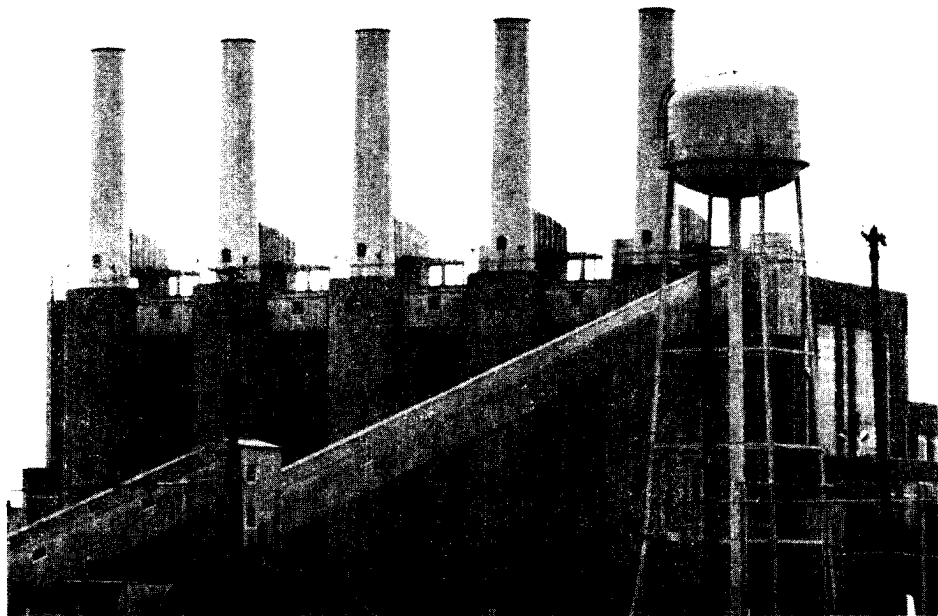


FINAL SUBMISSION

EXECUTIVE SUMMARY

Steam/Power Plant Modernization Program  
for  
Indiana Army Ammunition Plant



*Prepared for*



**The Department of the Army**

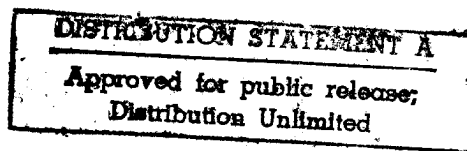
Omaha District  
Corps of Engineers  
Contract No. DACA45-80-C-0090

*By*



**Sanders & Thomas, Inc.**

An STV Engineers Professional Firm  
*Consulting Engineers*  
Pottstown, Pennsylvania 19464



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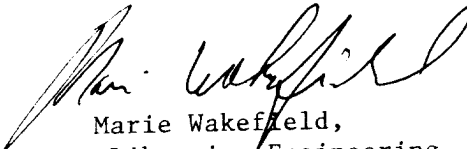


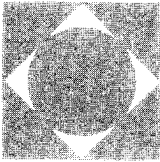
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CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS  
P.O. BOX 9005  
CHAMPAIGN, ILLINOIS 61826-9005

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**CONSULTING ENGINEERS.** 11 ROBINSON STREET, POTTSTOWN, PA 19464  
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June 17, 1983

U. S. Army Corps of Engineers  
Omaha District  
6014 U. S. Post Office and Court House  
Omaha, NE 68102

Attention: MROED-MC  
Reference: Steam/Power Plant Modernization Study  
(Modified Increment E)  
Indiana Army Ammunition Plant  
Charlestown, Indiana  
Subject: Final Submission  
Contract No.: DACA45-80-C-0090  
Our Project No: 05-4660

Gentlemen:

Enclosed is the Final Submission of the Executive Summary for the Steam/Power Plant Modernization Study at the Indiana Army Ammunition Plant.

The Study consists of five volumes: (1) Executive Summary, (2) Report, (3) Appendix I: Calculations, (4) Appendix II: Drawings, and (5) Appendix III: Computer Output.

The Study presents alternative approaches to satisfying the plant's steam demands during peacetime and mobilization periods including the applicability of central boiler plants. A recommended plan is presented representing the most cost-effective and technically practical plan for steam/power plant modernization.

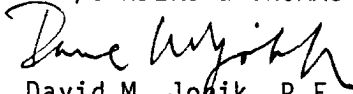
This submittal incorporates all applicable comments by plant personnel and reviewing agencies.

This plan represents a combined effort of Sanders & Thomas and various Army Departments. We wish to thank all who were involved in the preparation and review of this report.

Thank you for this opportunity to be of continued service.

Very truly yours,

STV/SANDERS & THOMAS

  
David M. Jofik, P.E.  
Project Manager

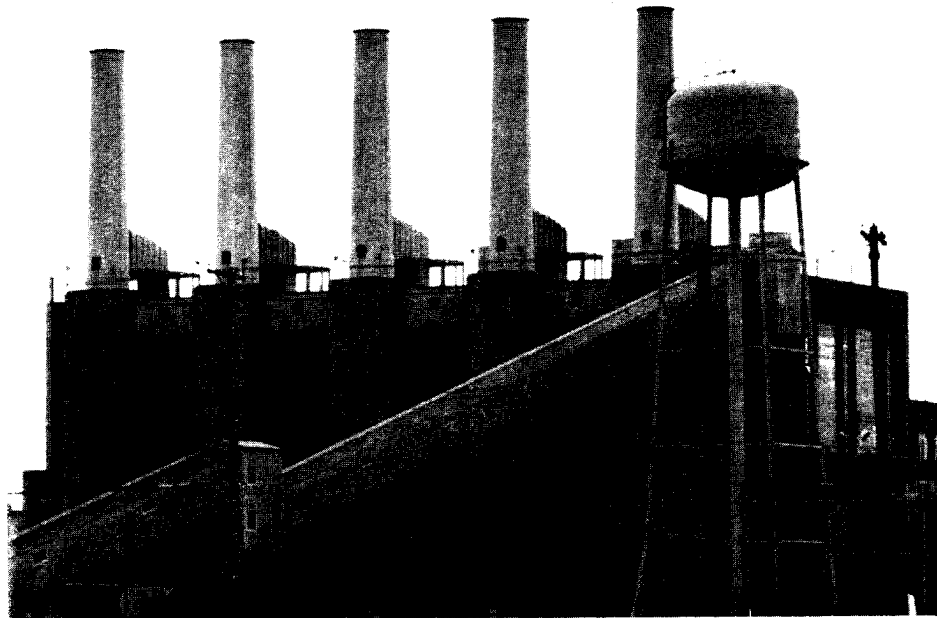
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Enclosure

FINAL SUBMISSION

EXECUTIVE SUMMARY

**Steam/Power Plant Modernization Program  
for  
Indiana Army Ammunition Plant**



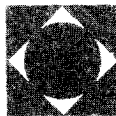
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**The Department of the Army**

Omaha District  
Corps of Engineers  
Contract No. DACA45-80.C-0090

*By*



**Sanders & Thomas, Inc.**

An STV Engineers Professional Firm  
*Consulting Engineers*  
Pottstown, Pennsylvania 19464

## **PROJECT ABSTRACT**

This study is to develop a cost-effective and technically practical modernization program for the steam/power plants at the Indiana Army Ammunition Plant (INAAP).

The recommended modernization approach for the Load, Assemble and Pack (LAP) Area is to construct a new coal-fired central steam plant and distribution system. In the Propellant & Explosives (P&E) Area, modernization of the existing coal-fired facility, Building 401-2, and use of the existing steam distribution system is recommended.

Total expenditures required to complete this modernization program are \$113 million in FY 1983 dollars. Funding allocations are anticipated for FY 1987 through FY 1993.

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## **EXECUTIVE SUMMARY**

### **PROJECT REQUIREMENTS AND OBJECTIVES**

The purpose of this study is to develop a cost-effective and technically practical modernization program for the steam/power plants at the Indiana Army Ammunition Plant (INAAP), Charlestown, Indiana. The objective is to reduce dependence on oil and natural gas.

The program plan presents that method which is consistent with present Army energy goals, is technically feasible, and meets peacetime and mobilization energy requirements.

The plant life-cycle analysis is based on a 25-year life with the period from 1950 to 1975 used as a representative life-cycle for peacetime and mobilization periods. This cycle includes a five-year and seven-year mobilization period.

This study considers both technical and economic criteria in developing the final recommended modernization program.

### **BACKGROUND**

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 1: Location Map.

INAAP consists of approximately 10,500 acres with over 1,700 buildings, 90 miles of roads, and 84 miles of railroad track. General site maps of the P&E Area and LAP Area are shown in the back of this Executive Summary.

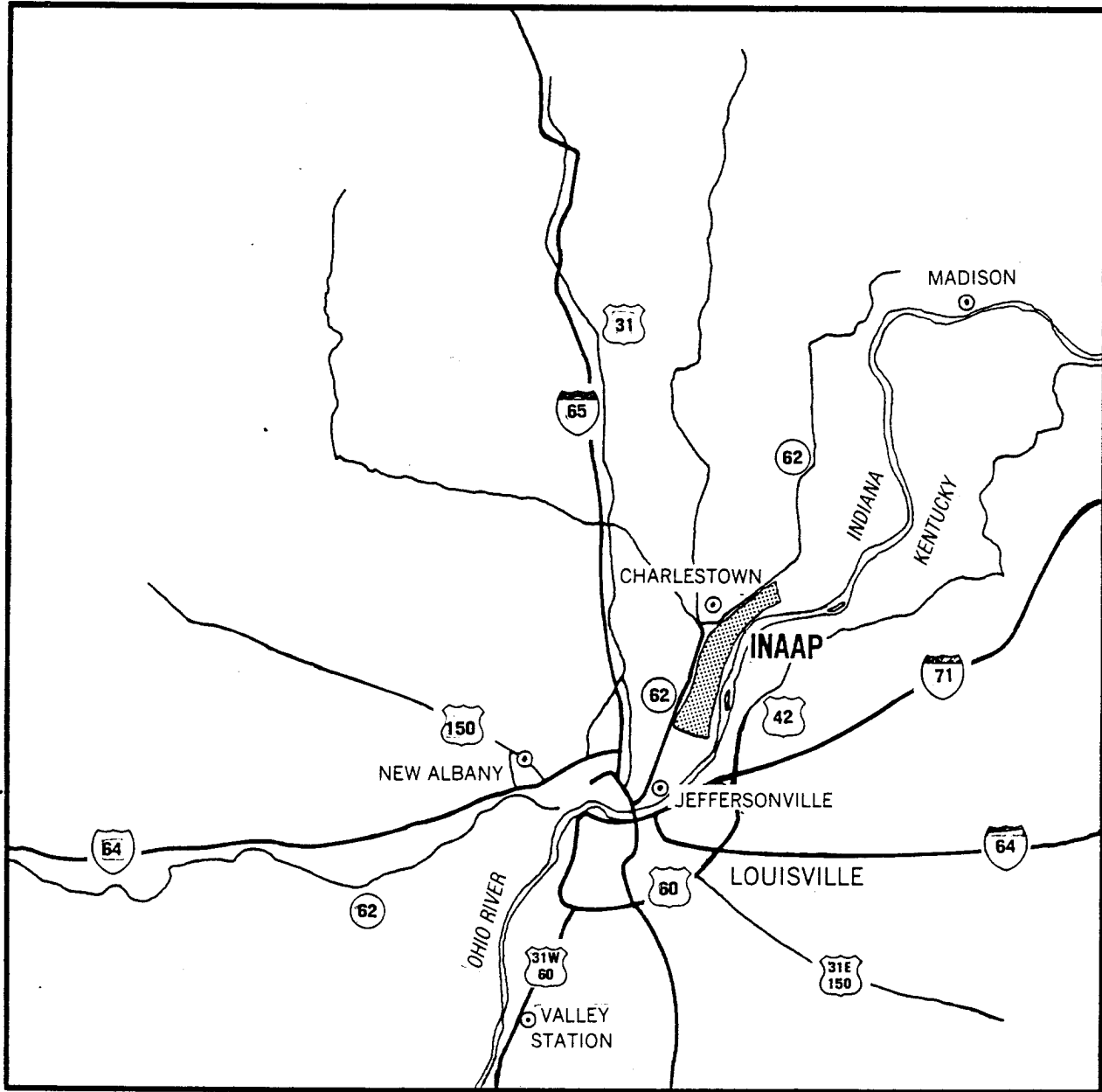
The plant is divided as follows:

