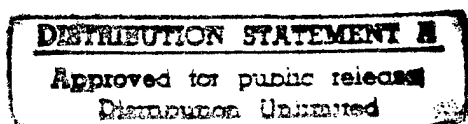


ENERGY REPORT

ENERGY ENGINEERING ANALYSIS PROGRAM

LIMITED ENERGY STUDY OF STEAM DISTRIBUTION SYSTEMS

HAWTHORNE ARMY AMMUNITION DEPOT HAWTHORNE, NEVADA



PREPARED FOR

**DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA**

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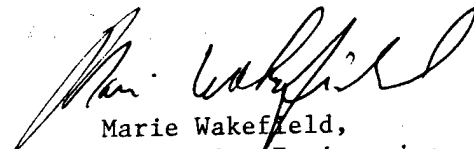

Marie Wakefield,
Librarian Engineering

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1.0 Executive Summary

1.1 Introduction

This report summarizes all work of the Limited Energy Study of Steam Distribution Systems, Energy Engineering Analysis Program, Hawthorne Army Ammunition Depot (HWAAD), Nevada. The project is authorized under Contract No. DACA05-92-C-0155 with the U.S. Army Corps of Engineers, Sacramento District, California.

The purpose of this limited energy study is to evaluate steam distribution and condensate collection systems in both the Industrial Area and Ordnance Area of HWAAD to develop a set of replacement actions that will reduce energy consumption and operating costs.

These efforts consist of corrections and revisions to previously submitted funding requests. Amended DD Forms 1391 and supporting documentation are prepared for:

- Project 40667, Modernize Steam Distribution System, Industrial Area, and
- Project 42166, Modernize Ordnance Area Steam Distribution, Ordnance Area.

1.2 Descriptions of Existing Facilities

HWAAD is located next to Highway 95 near the center of Nevada's border with California, about 130 miles southeast of Reno. The elevation is about 4,100 feet. The location is depicted on Figure 1-1. A number of facilities covering over 140,000 acres constitute HWAAD; however, this study was limited to the Industrial and Ordnance Areas. Distribution systems are shown on Figures 1-2 and 1-3.

1.2.1 Industrial Area

The Industrial Area is located west of Highway 95 and consists of administrative offices and maintenance shops. Family housing, dormitories for soldiers and a golf course are also located there.

The steam plant located in building 13 serves the area. Three steam boilers are operated when space heating is required. The boiler operating and steam distribution pressure is about 100 pounds per square inch (psig). Reduced pressure distribution is provided for the family housing area. Condensate is returned to the boiler plant through a system of pumped and gravity return lines.

The steam distribution and condensate return system is installed either in concrete trenches (covers form sidewalks) or is direct buried. Extensive repairs have been performed over the years and some piping has been replaced. The system is presently deteriorated.



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Uninsulated fiber reinforced plastic pipe (FRP), or fiberglass pipe, was installed in much of the family housing area to replace condensate return piping. The FRP pipe has sustained extensive damage from exposure to temperatures above 250°F.

1.2.3 Ordnance Area

The Ordnance Area 103 is located a few miles east of Highway 95, across the highway from the Industrial Area. Explosives are processed in the 103 Area, thus, buildings are located distant from one another. Only a few of the existing facilities are in current use.

Building 103-6 houses the central steam plant serving all buildings in the 103 Area. Steam is generated in three boilers and is distributed to buildings at about 112 psig. Condensate is returned via a pumped system. Both steam distribution and condensate return piping are encased within a single conduit. Frequent repairs have been required.

1.3 Selection of Replacement Piping Systems

Several alternative piping system types were evaluated. The evaluations were performed separately for each type of placement for the predominant pipe size in each area. Note that the costs listed below were for selecting the piping system only. Actual replacement costs were determined separately.

1.3.1 Industrial Area Replacement Piping System Selection

Existing Industrial Area piping is installed either in shallow concrete trenches or is direct buried. The predominant pipe sizes used for evaluations include 4-inch steam and 3-inch condensate pipe diameters.

Industrial Area concrete trench replacement piping systems evaluated and their total costs considering both construction and maintenance costs are:

- Preengineered steel steam and condensate pipes in a common conduit laid on a sand bed in the existing trench (Alternative CT1): \$204.20 per foot
- Preengineered steel steam and FRP condensate pipes in separate conduits laid on a sand bed in the existing trench (Alternative CT2): \$299.23 per foot
- Preengineered steel steam and condensate pipes in separate conduits laid on a sand bed in the existing trench (Alternative CT3): \$184.53 per foot
- Separate field fabricated steel steam and condensate pipes placed on existing rollers in the existing concrete trench (Alternative CT4): \$93.92 per foot

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Industrial Area direct burial replacement piping systems evaluated include:

- Preengineered steel steam and condensate pipes in a common conduit (Alternative DB1): \$209.90 per foot
- Preengineered steel steam and FRP condensate pipes in separate conduits (Alternative DB2): \$307.20 per foot
- Preengineered steel steam and condensate pipes in separate conduits (Alternative DB3): \$188.80 per foot

The alternatives with the lowest total costs are Alternative DB3 for direct burial pipe sections and Alternative CT4 for sections of piping replacements within existing concrete trenches.

1.3.2 Ordnance Area Replacement Piping System Selection

Above ground and underground alternatives are considered for the Ordnance Area. Above ground is less costly than underground piping, thus, replacement will be predominantly above ground. Underground piping will be used for street and railroad crossings. The predominant pipe sizes used in evaluations are 8-inch for steam and 4-inch for condensate return pipes.

Above ground piping systems considered for the Ordnance Area and the total costs, including both construction and maintenance costs, are:

- Preengineered steel steam and condensate pipes in a common conduit on pipe supports (Alternative A1): \$723.16 per foot
- Preengineered steel steam and FRP condensate pipes in separate conduits on pipe supports (Alternative A2): \$629.82 per foot
- Preengineered steel steam and condensate pipes in separate conduits on pipe supports (Alternative A3): \$560.38 per foot
- Field fabricated steel steam and condensate pipes on pipe supports (Alternative A4): \$213.22 per foot

Ordnance Area direct burial replacement piping systems evaluated include:

- Preengineered steel steam and condensate pipes in a common conduit (Alternative U1): \$686.30 per foot
- Preengineered steel steam and FRP condensate pipes in separate conduits (Alternative U2): \$641.43 per foot



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- Preengineered steel steam and condensate pipes in separate conduits (Alternative U3):
\$570.34 per foot

The aboveground and underground alternatives with the least total costs are A4 and U3. The above ground alternative A4 total cost is considerably below that of the underground selection, thus, above ground replacements are maximized. Underground replacement piping is used only where necessary, i.e., only for street and railroad crossings.

1.4 Evaluation of Distribution Piping Replacements

1.4.1 Piping Replacement Alternatives

Replacement of all the piping in both the Industrial and Ordnance Areas is considered. Unfortunately, available funds cannot accommodate complete system replacements. Each areas distribution system is divided into segments for consideration. Several segments are selected for replacement in each of the two areas. The selections of segments recommended for replacement are prioritized based on the greatest need for replacement within reach of the available funds. Piping segments recommended for replacement are shown on Figures 1-4 and 1-5; cost estimates are summarized on Tables 1-1 and 1-2.

1.4.2 Energy Savings

Energy and maintenance cost savings are achieved by replacing piping. Energy savings are from reduced heat losses to the air and ground and the from reduced leakage. Energy loss calculations for leaks are based on makeup water and fuel consumption records and from boiler combustion efficiency measurements.

Thermal losses to the air and ground from conduction and convection losses are calculated based on thermodynamic properties of the piping systems and on steam and condensate system operating temperatures. Refer to Appendix C for detailed calculations.

The energy savings from each source for sections of the distribution systems recommended for repair are:

Type of Savings	Industrial Area	Ordnance Area
Steam and Condensate Leaks (Million BTU / year)	16,290	7,396
Thermal Losses from Piping (Million BTU / year)	<u>8,646</u>	<u>9,875</u>
Total No. 2 Fuel Oil Savings (Million BTU / year)	24,936	17,271

1.4.3 Maintenance Labor Savings

Labor savings are achieved by reducing the amount of effort required to keep deteriorated piping systems operational. Based on the latest year for which complete maintenance records are available,



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labor savings are estimated at 3,225 hours per year in the Industrial Area and 2,775 labor hours per year in the Ordnance Area.

1.4.4 Life Cycle Cost Analyses

Life cycle cost analyses were conducted for both recommended repair projects. The analyses are provided on Tables 1-3 and 1-4 for the Industrial and Ordnance Areas, respectively. Results are:

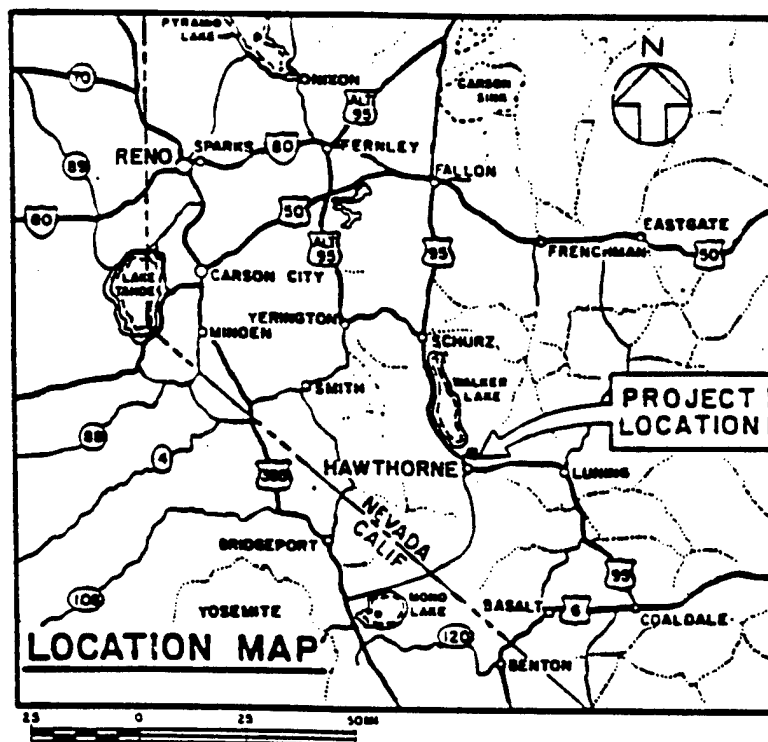
- **Industrial Area**

Investment (including SIOH and Design):	\$851,618
Savings to Investment Ratio:	3.87
Simple Payback Period:	3.43 years
- **Ordnance Area**

Investment (including SIOH and Design):	\$1,198,535
Savings to Investment Ratio:	2.39
Simple Payback Period:	5.43 years

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Figure 1-1
Site Location Map



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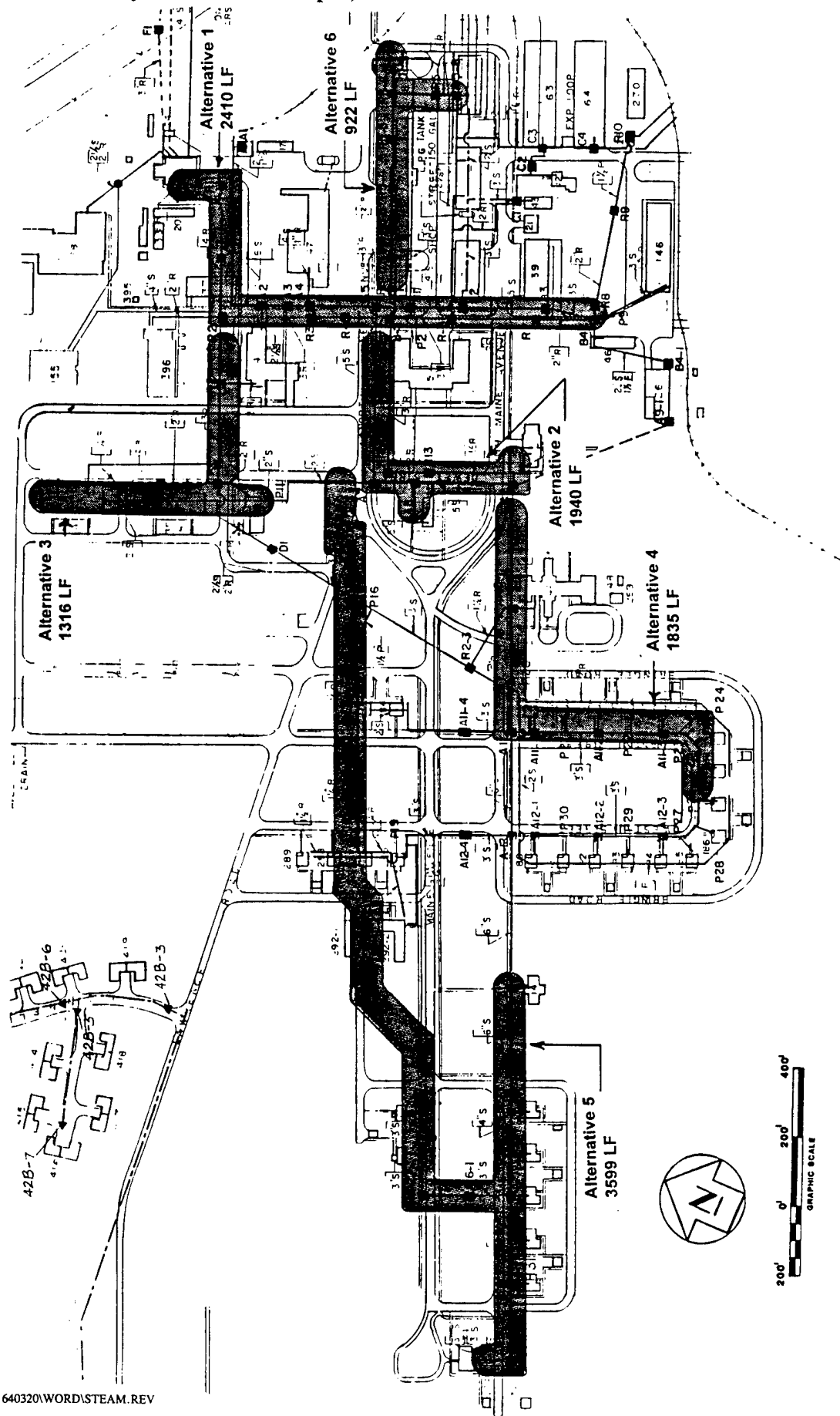


Figure 1-2
Industrial Area Steam Distribution System Pipe Replacement Alternatives

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Hawthorne Army Ammunition Depot, Nevada

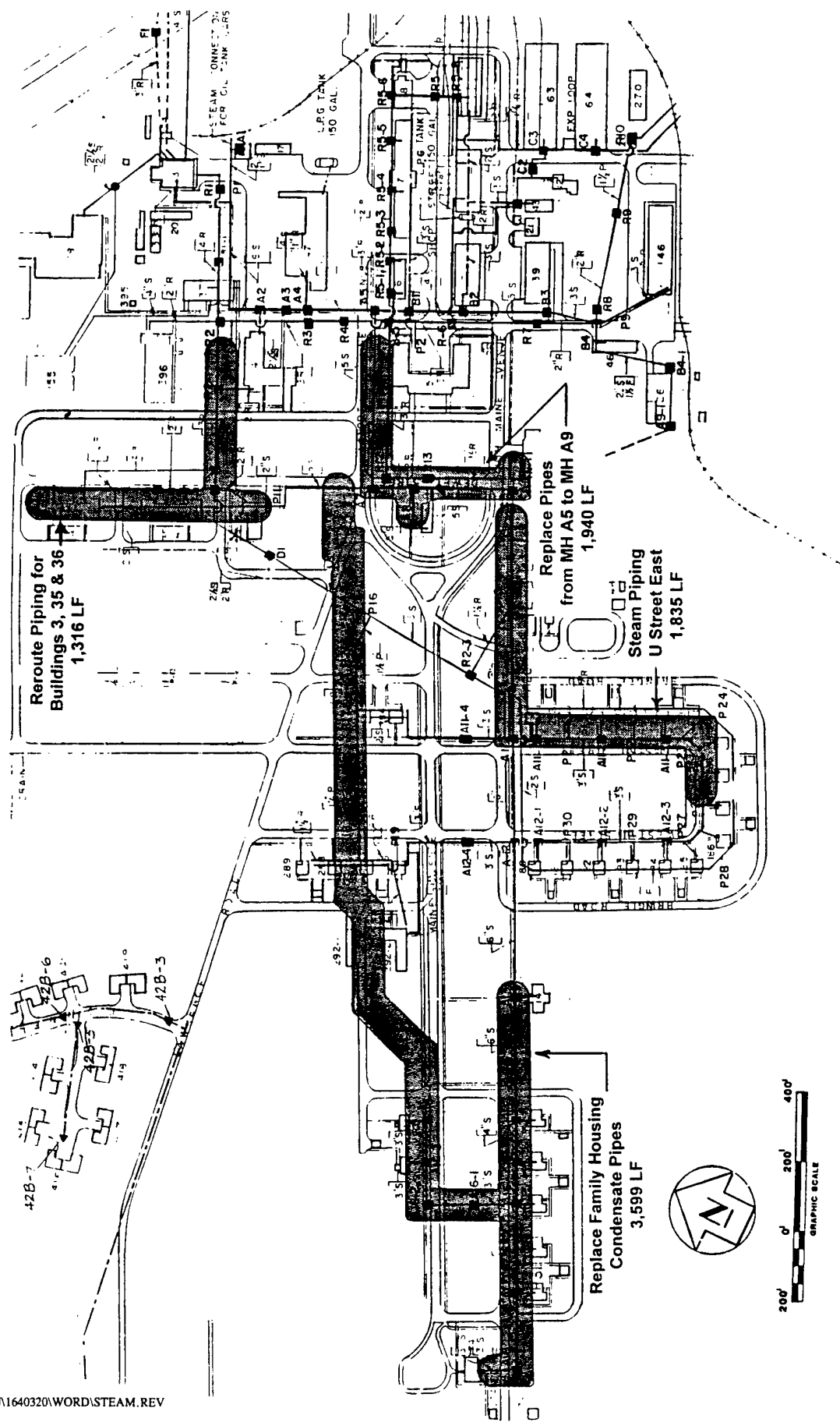


Figure 1-3
Industrial Area Steam Distribution System Recommended Pipe Replacement Alternatives

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Hawthorne Army Ammunition Depot, Nevada

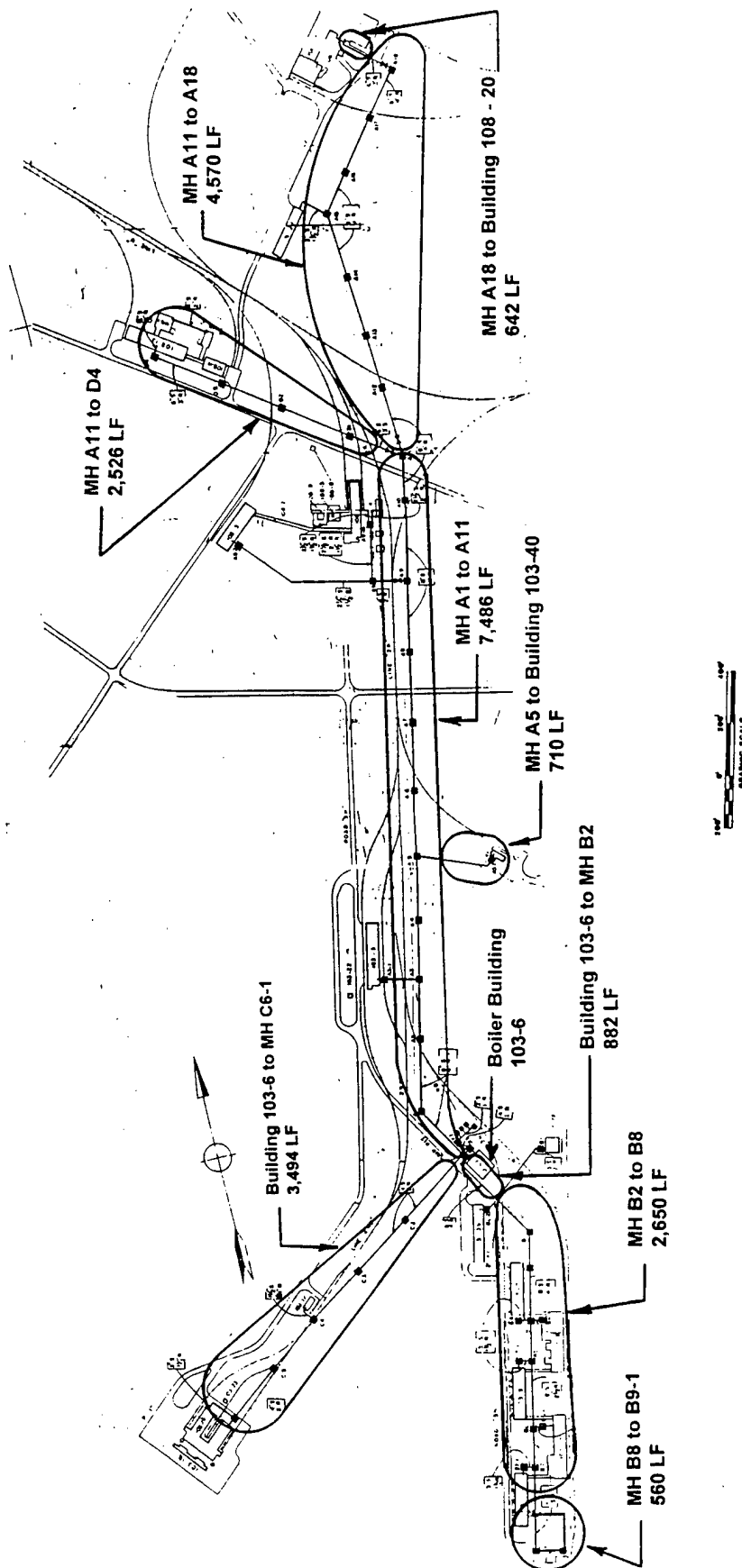


Figure 1-4
Ordinance Area Steam Distribution System Pipe Replacement Alternatives

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Hawthorne Army Ammunition Depot, Nevada

