changes in building and system operation which are within the funding authority and management control of the Facilities Engineer.

9.1.1 Increment F Projects Developed

Increment F projects developed are shown in Table 5: Potential Increment F Projects Developed. Projects are listed by descending SIR. If all projects are implemented, total savings will be

approximately 12,100 MBTU's per year. The total investment will be $160,100 and the first year dollar savings will equal $84,000.

TABLE 5

POTENTIAL INCREMENT F PROJECTS DEVELOPED

Project No.	Project Title	Annual Energy Savings (MBTU)	First Year Savings	Total Investment	SIR
5-1	Install Package Boiler	5,600	$41,300	$43,700	10.75
9-2	Install Package Boiler	2,640	19,300	23,000	9.59
1-2	Install Package Boiler	2,110	15,300	20,800	8.40
1-1	Install Enthalpy Controls	570	2,600	22,900	1.29
9-1	Small Air Compressors Installation	1,200	5,500	49,700	1.25
		12,120	$84,000	$160,100	

9.1.2 Infeasible Projects

The following projects were reviewed and found not applicable for implementation at INAAP:

- The use of evaporative cooling for Building 703.
- The use of heat pumps for heating and cooling at the remote administration area (Building 2501).
- Process heat recovery in the New Black Powder Area.

10.1 MINOR CONSTRUCTION, MAINTENANCE, AND REPAIR PROJECTS (INCREMENT "G" PROJECTS)

Minor construction, maintenance, and repair projects selected for implementation are shown in Table 6: Minor Construction, Maintenance, and Repair Projects (Increment "G" Projects). Projects are listed for both standby and mobilization status. Projects are shown in order of descending ECR. The plant has no funding status for Increment G. Therefore, Increment G projects can be submitted along with ECAM projects for funding.

TABLE 6

MINOR CONSTRUCTION, MAINTENANCE, AND REPAIR PROJECTS
(INCREMENT "G" PROJECTS)

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings ($000)	TIC ($000)	ECR	SAP	Manhours
12-2	Install Strip Doors Bldg. 3011, 3611	590	7	1	1010	1	12
12-1	Small Compressor for Pneumatic Controls	4,600	11	18	267	2	140
12-5	Insulate Steam & Hot Water Lines	3,190	42	51	66	1	840
5-2	Misc. Building Lighting	2,450	12	52	50	4	497
12-7	Heat Destratification Bldg. 2551 & 2561	1,210	16	28	46	2	400
12-9	Reduce Infiltration in Bldg. 3011	430	6	17	26	3	240
5-3	Small Bldg. Insulation	100	1	5	20	4	80
	SUBTOTAL	12,570	95	172			

11.1 SUMMARY OF PROJECTS

Table 7: Summary of Projects, presents a summation of energy savings and costs for all categories of projects.

TABLE 7

SUMMARY OF PROJECTS

	MBTU/Yr Energy Savings	Total Installed Cost ($000)
Selected ECAM Standby Projects	29,400	$ 1,736
Selected ECAM mobilization Projects	0	0
Projects Not Selected - Standby	23,800	581
Projects Not Selected - Mobilization	3,365,000	21,397

TABLE 7 (Continued)

Increment F Projects	12,120	160*
Increment G Projects - Standby	12,570	172
Increment G Projects - Mobilization	0	0
Total	3,442,890	$24,046

*Total Investment per SIR Guidance.

12.1 PROJECTED ENERGY TRENDS

Figure 5: Standby Status Projected Energy Consumption, shows the projected energy consumption trend over the period FY 1975 to FY 2000 as a result of implementing projects developed by INAAP and the projects described in this report. From FY 1983 to FY 1985, when the energy projects will be implemented, energy use will decline by 128,000 MBTU's. Building energy use per square foot will be reduced from 109 to 47 KBTU's per gross square foot per year for the period from FY 1975 to FY 1985.

13.1 TYPICAL BUILDING ENERGY CONSUMPTION

Table 8: Typical Building Energy Consumption, is compiled using calculated data from Appendix III of the Energy Engineering Analysis: Annual Energy Consumption.