- . Administration Area
- . Black Powder Area
- . Load, Assemble, and Pack (LAP) Area
- . Propellant and Explosive (P&E) Area
- . Remote, Storage and Miscellaneous Areas

Steam/power facilities are located in various buildings within each area, with steam distribution systems serving the heated buildings along their respective lines.

The LAP and P&E Areas are the only areas considered in the modernization program. Unheated buildings have been omitted since they have no impact on a heat generating facility. Other areas not included in this study are Family Housing, the Black Powder Area, areas of the plant that operate independently, and small heat generating facilities whose load is picked up by larger facilities during mobilization.

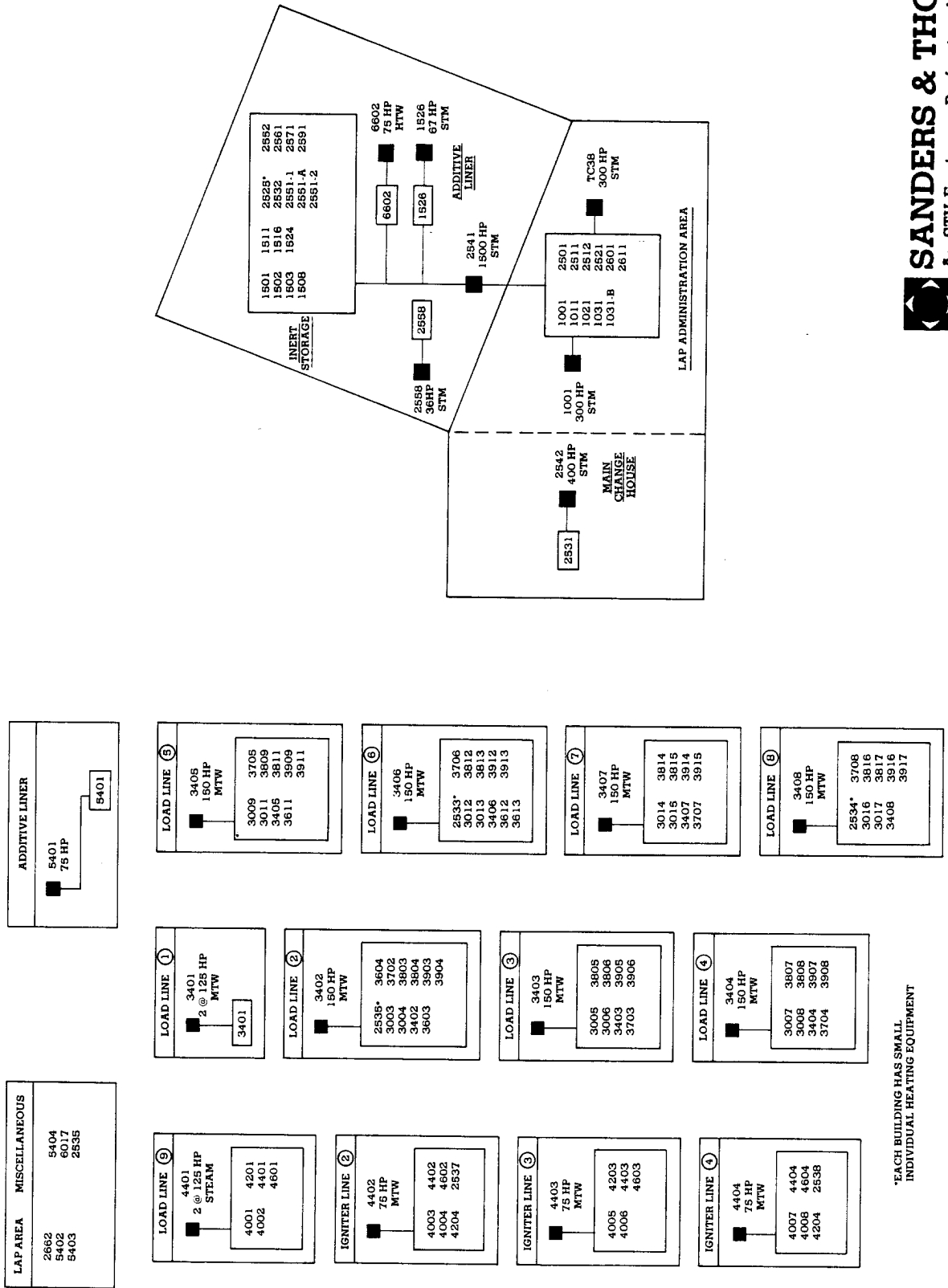
Figures 2 and 3 show the area assignments (LAP or P&E) for heated buildings.



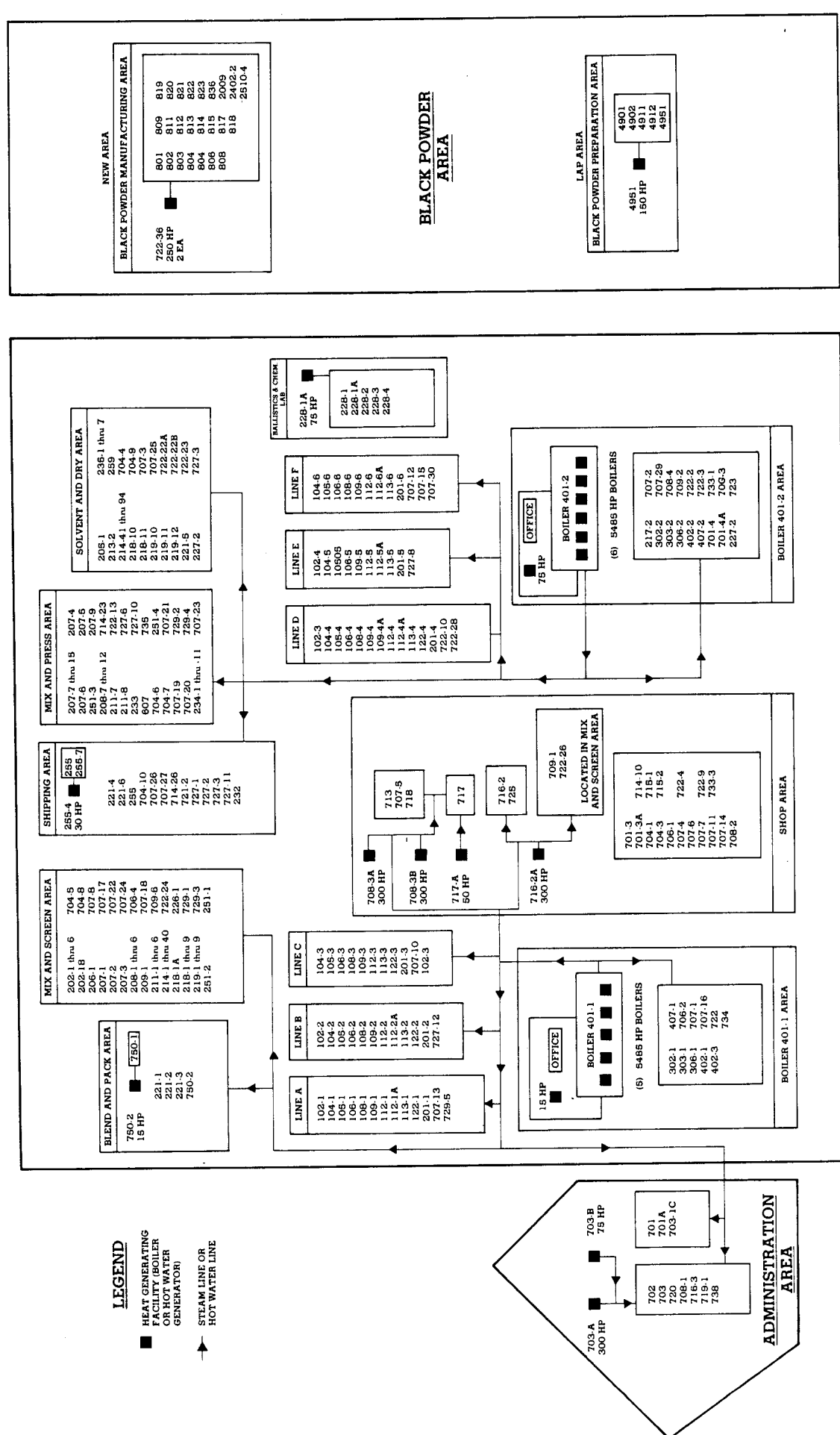
**FIGURE 1**  
Indiana Army Ammunition Plant  
Location Map

FIGURE 2

**INDIANA ARMY AMMUNITION PLANT  
HEATED BUILDING  
AREA ASSIGNMENT CHART  
LOAD, ASSEMBLE PACK AREA**



**FIGURE 3**  
**INDIANA ARMY AMMUNITION PLANT**  
**HEATED BUILDING**  
**AREA ASSIGNMENT CHART**  
**PROPELLANT AND EXPLOSIVES MANUFACTURING AREA**



## **ANALYSIS METHOD**

Planning the INAAP modernization program involved analyzing plant energy use in both existing and proposed plant configurations. Existing configuration energy use is based on historical fuel consumption records extrapolated to future requirements. Energy use for the plant in its proposed configuration is projected based on historical records, previous technical reports and studies, and operating modes. Energy consumption profiles are then developed to determine the proposed plant configuration and size. Economic factors related to the proposed plant configuration are then used as an input to the Life-Cycle Cost Analysis.