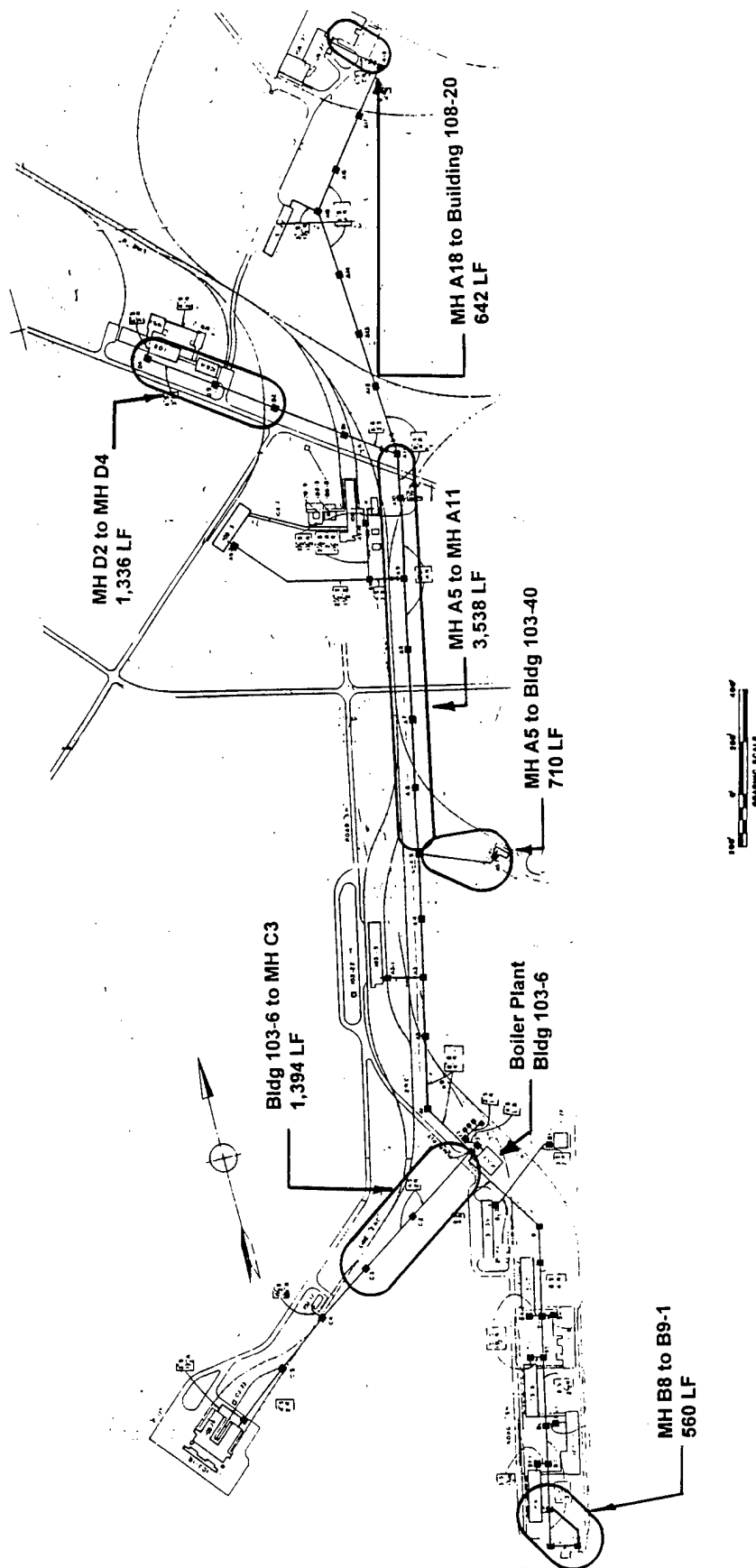


Figure 1-5
Ordinance Area Steam Distribution System Recommended Pipe Replacement Alternatives

**EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada**

**Table 1-1
Summary of Piping Replacement Costs
Industrial Area Steam and Condensate System**

<u>Alt.</u>	<u>Alternative Description</u>	<u>Base Case, Total Lengths</u>			<u>Recommended</u>	
		<u>Total LF</u>	<u>Cost \$</u>	<u>\$/LF</u>	<u>Total LF</u>	<u>Cost \$</u>
1	Replace Pipes Bldg 13 to MH B4	2,410	\$266,492	\$110.58	-	-
2	Replace Pipes MH A5 to MH A9	1,940	\$165,343	\$85.23	1,940	\$165,343
3	Rerouting for Buildings 3, 35 & 36	1,316	\$157,696	\$119.83	1,316	\$157,696
4	Steam Piping - U Street East	1,835	\$158,033	\$86.12	1,835	\$158,033
5	Family Housing Condensate Pipes	3,599	\$282,027	\$78.36	3,599	\$282,027
6	Shop Area Condensate Piping	922	\$106,940	\$115.99	-	-
Total of Industrial Area Alternatives		12,022	\$1,136,531	\$94.54	8,690	\$763,099
SIOH 5.6%			\$63,646			\$42,734
Design 6.0%			\$68,192			\$45,786
Total Request		12,022	\$1,268,368	\$105.50	8,690	\$851,618

**EEAP Limited Energy Study of Steam Distribution Systems
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Table 1-2
Summary of Above Ground Piping Replacement Costs
Ordnance Area Steam and Condensate System
(Road and Rail Crossings Underground)

<u>Alt. Pipe Run Description</u>	<u>Base Case, Total Lengths</u>			<u>Recommended</u>	
	<u>Total LF</u>	<u>Cost \$</u>	<u>\$/LF</u>	<u>Total LF</u>	<u>Cost \$</u>
1 MH A1 to MH A11	7,486	\$1,020,250	\$136.29	-	-
MH A5 to MH A11	-	-	-	3,538	\$531,951
2 MH A11 to MH A18	4,570	\$603,930	\$132.15	-	-
3 MH A11 to MH D4	2,526	\$360,732	\$142.81	-	-
MH D2 to MH D4	-	-	-	1,336	\$191,263
4 MH A18 to Bldg 108-20	642	\$90,837	\$141.49	642	\$90,837
5 MH A5 - Bldg 103-40	710	\$42,631	\$60.04	710	\$42,631
6 Bldg 103-6 to MH C6-1	3,494	\$328,594	\$94.05	-	-
Bldg 103-6 to MH C3	-	-	-	1,394	\$167,348
7 Bldg 103-6 to MH B2	882	\$136,571	\$154.84	-	-
8 MH B8 to MH B9-1	560	\$49,925	\$89.15	560	\$49,925
9 MH B2 to MH B8	2,650	\$411,344	\$155.22	-	-
Total Ordnance Area Piping	23,520	\$3,044,814	\$129.46	8,180	\$1,073,956
SIOH 5.6%		\$170,510			\$60,142
Design 6.0%		\$182,689			\$64,437
Total Request	23,520	\$3,398,013	\$144.47	8,180	\$1,198,535

**EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada**

**Table 1-3
Life Cycle Cost Analysis Summary - Industrial Area**

Location: Hawthorne Army Ammunition Depot Region No. 4 Project No. 40667
Project Title: ECIP Modernize Industrial Area Steam Distribution Fiscal Year FY97
Discrete Portion: Total Project Preparer: KELLER & GANNON
Analysis Date: July 1995 Economic Life: 15 Years

1. Investment Costs

A. Construction Costs	\$763,099	
B. SIOH 5.6%	\$42,734	
C. Design Cost 6.0%	\$45,786	
D. Total Cost (1A + 1B + 1C)	\$851,618	
E. Salvage Value of Existing Equipment	\$0	
F. Public Utility Company Rebate	\$0	
G. Total Investment (1D-1E-1F)		\$851,618

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost \$/MBTU	Saving MBTU/Yr(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	\$12.82	0	\$0	12.02	\$0
B. Dist	\$6.13	23,723	\$145,423	14.23	\$2,069,366
C. LPG					
D. Other					
E. Demand Savings		0.0 kW	\$0	11.30	\$0
F. Total		23,723	\$145,423		\$2,069,366

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	\$102,620	
(1) Discount Factor (Table A)	11.94	
(2) Discounted Savings/Cost (3A x 3A1)		\$1,225,277

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2 + 3Bd4) \$1,225,277

4. First Year Dollar Savings (2F3 + 3A + (3Bd1/Economic Life)):	\$248,042	
5. Simple Payback (1G/4):	3.43	Years
6. Total Net Discounted Savings (2F5 + 3C):	\$3,294,643	
7. Savings to Investment Ratio (SIR) (6/1G):	3.87	

**EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada**

**Table 1-4
Life Cycle Cost Analysis Summary - Ordnance Area**

Location: Hawthorne Army Ammunition Depot Region No. 4 Project No. 42166
Project Title: ECIP Modernize Ordnance Area Steam Distribution Fiscal Year FY97
Discrete Portion: Total Project Preparer: KELLER & GANNON
Analysis Date: July 1995 Economic Life: 15 Years

1. Investment Costs

A. Construction Costs	\$1,073,956	
B. SIOH 5.6%	\$60,142	
C. Design Cost 6.0%	\$64,437	
D. Total Cost (1A + 1B + 1C)	\$1,198,535	
E. Salvage Value of Existing Equipment		\$0
F. Public Utility Company Rebate		\$0
G. Total Investment (1D-1E-1F)		\$1,198,535

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost \$/MBTU	Saving MBTU/Yr(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	\$12.82	0	\$0	12.02	\$0
B. Dist	\$6.13	16,549	\$101,447	14.23	\$1,443,592
C. LPG					
D. Other					
E. Demand Savings		0.0 kW	\$0	11.30	\$0
F. Total		16,549	\$101,447		\$1,443,592

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	\$119,261	
(1) Discount Factor (Table A)	11.94	
(2) Discounted Savings/Cost (3A x 3A1)		\$1,423,970

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2 + 3Bd4) \$1,423,970

4. First Year Dollar Savings (2F3 + 3A + (3Bd1/Economic Life)):	\$220,708	
5. Simple Payback (1G/4):	5.43	Years
6. Total Net Discounted Savings (2F5 + 3C):	\$2,867,562	
7. Savings to Investment Ratio (SIR) (6/1G):	2.39	

2.0 Introduction

This report contains the results of all work for the Energy Engineering Analysis Program (EEAP), Limited Energy Study of Steam Distribution Systems in the Industrial and Ordnance Areas, Hawthorne Army Ammunition Depot (HWAAD), Hawthorne, Nevada. The work was authorized under Contract Number DACA05-92-C-0155 with the U.S. Army Corps of Engineers, Sacramento District, Sacramento, California.

2.1 Purpose

The purpose of this limited energy study is to evaluate the steam distribution and condensate collection systems in both the Industrial Area and Ordnance Area of HWAAD to develop a set of replacement actions that will reduce energy consumption and operating costs.

2.2 Scope

The scope of work as established by the U.S. Army Corps of Engineers, Sacramento District, consists of the following tasks:

- Limited site investigation of Industrial Area and Ordnance Area steam distribution and condensate collection systems.
- Evaluation of alternative replacement strategies—including in-trench, above ground, and direct burial piping—to determine cost effective alternatives.
- Estimation of the magnitude of thermal losses from steam distribution system and condensate return lines.
- Definition of scopes of work for steam distribution and condensate return system repair and replacement in the two areas.
- Preparation of funding documentation for the recommended projects.
- Preparation of a report documenting the data collected, analyses performed, and projects recommended.

The complete scope of work and minutes of the prenegotiation scoping and interim report review conferences, comments and responses appear in Appendix A.

2.3 Methodology

The sequence of the study, in chronological order, progressed from the site investigation to the interim report preparation to the final report preparation. Methodologies used during each phase of the study are addressed as follows:



2.3.1 Site Investigation

An entry briefing attended by the architect/engineer (A/E), representatives of HWAAD Directorate of Engineering and Housing (DEH) and the facility operating contractor, Day & Zimmerman/Basil (DZB), was held prior to beginning the facility inspections. Survey schedules and support requirements from HWAAD DEH and DZB were discussed during this briefing.

Copies of available as-built drawings were obtained for the two steam distribution and condensate return systems. Field team members then inspected the two site steam distribution systems and recorded findings on as-built drawings and the standard forms developed by the A/E for this purpose.

An exit briefing was held at the completion of the facility investigations. The purpose of the briefing was to report progress and to report any maintenance needs or "quick fix" measures that could be readily implemented by DEH.

2.3.2 Interim Report

The first step in preparation of the Interim Report was the reduction of data collected during the site investigation and creation of a steam system database. Unit costs were then developed for each of the alternative steam supply and condensate return piping replacement strategies. Existing system thermal losses and upgraded system losses were estimated using a computer model developed by S.K. Siddiqui, and published in the November 1994 issue of Heating/Piping/Air Conditioning magazine.

Following completion of the databases and energy modeling, upgrade strategies were evaluated for both steam distribution systems according to the scope of work. Computer modeling as described above, spreadsheet software and, where necessary, manual calculations were employed to determine the relative benefits of each upgrade strategy. Life cycle cost analyses were performed for all alternatives in accordance with the latest "Energy Conservation Investment Program (ECIP) Guidance."

2.3.3 Final Report

Following the Interim Report presentation and review conference, a revised energy report and funding documents were prepared for the two ECIP steam system modernization projects for the Ordnance Area and Industrial Area, as directed by the Government review. In addition, revisions resulting from the review conference were incorporated into these documents, and into the report narratives and calculations.

3.0 Description of Existing Facility

3.1 Location, Size and Climate

The Hawthorne Army Ammunition Depot is located next to Highway 95 in Central Nevada, approximately 130 miles southeast of Reno, adjacent to the city of Hawthorne. The site location is shown on Figure 3-1. The installation covers approximately 148,000 acres at an average elevation of 4,100 feet.

The summer design dry and wet bulb temperatures are 95°F and 64°F, respectively. These are the temperatures equaled or exceeded 2-1/2 percent of the time, on the average, during the warmest four consecutive months (June through September). The dry bulb temperature exceeds 80°F an average of 878 hours per year and the wet bulb temperature exceeds 67°F an average of 9 hours per year during the six warmest months of the year.

The winter design dry bulb temperature is 11°F. This temperature is equaled or exceeded 2-1/2 percent of the time, on the average, during the coldest consecutive three months (December through February). Heating degree days (the difference between the mean daily temperature and a base temperature of 65°F), as listed in TM 5-785, total 5,508 annually.

This effort addresses the steam distribution and condensate return systems in the Industrial and Ordnance Areas of the Hawthorne Army Ammunition Depot. Steam in each area is generated in boilers fired with Low Sulfur No. 2 Fuel Oil. The steam plants are operated during non-summer months with steam used predominantly for space heating purposes. The Ordnance Area has some process uses for steam.

3.2 Industrial Area Steam Distribution System

The Industrial Area is located to the west of Highway 95 and consists of administrative offices and maintenance shops required to serve the depot. Family housing, dormitories and a golf course are also located in the Industrial Area.

The central steam plant is housed in building 13, in the northeast part of the area. The central plant has three diesel fired Nebraska fire tube boilers, each capable of producing up to 18,000 pounds per hour (PPH) of steam. The boilers are replacement boilers, the original plant having been built in the early 1930's. The operating pressure of the steam plant is about 100 pounds per square inch (psig). Although the boilers are over 20 years old (built in 1974), they are well maintained and have many years of remaining service life.

Steam is distributed in the Industrial Area through a piping distribution system located mostly in shallow concrete trenches. Trench covers form the sidewalks in most of the Industrial Area. The trenches are not only easy to open for maintenance, but keep sidewalks clear of ice during the winter

due to heat losses from steam and condensate piping. The steam distribution system is shown on Figure 3-2.

Most facilities receive 100 psig steam. Building heating systems require lower pressures, thus most buildings are provided with dedicated pressure reducing valves. The family housing area receives steam at 100 psig at manhole No. A11. Pressure reducing valves installed there reduce the distribution pressure for the entire family housing area of the facility.

Deficiencies of particular note include the family housing area FRP condensate return piping problems, deteriorated original red brass condensate piping and unique "sand trap" structures, and leaks in steam and condensate pipes throughout the area.

Figure 3-2 is annotated with observations made during the limited field investigations conducted for the project. Notations are keyed to entries on Table 3-1.

Condensate collection is composed of a combination of gravity and forced mains. Some of the original red brass piping installed in the mid 1930s is still in service. Little, if any, of the condensate collection piping is insulated, and most is direct buried next to trenches containing steam distribution piping. The housing area condensate piping has been replaced with direct buried, uninsulated fiber reinforced (thermosetting) plastic pipe (FRP).

Although more resistant to corrosion than the customary metallic piping systems, FRP piping is subject to damage when heated in excess of 250°F. Much of the FRP piping has been damaged due to stuck steam traps and other causes of steam entry into the piping. The FRP piping was installed before a major design change was instituted by the Army for FRP piping systems. Thermal protective devices are now required for all entries of condensate into the system.

The sand traps are manholes with an approximate 1 cubic foot covered chamber in the bottom which receives condensate flows and allows them to flow out by gravity into an outlet pipe at a slightly lower level than the inlet pipes. This arrangement prevents grit from entering the condensate collection system. It also allows the condensate to be lost through cracks in the concrete structures and to be cooled by exposure to the air.

3.3 Ordnance Area Steam Distribution System

Ordnance Area 103 is located a few miles east of Highway 95, across the highway from the Industrial Area. The area extends along the access road for over a mile. The 103 area is an explosives processing, shipping and receiving operations area. Buildings are located fairly far apart for explosives safety purposes. Much of the 103 area is currently shut down. Only a few facilities are still operating.

Building heating systems are served by steam from a central steam plant located in building 103-6. Three water tube steam boilers, each capable of generating about 20,000 PPH of steam are located

in the steam plant. The system operating pressure is about 112 psig. Distribution system piping is underground and consists of steam and condensate piping encased in a single conduit. Underground structures contain valving and other control components. Expansion loops are installed between each pair of manholes.

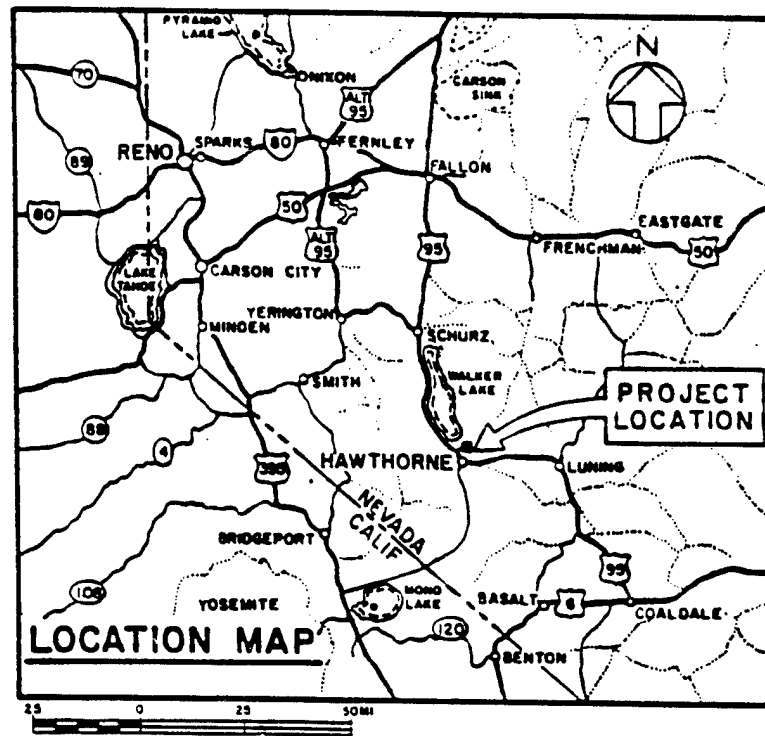
The operating buildings are located at the extremities of the distribution system, thus the entire distribution system must be kept operational. The distribution system has experienced chronic problems of steam and condensate pipe leakage. Some stretches of the piping contain multiple repairs.

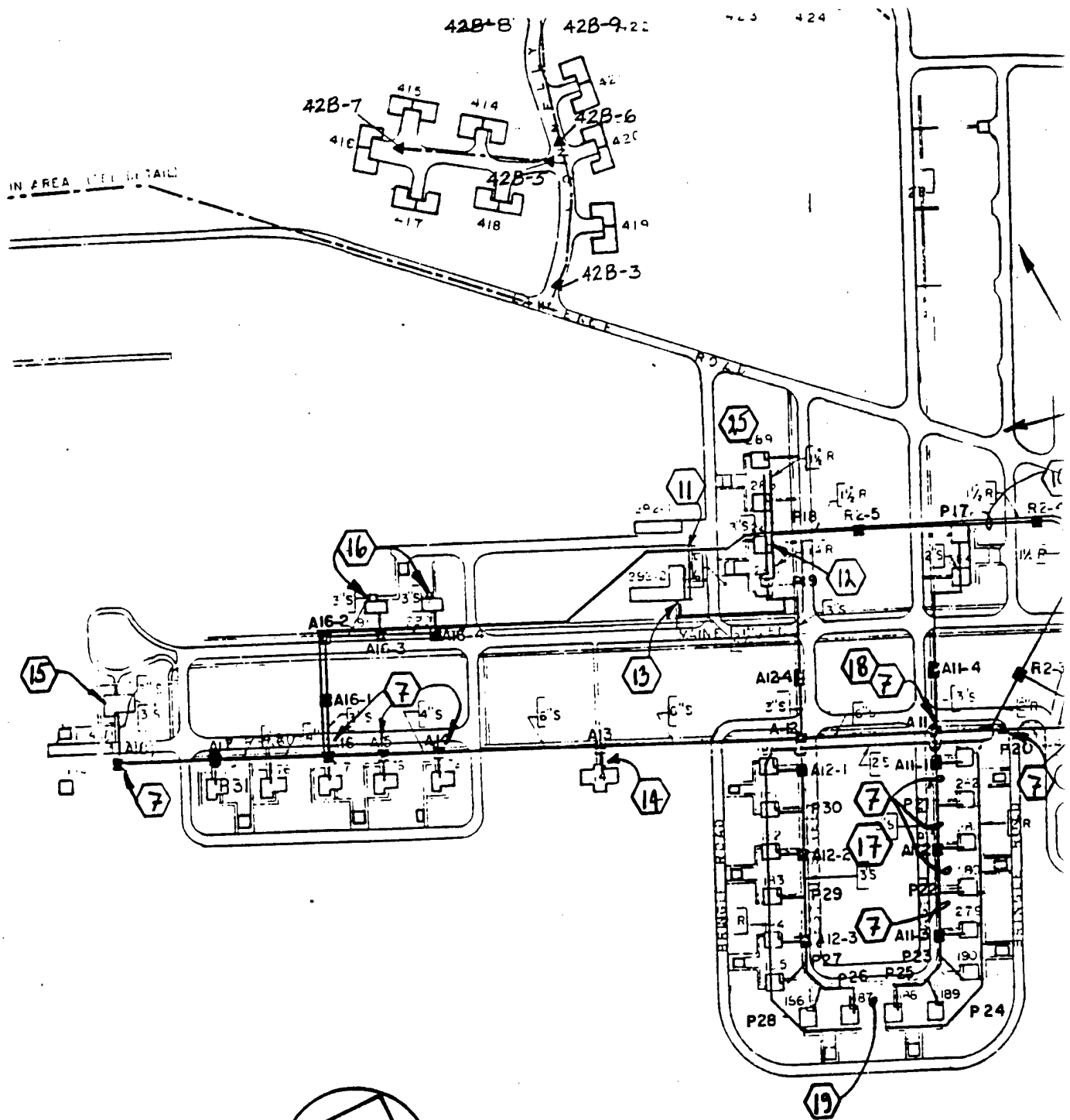
The Ordnance Area steam distribution piping system is shown on Figure 3-3. The figure is annotated with observations made during field investigations. Notes on Figure 3-3 are keyed to entries on Table 3-2.



EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada

Figure 3 - 1
Site Location Map





①

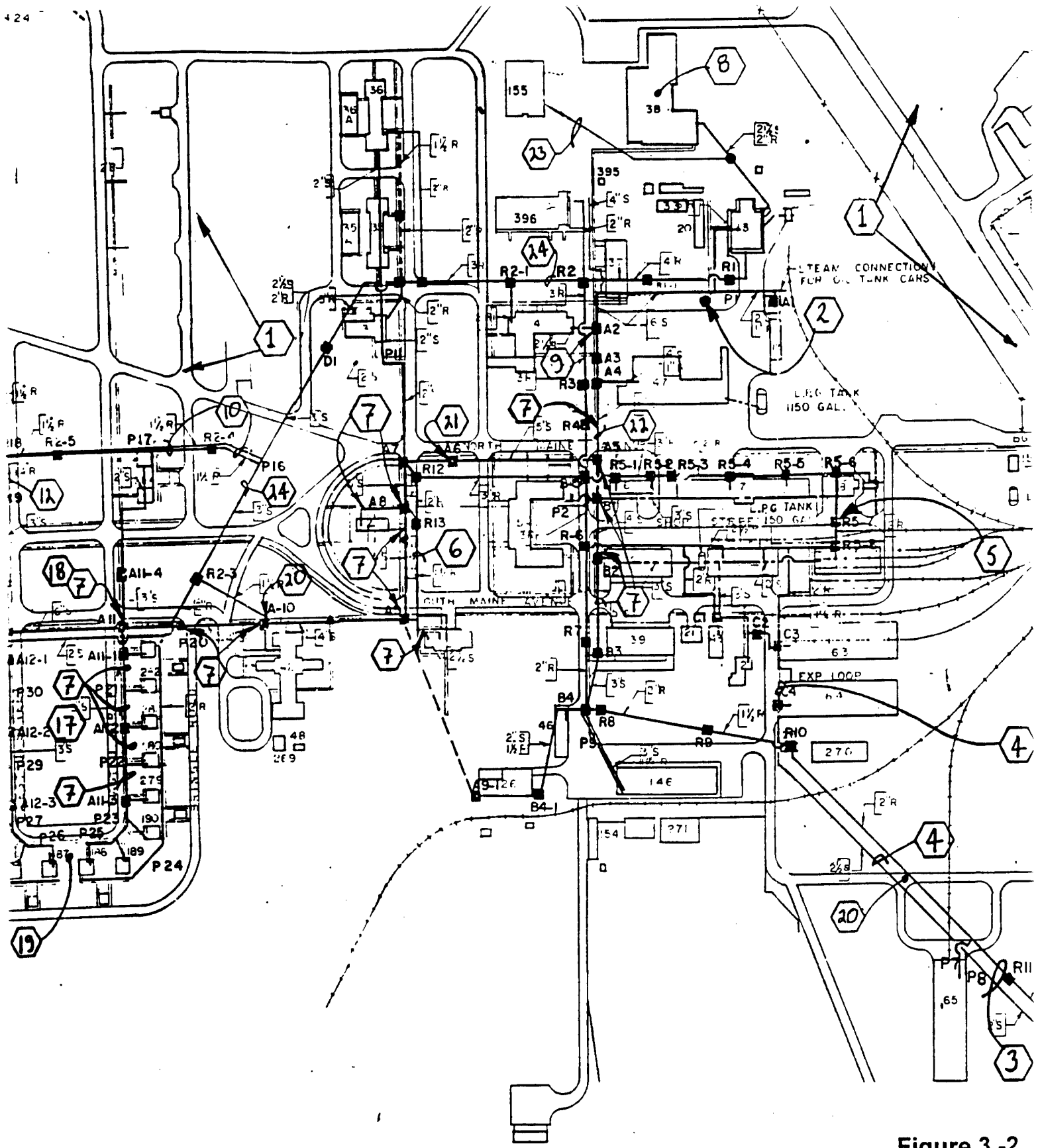


Figure 3 -2
Industrial Area Steam Distri
Piping Inspectio

Number refers to notes on Table 3-1

2

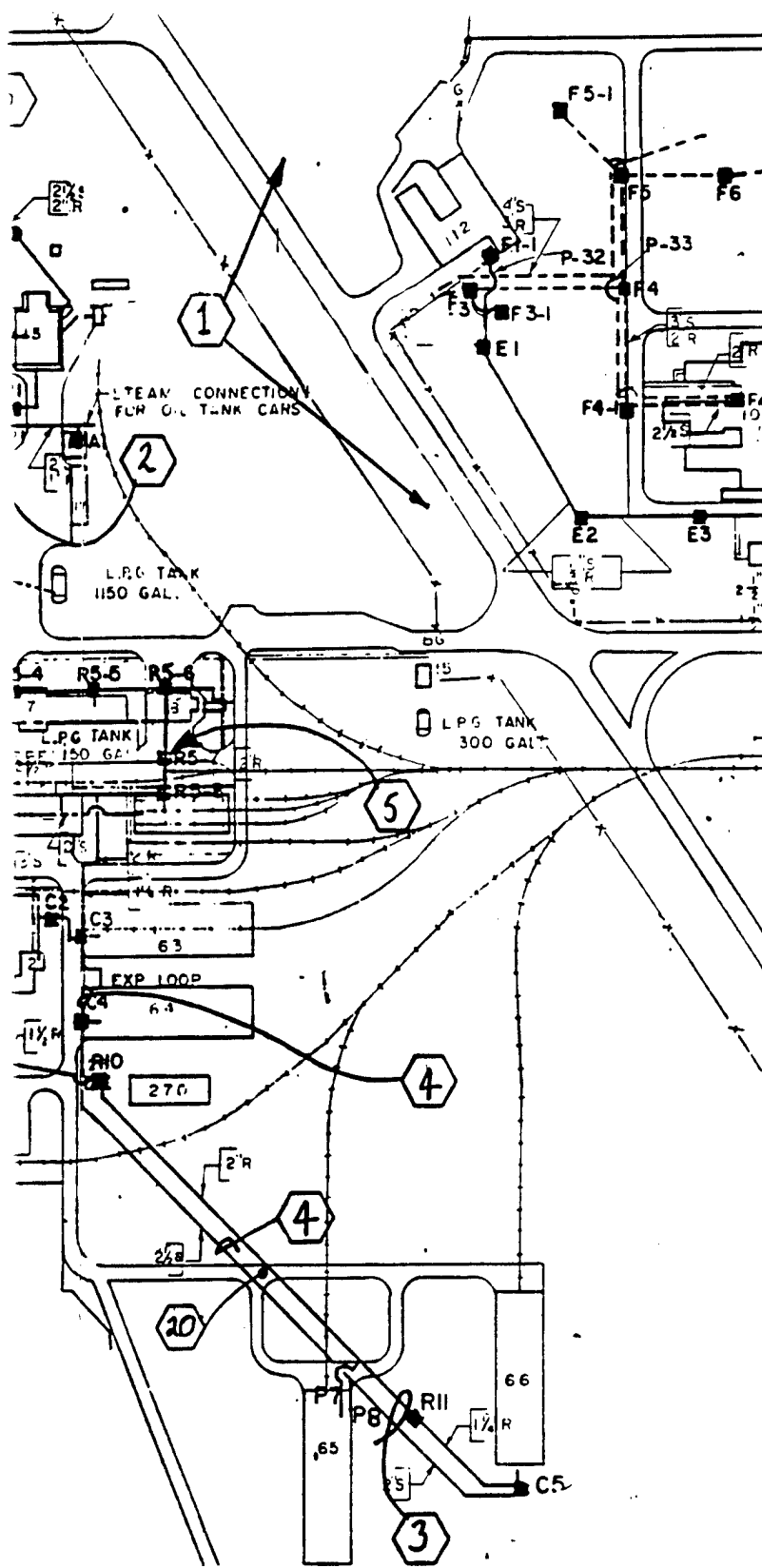
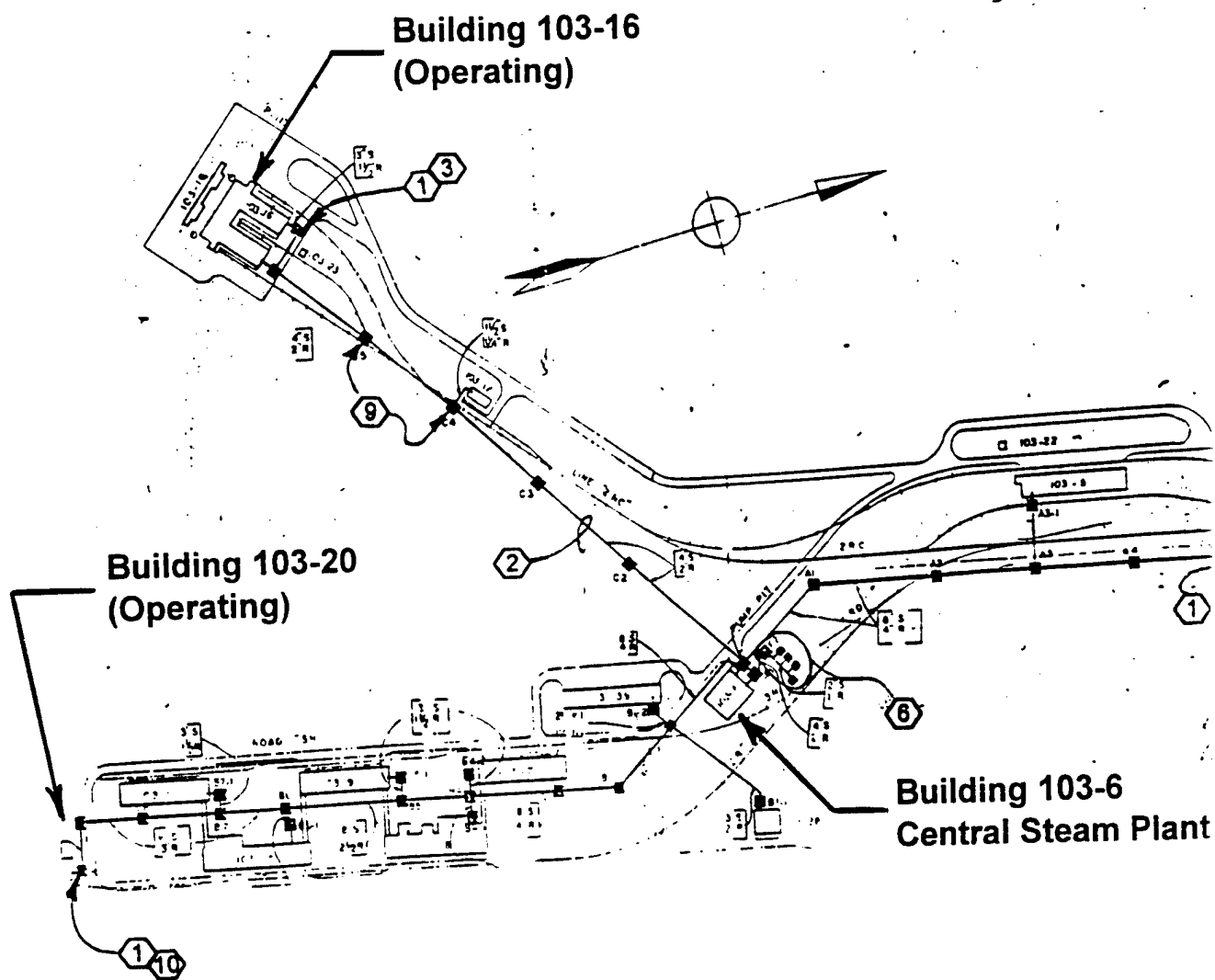


Figure 3 -2
Industrial Area Steam Distribution System
Piping Inspections

3



Number refers

①

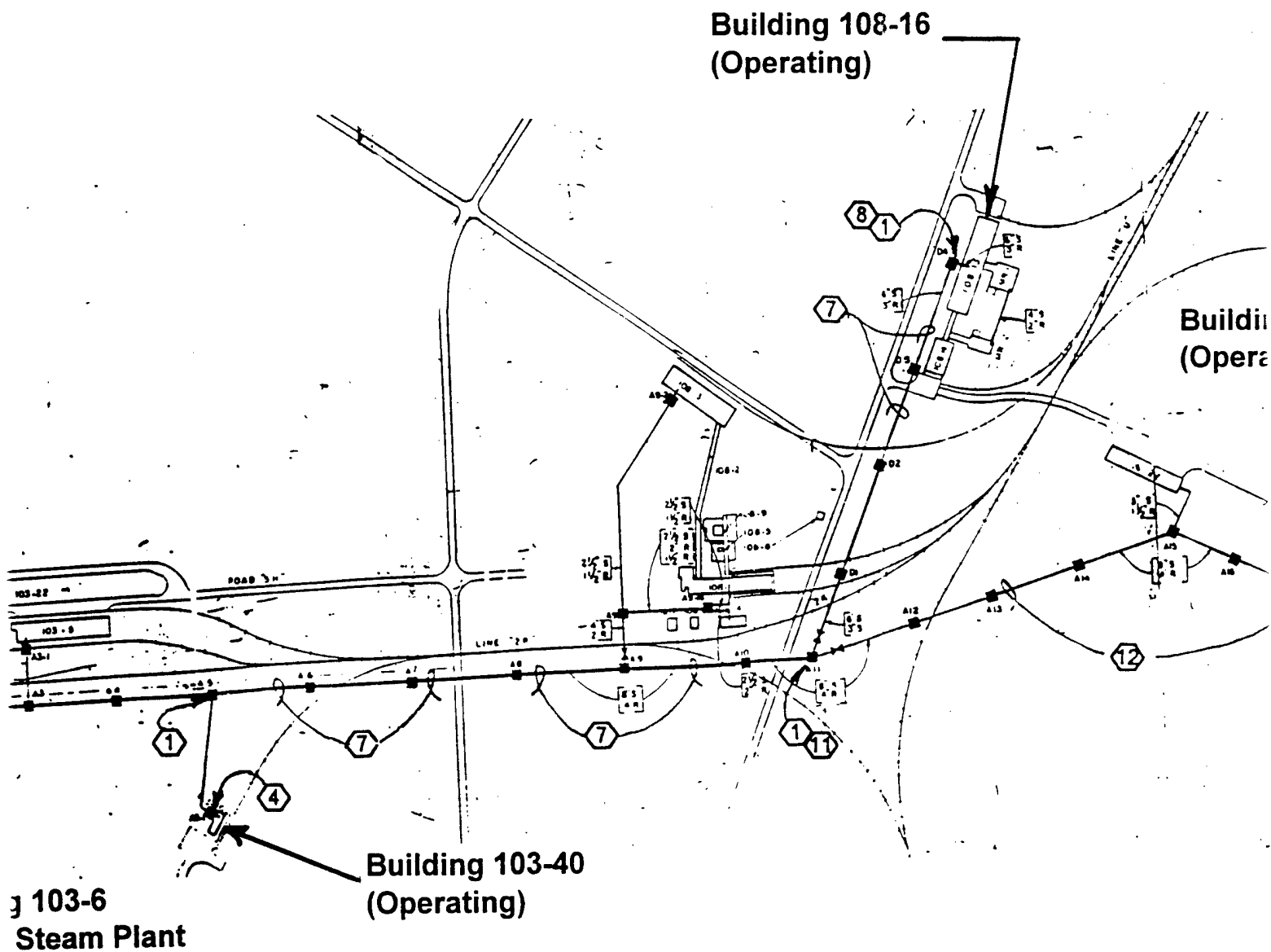


Figure 3 - 3
Ordnance Area
Steam Distribution System
Piping Inspection

Number refers to notes on Table 3-2

2

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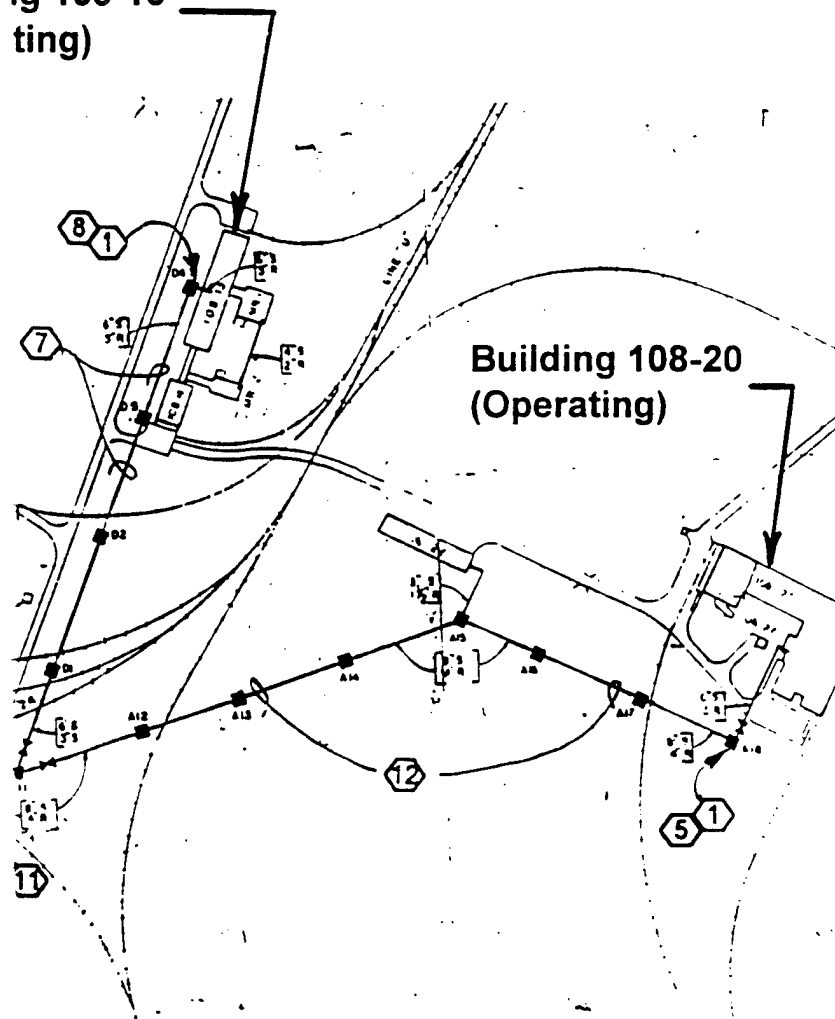


Figure 3 - 3
Ordnance Area
Steam Distribution System
Piping Inspections

3

Table 3-1
Notes for Industrial Area Steam Distribution System Inspections

- ① Number refers to notes on Table 3-1
- ② Excavation to remove underground storage tanks is open, some steam, condensate and other utility lines are "hanging on the edge" of the excavation.
- ③ Piping between Buildings 65 and 66 has recently been replaced with a two-pipe conduit. It appears to be in good condition.
- ④ Lines were replaced 20-25 years ago; trench is filled with Gilsolate.
- ⑤ Manhole R5-7 was not found, nor was there any evidence of a paved-over manhole cover.
- ⑥ The condensate line through MH R13 actually runs across the street next to the steam line trench.
- ⑦ Steam plume was observed coming out of concrete-covered trench.
- ⑧ Building 38 is abandoned and will not be reused due to asbestos contamination.
- ⑨ MH A2 has a significant steam leak at steam flange recently installed. Service to building 4 from this location has been disconnected. Water standing in manhole.
- ⑩ Condensate piping for the housing area has been replaced with direct buried Fiber Reinforced Plastic (FRP) pipe. No thermal protective devices were used in the construction, thus, large portions of the system are reported to be damaged from steam blowing by stuck-open traps. The line(s) were laid parallel to previous red brass lines (the red brass lines and structures were abandoned in place.
- ⑪ Condensate line rerouted from Building 292-2 to newer FRP pipe, connection is non-standard "T" installed, no leaks as yet.
- ⑫ Condensate: 2-inch Schedule 40 black steel line has been replaced between buildings 286 & 287. Condensate line from building 287 to 288 has been patched at both ends. Joints for the condensate line between buildings 288 & 289 have also been replaced.
- ⑬ A steam meter has been installed to measure steam to the National Guard building 292-2.



Table 3-1
Notes for Industrial Area Steam Distribution System Inspections

- ⑮ Building 14: Some of the condensate drains are reportedly not connected to the collection system and drain into rock-filled pits.
- ⑮ Building 174: One condensate drain still flows to the sewer.
- ⑮ Buildings 290 & 291: Reported that condensate flows directly to the sewer from these homes.
- ⑮ U Street branch connections to steam lines have deteriorated and are leaking chronically.
- ⑮ Flange connections in MH A11 have pulled apart creating leaks.
- ⑮ The two sides of U Street steam supplies are not looped together. Maintenance personnel report a "hammer" problem when the system is starting up or when loads are shut down. Looping the piping together could help to solve this problem.
- ⑮ Area showed evidence of recent patching, indicating that a repair was required to piping.
- ⑮ Manhole A6 was not found.
- ⑮ Steam line was replaced; old line was abandoned in place (typical for many sections).
- ⑮ Steam and condensate to building 155 appear to both originate in the manhole to the South-East of building 38. The connection to building 155 previously shown to building 396 steam supply has been erased (assumed incorrectly shown).
- ⑮ Red Brass Condensate Collection Piping: Piping was installed beginning in 1935; many sections are still in excellent condition. Some sections have had to be repaired principally due to clogged pipes. The system is gravity flow through "Sand Traps". Sand traps are approximately 1-cubic foot chambers at the bottom of a manhole with condensate inlet pipes flowing into the chamber and a pipe at a slightly lower invert elevation flowing away from the chamber. In this fashion, the sand traps act as grit collection devices. An open condensate collection system such as this results in thermal losses as the condensate is exposed to the atmosphere. Several of these sand traps were opened. As originally designed, the sand trap chambers had heavy, sealed covers, reducing the amount of heat lost (many are still installed). Through the years covers have been lost from a number of these chambers. The need for grit collection in the condensate system is questioned. It is recommended that all such sand traps be opened up and the piping connections made "hard". If desired, a

Table 3-1
Notes for Industrial Area Steam Distribution System Inspections

"Y" type strainer could be installed in each of the chamber outlets to provide for grit separation.

- ② Condensate return pumps are installed in buildings 288, 287 & 285. Gravity flow to these pumps from buildings 284, 286 & 289.

Table 3-2
Notes for Ordnance Area Steam Distribution System Inspections

- ① Number refers to notes on Table 3-2
- ② Excavation in this area has exposed damaged piping. The conduit casing has been crushed and ripped open. A steam plume emanates from the opening.
- ③ Steam pipe appears to be leaking.
- ④ PRV is leaking in manhole A5-1.
- ⑤ The union fitting to the steam trap is leaking severely.
- ⑥ Underground structures are no longer in use.
- ⑦ Serious and chronic leakage is reported in these stretches of underground piping.
- ⑧ Condensate has filled the underground structure in this area; water is bubbling out of the ground continuously.
- ⑨ Manholes in this area are misnumbered compared to the plans.
- ⑩ Building 103-20 heating system is in poor condition; a warm air furnace fitted with a steam coil is reportedly used for space heating.
- ⑪ Valves are very difficult to operate. (Valves shown on plans near manhole A-11 are actually inside the manhole.
- ⑫ Piping between manholes A13 and A17 has been repaired frequently. Repaired areas may not be conduit encased piping; steam pipe has been routed separately.

4.0 Energy Conservation Evaluations

4.1 Life Cycle Cost Analysis Assumptions

4.1.1 Economic Assumptions

Economic analyses based on present value techniques were performed for all potential steam and condensate system repairs using energy conservation opportunities using the economic analysis form and procedures outlined in "Energy Conservation Investment Program (ECIP) Guidance" dated January 1994. The following assumptions and methods were used to develop standard input for economic analysis of all projects:

- a. Investment costs include the following: Construction costs; contingency estimated at 10% of construction costs; supervision, inspection and overhead (SIOH) at 5.6% of construction costs; and design at 6% of construction costs.
- b. The economic analysis was performed based on current (first quarter FY95) costs.
- c. Discount factors and uniform present value factors used in computing present values are obtained from the supplement to NIST Handbook 135, "Energy Prices and Discount Factors for Life-Cycle Cost Analysis 1995." The discount rate set for 1995 by the Dept. of Energy is equivalent to a market rate of 6.6%. Allowing for an assumed rate of general price inflation yields a "real" discount rate lower than the 3.0 percent floor prescribed in 10 CFR 436. Thus, the 3.0 percent floor is used as the real discount rate for FY 1995 analyses. Uniform present value factors (designated UPV*) using the 3.0% discount rate and adjusted for average fuel price escalation in the industrial sector for Census Region 4 are used in the analyses below.
- d. The present value of recurring non-energy benefits and costs was obtained using a 0% differential rate and a 3.0% discount rate.