TABLE 8

TYPICAL BUILDING ENERGY CONSUMPTION

Building No.	Name	Consumption MBTU/YR
704-6	Supervisor's Office	730
707-1	Change House	665
708-1	Cafeteria	5,146
713	General Storehouse	3,877
1502	Inert Storage Warehouse	3,792

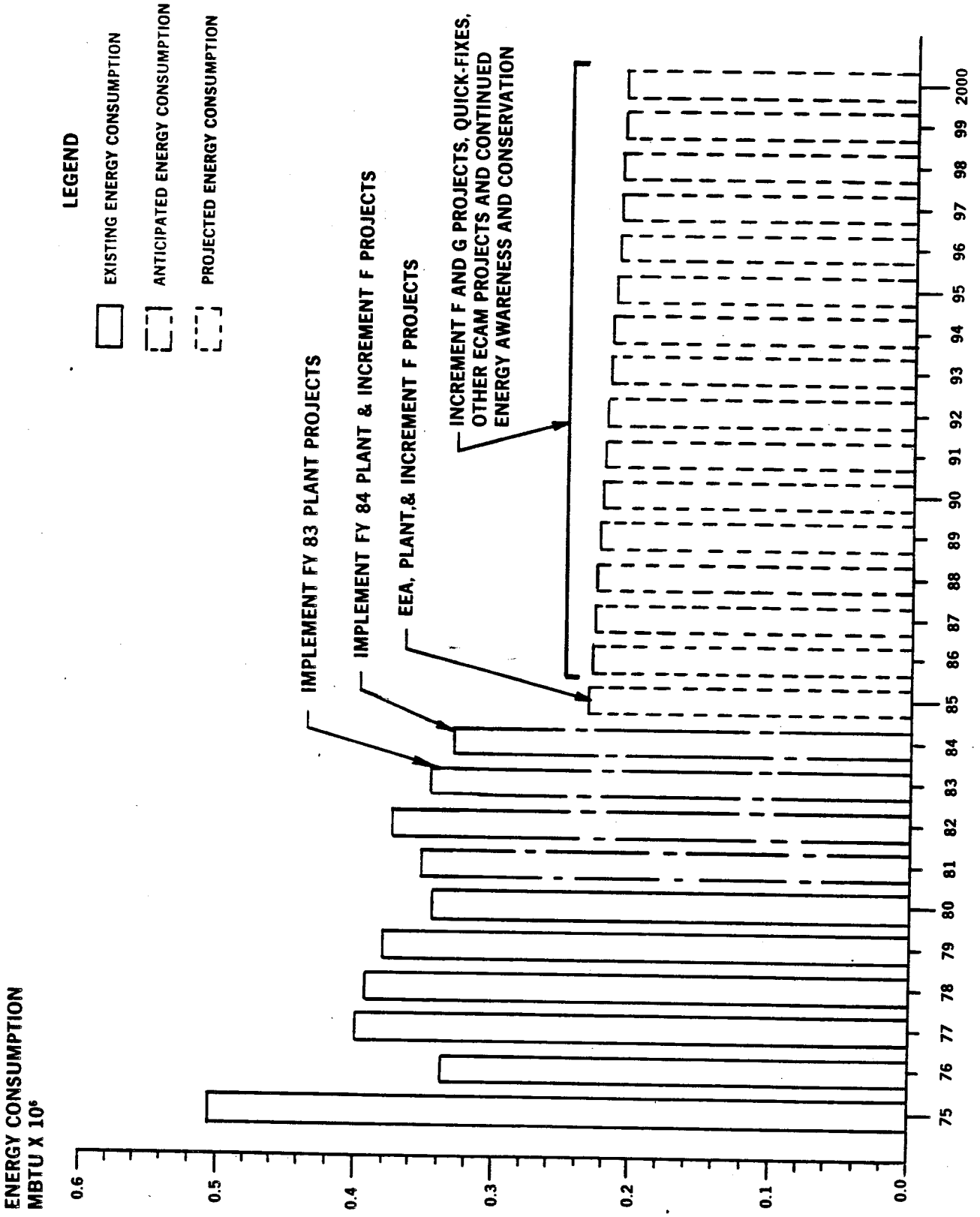
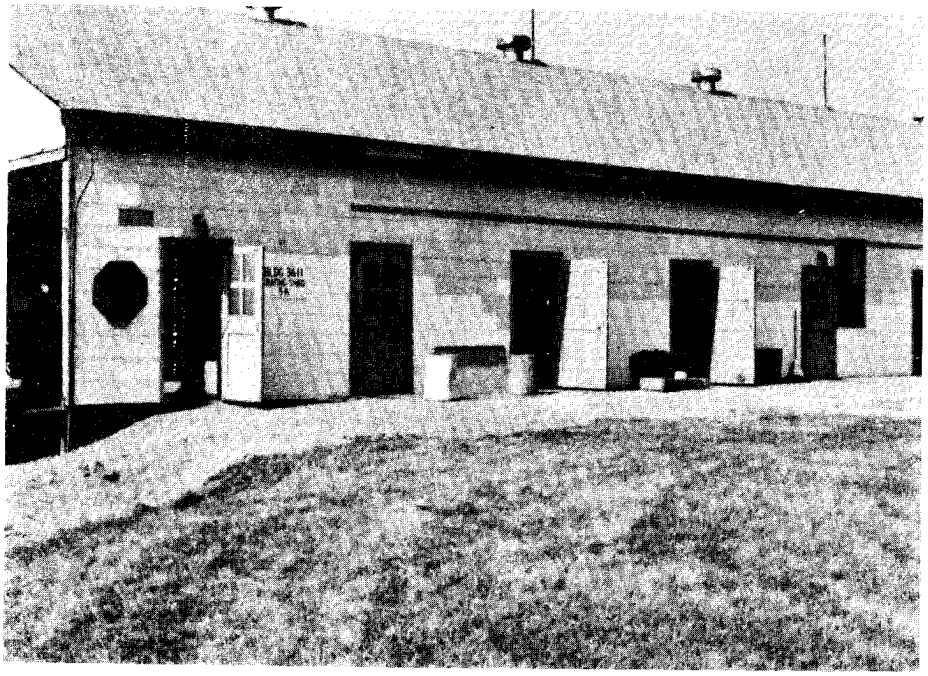
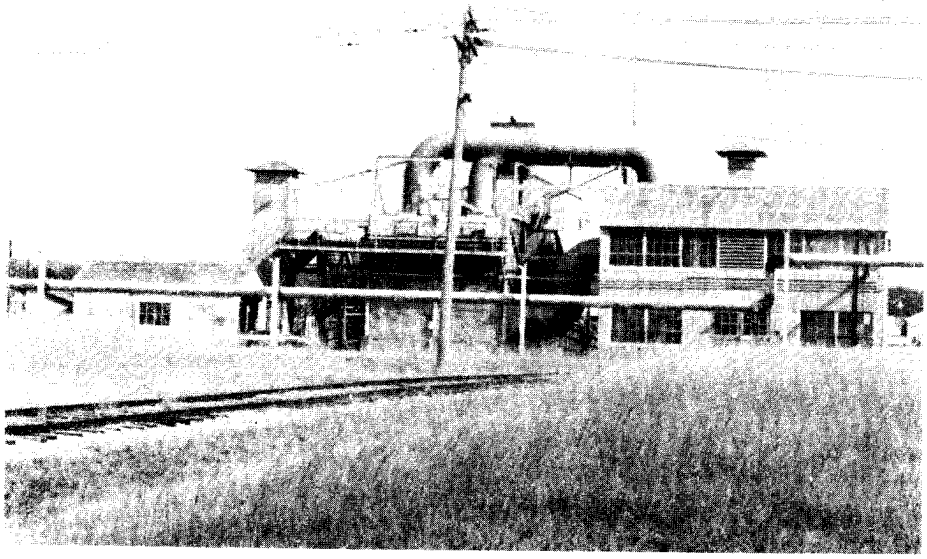