The study involved assembling the data base to develop a load profile for peacetime and mobilization periods. Existing equipment was analyzed and evaluated to determine the need for physical improvement. Various energy systems were considered with the final selection based on anticipated load centers, effective distribution systems, and site access. Other factors including heat transfer mediums, cogeneration, potential fuels, and combustion techniques were also examined.

A comprehensive life-cycle analysis was performed for the selected methods, which were then ranked in ascending order of capital cost and life-cycle costs.

## **REGULATORY REQUIREMENTS**

All applicable Federal, State, Army and Department of Defense regulations have been complied with in preparing this study and its recommendations.

## **EMERGING TECHNOLOGIES**

The study examined the applicability of using emerging technologies to produce steam for process and heating use. Coal gasification, fluidized bed combustion, and refuse-derived fuels were considered for applicability and fluidized bed combustion is recommended for further study.

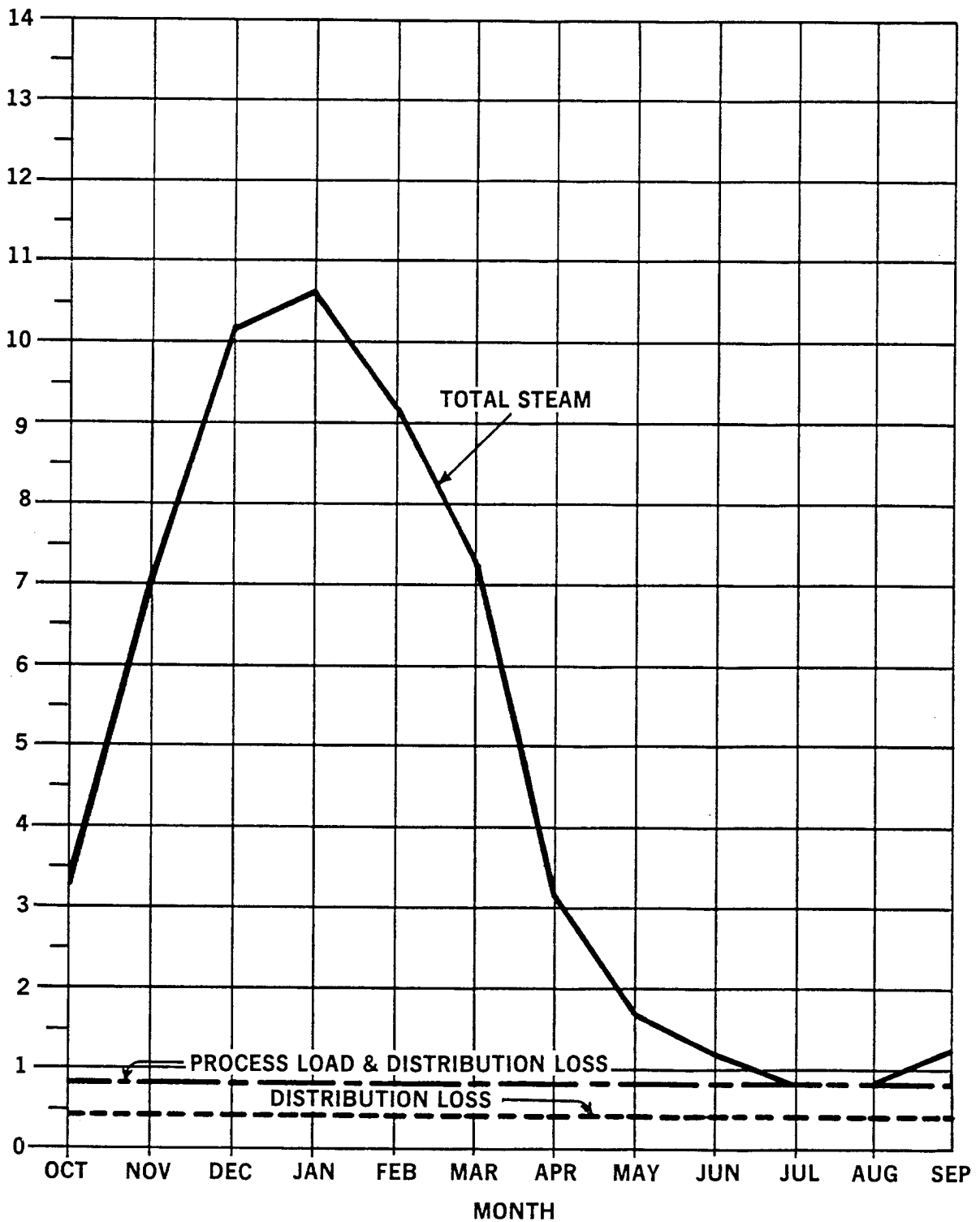
## **ENERGY REQUIREMENTS/MODES OF OPERATION**

Energy requirements were established for the two areas under consideration, P&E and LAP for peacetime and mobilization, as detailed in Figures 4, 5, 6, and 7. The study considered the effects of plant activity levels and their relationship to the heat generating facilities, and developed the optimum heating plant arrangement to furnish energy for peacetime and mobilization requirements.

## **FUEL SELECTION**

Coal and biomass were evaluated as candidate fuels. Biomass fuels were investigated as to their local availability and long term supply. Of the biomass fuels investigated (agricultural crops, agricultural crop residue, farm animal residue, wood and wood residue, special energy crops in the form of fast-growth hybrid poplars, and urban waste), fast-growth hybrid poplars were found to be most promising. Hybrid poplars could possibly be used to

MILLION POUNDS  
OF STEAM



**FIGURE 4**  
**BASE YEAR PEACETIME MINIMUM**  
**LAP AREA**

MILLION POUNDS  
OF STEAM

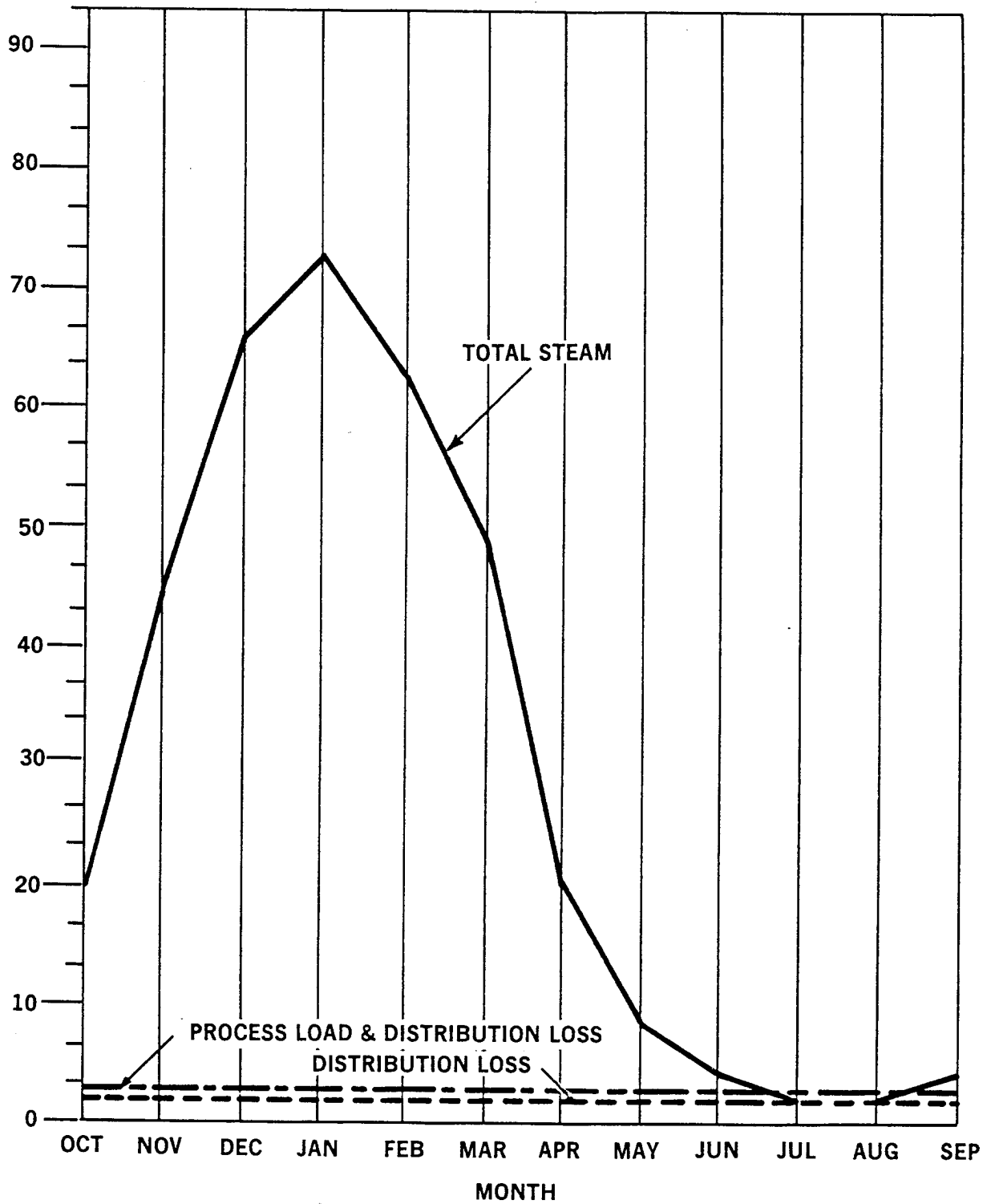
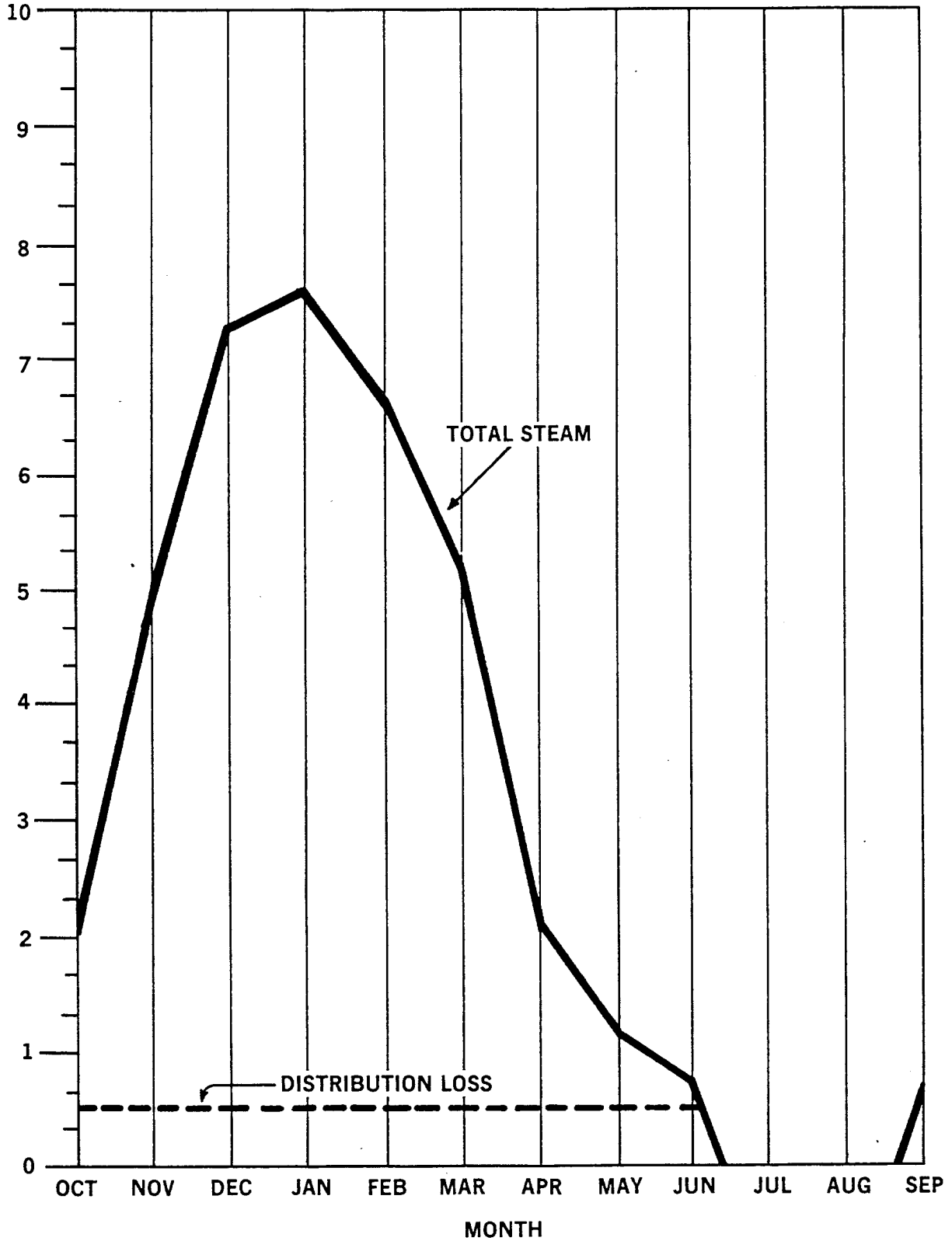