4.1.2 Energy Cost Assumptions

4.1.2.1 Electricity

Electric power is provided to the HWAAP by Sierra Pacific Power Company under "Schedule E93 Resale Service," which includes a demand charge with ratcheting provision, an energy charge and an adjustment for power factor. Current rates—including the effect of the projected fuel adjustment and power factor discount used in the analyses—are as follows:

Demand Charge = \$8.51713 per kW per month (\$102.21 per kW per year)

Where billing demand kW is the highest measured demand occurring during the month, with a minimum of 50 percent of the highest billing demand in the previous eleven months.

Energy Charge = \$0.04375 per kWh (\$12.82 per million BTUs)

Power Factor Discount (or Surcharge) =
(Average Power Factor in Percent - 80) x 0.15% x (Demand Charge + Energy Charge)

4.1.2.2 No. 2 Fuel Oil

The current cost of No. 2 fuel oil delivered to the site is \$0.85 per gallon (\$6.13 per million BTUs). Boilers at both Building 103-6 (Ordnance Area) and Building 13 (Industrial Area) use No. 2 fuel oil.

4.2 Construction Cost Estimate Methodology

Construction costs are estimated for each type of piping replacement. Cost estimates are prepared to the level of accuracy required to assess project economic viability and may be considered budget-level cost estimates. Labor and material costs are based predominantly on the 1995 Means Cost Estimating Guides with adjustments for geographic location and difficulty of retrofit work, as appropriate. Whenever feasible, budget quotes from equipment manufacturers have been used to improve accuracy. Refer to Appendix E for manufacturers' budget quotes.

Factors added to the subtotal of labor and materials costs include:

- Nevada State Sales Tax at 3.75% (added to materials cost only)
- Contractor Overhead, Profit and Bond at 25%
- Estimating Contingency at 10%

The resulting total probable construction costs are subsequently used in life cycle cost analyses.

4.3 Selection of Replacement Piping Systems

Alternative replacement piping system types are evaluated separately for the Industrial and Ordnance Areas. The alternatives evaluated include only those considered appropriate for the area. For example, it is not proposed to replace existing underground piping in the Industrial Area with above ground piping. Once identified, the selected construction types are used in developing costs for each area.

Typical pipe runs are evaluated for each area. In the Ordnance Area, a typical run of 250 feet is used, representing the distance between existing underground structures. In the Industrial Area, the typical run is only 100 feet as the area is much more congested; underground structures are more concentrated.



Tabular summaries of evaluations for each area are provided below. The first columns for each alternative show unit construction costs for each piping alternative and placement. The second column indicates maintenance cost differences between alternatives. The sum of these two costs, installation and maintenance costs, for each alternative are compared to determine the recommended piping system type. Refer to Appendix E for detailed calculations.

4.3.1 Ordnance Area Piping System Alternative Evaluations

The Ordnance Area is an explosives processing area of widely-separated buildings with all existing steam and condensate return piping installed underground in conduit systems. A typical run of 250 feet between existing underground structures is used for the evaluation. Costs estimated for the typical run include allowances for expansion loops, supports and underground structures, as appropriate.

Both above and underground alternatives are evaluated. Above ground piping alternatives employ underground piping at street and rail crossings. The predominant pipe run in the Ordnance Area consists of 8-inch diameter steam pipe and 4-inch diameter condensate return piping. These pipe sizes are used for comparing alternatives. Results for alternatives evaluated are summarized as follows:

Ordnance Area Above Ground Alternatives	First Cost \$/LF	Maintenance \$/LF	Total Cost \$/LF
Alternative A1: Conduit containing both Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 361.58	\$361.58	\$ 723.16
Alternative A2: Separate Conduits with Schedule 40 Steel Steam Pipe & FRP Condensate Pipes	\$ 343.84	\$ 285.98	\$ 629.82
Alternative A3: Separate Conduits with Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 373.59	\$ 186.79	\$ 560.38
Alternative A4: Separate Built-Up Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 170.57	\$ 42.65	\$ 213.22

Ordnance Area	First Cost	Maintenance	Total Cost
<u>Underground Alternatives</u>	<u>\$/LF</u>	<u>\$/LF</u>	<u>\$/LF</u>
Alternative U1:			
Conduit containing both Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 343.15	\$ 343.15	\$ 686.30
Alternative U2:			
Separate Conduits with Schedule 40 Steel Steam Pipe & FRP Condensate Pipes	\$ 350.47	\$ 290.96	\$ 641.43
Alternative U3:			
Separate Conduits with Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 380.22	\$ 190.12	\$ 570.34

The aboveground and underground alternatives with the least total costs are A4 and U3. The above ground alternative A4 total cost is considerably below that of the underground selection, thus, above ground replacements should be maximized. Underground replacement piping is, therefore, to be used only where necessary, for street and railroad crossings.

4.3.2 Industrial Area Piping System Alternative Evaluations

The Industrial Area is nowadays, more of an administrative and maintenance yard area. All but a few sections of pipe are underground. Existing installations include direct buried pipe, pipe in concrete trenches and some conduit encased direct buried piping. Only underground replacement piping is considered.

A typical pipe run in the Industrial Area, and that used for evaluation between alternatives, consists of 100 feet of 4-inch diameter steam piping and 3-inch diameter condensate return piping. Direct burial of both single and double pipe conduit encased piping is considered. Replacement of piping in concrete trenches with conduit systems and built-up piping systems are considered.

Unlike alternatives evaluated for the Ordnance Area, piping alternatives in the Industrial Area do not include allowances for expansion because expansion loops are not used. Expansion fittings required for each alternative evaluated are the same, thus, comparison costs estimates do not include them. Results for alternatives evaluated are summarized below:

Industrial Area	First Cost	Maintenance	Total Cost
<u>Direct Bury Alternatives</u>	<u>\$/LF</u>	<u>\$/LF</u>	<u>\$/LF</u>
Alternative DB1:			
Conduit containing both Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 104.95	\$104.95	\$ 209.90
Alternative DB2:			
Separate Conduits with Schedule 40 Steel Steam Pipe & FRP Condensate Pipes	\$ 135.29	\$ 171.73	\$ 307.20

Industrial Area	First Cost	Maintenance	Total Cost
<u>Direct Bury Alternatives (continued)</u>	<u>\$/LF</u>	<u>\$/LF</u>	<u>\$/LF</u>
Alternative DB3:			
Separate Conduits with Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 125.87	\$ 59.93	\$ 188.80
Industrial Area	First Cost	Maintenance	Total Cost
<u>Concrete Trench Placement Alternatives</u>	<u>\$/LF</u>	<u>\$/LF</u>	<u>\$/LF</u>
Alternative CT1:			
Conduit containing both Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 102.10	\$ 102.10	\$ 204.20
Alternative CT2:			
Separate Conduits with Schedule 40 Steel Steam Pipe & FRP Condensate Pipes	\$ 130.90	\$ 168.43	\$ 299.33
Alternative CT3:			
Separate Conduits with Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 123.02	\$ 61.51	\$ 184.53
Alternative CT4:			
Separate Built-Up Schedule 40 Steam & Schedule 80 Condensate Steel Pipes	\$ 70.57	\$ 17.65	\$ 88.22

Selecting the alternatives with the lowest total cost yields Alternative DB3 for direct burial pipe sections and Alternative CT4 for sections of piping replacements within existing concrete trenches.

4.4 Economic Evaluations of Alternatives

Steam and condensate system piping replacements are evaluated for both the Industrial and Ordnance Areas. Each distribution system is broken down into several segments. Costs are estimated for replacing piping using the recommended replacement methodologies selected above for each area. Each of the distribution system segments are labeled and evaluated as replacement alternatives. Figures 4-1 through 4-4 display alternative distribution system segments considered and those recommended for replacement. Table 4-1 and Table 4-2 list the alternatives and construction costs of piping replacements evaluated for each area and segment.

Available funds are not sufficient to replace all of the distribution piping in either area. Funding limits for the proposed projects are based on previous DD Form 1391 submittals. Only minor differences in the amount of funds requested may be tolerated. Funds originally requested for each area are as follows:

- Industrial Area, Project 40667 (from previous DD Form 1391):

\$ 703,000	Estimated Contract Cost
<u>\$ 35,000</u>	5.0% Contingency
\$ 738,000	Subtotal
<u>\$ 44,000</u>	5.6% SIOH
\$ 782,000	Total Request (\$780,000 rounded)

- Ordnance Area, Project 42166 (from previous DD Form 1391):

\$ 977,000	Estimated Contract Cost
<u>\$ 49,000</u>	5.0% Contingency
\$1,026,000	Subtotal
<u>\$ 57,000</u>	5.6% SIOH
\$1,083,000	Total Request (\$1,100,000 rounded)

The original DD Forms 1391 did not include design cost of 6%; funding requests developed for this effort include this expense.

Tables 4-1 and 4-2 show both the costs of all alternatives considered and those alternatives recommended for implementation within the funding limits shown here. The replacement alternatives recommended attempt to reflect priorities for replacement identified during discussions with maintenance personnel and their management.

The investments required to replace the recommended steam and condensate piping in each area are justified by costs saved from reduced repair and maintenance requirements and from energy savings achieved from reduced thermal and steam and condensate leakage losses.

Boiler fuel savings from piping replacements are calculated in Appendix C. Savings from repair of leaking steam and condensate lines are calculated based on a conservative assumption that 90% of the make-up water requirements are due to losses of condensate and only 10% from steam leaks. (This assumption is needed as the contribution of each to total energy loss cannot be determined using available information.)

Thermal losses from ineffectively and non-insulated piping are estimated assuming existing piping has the equivalent of 1/2-inch of insulation compared to replacement piping. This is a fairly conservative assumption because large parts of the distribution systems in both areas have had repairs made with uninsulated piping and remaining areas have had their insulation flooded due to leaking pipes. Energy savings calculated for recommended retrofits in each area are calculated in Appendix C; results are summarized as follows:

- **Industrial Area:**

Savings from leaks	15,077 Million BTU per year
Savings from thermal (insulation) losses	<u>8,646 Million BTU per year</u>
Total annual No. 2 fuel oil savings	23,723 Million BTU per year

- **Ordnance Area:**

Savings from leaks	6,675 Million BTU per year
Savings from thermal (insulation) losses	<u>9,875 Million BTU per year</u>
Total annual No. 2 fuel oil savings	16,549 Million BTU per year

Additional cost savings will be achieved due to reduced operations and maintenance (O&M) requirements to repair leaks and other malfunctions. Operations and maintenance cost savings are determined in Appendix C.

Tables 4-3 and 4-4 are summaries of life-cycle cost analyses considering the required investments, fuel and O&M cost savings, overall results are:

- **Industrial Area Summary of Recommended Piping Replacements:**

Investment, including SIOH and Design		\$851,618
- Annual Fuel Cost Savings	\$145,423	
- Annual O&M Cost Savings	<u>\$102,620</u>	
- Total Annual Cost Savings	\$248,042	
- Life-Cycle Cost Savings (15 Year Life)		\$3,294,643
- Savings-to-Investment Ratio (SIR)	3.87	
- Simple Payback Period	3.43 years	

- **Ordnance Area Summary of Recommended Piping Replacements:**

- Investment, including SIOH and Design		\$1,198,535
- Annual Fuel Cost Savings	\$101,447	
- Annual O&M Cost Savings	<u>\$119,261</u>	
- Total Annual Cost Savings	\$220,708	
- Life-Cycle Cost Savings (15 Year Life)		\$2,867,562
- Savings-to-Investment Ratio (SIR)	2.39	
- Simple Payback Period	5.43 years	

4.5 Recommended Modernization Alternatives

Piping replacement alternatives are shown on Figures 4-1 through 4-4. Recommended replacements for the Industrial and Ordnance Areas as shown, respectively, on Figures 4-2 and 4-4. Each alternative stretch of piping considered for replacement is described as follows:

4.5.1 Industrial Area

Recommended piping repairs for the Industrial Area consist of a total of 8,690 feet of steam and condensate piping. The estimated construction cost, energy and cost savings are summarized above.

Pipe Replacement Bldg 13 to Manhole B4 (Alternative 1): **Not Recommended for Implementation Due to Budget Constraints.** Replace 2,410 feet of steam and condensate piping. Steam piping is located predominantly in concrete trenches. Condensate piping is mostly direct buried parallel to the steam pipe trench. Piping replacement strategy evaluated consists of installing new steam and condensate pipe in the concrete trench. Existing steam lines and an abandoned condensate line are removed to make room for the new piping.

Pipe Replacement Manhole A7 to Manhole A9 (Alternative 2): **Recommended for Implementation.** Replace steam and condensate piping from the manhole (A7) north of building 5 along North Main Street, around the corner to the west past building 2 on Dewey Street, across South Main Street to manhole A9, including piping serving buildings 2 and 42. A similar approach is taken to that described above. New steam and condensate piping are to be placed into the same concrete trench system.

Pipe Rerouting for Buildings 3, 35 & 36 (Alternative 3): **Recommended for Implementation.** Rerouting of steam and condensate piping is recommended for services to buildings 3, 35 and 36. Connections to the old red brass condensate line passing to the west and north of building 3 and the connection to the steam line to the south of building 3 are to be severed. Condensate from buildings 3, 35 and 36 will be collected in new underground piping extending east to manhole R2 along the road between buildings 3 and 35. New steam piping will be extended along this same route. Steam piping extending to building 3 (and then northward to buildings 35 and 36) from the south will be disconnected.

Steam Pipe Replacements for U Street - East (Alternative 4): **Recommended for Implementation.** Steam and condensate piping appeared to be significantly deteriorated along the eastern section of U Street and along the concrete trench system extending west from manhole A9 next to building 1. Measures include new steam piping, replacement of manhole A11, the pressure reducing station for the family housing service area and interception of and rerouting of condensate piping from U Street family housing buildings. New condensate collection piping is to be routed in the concrete trench from near existing manhole A11 back to the steam plant along with the steam line. The very old, and much-in-need-of-repair, red brass condensate pipe extending northwards towards building 3 is to be abandoned in place.

Family Housing Condensate Piping Replacement (Alternative 5): **Recommended for Implementation.** The condensate piping serving officer family housing along Main and Farragut Avenues connecting to the red brass condensate pipe was replaced several years ago with fiber reinforced plastic (FRP) pipe. This piping has melted in many locations and is to be replaced with schedule 80 steel piping. The routing is revised to no longer connect to the red brass main, but, rather, is recommended for connection in the concrete trench system to condensate piping at

manhole A7. Existing FRP and red brass piping are recommended for abandonment in place. Along with piping replacements, condensate flows not previously collected will be picked up.

Shop Area Condensate Piping Replacements (Alternative 6): **Not Recommended for Implementation Due to Budget Constraints.** Shop areas, building 6, 7 and 8, plus building 11 are connected to the original condensate collection system consisting of red brass piping and "sand traps". (Refer to Section 3 for an explanation of sand traps). This alternative consists of extending new piping to existing condensate manholes and hard-piping connections.

4.5.2 Ordnance Area

Recommended piping repairs for the Ordnance Area consist of a total of 7,620 feet of steam and condensate piping. The estimated construction cost, energy and cost savings are summarized above.

Manhole A1 to Manhole A11 (Alternative 1): **Only a Portion Recommended for Implementation Due to Budget Constraints.** The underground steam and condensate conduit extending from the steam plant in building 103-6 to manhole A11, next to the main access road has seen numerous and chronic repairs. Available funding cannot support complete replacement of this section of the distribution system, thus, based on maintenance personnel interviews, the worst section of pipe (from manhole A5 to manhole A11) is recommended for replacement. Replacement piping in the Ordnance Area is to be predominantly above ground. Rail and road crossings will continue to be underground. Only one underground structure (manhole) is provided per crossing to allow for condensate drip legs to be installed at the lowest points of the steam piping.

Manhole A11 to Manhole A18 (Alternative 2): **Not recommended for implementation due to budget constraints.** Selected portions of the piping extending toward building 108-20 from manhole A11 has been repaired. Replacement piping is reported to consist of separate steam and condensate piping connected to the existing conduit system. This section of pipe was removed from those recommended for replacement because no existing leaks could be detected and sections have recently been replaced.

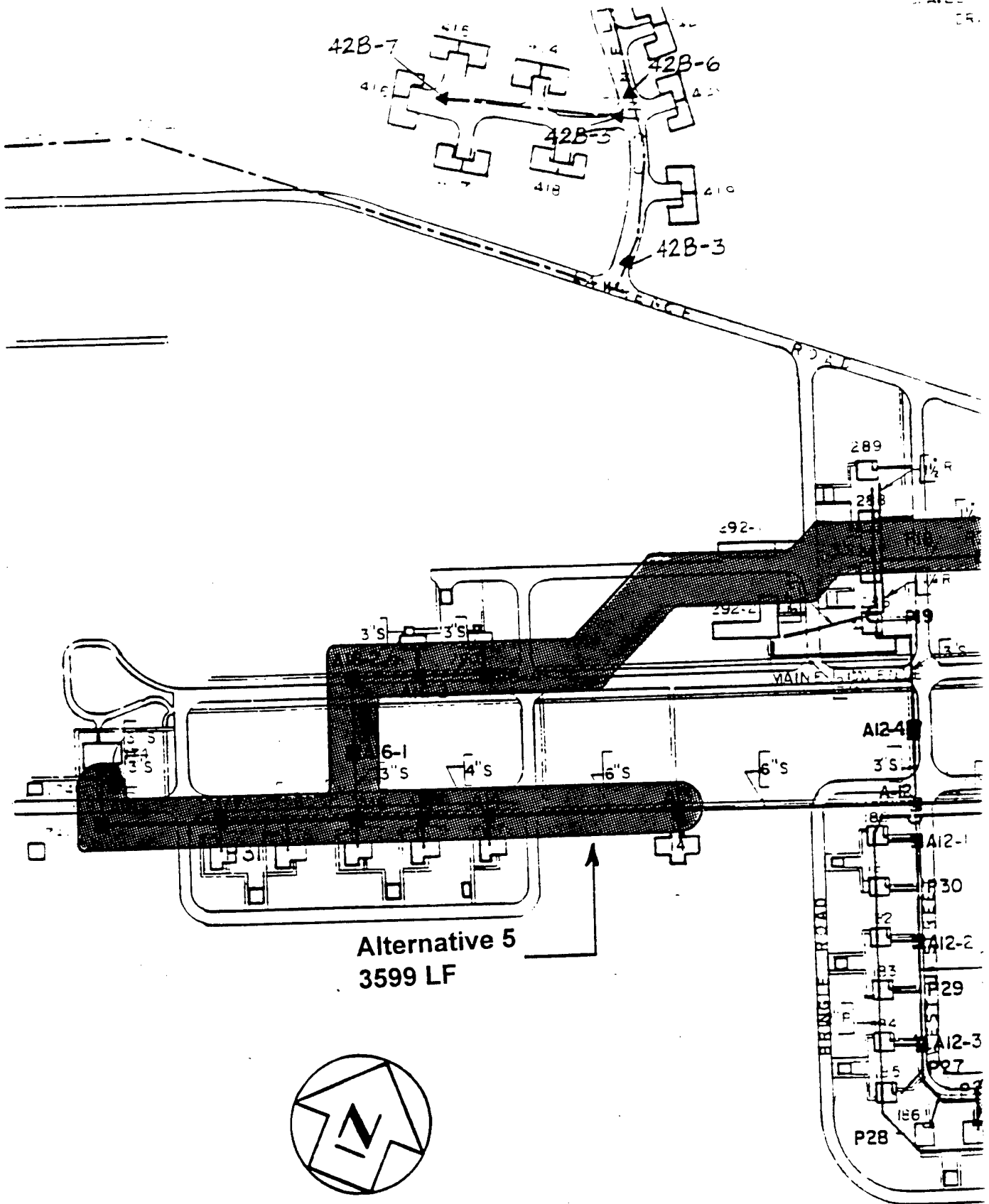
Manhole A11 to Manhole D4 (Alternative 3): **Only a Portion Recommended Implementation Due to Budget Constraints.** Maintenance personnel have identified this stretch of piping extending to the west towards building 108-13 as a chronic problem. Project funding constraints prohibit replacing the entire line, thus, the portion that appears to be in the worst condition is identified for replacement, including underground structures and the building connection at building 108-13.

Manhole A18 to Building 108-20 (Alternative 4): **Recommended for Implementation.** Steam and condensate piping extending underground from manhole A18 are recommended for replacement. The replacement includes repairs to steam and condensate pipe fittings in manhole A18 which are presently leaking.

Manhole A5 to Building 103-40 (Alternative 5): **Recommended for Implementation.** Replacement piping is to be extended above ground from the existing manhole A5 to building 103-40. No rail or road crossings are encountered, thus, the entire route may be above ground.

Building 103-6 to Manhole C6-1 (Alternative 6): **Only a Portion Recommended for Implementation Due to Budget Constraints** Building 103-16 is served by this steam and condensate circuit. A portion of the piping is exposed due to a recent excavation west of the boiler plant (building 103-6); severe conduit system damage is noted. Budget constraints limit the extent to which this piping circuit can be replaced. The most severely damaged piping, between the boiler plant and manhole C3, is recommended for replacement.

Building 103-6 to Manhole B2, Manhole B8 to Manhole B9-1 and Manhole B2 to Manhole B8 (Alternatives 7, 8 and 9, respectively): **Not Recommended for Implementation Due to Budget Constraints.** This series of alternatives comprise piping extending to the south from building 103-6 (boiler plant) to building 103-20. This piping has seen some repairs in the recent past and is presently leaking at manhole B9. Above ground piping replacements are evaluated, however they are too costly (and assumed less important than the other alternatives) to fit within the budget constraints.