FIGURE 5

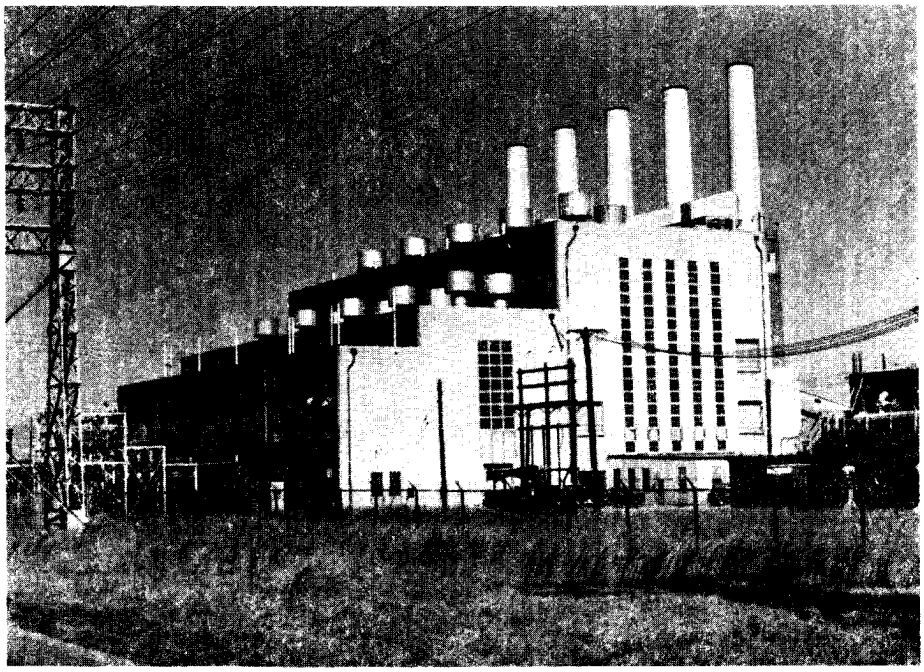
STANDBY STATUS-PROJECTED ENERGY CONSUMPTION



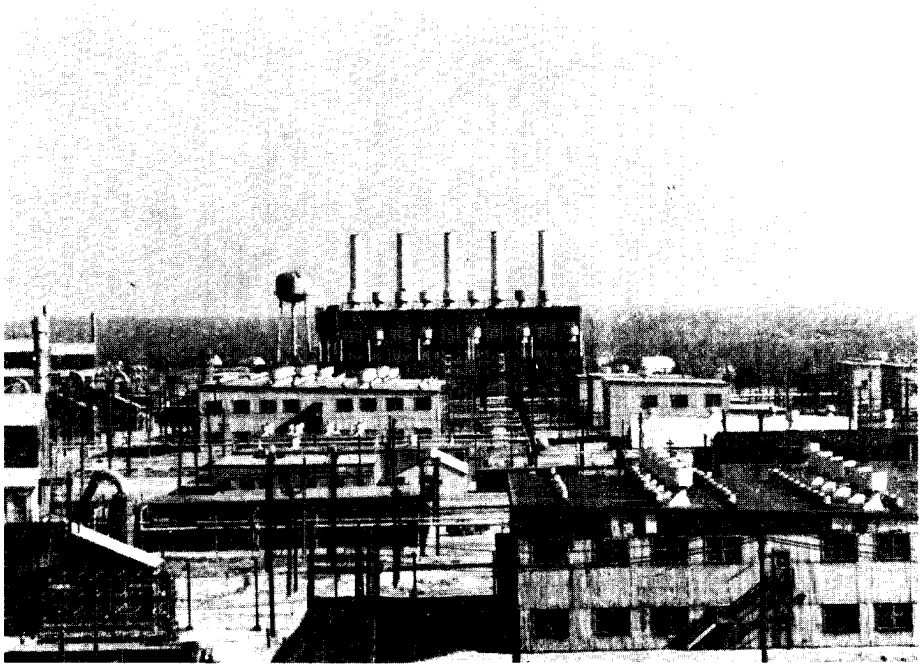
BUILDING 3611 — WOOD FRAME WITH ASBESTOS SHINGLES



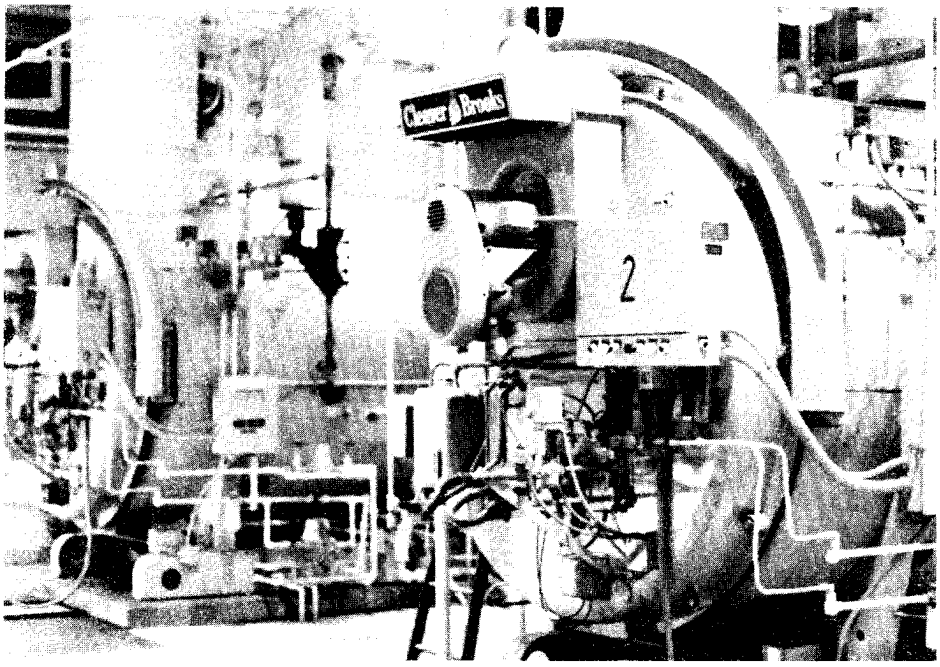