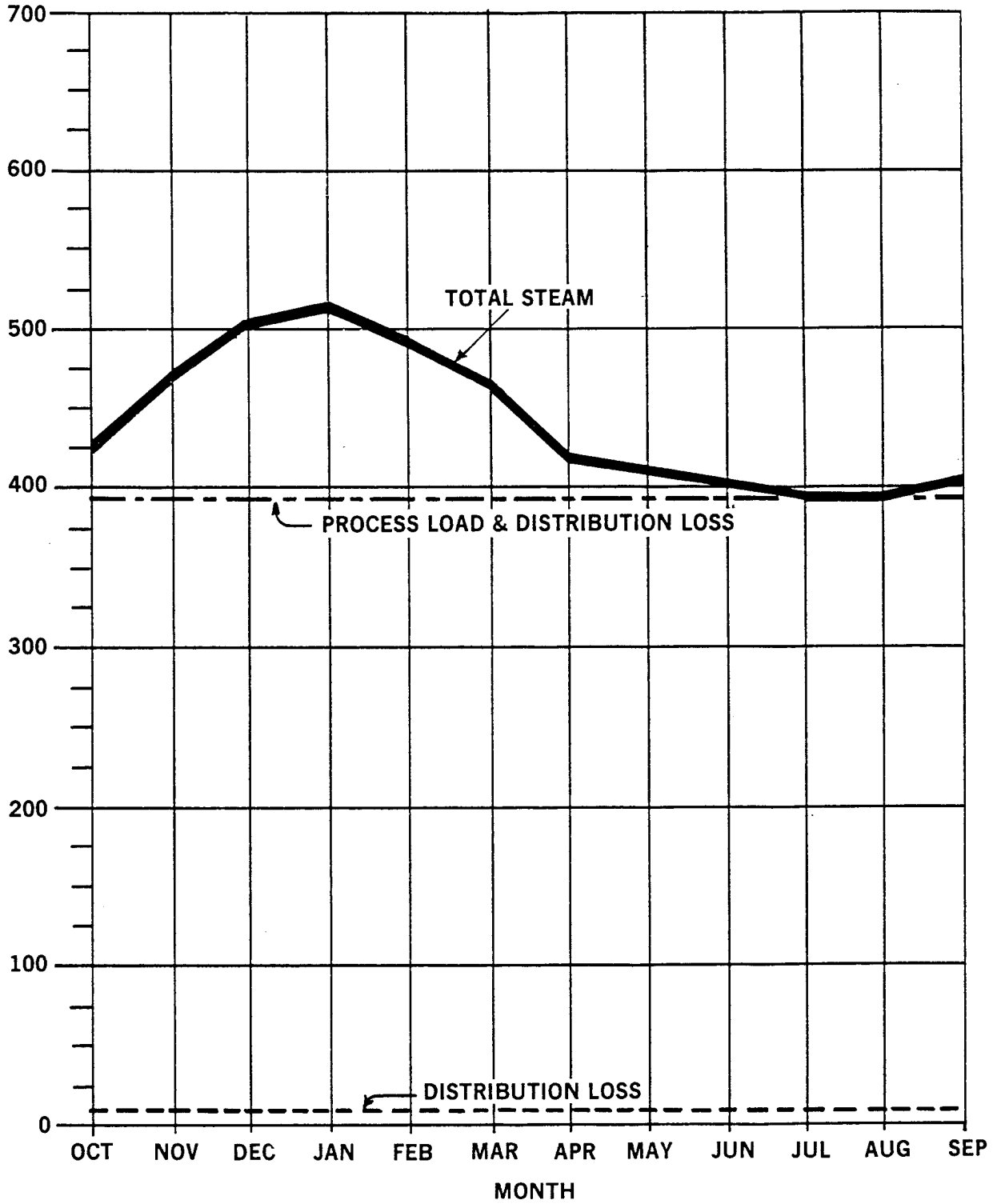
FIGURE 5  
BASE YEAR MOBILIZATION MAXIMUM  
LAP AREA

**MILLION POUNDS  
OF STEAM**



**FIGURE 6  
BASE YEAR PEACETIME MINIMUM  
P&E AREA**

MILLION POUNDS  
OF STEAM



**FIGURE 7**  
**BASE YEAR MOBILIZATION MAXIMUM**  
**P&E AREA**

replace coal or used in conjunction with coal. Eastern Kentucky coal, however, was chosen as the primary fuel. Eastern Kentucky coal has the following approximate values:

As received BTU value	11,825
Ash content	7.4%
Moisture content	9.8%
Sulfur content	2.8%
Ash fusion temperature	2,015°F

### **LAP AREA CENTRAL PLANT ALTERNATIVES**

Eight possible heat generation methods were considered for the LAP Area: Construct New Coal-Fired Central Steam Plant, Construct New Coal-Fired Central HTW Plant, Convert Steam/Power Plant 2541 to Fire Coal, Install New Coal-Fired Steam Generating Equipment in 2541, Install New Coal-Fired HTW Generating Equipment in 2541, Modernize Existing Equipment and Continue Firing No. 2 Oil, Construct Small Coal-Fired Plants at Each Specific Area, and Expand the Capacity of Steam/Power Plant 2541 if Converted to Fire Coal.

The above were screened and three identified as worthy of detailed technical and economic analysis.

- . New Coal-Fired Steam Plant
- . New Coal-Fired HTW Plant
- . Modernize Existing Equipment and Continue Firing No. 2 Oil

The New Coal-Fired Steam Plant was selected as the preferred method because of its lower initial and life-cycle costs. This plant would satisfy a peak steam mobilization level requirement of 117,000 Lbs./Hr.

The plant will be centrally located in the LAP Area near existing roads and rail spurs with room for the heating plant house, fuel storage and handling facilities, ash handling facilities, and pollution abatement facilities. The heating plant will contain five, 30,000 Lbs./Hr. steam boilers and associated appurtenances. Heat distribution will be accomplished by an aboveground piping distribution system.

### **P&E AREA CENTRAL PLANT ALTERNATIVES**

Four possible heat generation methods were considered for the P&E Area: Construct New Coal-Fired Central Steam Plant, Construct New Coal-Fired Central HTW Plant, Modernize Existing Equipment Firing No. 2 Oil, and Modernize Existing Equipment Firing Coal.

Of the four methods, two were selected for technical and economic analysis:

- . Construct New Coal-Fired Central Steam Plant
- . Modernize Existing Equipment Firing Coal

Modernizing Existing Equipment Firing Coal was selected as the most cost-effective on the basis of the lowest initial cost and the lowest life-cycle cost. The recommended plan would satisfy a peak mobilization steam requirement of 725,000 Lbs./Hr.

The existing steam plant in Building 401-2, with its six 170,000 Lbs./Hr. steam boilers, will be modernized to meet the facilities steam requirements. The existing equipment will be refurbished or replaced as required. New pollution abatement facilities will be provided to meet regulations. The existing steam distribution system will be reused.