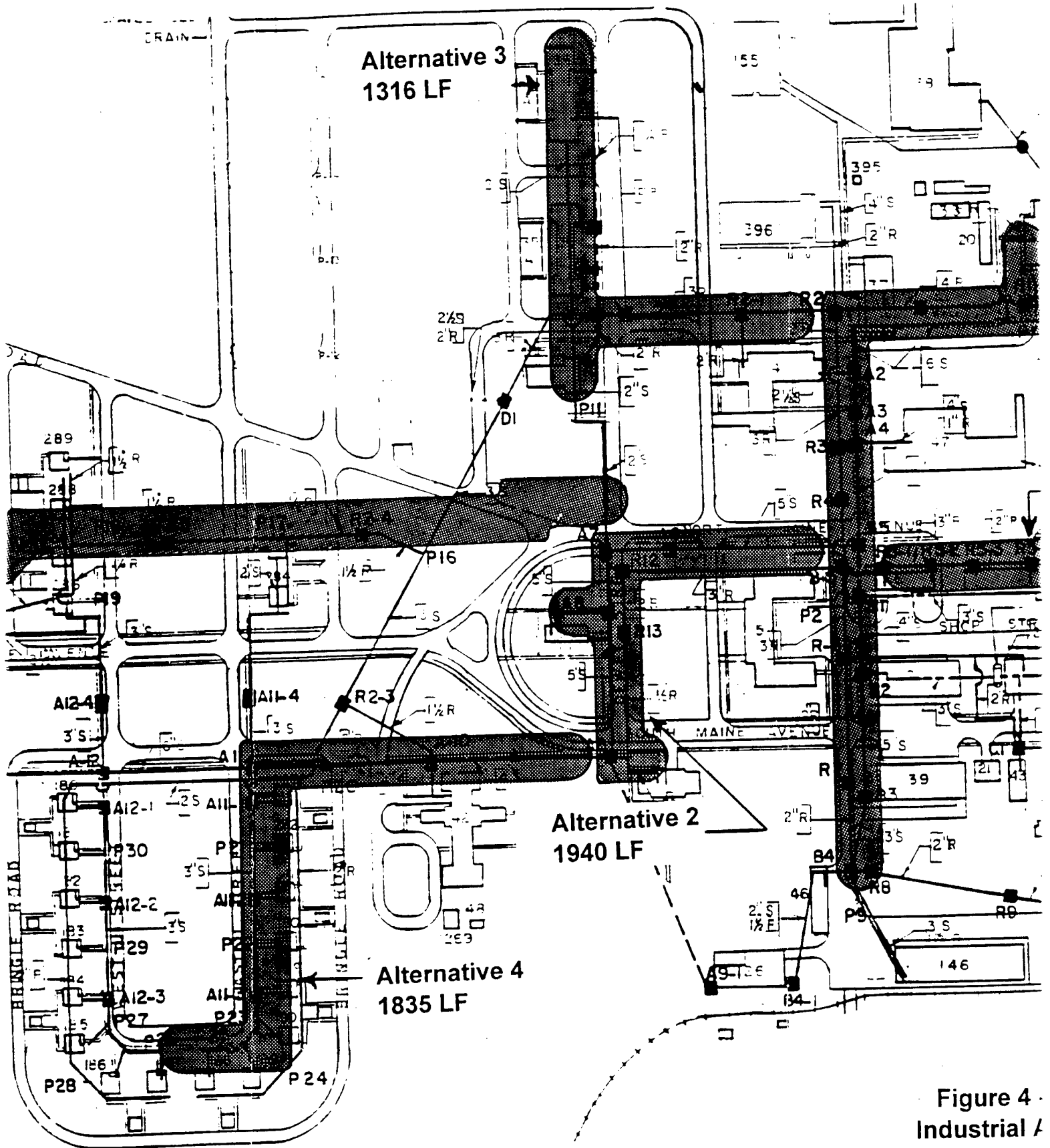


Figure 4
Industrial /
Steam Distribut
Pipe Replacement

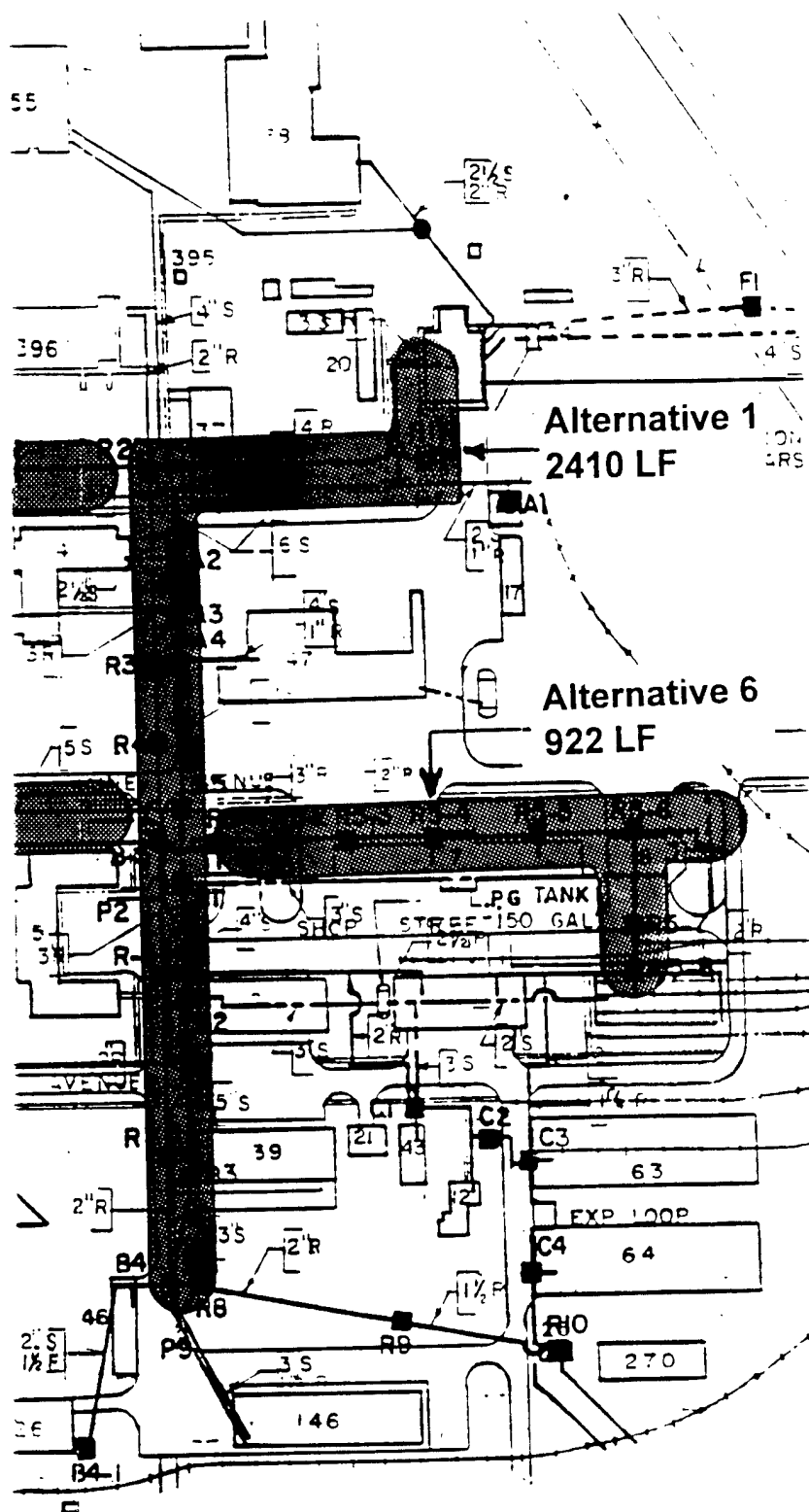
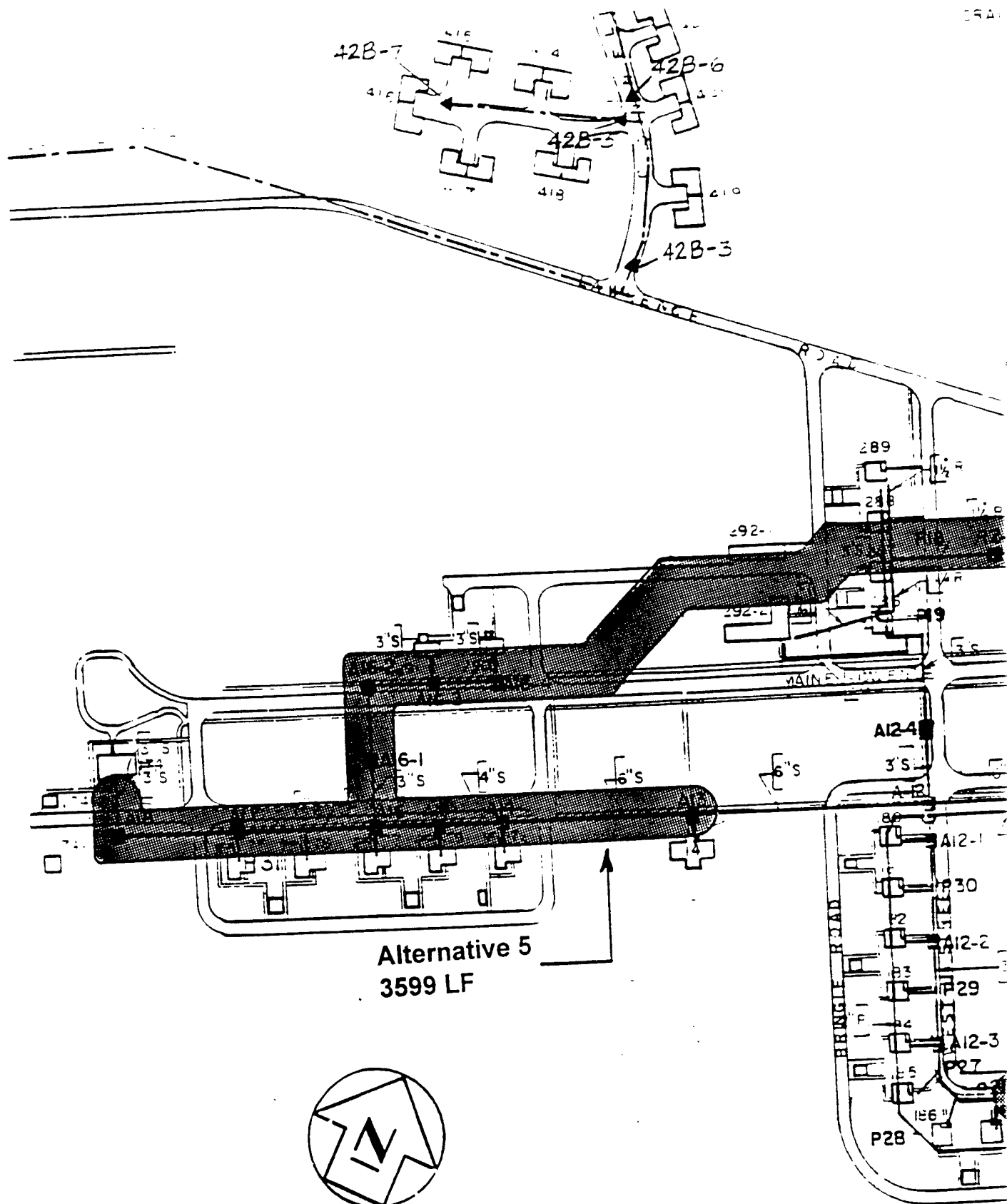
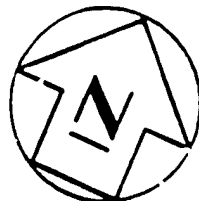


Figure 4 - 1
Industrial Area
Steam Distribution System
Pipe Replacement Alternatives

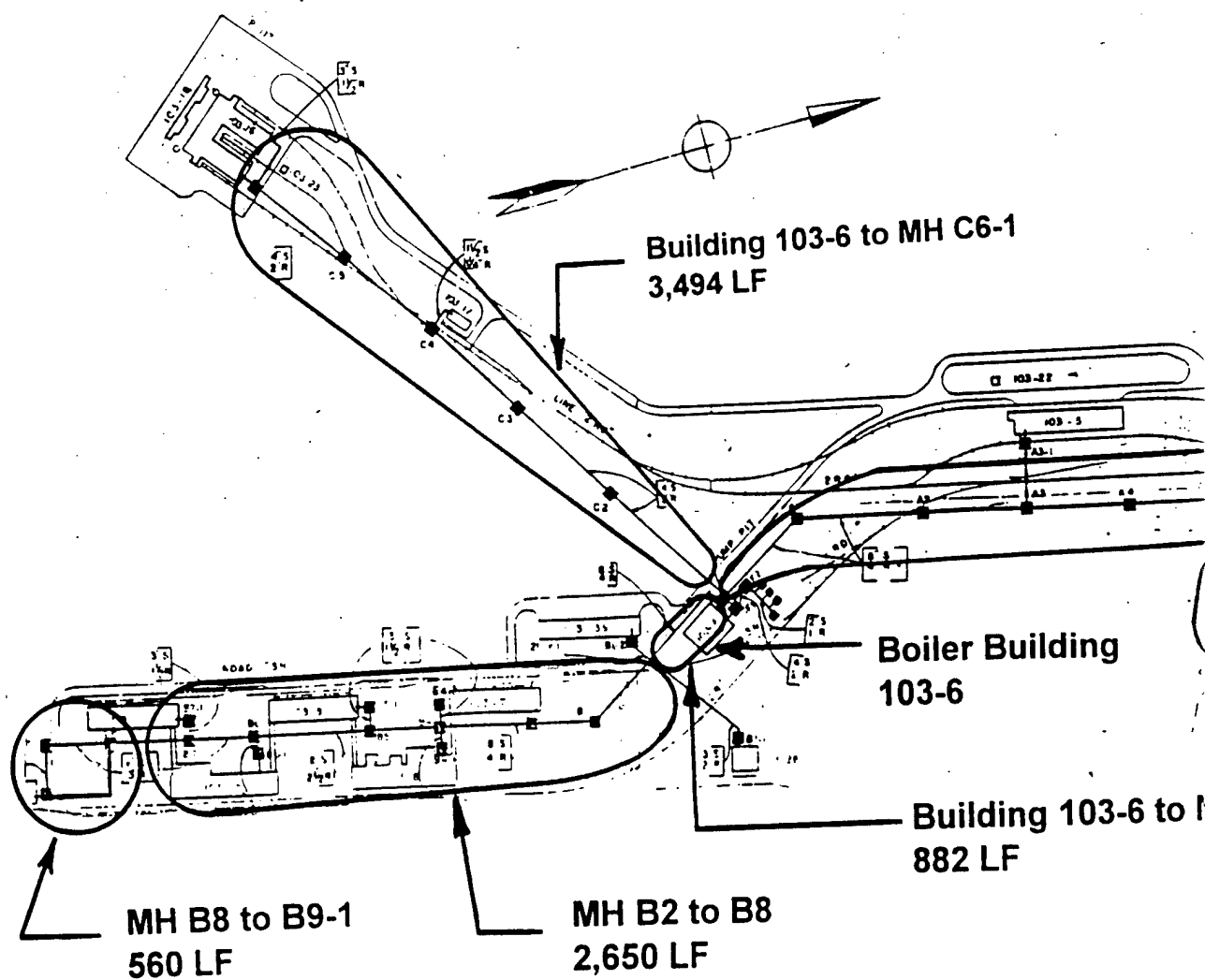
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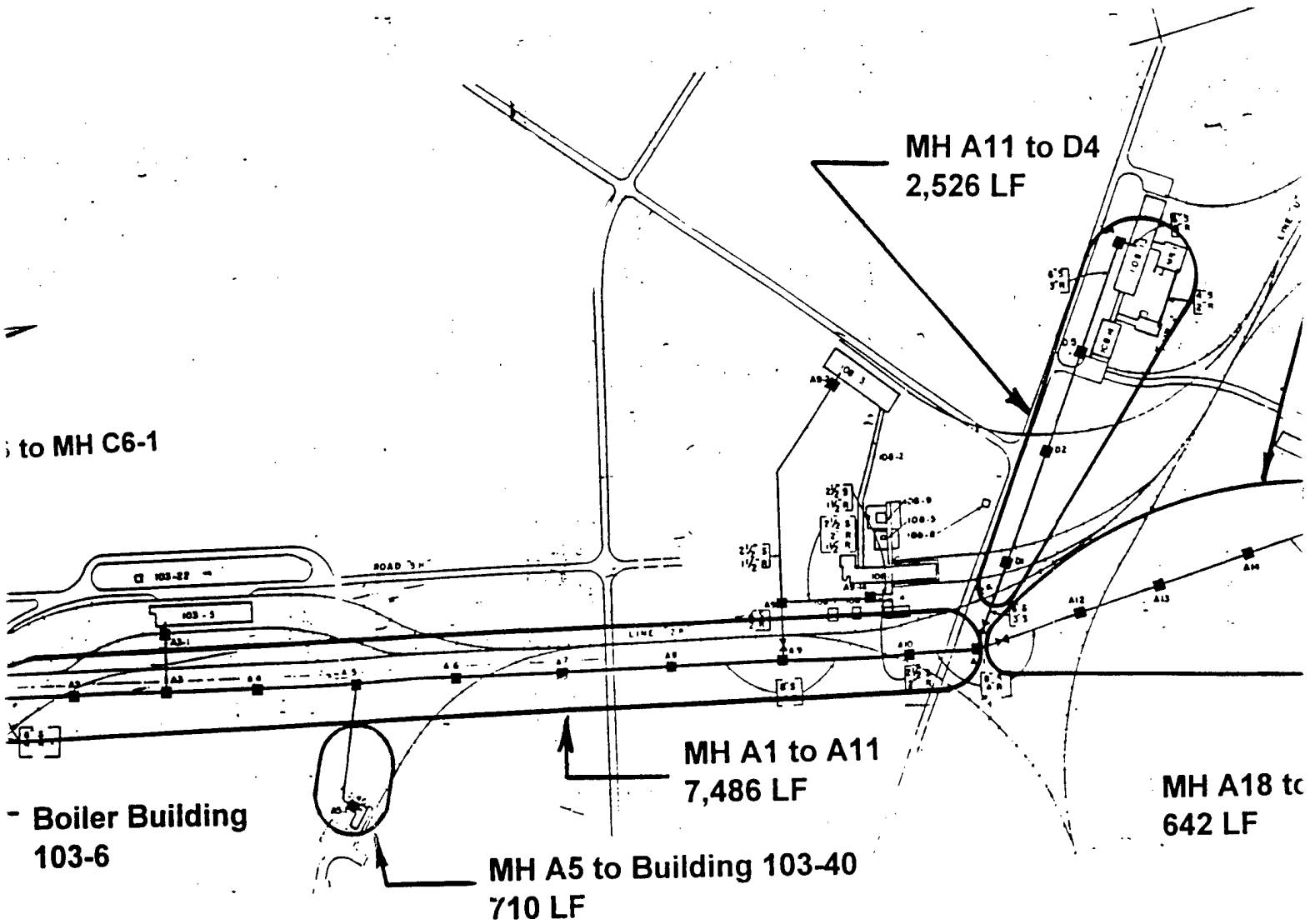
Alternative 5
3599 LF



①



①



— Building 103-6 to MH B2
882 LF

Fi
Ord
Steam Dis
Pipe Replac

2

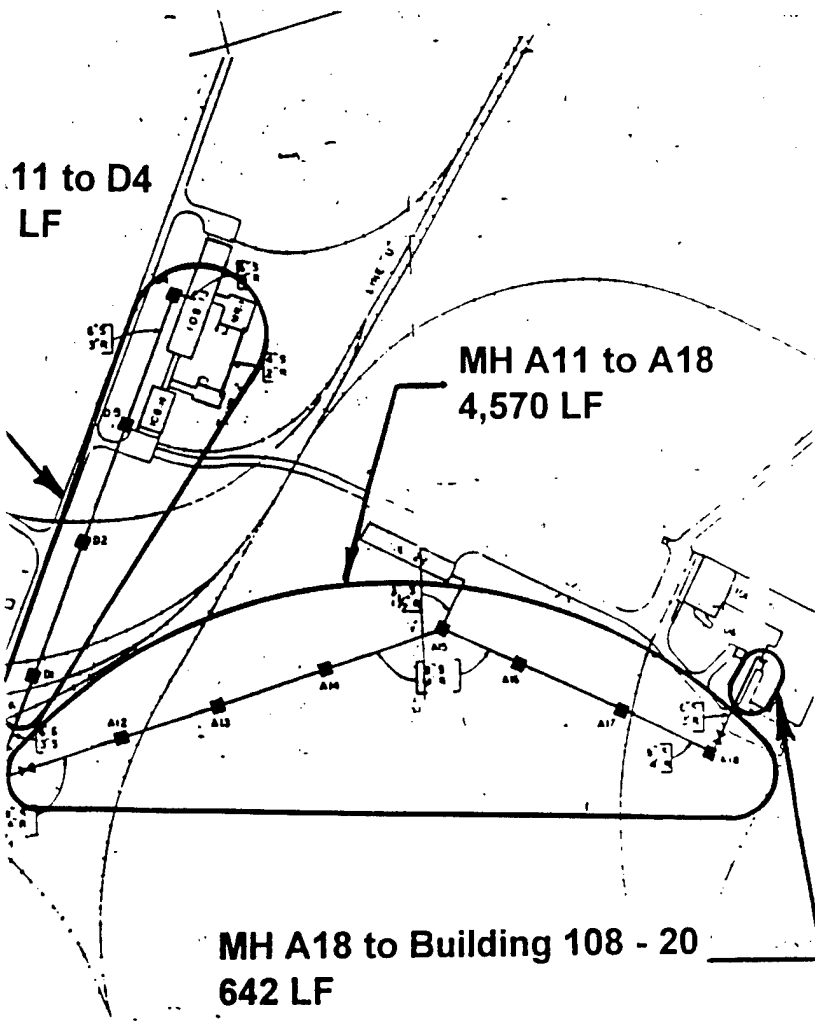
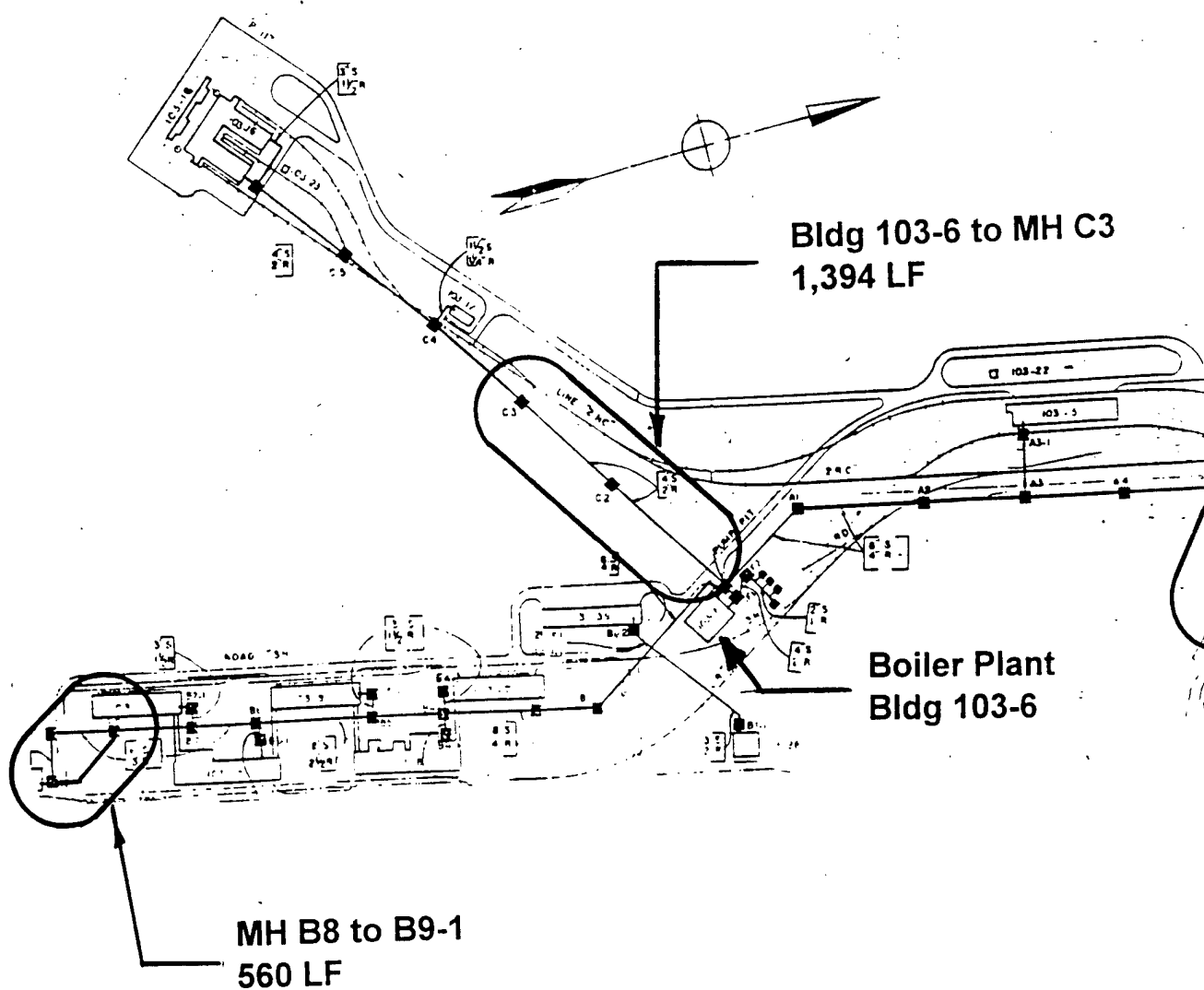