BUILDING 220 — CC DRYER. ASBESTOS SIDING WITH LARGE WINDOW AREA



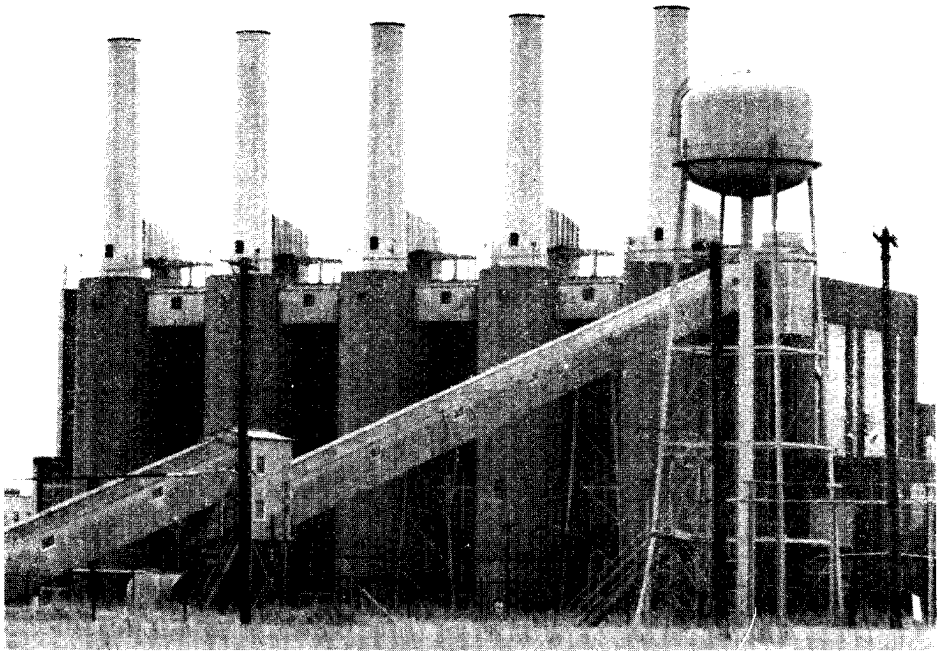
BOILER HOUSES



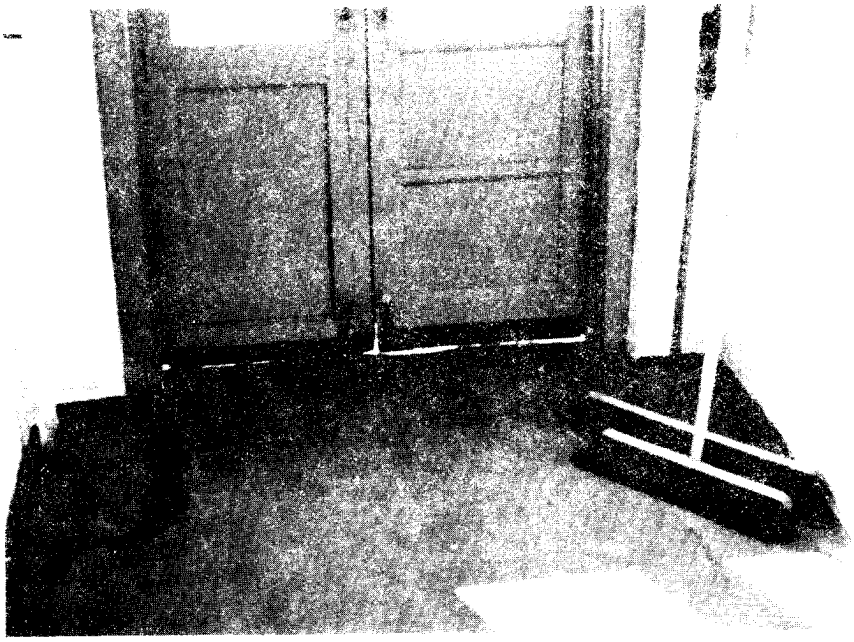
BOILER PLANT — P&E AREA



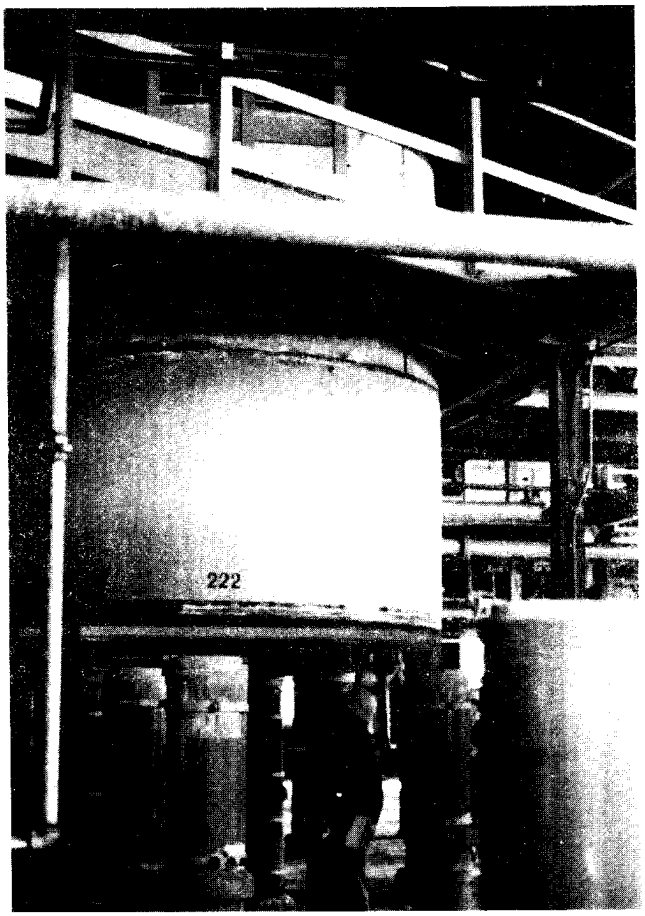
BOILERS IN BLACK POWDER AREA



SOUTHERN VIEW OF BUILDING 401-1 BOILER HOUSES



INFILTRATION DUE TO LACK OF DOOR SILL
IN BUILDING 3011 (LOAD LINE 5B)



NITROCELLULOSE PROCESSING -
TYPICAL UNINSULATED HEATED
TANK (BUILDING 112-1)