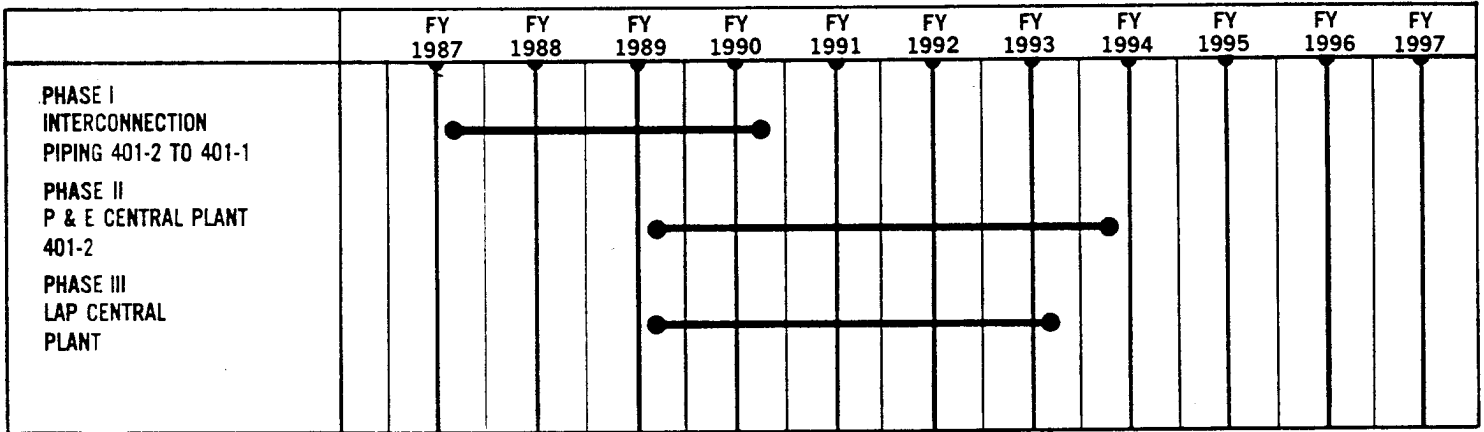
### **PROGRAM PLAN IMPLEMENTATION**

A three-phase plan, shown in Figure 8: Overall Program Plan, is recommended to implement the Steam/Power Modernization Program for INAAP. The three-phase plan is:

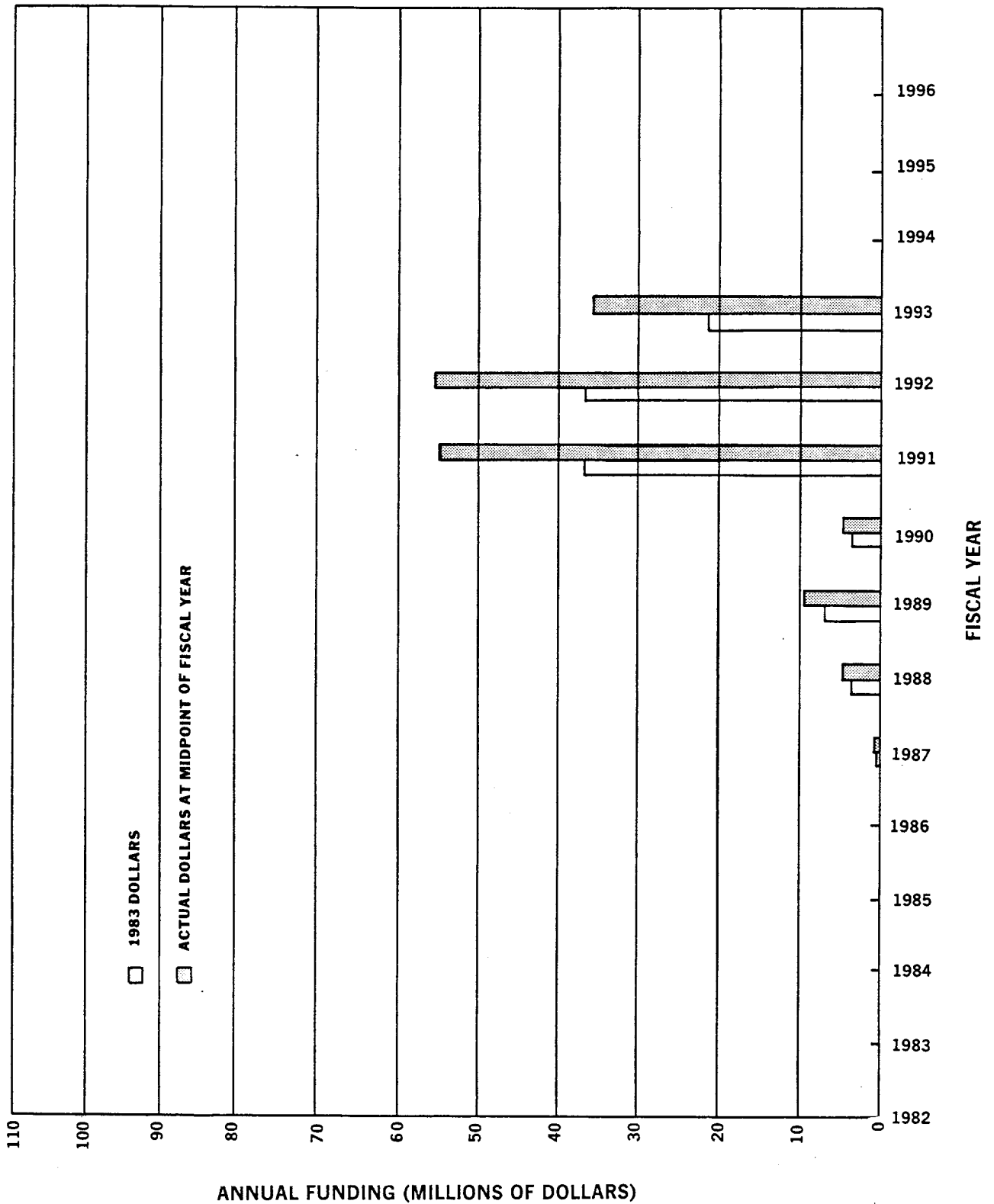
- Phase I: Interconnect steam/power plant steam distribution systems presently served by steam/power plants 401-1 and 401-2.
- Phase II: Modernize steam/power plant 401-2 in the P&E Area.
- Phase III: Construct a new coal-fired steam generating plant for the LAP Area.

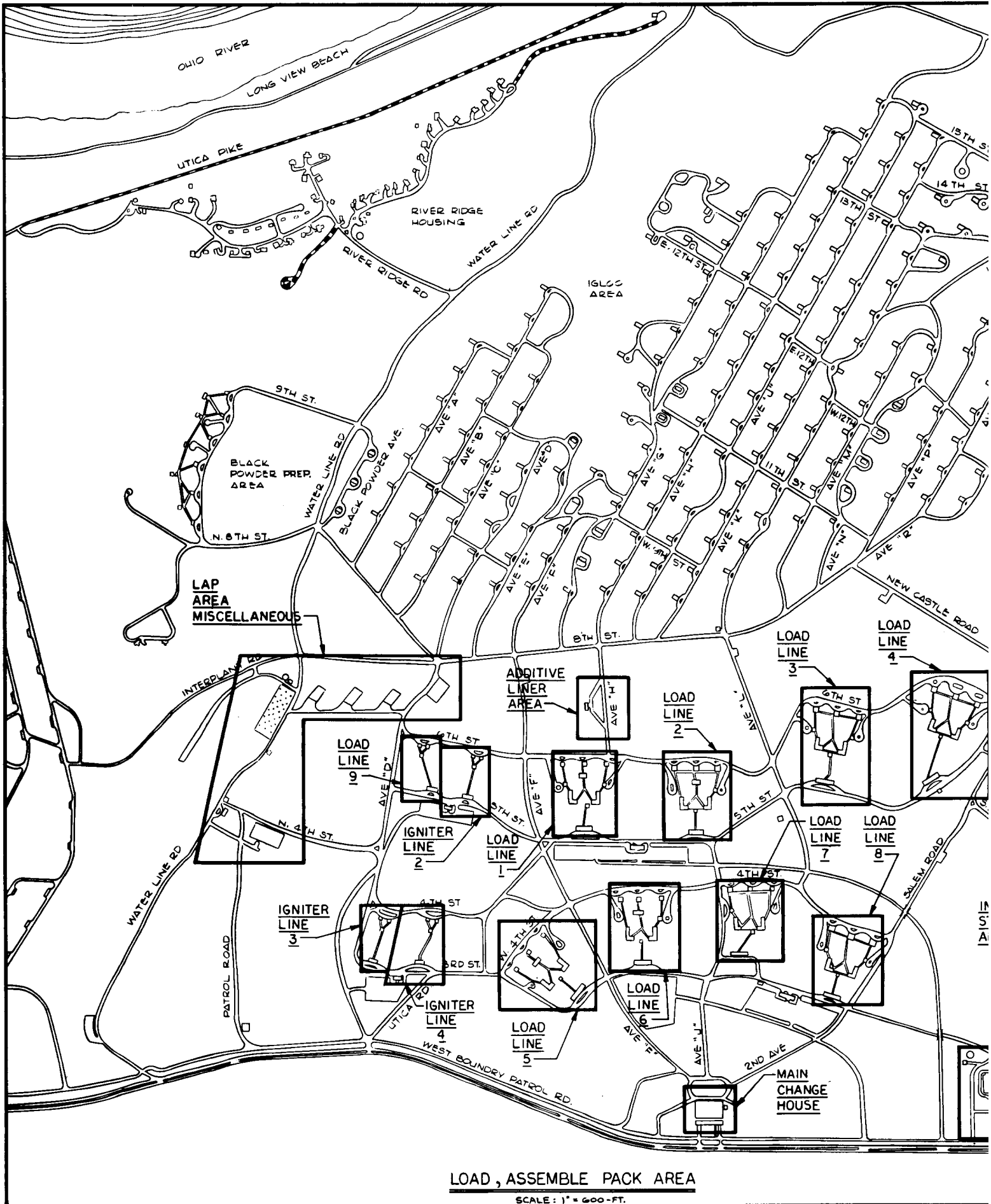
The proposed funding profile is shown in Figure 9: Funding Profile. Total expenditures for all phases is approximately \$113 million in 1983 dollars.