Figure 4 - 3
Ordnance Area
Steam Distribution System
Pipe Replacement Alternatives



①

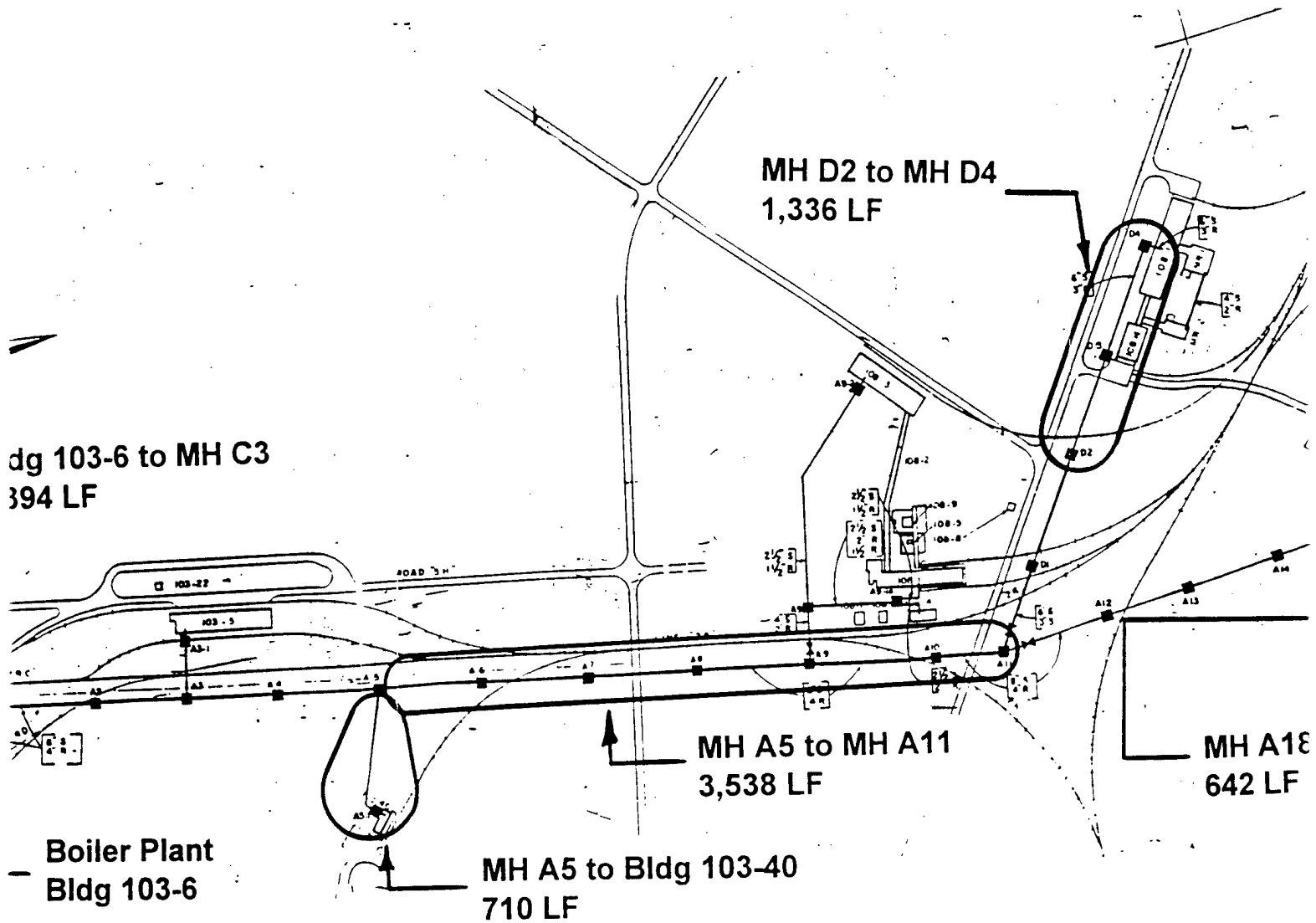


Fig
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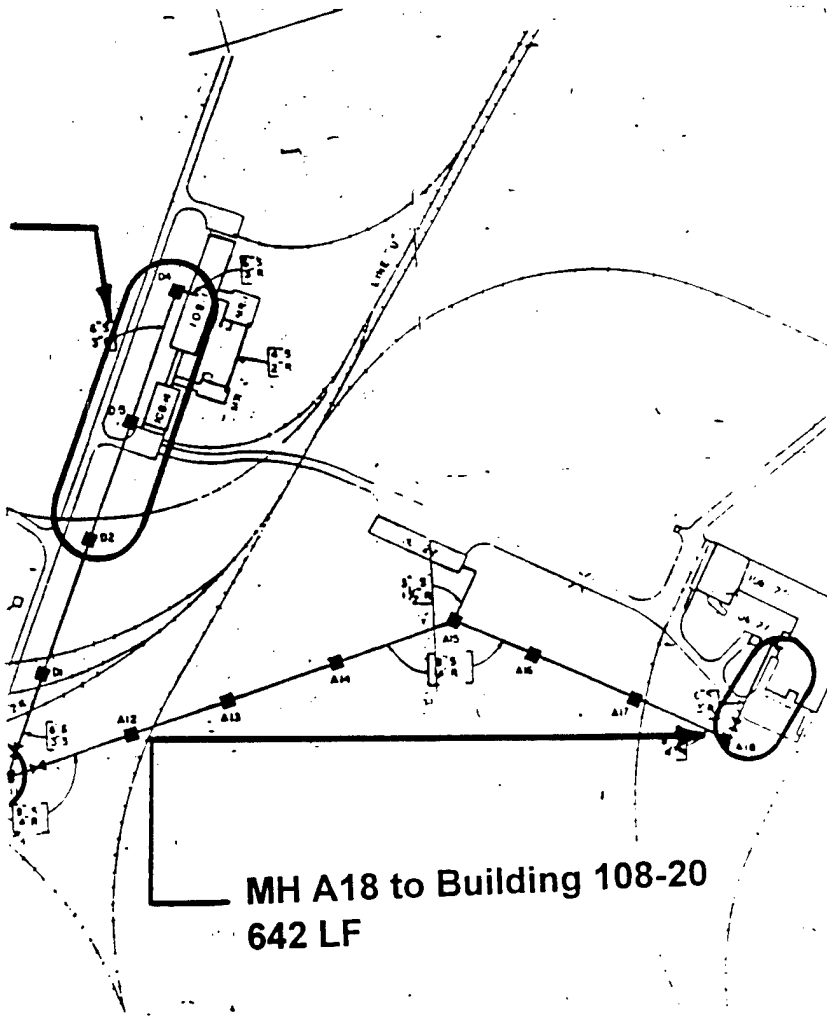


Figure 4 - 4
Ordnance Area
Steam Distribution System
Recommended Pipe Replacements

Table 4-1
Summary of Piping Replacement Costs
Industrial Area Steam and Condensate System

<u>Alt.</u>	<u>Alternative Description</u>	<u>Base Case, Total Lengths</u>			<u>Recommended</u>	
		<u>Total LF</u>	<u>Cost \$</u>	<u>\$/LF</u>	<u>Total LF</u>	<u>Cost \$</u>
1	Replace Pipes Bldg 13 to MH B4	2,410	\$266,492	\$110.58	-	-
2	Replace Pipes MH A5 to MH A9	1,940	\$165,343	\$85.23	1,940	\$165,343
3	Rerouting for Buildings 3, 35 & 36	1,316	\$157,696	\$119.83	1,316	\$157,696
4	Steam Piping - U Street East	1,835	\$158,033	\$86.12	1,835	\$158,033
5	Family Housing Condensate Pipes	3,599	\$282,027	\$78.36	3,599	\$282,027
6	Shop Area Condensate Piping	922	\$106,940	\$115.99	-	-
Total of Industrial Area Alternatives		12,022	\$1,136,531	\$94.54	8,690	\$763,099
SIOH 5.6%			\$63,646			\$42,734
Design 6.0%			\$68,192			\$45,786
Total Request		12,022	\$1,268,368	\$105.50	8,690	\$851,618

Table 4-2
Summary of Above Ground Piping Replacement Costs
Ordnance Area Steam and Condensate System
(Road and Rail Crossings Underground)

<u>Alt. Pipe Run Description</u>	<u>Base Case, Total Lengths</u>			<u>Recommended</u>	
	<u>Total LF</u>	<u>Cost \$</u>	<u>\$/LF</u>	<u>Total LF</u>	<u>Cost \$</u>
1 MH A1 to MH A11	7,486	\$1,020,250	\$136.29	-	-
MH A5 to MH A11	-	-	-	3,538	\$531,951
2 MH A11 to MH A18	4,570	\$603,930	\$132.15	-	-
3 MH A11 to MH D4	2,526	\$360,732	\$142.81	-	-
MH D2 to MH D4	-	-	-	1,336	\$191,263
4 MH A18 to Bldg 108-20	642	\$90,837	\$141.49	642	\$90,837
5 MH A5 - Bldg 103-40	710	\$42,631	\$60.04	710	\$42,631
6 Bldg 103-6 to MH C6-1	3,494	\$328,594	\$94.05	-	-
Bldg 103-6 to MH C3	-	-	-	1,394	\$167,348
7 Bldg 103-6 to MH B2	882	\$136,571	\$154.84	-	-
8 MH B8 to MH B9-1	560	\$49,925	\$89.15	560	\$49,925
9 MH B2 to MH B8	2,650	\$411,344	\$155.22	-	-
Total Ordnance Area Piping	23,520	\$3,044,814	\$129.46	8,180	\$1,073,956
SIOH 5.6%		\$170,510			\$60,142
Design 6.0%		\$182,689			\$64,437
Total Request	23,520	\$3,398,013	\$144.47	8,180	\$1,198,535

Table 4-3
Life Cycle Cost Analysis Summary - Industrial Area

Location: Hawthorne Army Ammunition Depot Region No. 4 Project No. 40667
 Project Title: ECIP Modernize Industrial Area Steam Distribution Fiscal Year FY97
 Discrete Portion: Total Project Preparer: KELLER & GANNON
 Analysis Date: July 1995 Economic Life: 15 Years

1. Investment Costs

A. Construction Costs	\$763,099	
B. SIOH 5.6%	\$42,734	
C. Design Cost 6.0%	\$45,786	
D. Total Cost (1A + 1B + 1C)	\$851,618	
E. Salvage Value of Existing Equipment	\$0	
F. Public Utility Company Rebate	\$0	
G. Total Investment (1D-1E-1F)		\$851,618

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost \$/MBTU	Saving MBTU/Yr(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	\$12.82	0	\$0	12.02	\$0
B. Dist	\$6.13	23,723	\$145,423	14.23	\$2,069,366
C. LPG					
D. Other					
E. Demand Savings		0.0 kW	\$0	11.30	\$0
F. Total		23,723	\$145,423		\$2,069,366

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	\$102,620	
(1) Discount Factor (Table A)	11.94	
(2) Discounted Savings/Cost (3A x 3A1)		\$1,225,277

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2 + 3Bd4) \$1,225,277

4. First Year Dollar Savings (2F3 + 3A + (3Bd1/Economic Life)):	\$248,042	
5. Simple Payback (1G/4):	3.43	Years
6. Total Net Discounted Savings (2F5 + 3C):	\$3,294,643	
7. Savings to Investment Ratio (SIR) (6/1G):	3.87	

**EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada**

**Revised
September 1995**

**Table 4-4
Life Cycle Cost Analysis Summary - Ordnance Area**

Location: Hawthorne Army Ammunition Depot Region No. 4 Project No. 42166
Project Title: ECIP Modernize Ordnance Area Steam Distribution Fiscal Year FY97
Discrete Portion: Total Project Preparer: KELLER & GANNON
Analysis Date: July 1995 Economic Life: 15 Years

1. Investment Costs

A. Construction Costs	\$1,073,956	
B. SIOH 5.6%	\$60,142	
C. Design Cost 6.0%	\$64,437	
D. Total Cost (1A + 1B + 1C)	\$1,198,535	
E. Salvage Value of Existing Equipment	\$0	
F. Public Utility Company Rebate	\$0	
G. Total Investment (1D-1E-1F)		\$1,198,535

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost \$/MBTU	Saving MBTU/Yr(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	\$12.82	0	\$0	12.02	\$0
B. Dist	\$6.13	16,549	\$101,447	14.23	\$1,443,592
C. LPG					
D. Other					
E. Demand Savings		0.0 kW	\$0	11.30	\$0
F. Total		16,549	\$101,447		\$1,443,592

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	\$119,261	
(1) Discount Factor (Table A)	11.94	
(2) Discounted Savings/Cost (3A x 3A1)		\$1,423,970

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2 + 3Bd4) \$1,423,970

4. First Year Dollar Savings (2F3 + 3A + (3Bd1/Economic Life)):	\$220,708	
5. Simple Payback (1G/4):	5.43	Years
6. Total Net Discounted Savings (2F5 + 3C):	\$2,867,562	
7. Savings to Investment Ratio (SIR) (6/1G):	2.39	

APPENDIX A

Scope of Work and Minutes of Project Meetings

**EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada**

APPENDIX A

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Scope of Work, Dated 22 March 1995

General Scope of Work for a Limited Energy Study, Dated 16 March 1995

Minutes of Meeting (Scope Claification Conference) on 22 February 1995

22 Mar 95

SCOPE OF WORK

SUBJECT: EEAP, FY 95, Limited Energy Study of Steam Distribution Systems, Mains and Condensate Return in the Industrial and Ordnance Areas, Hawthorne AAP, Hawthorne, NV

CONTRACT NUMBER: DACA05-C-92-0155

DELIVERY ORDER NUMBER:

1. PROJECT DATA:

a. Installation: Hawthorne AAP, NV

b. A-E: Keller & Gannon
1453 Mission Street
San Francisco, CA 94103

POC: Mr. Richard Lennig

PHONE: (415) 621-1199

FAX: (415) 864-3681

c. Specification No.: 9639

d. Project Number: 081

e. Authorization: CEMP-ET Memo dated 30 Dec 1994, ' Subject: Energy Engineering Analysis Program (EEAP) - FY95.

*2. PROJECT DESCRIPTION AND BACKGROUND INFORMATION: This project consists of performing field investigations and analyses for a limited energy survey/study of the Industrial Area Steam Distribution System serviced by Building 13 and the Ordnance Area Steam Distribution System served by Building 103-6, located at Hawthorne AAP, Hawthorne, NV.

*3. A-E WORK AND SERVICES: General: The A-E shall provide all professional architectural and engineering services required for and related to the preparation, coordination and completion of all work described or specified herein. The work involved shall be as shown in paragraph 4.b. Functional Requirements and to include but not be limited to the following:

a. Field Survey/Investigation: The A-E shall review all project-related available as-built and utility plans for the Facility to aid in determining the existing site conditions. The A-E shall verify as-built plans as applicable if the site survey indicates a variance. The A-E shall conduct an on-site survey (other than the brief survey conducted during the pre-design conference) of the facility to verify current conditions. The A-E shall reflect in the study current conditions and actual existing services and equipment as verified from the field investigation. Ample time will be given the A-E to perform a thorough and complete investigation.

1) Review Previous Studies. Review the previous EEAP study which applies to the specific building, system, or ECO covered by this study. This review should acquaint the AE with the work that has been performed previously. Much of the information the AE may need to develop the ECOs in this study may be contained in the previous study.

2) Perform a Limited Site Survey. The AE shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the AE is encouraged to use any data that may have been documented in a previous study. The AE shall document his site survey on forms developed for the survey, or on standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

3) Reevaluate Selected Projects. The AE shall reevaluate the projects and ECOs for projects ECIP PN 42166, Modernize Ordnance Area Steam Distribution and ECIP PN-40667, Modernize Steam Distribution System. These projects and ECOs were previously identified but have not been accomplished or have been only partially accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information the project shall then be analyzed based on current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy savings, the energy costs and construction costs shall be updated, and the revised project or ECO shall then be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected of being inaccurate, but the project or ECO is still considered feasible, the AE shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the report.

b. Interim Submittal. [Due 60 calendar days after Notice to Proceed (NTP)]. An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included. The results of the ECO analyses shall be summarized by lists as follows:

1) All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination.

2) All ECOs which were analyzed shall be grouped into two listings, recommended and non-recommended, each arranged in order of descending SIR. These lists may be subdivided by building or area as appropriate for the study.

3) The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing

the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the Government's and AE's representatives shall coordinate with the Director of Public Works to provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

c. **Review Conference:** A one day review conference shall be held at the installation within 10 days after the receipt of the Government's review comments for the interim report.

d. **Final Report Submittal:** (Due 30 calendar days after receipt of Government review comments on the interim report). The AE shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The AE shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with this study, shall be presented in order of priority by SIR. The lists of ECOs specified shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:

1) An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible.

2) The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

3) Documentation for the recommended projects (includes LCCA Summary Sheets).

4) Appendices to include as a minimum:

- a) Energy cost development and backup data
- b) Detailed calculations
- c) Cost estimates
- d) Computer printouts (where applicable)
- e) This Scope of Work

***4. PROJECT CRITERIA:**

a. Functional Criteria:

1) GSOW dated Jan 1995. (ENCL 1)

b. **Functional Requirements:** The following project tasks shall be performed both for the complete Industrial Area Steam Distribution System serviced by Building 13 and the Ordnance Area Steam Distribution System served by Building 103-6.

1) Determine the extent of repairs already completed by previous upgrade projects and field verify existing conditions. The field survey shall include an inspection within at least 10% of the manholes distributed throughout both distribution systems.

2) Establish the magnitude of thermal losses in the steam supply and condensate return lines due to leaks and deteriorated insulation. Assess thermal losses in each central steam plant, including measurements of combustion efficiency.

3) Evaluate alternative replacement strategies, including in-trench, above ground and direct burial piping, to determine the most cost effective alternative that satisfies mission needs. The life cycle economic analysis of each alternative shall include:

- a) Estimated concept-level construction costs
- b) Estimated life Cycle energy consumption and costs
- c) Estimated life cycle maintenance costs
- d) Life cycle cost analysis summary

4) Based on results of life cycle economic analyses, define the specific scopes of steam distribution repair and replacement that may be accomplished within the programmed amounts for Project Nos. 40667 and 42166, respectively.

c. Criteria Documents:

1) Architectural and Engineering Instruction DATED 9 December 1991.

2) A-E Guide Instruction for Army Projects, Volume 1, DATED January 1990.

3) A-E Guide, CESPCK Cost Estimate Guide, Volume 2, DATED December 1989. This document shall be used as a guide for cost estimate format and content regardless of whether or not the Corps' software is used by the A-E.

4) A-E Guide Volume III, Specifications, DATED December 1990.

NOTE THIS VOLUME IS TO BE USED ONLY AS INFORMATION EXCEPT WHERE SPECIFICALLY REFERENCED. IT IS NOT UP TO DATE. THE MOST CURRENT SPECIFICATIONS ARE TO BE OBTAINED FROM THE CRITERIA BULLETIN BOARD. CONTACT STEVE FREITAS FOR ACCESS TO THE BULLETIN BOARD AT (916) 557-7296.

d. Technical Criteria:

- 1) Publications listed in A-E Guide, Vol. 1, General Instructions, Chapter V.
- 2) Corps of Engineers Guide Specifications obtained from the Criteria Bulletin Board.
- 3) ETLs 1110-3-254, Use of Electric Power for Comfort Space Heating (if applicable), and 1110-3-282, Energy Conservation (optional).
- 4) Energy Conservation Investment Program (ECIP) Guidance, dated 10 Jan 1994 and the latest revision with current energy prices and discount factors for life cycle cost analysis, **essential**.
- 5) TM 5-785, Engineering Weather Data, (applicable portions)
- 6) TM 5-800-2, General Criteria Preparation of Cost Estimates, or MCACES instructions if required by your district, **essential**
- 7) Other Army Technical Manuals (TMs) related to the design of systems addressed in this study, **as applicable**.
- 8) AR 415-15, 1 Jan 84, Military Construction, Army (MCA) Program Development, **essential if ECIP project documentation will be required**.
- 9) AR 420-10, 2 July 1987, Management of Installation Directorates of Engineering and Housing, and Future Change, dated 11 July 1994, **optional, good background for FEMP projects**.
- 10) Latest MCP Index, **essential for projecting costs for project documentation**.
- 11) The following items are important and shall be provided to the AE to the extent to which they are available: Coordinate with DEH for available copies.
 - a) As-built drawings of applicable buildings, equipment, or systems
 - b) Handbooks or SOPs relating to the operation of applicable equipment or systems.
 - c) Applicable records of energy or fuel usage.
 - d) Copies of bills for electrical energy or fuel purchases.

~~Space Heating (if applicable), and 1110-2-200, Energy Conservation~~

12) CEMP-ET Memorandum dated 11 October 1994, subject: Heat Distribution Systems..

The request for technical manuals, Army/Air Force publications, DOD manuals and Sacramento District prepared manuals can be made by calling the Sacramento District Technical Manager, Alex Azares, at (916) 557-5126 or faxing the request to (916) 557-7850. Other references such as CFRs, other Government Agency publications and Industry Standards (ASCE, ASTM, AISC, NEMA, etc.) will not be available from the Corps of Engineers. Experienced A-Es generally have and/or are familiar with these references. Correspondence to the Sacramento District concerning this project shall be sent to the following address:

U.S. Army Corps of Engineers
Sacramento District
ATTN: CESPK-ED-M, Alex Azares
1325 J Street
Sacramento, CA 95814-2922

*5. DISTRIBUTION LIST: Report submittal and distribution shall be as specified below:

Name & Address	Number of Copies
U.S. Army Corps of Engineers Mobile District/CESAM-EN-DM Attn: Mr. Tony Battaglia 109 St. Joseph Street Mobile, AL 36628-0001 PH: (334) 690-2618 FAX: (334) 690-2424	1
Commander US Army Material Command Attn: AMCEN-A Ms Linda Custer 5001 Eisenhower Ave Alexandria, VA 22333-6000 PH: (703) 274-8900 FAX: (703) 274-3409	1
Commander, Hawthorne Army Ammunition Plant SWCHW-OR Attn: Mr. Floyd Justus Building 5 Hawthorne, NV 89415-5000 PH: (702) 945-7340 FAX: (702) 945-7968	6
US Army Corps of Engineers	1

South Pacific Division
CESPD-ED-TE
Attn: Mr Foo Eng
630 Sansome Street
San Francisco, CA 94111-2206
PH: (415) 705-2415
FAX: (415) 705-1062

Commander, US Army Materiel Command (I&SA) 1
Industrial Operations Command
Attn: Mr. Robert Burchett
Rock Island, IL 61299-7190
FAX: (309) 782-7566

US Army Corps of Engineers 3
Sacramento District
CESPK-ED-M (Army/ISS Section)
Attn: Mr. Alex Azares
1325 J Street
Sacramento, CA 95814-2922
PH: (916) 557-5126
FAX: (916) 557-7850

Commander 1 copy final
US Army Corps of Engineers Executive summary only
Attn: CEMP-ET (Mr. Dan Gentil)
20 Massachusetts Ave., NW
Washington DC, 20314-1000

Commander 1 copy final
US Army Logistics Evaluation Agency Executive summary only
Attn: LOEA-PL (Mr. Keath)
New Cumberland Army Depot
New Cumberland, PA 17070-5007

6. REVIEW & CORRECTION PROCESS:

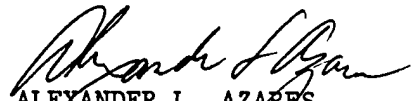
a. The review process and annotation of comments shall be performed using the Automated Review Management System (ARMS). ARMS is a computerized method for transmittal and storage of review comments. Contact JAE KIM at (916) 557-7218 for an access password and instructions. Further guidelines for the review process are provided in A-E Guide, Vol I, Chapter 1.

b. Upon completion of the Government review, all review comments will be transmitted to the A-E via ARMS. The submittal shall be prepared in accordance with the format and instructions contained in the enclosure, General Scope of Work (GSOW). Upon completion of corrections in accordance with review comments, the A-E shall submit all corrected original documents, including annotated review comments with rebuttals (if any) to addresses in the Distribution list. Where prepared in electronic media, drawings, specifications and engineering data shall also be submitted in such format in addition to the hard (paper) copies. If

discrepancies still exist all original documents will be returned to the A-E for resolution of discrepancies. Thereafter the A-E resubmit all the original documents and same quantity as before of the printed sets of all documents.

7. PERIODS OF SERVICE: The periods of service shall be as specified hereinbefore. The periods of service do not include Government review time, but do include transmittal time from the A-E to the Sacramento District Technical Manager. Additionally, close coordination shall be maintained with the Sacramento District Technical Manager to insure quick response and resolution to any questions or problems that may be encountered during the course of this design which deviates from the requirements stated in this Scope of Work. The A-E shall immediately notify the Sacramento District Technical Manager of any such requests.

8. The A-E is cautioned to take no guidance from any source other than the Contracting Officer during the course of this design which deviates from the requirements stated in this Scope of Work. The A-E shall immediately notify the Sacramento District Technical Manager of any such requests.


ALEXANDER L. AZARES
Technical Manager

ENCLOSURE:

1. GENERAL SCOPE OF WORK (GSOW) FOR A LIMITED ENERGY STUDY W/ ANNEXES

DISTRIBUTION:

CESAM-EN-CM (BATTAGLIA)
A-E (LENNIG)
A-E NEGO
ISS (AZARES)
INSTALLATION (JUSTUS)

CESAN-EN-DM

JANUARY 1995
Revised 16 Mar 1995

GENERAL SCOPE OF WORK (GSOV)
FOR A
LIMITED ENERGY STUDY
OF THE STEAM DISTRIBUTION SYSTEMS IN THE
INDUSTRIAL AND ORDNANCE AREAS OF
HAWTHORNE ARMY AMMUNITION PLANT, NEVADA

Performed as part of the
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

GSOVLS95.LP2

SCOPE OF WORK
FOR A
LIMITED ENERGY STUDY

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 - 7.6 Submittals, Presentations and Reviews

ANNEXES

- A - DETAILED SCOPE OF WORK
- B - EXECUTIVE SUMMARY GUIDELINE
- C - REQUIRED DD FORM 1391 DATA

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GENERAL SCOPE OF WORK (GSOW)

1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (AE) shall:

- 1.1 Review the previously completed Energy Engineering Analysis Program (EEAP) study which applies to the specific building, system, or energy conservation opportunity (ECO) covered by this study. See Basewide Energy Systems Plan, HWAAP, prepared by Chilton Engineering, dated May 20 1982.
- 1.2 Perform a limited site survey of specific buildings or areas to collect all data required to evaluate the specific ECOs included in this study.
- 1.3 Reevaluate the specific project or ECO from the previous study to determine its economic feasibility based on revised criteria, current site conditions and technical applicability.
- 1.4 Evaluate specific ECOs to determine their energy savings potential and economic feasibility.
- 1.5 Provide project documentation for recommended ECOs as detailed herein.
- 1.6 Prepare a comprehensive report to document all work performed, the results and all recommendations.

2. GENERAL

- 2.1 This study is limited to the evaluation of the specific buildings, systems, or ECOs listed in Annex A, DETAILED SCOPE OF WORK.
- 2.2 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study.
- 2.3 For the buildings, systems or ECOs listed in Annex A, all methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination.
- 2.4 The study shall consider the use of all energy sources applicable to each building, system, or ECO.
- 2.5 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from DAIM-FDF-U, dated 10 Jan 1994 (including current updates) establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. The program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. If any program other than LCCID is proposed for life cycle cost analysis, it must use the mode of calculation specified in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to

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the Contracting Officer.

2.6 Computer modeling will be used to determine the energy savings of ECOs which would replace or significantly change an existing heating, ventilating, and air-conditioning (HVAC) system. The requirement to use computer modeling applies only to heated and air-conditioned or air-conditioned-only buildings which exceed 8,000 square feet or heated-only buildings in excess of 20,000 square feet. Modeling will be done using a professionally recognized and proven computer program or programs that integrate architectural features with air-conditioning, heating, lighting and other energy-producing or consuming systems. These programs will be capable of simulating the features, systems, and thermal loads of the building under study. The program will use established weather data files and may perform calculations on a true hour-by-hour basis or may condense the weather files and the number of calculations into several "typical" days per month. The Detailed Scope of Work, Annex A, will list programs that are acceptable to the Contracting Officer. If the AE desires to use a different program, it must be submitted for approval with a sample run, an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP or FEMP funding, and determining in coordination with installation personnel the appropriate packaging and implementation approach for all feasible ECOs.

2.7.1 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.7.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

2.7.3 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Public Works will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant.

2.8 Metric Reporting Requirements: In this study, the analyses of the ECOs may be performed using English or Metric units as long as they are consistent throughout the report. The final results of energy savings for individual recommended projects and for the overall study will be reported in units of MegaBTU per year and in MegaWatts per year. Paragraph 7.6.2 details requirements for the contents of the final submittal.

3. PROJECT MANAGEMENT

3.1 Project Managers. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible

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for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

3.2 Installation Assistance. The Commanding Officer or authorized representative at the installation will designate an individual to assist the AE in obtaining information and establishing contacts necessary to accomplish the work required under this contract. This individual will be the installation representative.

3.3 Public Disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE's project manager and the Government's representative shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, will be in addition to the presentation and review conferences.

3.5 Site Visits, Inspections, and Investigations. The AE shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records

3.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

3.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of material.

3.7 Interviews. The AE and the Government's representative shall conduct entry and exit interviews with the Director of Public Works before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall describe the intended procedures for

the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

- a. Schedules.
- b. Names of energy analysts who will be conducting the site survey.
- c. Proposed working hours.
- d. Support requirements from the Director of Public Works.

3.7.2 Exit. The exit interview shall be held when the field work is essentially complete; it shall briefly describe the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Public Works.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), labor, supervision, and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All energy conservation opportunities which the AF has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than \$300,000, a Savings to Investment Ratio (SIR) greater than 1.25 and a simple payback period of less than ten years. The overall project and each discrete part of the project shall have an SIR greater than 1.25. All projects meeting the above criteria shall be arranged as specified in paragraph 2.7.1 and shall be provided with programming documentation. Programming documentation shall consist of a DD Form 1391 and life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented). A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs.

5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate, but which have an SIR greater than 1.25 shall be documented. Projects or ECOs in this category shall be arranged as specified in paragraph 2.7.2 and shall be provided with the following documentation: the life cycle cost analysis (LCCA) summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA (energy savings calculations and cost estimate), and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation prepared, as required by the Government's representative, for one of the following categories:

a. Federal Energy Management Program (FEMP) Projects. A FEMP (or O&M Energy) project is one that results in needed maintenance or repair to an existing facility, or replaces a failed or failing existing facility, and also results in energy savings. The criteria are similar to the criteria for ECIP projects, ie, $SIR \geq 1.25$, and simple payback period of less than ten years. Projects with a construction cost estimate up to \$1,000,000 shall be documented as outlined in par 5.2 above; projects over \$1,000,000 shall be documented on 1391s. In the FEMP program, a system may be defined as "failed or failing" if it is inefficient or technically obsolete. However, if this strategy is used to justify a proposed project, the equipment to be replaced must have been in use for at least three years.

b. Low Cost/No Cost Projects. These are projects which the Director of Public Works (DPW) can perform using his resources. Documentation shall be as required by the DPW.

5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The Detailed Scope of Work is contained in Annex A.

7. WORK TO BE ACCOMPLISHED.

7.1 Review Previous Studies. Review the previous EEAP study which applies to the specific building, system, or ECO covered by this study. This review should acquaint the AE with the work that has been performed previously. Much of the information the AE may need to develop the ECOs in this study may be contained in the previous study. See paragraph 1.1 and ANNEX A.

7.2 Perform a Limited Site Survey. The AE shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the AE is encouraged to use any data that may have been documented in a previous study. The AE shall document his site survey on forms developed for the survey, or on standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.3 Reevaluate Selected Projects. The AE shall reevaluate the projects and ECOs listed in Annex A T.E., ECIP PN 42166, Modernize Ordnance Area Steam Distribution and ECIP PN-40667, Modernize Steam Distribution System. These projects and ECOs were previously identified but have not been accomplished or have been only partially accomplished. If the project or ECO is acceptable as is, that is, there are no changes to the basic project or ECO, the energy savings shown in the previous project may be accepted as accurate but the energy cost and construction cost estimates shall be updated based on the most current data available. With the above information the project shall then be analyzed based on current ECIP criteria. If the project or ECO is basically acceptable but some of the buildings in the original project have been deleted or new buildings can be added, the necessary changes shall be made to the energy savings, the energy costs and construction costs shall be updated, and the revised project or ECO shall then be analyzed using current ECIP guidance. If the original project or ECO has had numerous changes made to it so that all of the numbers are suspected

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of being inaccurate, but the project or ECO is still considered feasible, the AE shall develop the project from the beginning and analyze it with the current ECIP guidance. These projects shall be separately listed in the report.

7.4 Evaluate Selected ECOs. The AE shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined using current ECIP guidance. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions and engineering equations shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.

7.5 Combine ECOs Into Recommended Projects. During the Interim Review Conference, as outlined in paragraph [7.6.1], the AE will be advised of the DEH's preferred packaging of recommended ECOs into projects for implementation. Some projects may be a combination of several ECOs, and others may contain only one. These projects will be evaluated and arranged as outlined in paragraphs 5.1, 5.2, and 5.3. Energy savings calculations shall take into account the synergistic effects of multiple ECOs within a project and the effects of one project upon another. The results of this effort will be reported in the Final Submittal per par [7.6.2].

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included. The AE shall give a formal presentation of the interim submittal to installation, command, and other Government personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that the presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date agreeable to the Director of Public Works, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, STR, and simple payback period of all the ECOs shall

be included. The results of the ECO analyses shall be summarized by lists as follows:

a. All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed in par 5.3.

b. All ECOs which were analyzed shall be grouped into two listings, recommended and non-recommended, each arranged in order of descending SIR. These lists may be subdivided by building or area as appropriate for the study.

The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the Government's and AE's representatives shall coordinate with the Director of Public Works to provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Final Submittal. The AE shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The AE shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The lists of ECOs specified in paragraph [7.6.1] shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:

a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex B for minimum requirements).

b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

c. Documentation for the recommended projects (includes LCCA Summary Sheets).

d. Appendices to include as a minimum:

- 1) Energy cost development and backup data
- 2) Detailed calculations
- 3) Cost estimates

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- 4) Computer printouts (where applicable)
- 5) Scope of Work

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ANNEX A

DETAILED SCOPE OF WORK

1. This annex contains the detailed scope of work for this energy study.
2. The following project tasks shall be performed both for the complete Industrial Area Steam Distribution System serviced by Building 13 and the Ordnance Area Steam Distribution System served by Building 103-6.
 - a. Determine the extent of repairs already completed by previous upgrade projects and field verify existing conditions. The field survey shall include an inspection within at least 10% of the manholes distributed throughout both distribution systems.
 - b. Establish the magnitude of thermal losses in the steam supply and condensate return lines due to leaks and deteriorated insulation. Assess thermal losses in each central steam plant, including measurements of combustion efficiency.
 - c. Evaluate alternative replacement strategies, including in-trench, above ground and direct burial piping, to determine the most cost effective alternative that satisfies mission needs. The life cycle economic analysis of each alternative shall include:
 - 1) Estimated concept-level construction costs
 - 2) Estimated life Cycle energy consumption and costs
 - 3) Estimated life cycle maintenance costs
 - 4) Life cycle cost analysis summary
 - d. Based on results of life cycle economic analyses, define the specific scopes of steam distribution repair and replacement that may be accomplished within the programmed amounts for Project Nos. 40567 and 42156, respectively.
3. Submittals or Services and Periods of Service
 - a. Interim Report: The Interim Report shall be submitted 60 calendar days after Notice to Proceed (NTP). The interim report contents and format shall conform with the requirements of the GSOW.
 - b. Final Report : The final report shall be submitted 30 calendar days receipt of review comments on the interim report. The final report submittal shall conform with the requirements of the GSOW.
 - c. Review Conference: A one day review conference shall be held at the installation within 10 days after the receipt of the Government's review comments for the interim report.

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4. Distribution List: Report submittal and distribution shall be as specified below:

Name & Address	Number of Copies
U.S. Army Corps of Engineers Mobile District/CESAM-EN-DM Attn: Mr. Tony Battaglia 109 St. Joseph Street Mobile, AL 36628-0001 PH: (334) 690-2618 FAX: (334) 690-2424	1
Commander US Army Material Command Attn: AMCEN-A Ms Linda Custer 5001 Eisenhower Ave Alexandria, VA 22333-6000 PH: (703) 274-8900 FAX: (703) 274-3409	1
Commander, Hawthorne Army Ammunition Plant SWCHV-OR Attn: Mr. Floyd Justus Building 5 Hawthorne, NV 89415-5000 PH: (702) 945-7340 FAX: (702) 945-7968	6
US Army Corps of Engineers South Pacific Division CESPD-ED-TE Attn: Mr Foo Eng 630 Sansome Street San Francisco, CA 94111-2206 PH: (415) 705-2415 FAX: (415) 705-1062	1
Commander, US Army Materiel Command (I&SA) Industrial Operations Command Attn: Mr. Robert Burchett Rock Island, IL 61299-7190 FAX: (309) 782-7566	1
US Army Corps of Engineers Sacramento District CESPK-ED-M (Army/ISS Section) Attn: Mr. Alex Azaras 1325 J Street Sacramento, CA 95814-2922 PH: (916) 557-5126	3

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FAX: (916) 557-7850

Commander
US Army Corps of Engineers
Attn: CEMP-BT (Mr. Dan Gentil)
20 Massachusetts Ave., NW
Washington DC, 20314-1000

1 copy final
Executive summary only

Commander
US Army Logistics Evaluation Agency
Attn: LOEA-PL (Mr. Keath)
New Cumberland Army Depot
New Cumberland, PA 17070-5007

1 copy final
Executive summary only

5. Government-furnished Information.

- a. Projects and studies to be reevaluated:
 - o Basewide Energy Systems Plan, HVAAP, prepared by Chilton Engineering, dated May 20 1982. Contents of this plan may be used as background history. Coordinate with DEH.
 - o ECIP PN 42166. Modernize Ordnance Area Steam Distribution. Coordinate with DEH for copies of supporting or related programming documents.
 - o ECIP PN-40667, Modernize Steam Distribution System. Coordinate with DEH for copies of supporting or related programming documents.
- b. Latest copies of other energy studies performed since the previous EEAP study.
- c. ETLs 1110-3-254, Use of Electric Power for Comfort Space Heating (if applicable), and 1110-3-282, Energy Conservation (optional).
- d. Architectural and Engineering Instructions (applicable portions).
- e. Energy Conservation Investment Program (ECIP) Guidance, dated 10 Jan 1994 and the latest revision with current energy prices and discount factors for life cycle cost analysis, essential.
- f. TM 5-785, Engineering Weather Data, (applicable portions)
- g. TM 5-800-2, General Criteria Preparation of Cost Estimates, or MCACES instructions if required by your district, essential
- h. Other Army Technical Manuals (TMs) related to the design of systems addressed in this study, as applicable.
- i. AR 415-15, 1 Jan 84, Military Construction, Army (MCA) Program Development, essential if ECIP project documentation will be required.
- j. AR 420-10, 2 July 1987, Management of Installation Directorates of

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Engineering and Housing, and Future Change, dated 11 July 1994, optional, good background for FEMP projects.

k. Latest MCP Index, essential for projecting costs for project documentation.

l. The following items are important and shall be provided to the AE to the extent to which they are available: Coordinate with DEH for available copies.

(1) As-built drawings of applicable buildings, equipment, or systems

(2) Handbooks or SOPs relating to the operation of applicable equipment or systems.

(3) Applicable records of energy or fuel usage.

(4) Copies of bills for electrical energy or fuel purchases. c.
ETLs 1110-3-254, Use of Electric Power for Comfort
Space Heating (if applicable), and 1110-3-282, Energy Conservation

m. CEMP-ET Memorandum dated 11 October 1994, subject: Heat Distribution Systems.

6. Points of Contact: Points of contact during the study as noted below.

SCHVC-OR: Floyd Justus, PH: (702) 945-7340
Jim Purrel, PH: (702) 945-7590
Louis Dellamonica, PH: (702) 945-7354
Dave Waldron (DZB Eng'g), PH: (702) 945-7536

CHSAM-EN-DH: Tony Battaglia, PH: (334) 690-2618

CHSPK-ED-M: Alex Azares, PH: (916) 557-5126

7. A computer program shall be used to analyze and model the Steam Distribution System. Some acceptable simulation programs follow:

a. Building Loads and System Thermodynamics (BLAST)

b. DOE 2.1B

c. Carrier E20 or Hourly Analysis Program (HAP)

d. Trane Air-Conditioning Economics (TRACE)

This list may be expanded, contracted, or revised to include programs with which the reviewers are familiar provided such programs comply with Chapter 28, "Energy Estimating Methods" of the ASHRAE Handbook of Fundamentals.

8. A computer program titled Life Cycle Costing in Design (LCCID) is available from the BLAST Support Office in Urbana, Illinois for a nominal fee. This computer program can be used for performing the economic calculations for ECIP

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and non-ECIP ECOs. The AE is encouraged to obtain and use this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61801. The telephone number is (217) 333-3977 or (800) 842-5278."

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ANNEX B

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.
2. Steam Distribution System and Building Data (types, number of similar buildings, sizes, etc.)
3. Present Energy Consumption of Buildings or Systems Studied.
 - o Total Annual Energy Used.
 - o Source Energy Consumption.
 - Electricity - KWH, Dollars, BTU,
 - Fuel Oil - GALS, Dollars, BTU, MWH
 - Natural Gas - THERMS, Dollars, BTU, MWH
 - Propane - GALS, Dollars, BTU, MWH
 - Other - QTY, Dollars, BTU, MWH
4. Reevaluated Projects Results.
5. Energy Conservation Analysis.
 - o ECOs Investigated.
 - o ECOs Recommended.
 - o ECOs Rejected. (Provide economics or reasons)
 - o ECIP Projects Developed. (Provide list)*
 - o Non-ECIP Projects Developed. (Provide list)*
 - o Operational or Policy Change Recommendations.

* Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date.
6. Energy and Cost Savings.
 - o Total Potential Energy and Cost Savings.
 - o Percentage of Energy Conserved.
 - o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

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ANNEX C

REQUIRED DD FORM 1391 DATA

To facilitate ECIP project approval, the following supplemental data shall be provided:

- a. In title block clearly identify projects as "ECIP."
- b. Complete description of each item of work to be accomplished including quantity, square footage, etc.
- c. A comprehensive list of buildings, zones, or areas including building numbers, square foot floor area, designated temporary or permanent, and usage (administration, patient treatment, etc.).
- d. List references, and assumptions, and provide calculations to support dollar and energy savings, and indicate any added costs.
 - (1) If a specific building, zone, or area is used for sample calculations, identify building, zone or area, category, orientation, square footage, floor area, window and wall area for each exposure.
 - (2) Identify weather data source.
 - (3) Identify infiltration assumptions before and after improvements.
 - (4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.
- e. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.
- f. An ECIP life cycle cost analysis summary sheet as shown in the ECIP Guidance shall be provided for the complete project and for each discrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined shall be included.
- g. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple amortization period and a statement attesting that all buildings and retrofit actions will be in active use throughout the amortization period.

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- h. The calendar year in which the cost was calculated shall be clearly shown on the DD Form 1391.
- i. For each temporary building included in a project, separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable and (3) an economic analysis supporting the specific retrofit.
- j. Nonappropriated funded facilities will not be included in an ECIP project without an accompanying statement certifying that utility costs are not reimbursable.
- k. Any requirements required by the latest ECIP guidance. Note that unescalated costs/savings are to be used in the economic analyses.
- l. The five digit category number for all ECIP projects except for Family Housing is 80000. The category code number for Family Housing projects is 71100.