**FIGURE 8  
INDIANA ARMY AMMUNITION PLANT  
OVERALL PROGRAM PLAN**



**FIGURE 9  
FUNDING PROFILE  
INDIANA ARMY AMMUNITION PLANT**

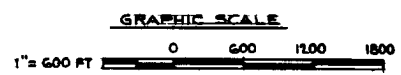
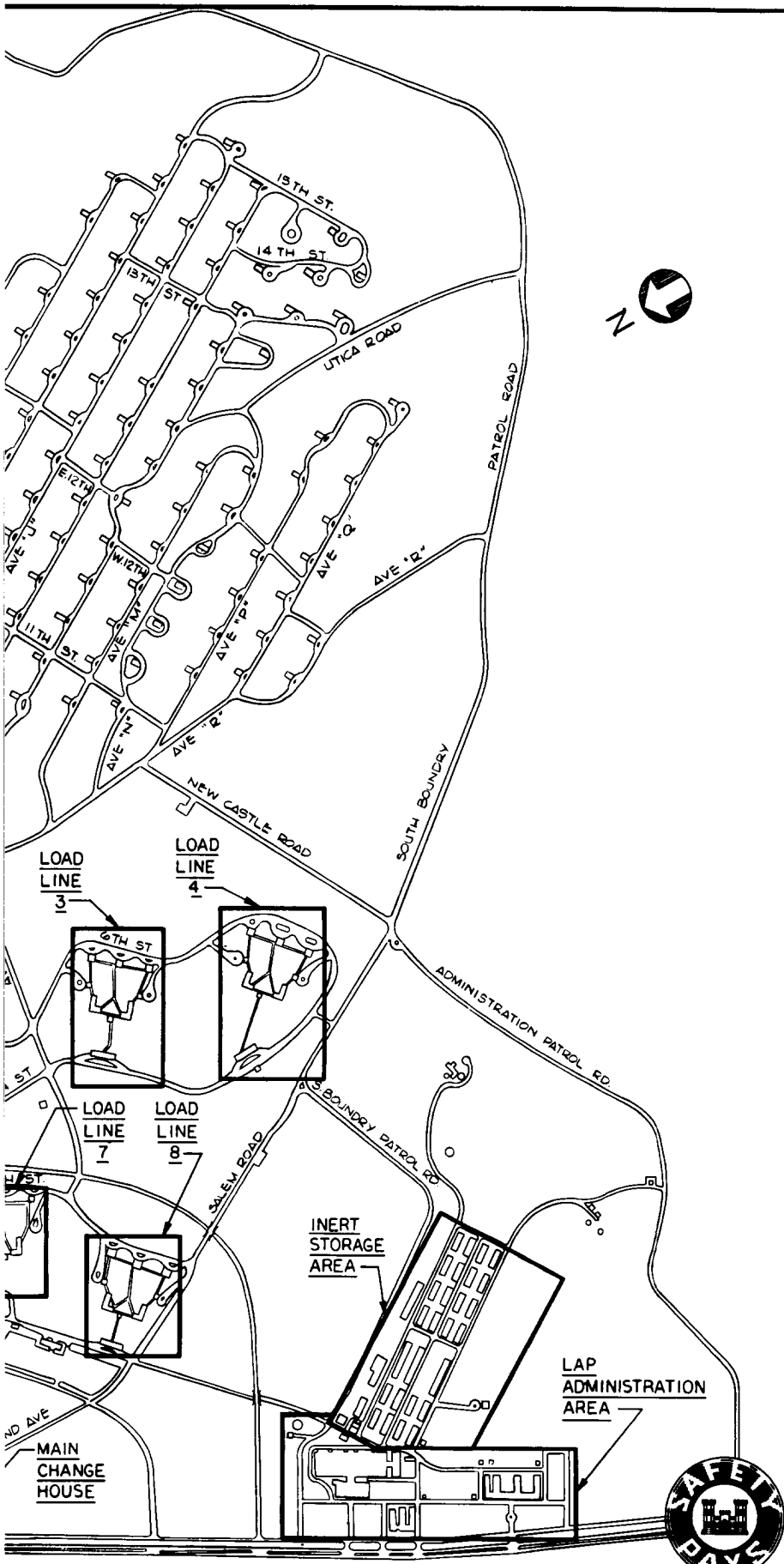




**LOAD, ASSEMBLE PACK AREA**

SCALE: 1" = 600'-FT.

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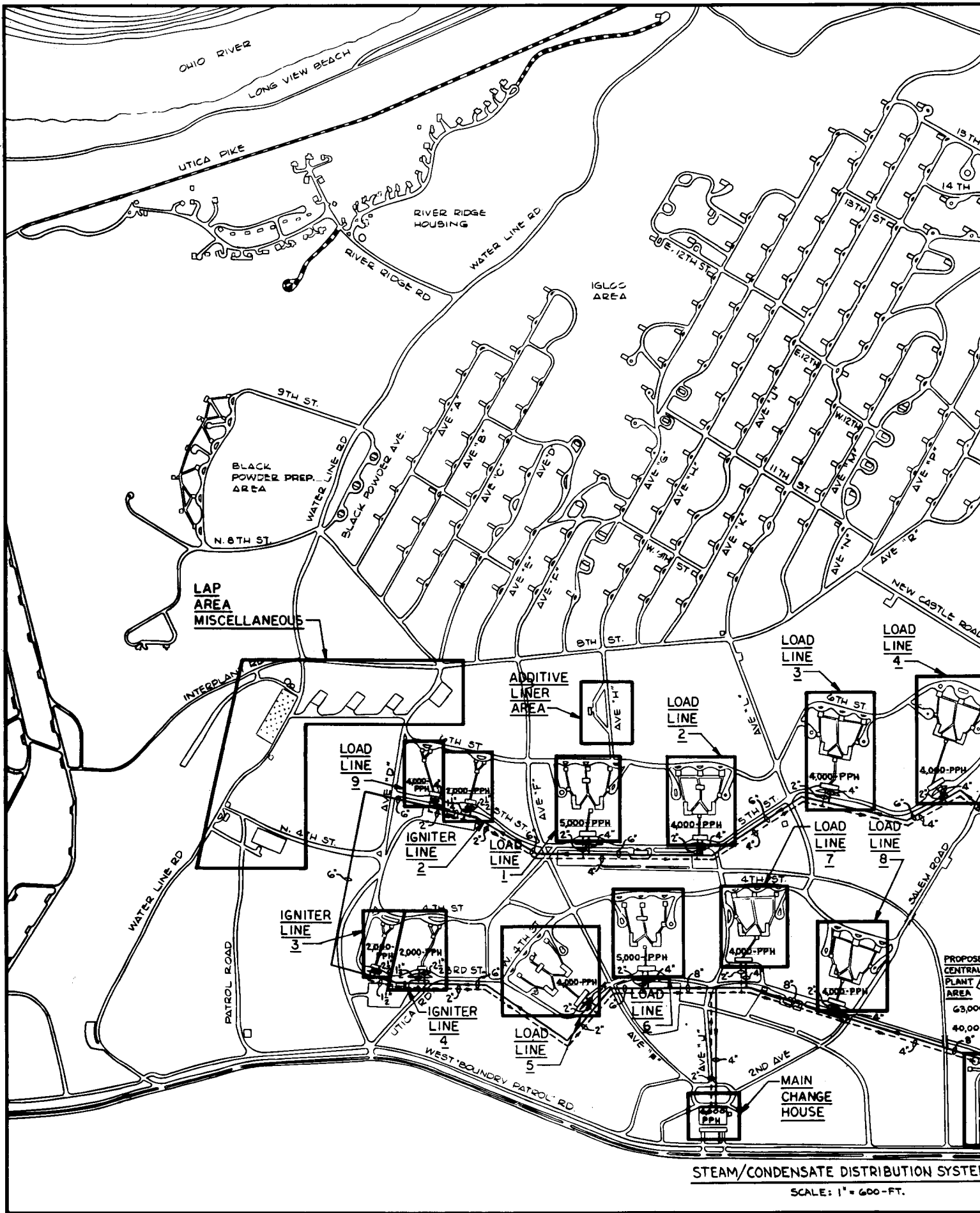


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DRAWN BY: <b>FREDERICK</b>			
CHECKED BY: <b>CREMI</b>			
SUBMITTED BY:			
ARCHITECT/ENGINEER	APPROVED:	DATE:	
REGISTERED:		<b>JULY 2, 1982</b>	
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APPROVED:		DRAWING NUMBER	
		<b>FIGURE II -05-01</b>	
<small>ED. S. E. DISTRICT ENGINEER</small>		<small>SHEET</small>	

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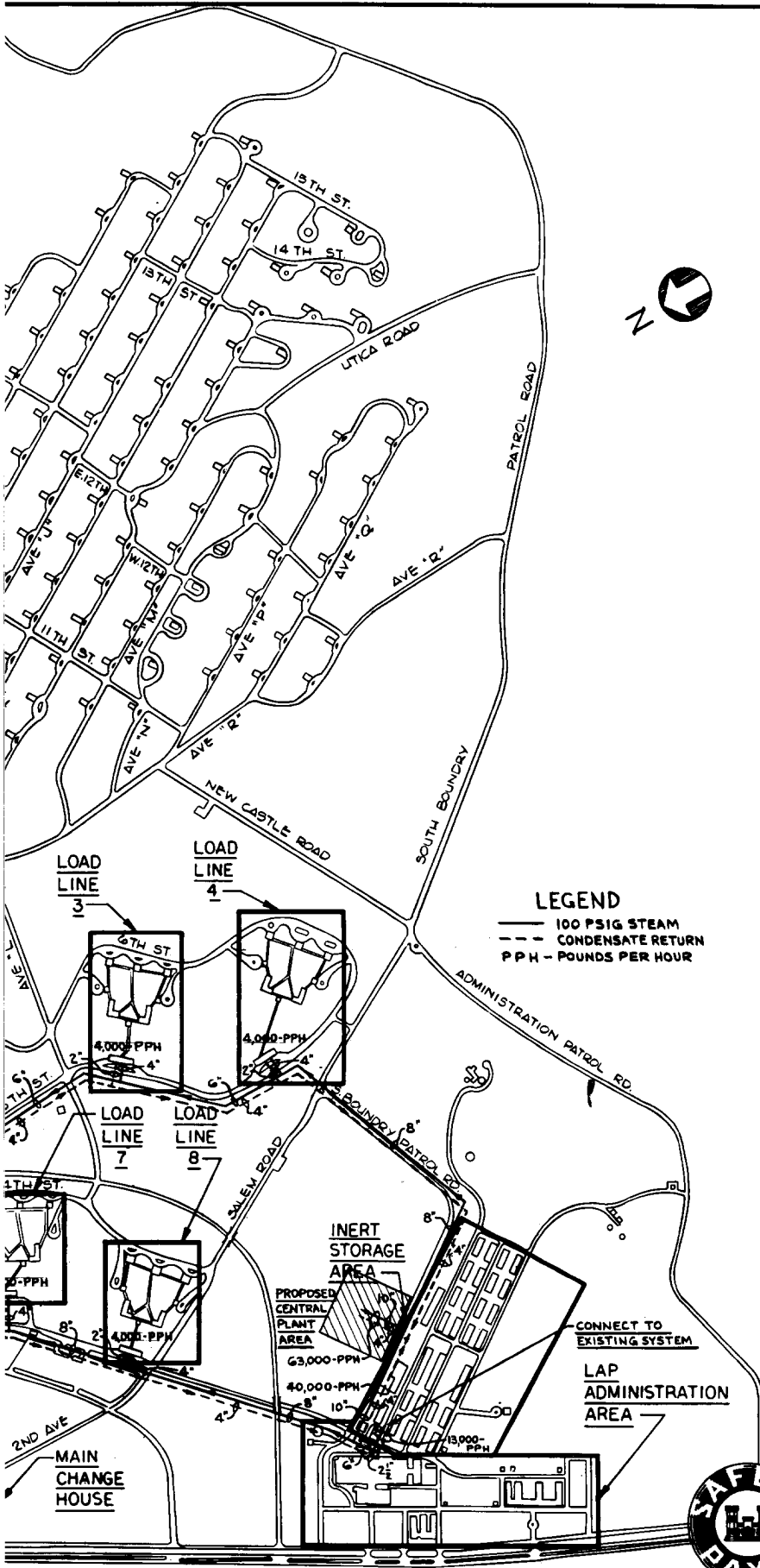


②



STEAM/CONDENSATE DISTRIBUTION SYSTEM  
 SCALE: 1" = 600'-FT.

①



**LEGEND**  
 ——— 100 PSIG STEAM  
 - - - CONDENSATE RETURN  
 PPH - POUNDS PER HOUR



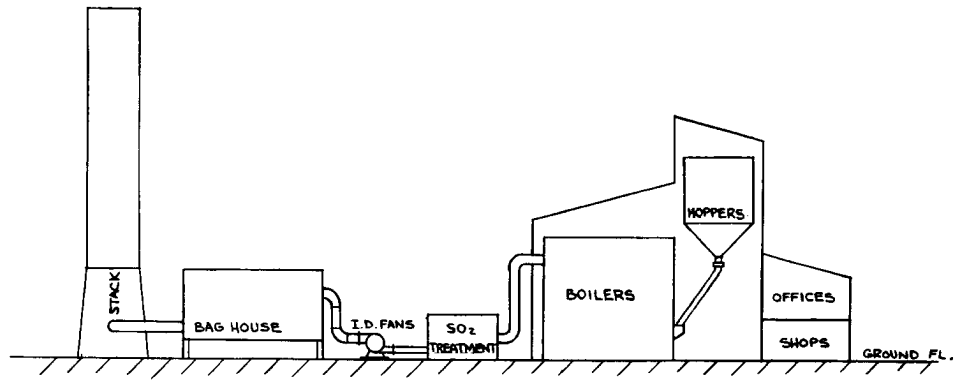
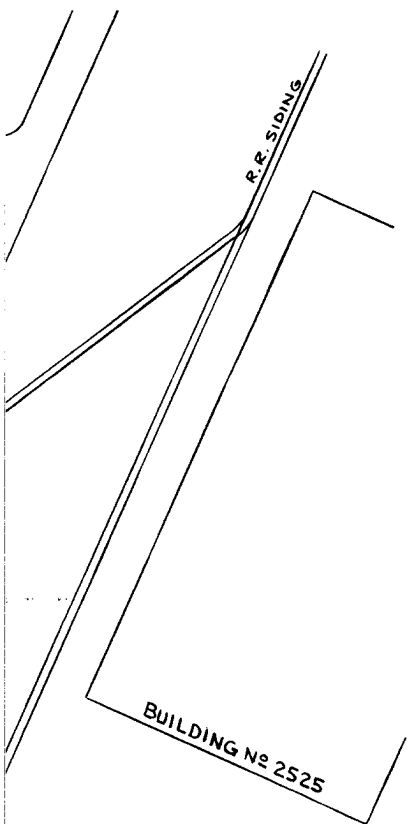
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DRAWN BY: FREDERICK	INDIANA ARMY AMMUNITION PLANT		
CHECKED BY: CREMI	LAP AREA		
QUANTIFIED BY:	STEAM/CONDENSATE DISTRIBUTION SYSTEM		
ARCHITECT-ENGINEER	APPROVED:	DATE:	JULY 2, 1982
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		FIGURE II-05-03	



**CONDENSATE DISTRIBUTION SYSTEM**  
 SCALE: 1" = 600'-FT.

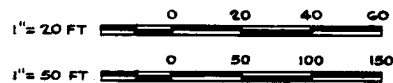
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SECTION THRU BOILER HOUSE  
SCALE: 1" = 20'-FT.

GRAPHIC SCALES

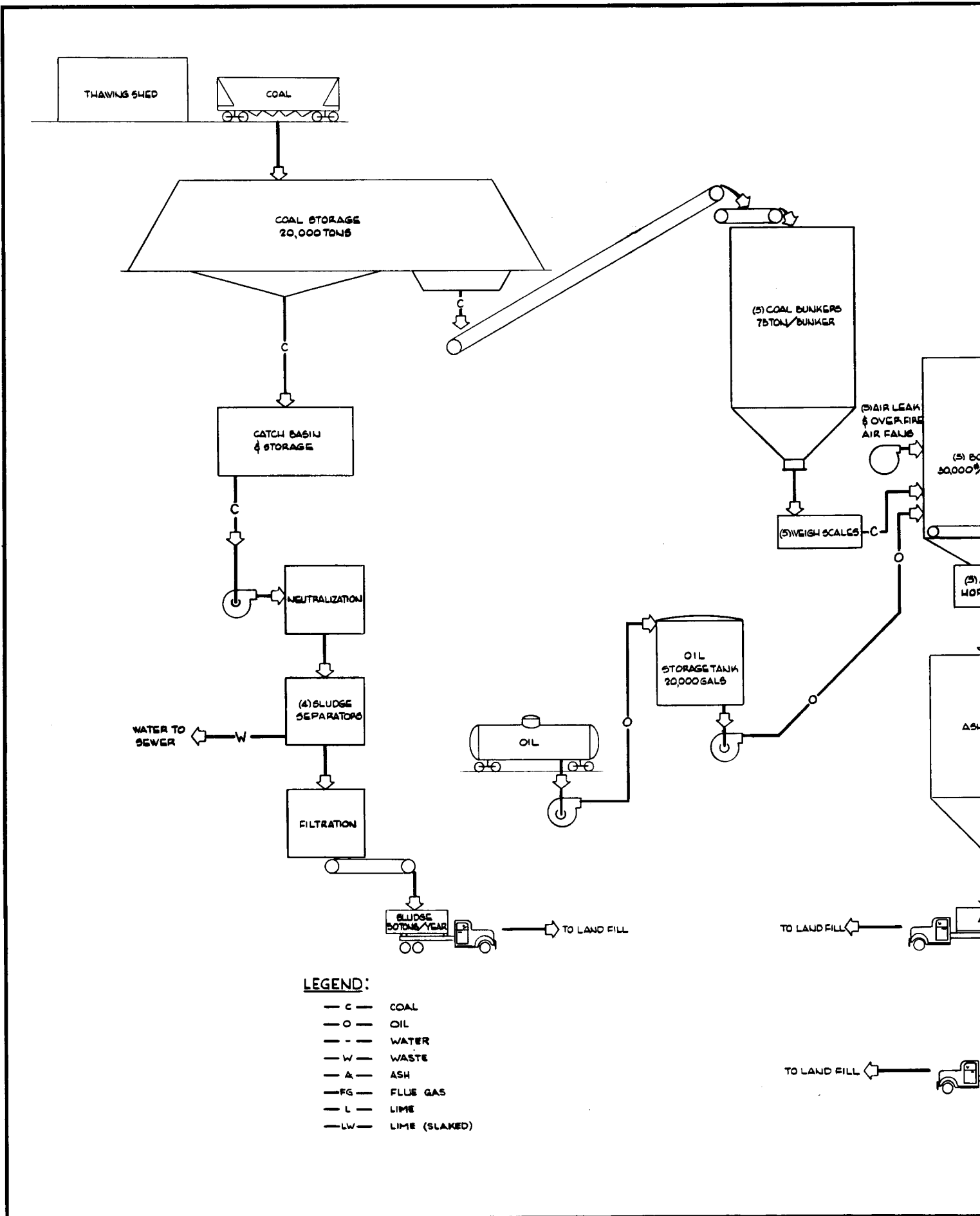


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DRAWN BY: FREDERICK	INDIANA ARMY AMMUNITION PLANT		
CHECKED BY: JONIK	LAP AREA		
SUBMITTED BY:	CENTRAL PLANT SITE PLAN & SECTION		
DESIGNED BY: CREMI	APPROVED:	DATE:	
RESUBMITTED BY:	CHIEF, DESIGN BRANCH	CHIEF, ENGINEERING DIVISION	
	APPROVED:	SCALE AS SHOWN	SPEC. NO. DACA45
		DRAWING NUMBER	
		FIGURE II-05-04	

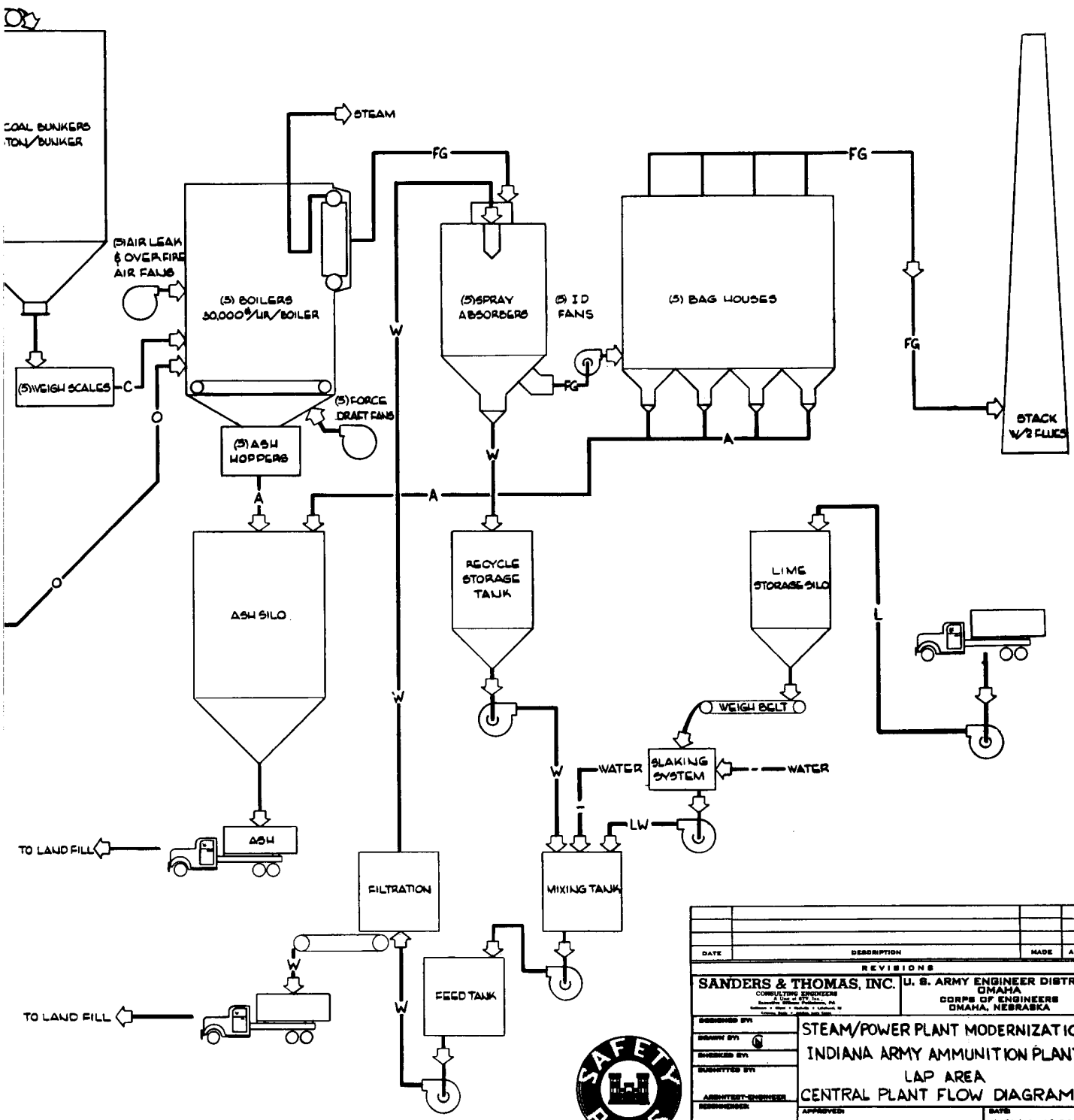


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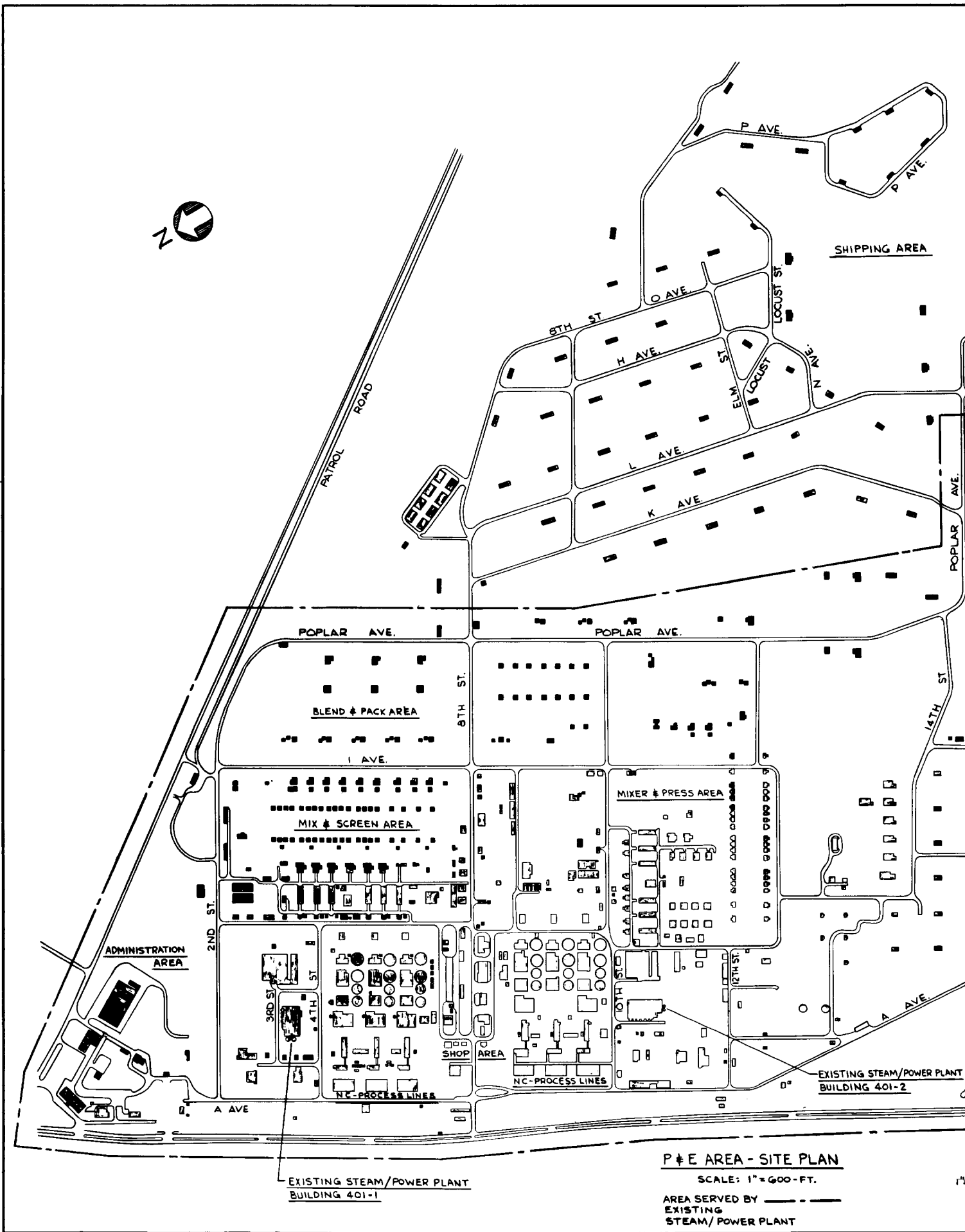
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OMAHA, NEBRASKA		OMAHA, NEBRASKA	
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CHECKED BY	LAP AREA		
APPROVED BY	CENTRAL PLANT FLOW DIAGRAM		
DATE	JULY 2 1982		
CHIEF, DESIGN BRANCH	CHIEF, ENGINEERING DIVISION	SCALE AS SHOWN	
APPROVED	DRAWN BY		FIGURE II-05-05



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**P & E AREA - SITE PLAN**

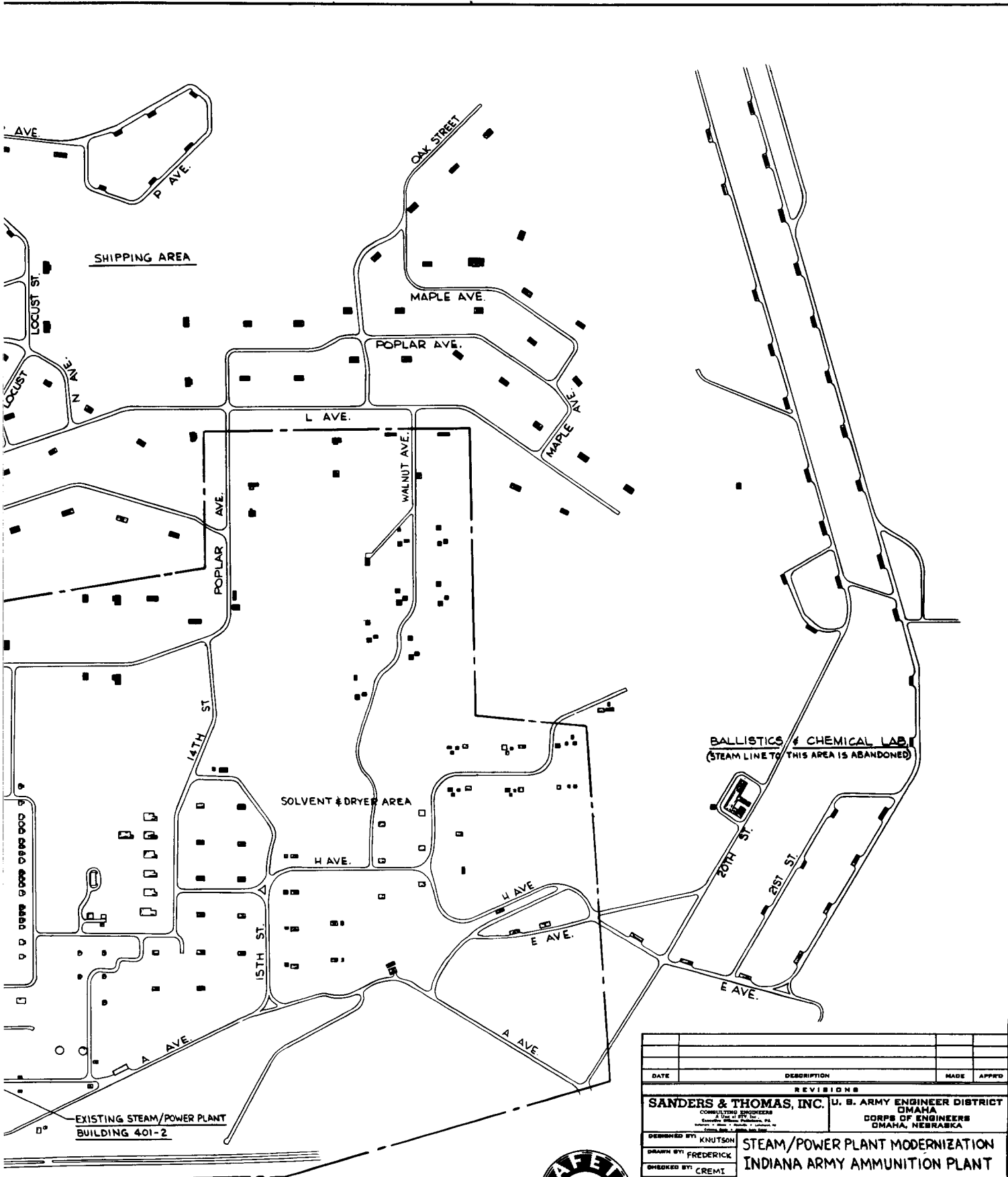
SCALE: 1" = 600'-FT.

AREA SERVED BY  
 EXISTING  
 STEAM/ POWER PLANT

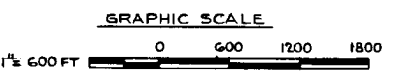
EXISTING STEAM/POWER PLANT  
 BUILDING 401-1

EXISTING STEAM/POWER PLANT  
 BUILDING 401-2

①



- SITE PLAN  
 1" = 600-FT.  
 R PLANT



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DESIGNED BY: KNUITSON	<b>STEAM/POWER PLANT MODERNIZATION</b> <b>INDIANA ARMY AMMUNITION PLANT</b> <b>P &amp; E AREA - SITE PLAN</b>		
DRAWN BY: FREDERICK			
CHECKED BY: CREMI			
SUBMITTED BY:			
ARCHITECT-ENGINEER	APPROVED:	DATE: JULY 2, 1962	
SECOND-CHECKER:	CHIEF, ENGINEERING DIVISION:	SCALE: AS SHOWN	
CHIEF, DESIGN BRANCH:	APPROVER:	SPEC. NO. DACA45	
COL. G. E. DISTRICT ENGINEER		DRAWING NUMBER <b>FIGURE II-05-06</b>	
		SHEET	

2