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ANNEX C - 2

23 February 1995

MINUTES OF MEETING

AT: Hawthorne Army Ammunition Plant (HWAAP), Hawthorne, Nevada

ON: 22 February 1995, 1300

SUBJECT: Contract No. DACA05-92-C-0155. ECIP Upgrade Steam Distribution Systems in Industrial and Ordnance Areas, Hawthorne AAP, Project Numbers 40667 and 42166

ATTACHMENT: (1) DD Form 1391, ECIP Steam Distribution System, Project No. 40667, Revised 1 November 1993
(2) DD Form 1391, ECIP Modernize Ordnance Areas, Project No. 42166, Revised 20 May 1994
(3) Memo to John Dean (Rich Haavisto) from Jim Blodget Regarding Project No. 40667 Scope Modification
(4) Fact Sheet # ISD-ENG-032, D&Z/B Fact Sheet FY 1996 contract Pricing Proposal, Replace Steam Distribution System in the Industrial Area
(5) Fact Sheet # ISD-ENG-029, D&Z/B Fact Sheet FY 1996 Contract Pricing Proposal, Replace Stream Distribution System at Bldg. 103-6
(6) Steam Distribution Maps, Industrial and Ordnance Areas 1-inch = 200 feet
(7) Steam Distribution System Upgrade Plans, Industrial Area, 1982 Project (5sheets)

THOSE PRESENT:

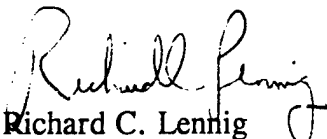
<u>Name</u>	<u>Affiliation</u>	<u>Telephone No.</u>
Alex Azares	CESPK-ED-M (Army/ISS)	916-557-5126
Stephen Jones	Corps of Engineering, Sacramento District	916-557-7216 916-557-7850FAX

James Purrell	ACO, Engineering, HWAAP	702-945-7590 702-945-7968FAX
Louis Dellamonica	ACO, Engineering, HWAAP	702-945-7354
David Waldron	DZB Engineering, HWAAP	702-945-7536
Richard C. Lennig	Keller & Gannon	415-621-1199
Blair I. Horst	Keller & Gannon	415-621-1199

1. The purpose of the meeting was a pre-negotiation scope clarification conference for (a) two design projects to upgrade steam distribution systems in the Industrial and Ordnance Areas and (b) a study project to evaluate existing steam supply and condensate return systems in both the Industrial and Ordnance Areas.
2. DD Form 1391 data for the Industrial Area, Project No. 40667, was reviewed with the following determinations:
 - a. Replacement of severely - deteriorated condensate return piping, not listed on the DD Form 1391, should be included in the project scope. This omission was identified during a site investigation by a former Sacramento District mechanical engineer.
 - b. Unit costs shown on the DD Form 1391 cost estimate are understated.
 - c. Some segments of the steam distribution system have been replaced by previous repair projects. Identification of the specific extent and location of these upgrades will be a part of the study effort.
 - d. The programmed amount is insufficient to accomplish extent of upgrades shown on the DD Form 1391. The design will be limited only to the work that can be performed within the programmed amount. A separate limited energy study task will include the evaluation of the entire Industrial Area system and provide specific recommendations for those portions of the system to be included in this upgrade design.
3. DD Form 1391 data for the Ordnance Area, Project No. 42166, was reviewed with the following determinations:
 - a. There is a considerably greater quantity of steam supply and condensate return lines fed from the Heat Plant Building No. 103-6 in the Ordnance Area than listed on the DD Form 1391: 11,360 L/F each of 2 1/2-inch through 8-inch

steam supply and 1 1/2-inch through 4-inch condensate return based on DZB records versus 5,730 L/F identified on the 1391. (See Attachment(5))

- b. Unit costs shown on the DD Form 1391 cost estimate are understated.
- c. A priority for steam distribution system replacement in the Ordnance Area was established as follows:
 - Priority 1: Main north 8-inch steam supply and 4-inch condensate return lines from Building 103-6 (approximately 4,300 LF each)
 - Priority 2: Lateral distribution from the main north line to Buildings 108-13 and 108-14, 108-20 and 103-40 (approximately 1,600 LF each of supply and return)
 - Priority 3: Main west 4-inch supply and 2-inch condensate return to Building 103-16. (approximately 1,500 L/F each)
- 4. The schedule calls for award of the construction contract by September 1995. To meet this goal, the final design must be completed by July 1995.
- 5. The AE agreed to provide the Sacramento District Technical Manager with a proposed Scope of Service for a limited energy study to evaluate the existing steam distribution systems in both the Industrial and Ordnance Areas. Greater effort will be focused on the Industrial Area since more scope identification for upgrades in this area are required prior to beginning work on the design package.


Richard C. Lennig

RCL:jc
16-403-20

cc: w/out Attachments to:
Mr. Steve Jones
Mr. Alex Azares
CESPK-ED-M/ISS
Corps of Engineers, Sacramento District



Post-it® Fax Note	7671	Date	8/24/95	# of pages	2
To	MR. ALEX AZARES	From	R. C. LENNIG		
Co./Dept.	CESPK-ED-M	Co.	KELLER & GANNON		
Phone #			Phone #		
Fax #	916-557-7850		Fax #		

23 August 1995

DATE SENT: _____
TIME SENT: 9:39
PROJECT No.: _____
ORIGINAL: 20PK / FILE _____
COPY: _____

MINUTES OF MEETING

AT: Hawthorne Army Ammunition Depot (HWAAD), Hawthorne, Nevada

ON: 22 August 1995

SUBJECT: Contract No. DACA05-92-C-0155
Limited Energy Study of Steam Distribution Systems, Industrial and Ordnance Areas, HWAAD, Nevada

ATTACHMENT (1): Memorandum Dated 18 August 1995, BIH to RCL, Responses to Review Comments from Tony Battaglia, CESAM-EN-DM

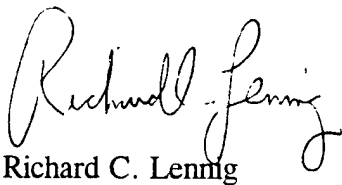
THOSE PRESENT:

<u>Name</u>	<u>Affiliation</u>	<u>Telephone No.</u>
Alex Azares	CESPK-ED-M (Army ISS)	916-557-5126
Louis Dellamonica	ACO, Engineering, HWAAD	702-945-7354
David Waldron	DZ/B Engineering, HWAAD	702-945-7536
Blair I. Horst	Keller & Gannon	415-621-1199
Richard C. Lennig	Keller & Gannon	415-621-1199

1. The purpose of the meeting was to present the results of the Interim Report and to discuss review comments and A/E responses.
2. Mssrs. Lennig and Horst presented the results of the study, covering methodology, existing conditions determined by the site investigation, upgrade alternatives evaluated, and recommended upgrade alternatives that could be constructed within the current programmed amounts for Project Nos. 40667 and 42166, respectively.
3. There was a discussion concerning the effects of adding additional alternative up-

grade segments to the recommended scopes of work in both the Industrial and Ordnance Areas. The A/E responded that the alternatives recommended were the most cost-effective and that adding alternatives would increase the energy savings, but reduce the overall SIRs and increase the payback periods.

4. Keller & Gannon was requested to prepare the DD Forms 1391 for both areas using the alternatives recommended in the study. A six percent design allowance should be added to both funding requests, thus causing the new programmed amounts to exceed those in the previous DD 1391s. This was acceptable to both Mr. Azares and Mr. Waldron.
5. In order to reduce the size of the two DD Forms 1391, it will be acceptable to reference the study for detailed backup data while including only a summary of the methodology and results.
6. The comments from Mr. Tony Battaglia, CESAM-EN-DM, were reviewed, with the A/E clarifying the few with which he did not agree.
7. Comment No. 22 from Mr. Battaglia will require action from Mr. Waldron of DZ/B to obtain the total manhours expended annually by the the DZ/B O & M staffs to maintain the Industrial Area and Ordnance Area steam distribution systems. If available, this data will be used to estimate maintenance manhour reductions generated by the proposed stream line upgrades.



Richard C. Lennig

RCL:rci
16-403-20

cc: without Attachment to:
Mr. Alex Azares
CESPK-ED-M/ISS
Corps of Engineers, Sacramento District

Memorandum
RCL

To:

Date: 18 August 1995

From: BIH

Subject: Responses to Review Comments:
Limited Energy Study of Steam Distribution Systems,
Hawthorne Army Ammunition Depot, Nevada - Energy Report
Contract No.: DACA 05-C-92-0155

Following are responses to comments made by Tony Battaglia, CESAM-EN-DM, to the most recent submittal of the subject Energy Study.

1. General
A/E Response: Thank you.
2. Pg 3-1 Para 3.1
A/E Response: Agree.
The size of the Hawthorne installation will be corrected.
3. Pg 3-1 General
A/E Response: Agree.
The end uses of steam will be discussed briefly in the introductory paragraph. Steam system operations will be discussed briefly in appropriate paragraphs in section 3.
4. Pg 3-3
A/E Response: Agree.
The figure number will be corrected.
5. Pg 3-10 Note 1
A/E Response: Agree.
The table number will be corrected.
6. Pg 4-1 Para 4.1.1.a
A/E Response: Agree.
The sentence will be deleted as suggested.
7. Pg 4-2 Para 4.2
A/E Response: Agree.
Budget quotes from Ravanco for conduit piping and fittings will be appended. A reference will be provided in paragraph 4.2.

8.a. Pg 4-3 Para 4.3

A/E Response: Agree.

Section 4.3 will be rewritten to clarify the analyses leading to selection of replacement strategies used as a basis of design.

8.b Pg 4-3 Para 4.3

A/E Response: Agree.

The appendix references will be revised.

9. Pg 4-4

A/E Response: Agree.

The pipe size will be corrected.

10. Pg 4-4 Para 4.3.2

A/E Response: Agree.

Industrial Area: The use of loops has been provided in the design of new pipe runs whenever space permits. The existing system uses expansion joints. Replacements in kind are assumed for existing routes as the cost of building new concrete trenches to replace single fittings cannot be justified.

Ordinance Area: Expansion loops are used exclusively in the conceptual design.

11. Pg 4-4

A/E Response: Agree.

Alternative CT4 will be added to the bottom of the page. Note that in response to comment 8.a, section 4.3 will be rewritten.

12. Pg 4-4 Opinion

A/E Response: Agree.

The A/E has seen similar instances and agrees with the reviewer.

13. Pg 4-5 Para 4.4

A/E Response: Agree.

The data provided refers to the original DD Form 1391 cost summaries for the two projects. The DD Forms 1391 did not display the design costs. Paragraph 4.4 will be revised to make this distinction clear; design costs will be considered and displayed as appropriate.

14. Pg 4-6

A/E Response: Agree.

The second paragraph will be coordinated with any changes that may be made in Appendix C in response to other comments.

15. Pg 4-7
A/E Response: Agree.
The typographic error will be corrected.
16. Section 4 General
A/E Response: Agree.
Costs are included for repairs to the condensate collection system.
This will be clarified in revisions to descriptions provided in Section 4.
17. Pg 4-15 & 4-17
A/E Response: Agree.
Design costs will be added as requested. The format was prepared to follow the existing DD Forms 1391.
18. Section 4 General
A/E Response: Agree.
An additional summary table (or tables) will be provided as requested.
19. Pg C-1
A/E Response: Done.
Reference is made to Appendix D at the top of page C-2.
20. Pg C-2
A/E Response: Agree.
The figure reference will be completed.
- 21.a. Pg C-3
A/E Response: Agree.
Steam production data is not available. Data kept on hand includes only makeup water requirements and fuel consumption.
- 21.b. Pg C-3
A/E Response: Agree.
An explanation has been provided explaining the various types of losses in more detail.
- 21.c. Pg C-3
A/E Response: Agree.
The subject study could be improved with the results of further testing. Testing to determine the relative contributions of steam and condensate leakage to makeup water requirements is outside the scope of services that can be provided within the budget. The relatively conservative assumptions used to determine fuel savings

justify the project economically. Further refinement would improve the already favorable economics an unknown amount.

21.d. Pg C-3

A/E Response: Agree.

Refer to the response to Comment No. 16, condensate return system repairs are included in the project. This will be clarified.

21.e. Pg C-3

A/E Response: Agree.

The requested text change will be made.

22. Pg C-4

A/E Response: Agree.

Records are not available to determine exact manpower requirements for each area. The estimates provided in the operations and maintenance cost savings estimates are based on discussions with maintenance supervisory personnel. Additional information will be requested from DZB regarding maintenance staffing.

23.a. Pg C-4 Industrial Area

A/E Response: Agree.

The word will be deleted as requested.

23.b. Pg C-4 Industrial Area

A/E Response: Agree.

The sentence will be reworded to make better sense.

24.a. Pg C-5

A/E Response: Agree.

The misleading title will be corrected; tabular data required for input to the program is summarized.

24.b. Pg C-5

A/E Response: Agree.

The units will be corrected to FT instead of LF.

24.c. Pg C-5

A/E Response: Agree.

The listing will be removed. When run, the program as used did not require a specific entry of thermal conductivity of the pipe material.

24.d. Pg C-5

A/E Response: Agree.

The calculations are provided follow examples provided with the article which presented the program. Refer to printouts of program runs for each pipe size in Appendix C.

25. Pg C-6

A/E Response: Agree.

Column headings will be revised.

26. Pg D-1

A/E Response: Agree.

"Elves" will be changed to "Levels".

27. Pg D-2

A/E Response: Agree.

The procedure indicated was developed several years ago for another EEAP study. Actual operating data was used to develop factors for multiple boiler installations. The use of actual plant records would, of course, improve the accuracy. However, an improvement in accuracy of a factor which only represents between 1% and 4% of the boiler plant efficiency would have little impact on calculations with factors with greater degrees of uncertainty.

28. Pg E-1

A/E Response: Agree.

Reference will be made to conceptual designs and costing of supporting structures. Insulation type will be addressed.

29.a. Pg E-4 and E-5

A/E Response: Disagree.

Point A to point B distances are 250 feet. The additional length listed accommodates piping required for expansion loops in the pipe run.

29.b. Pg E-4 and E-5

A/E Response: Agree.

Page G-56 will be referenced for support types and costs.

30. Pg E-10

A/E Response: Agree.

The quantity will be corrected and the calculation revised.

31. App F

A/E Response: Agree.

The estimates will be rechecked and expansion joint costs will be added as necessary.

32. Pg F-2

A/E Response: Agree.

Titles used in cost estimates will be reviewed for consistency with supporting calculations and will be modified as needed.

FACSIMILE TRANSMITTAL HEADER SHEET

For use of this form see AR 25-11; the proponent agency is ODISC4

COMMAND OFFICE		NAME/ OFFICE SYMBOL	OFFICE TELEPHONE NO. (AUTOVON/Comm.)	FAX NO. (AUTOVON/Comm.)		
FROM: ALEX AZARES		CESPKED-M (ARMY/ISS)	(916) 557-5126	(916) 557-7850		
TO: DICK LENNIG		K 3 6	(415) 621-1199	(415) 864-3681		
CLASSIFIC ATION	PRECEDEN CE	NO. PAGES (including this header)	DATE- TIME	MONTH	YEAR	RELEASER'S SIGNATURE
ROUTINE		7	17	AUG	95	JA

REMARKS

REVIEW COMMENTS LIMITED ENERGY STUDY, HWAAP
FROM TONY BATHUA

Space Below For Communications Center Use Only

DA FORM 3918-R JUL 94

DA FORM 3918-R AUG 72 IS OBSOLETE

For Your ACTION

DATE REC'D: 8-17-95
 TIME REC'D: 11:10
 PROJECT No.: 16-403-20
 ORIGINAL: RCL /FILE ✓
 COPY: TMR

FACSIMILE HEADER SHEET

COMMAND/OFFICE		NAME/OFFICE SYMBOL		OFFICE PHONE		FAX
From: USAED Mobile, AL		Tony Battaglia CESAM-EN-DM		(334) 690-2618		(334) 690-2424
To: USAED Sacramento, CA		Alex Azares CESPK-ED-M		(916) 557-5126		(916) 557-7850
CLASS	PREC	PAGES	DATE-TIME	MO	YR	RELEASER'S SIGNATURE
U	N	6	15 1430	08	95	<i>Anthony W. Battaglia</i>
REMARKS						
space below for communications center use only						

Alex:

Enclosed are my comments on the interim submittal for the Limited Energy Study, Steam Distribution, at Hawthorne AAP. Even though I have a lot of comments, I'm basically pleased with the study. Please let me know how things go.

Thanks,

Tony B.

MOBILE DISTRICT PROJECT REVIEW COMMENTS		Date: 15 Aug 95	Page 1 of 5
To: Alex Azares Sacramento District, CRSPK-ED-M		From: (Section) CESAM-EN-DM (Reviewer) A. Battaglia (334) 690-2618	
Project: FY95 Limited Energy Study, Steam Dist, Location: Hawthorne AAP, NV		Year: FY-95	Line Item No.:
Type of Action: Interim Submittal Review			
ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION

1. General This is a very good report. It is nice to see a study with this level of detail.
2. Pg 3-1
Par 3.1 Check size of reservation; 140 acres seems small.
3. Pg 3-1
General Add some discussion on the end use of the steam; is it heating only, or process also? When and how are the central plants operated; and how does this affect savings calculations?
4. Pg 3-3 In the last sentence, it appears that "Figure 3-1" should be "Figure 3-3".
5. Pg 3-10
Note 1 Appears that "Table 3-1" should be "Table 3-2".
6. Pg 4-1
4.1.1,a The last sentence, regarding utility company rebates could be deleted, since rebates are not applicable to this study.
7. Pg 4-2
Par 4.2 This mentions budget quotes from equipment manufacturers. I did not find any. If they were used, copies should be included in the appendices.
8. Pg 4-3
Par 4.3
 - a. The analysis of Alternative Replacement Strategies is a good approach for deciding which alternatives to pursue for the ICCAs. However, it took quite a bit of reading and rereading to understand how this section fits into the overall analysis. Please revise or expand the discussion to clarify this point.
 - b. The last sentence, referring to Appendix E, is applicable to both the Ordinance and the Industrial area. Revise as needed to clarify.
9. Pg 4-4 Change "40-inch diameter steam pipe" to "4.0-inch diameter".

PROJECT REVIEW COMMENTS (Continuation Sheet)		Date: 15 Aug 95	Page 2 of 5
Project and Location: FY95 Limited Energy Study, Steam Distribution, Hawthorne AAP, NV		FY-95	Section: CESAM-EN-DM
ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION

10. Pg 4-4
Par 4.3.2 Regarding expansion joints: Expansion loops are preferred where space allows. Could loops be used in any of the areas where the replacement lines would be underground?
11. Pg 4-4 Alternative CT4 should have been included at the bottom of the page.
12. Pg 4-4
Opinion With the experiences we have had with FRP condensate pipe, even when the design included devices to protect the FRP from direct contact with steam; I would not even consider using FRP condensate pipe.
13. Pg 4-5
Par 4.4 In the calculations of the TOTAL REQUEST for recommended projects, design (6%) should be included.
14. Pg 4-6 The second paragraph may need to be revised. See Comment 21 below.
15. Pg 4-7 On the first Savings-to-Investment Ratio (SIR), delete "years".
16. Section 4
General The descriptions of the recommended alternatives do not discuss any method of handling the condensate collected in the manholes. What is proposed?
17. Pg 4-15
& 4-16 In Tables 4-1 and 4-2, the design cost should be added to the overall cost to obtain the Total Request. See Comment 13 above.
18. Section 4
General Suggest adding a table prior to the LCCAs which would tabulate all of the savings from the various sources and the construction costs for each recommended project. This information can be found in the appendices, but it should be summarized in the narrative.
19. Pg C-1 A reference should be made to Appendix D for results of combustion efficiency tests.
20. Pg C-2 Complete the figure reference for radiation losses.

PROJECT REVIEW COMMENTS (Continuation Sheet)		Date: 15 Aug 95	Page 3 of 5
Project and Location: FY95 Limited Energy Study, Steam Distribution, Hawthorne AAP, NV		FY-95	Section: CESAM-EN-DM
ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION

21. Pg C-3

Steam Leakage and Condensate Energy Loss Calcs

a. It would be useful to also list the quantity of steam produced during the same period.

b. Agreed that one cannot take credit for saving all of the energy required to heat makeup water from 51F to saturated steam at 105 psig when the makeup water is replacing condensate that has been leaked or wasted; because, as steam, it did some useful work before it became condensate. However, this is not explained very well in the narrative (maybe not in this comment either). Please revise as needed to clarify.

c. It would be helpful to have some data to back up the assumption regarding the percentages of makeup water needed to replace steam leaks, condensate leaks, and wasted condensate. Please check and provide whatever you can; revise if necessary.

d. Having discovered that condensate is being wasted, it would seem logical to investigate the possibility of returning that condensate. Please discuss.

e. Under ENERGY SAVINGS: Change the wording to match "Boiler Plant Efficiency" as in tabulation for ENERGY LOSSES above.

22. Pg C-4

Please provide information on the current level (manhours) of maintenance being provided for each area.

23. Pg C-4

INDUSTRIAL AREA:

a. Delete word "are" in second line.

b. The last sentence, which starts, "One excursion...", doesn't make sense. Please revise.

PROJECT REVIEW COMMENTS (Continuation Sheet)			Date: 15 Aug 95	Page 4 of 5
Project and Location: FY95 Limited Energy Study, Steam Distribution, Hawthorne AAP, NV			FY-95	Section: CESAM-EN-DM
ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION	

24. Pg C-5
- At the top of the list it says "Above Ground Piping Systems"; so why is burial depth mentioned in the list?
 - Burial Depth would be measured in FT, not LF.
 - Why is thermal conductivity of pipe not applicable? Line 250 in the referenced program asks for INPUT, K_p .
 - Under Pipe ID/OD Insulation, it looks as if Conduit Casing and Air Space could be listed with Pipe OD & Pipe ID rather than with Insulation. Please check.
25. Pg C-6
- Looks as if Pipe ID/OD Insulation should be Pipe ID/OD Heat Loss Factors.
26. Pg D-1
- Under AUXILIARY EQUIPMENT USES: The use of the word "elves" is neat. Is that what you intended?
27. Pg D-2
- Shutdown/Cycling Losses: There are a lot of assumptions here. What can you learn from the the plant records that might support or revise the assumptions?
28. Pg E-1
- For above-ground alternatives, please note nominal height above ground, type of support, and proposed type of insulation. For underground alternatives, please note proposed type of insulation.
29. Pg E-4
- It is noted on the estimate form that the typical costs are based on a 250-ft section of pipe; but some of the costs were calculated for 317LF. Please correct as needed for consistency. Applies to pg E-5 as well.
 - For supports, please reference Pg G-56.
30. Pg E-10
- Alternative CT4: The quantity for "Demolish Existing 4-inch Steam Pipe" should be 100 LF. Please correct.

PROJECT REVIEW COMMENTS (Continuation Sheet)		Date: 15 Aug 95	Page 5 of 5
Project and Location: FY95 Limited Energy Study, Steam Distribution, Hawthorne AAP, NV		FY-95	Section: CESAM-EN-DM
ITEM NO.	DRAWING NO. OR PAR. NO.	COMMENTS	REVIEW ACTION

31. App F Did not find costs for expansion joints which would have to be used in Industrial Area. Unit costs are developed in Appendix G, but can't see where they were applied in Appendix F.
32. Pg F-2 CONSTRUCTION TOTAL COST: It seems that this title should agree with the title used for the unit cost estimate starting on pg F-23.

APPENDIX B

Steam System Piping and Manhole Take-off Tabulations

**EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada**

APPENDIX B

Table of Contents

Industrial Area Steam Distribution and Condensate Collection System Piping Take-Offs (6 Sheets)	B-1
Industrial Area Steam Distribution and Condensate Collection System Manhole Take-Offs (5 Sheets)	B-7
Ordnance Area Steam Distribution and Condensate Collection System Piping Take-Offs (5 Sheets)	B-12
Ordnance Area Steam Distribution and Condensate Collection System Manhole Take-Offs (4 Sheets)	B-17

Hawthorne Army Ammunition Depot - Industrial Area

Steam Distribution and Condensate Collection System Piping Take-Offs

<u>Sheet</u>	<u>Street Name</u>	<u>Service</u>	<u>Placement</u>	<u>Surface</u>	<u>Dia-Inch</u>	<u>LF</u>	<u>Material</u>	<u>Insul-Inch</u>	<u>Type</u>	<u>Ins Cond</u>	<u>Remarks</u>
M-2	East & West U	Cond	Direct Bury	Lawn	2	1,111	Red Brass	None	None	Leaks	Between houses, nic pipes in basements
M-2	East & West U	Cond	Direct Bury	Conc Road	2	63	Red Brass	None	None	Leaks	St Crossings, total LF
M-2	East & West U	Cond	Direct Bury	Lawn	2	96	Red Brass	None	None	Leaks	Between houses, allow for pipe connections in
M-2	Bldg 42 to Jncdn	Cond	Direct Bury	Lawn	2	171	Red Brass	None	None	None	1 Conc Trench Crossing
M-2	Bldg 42 to Jncdn	Cond	Direct Bury	Conc Road	2	24	Red Brass	None	None	None	1 Conc Trench Crossing
M-2	MH 283/V to Sht M-	Cond	Direct Bury	Lawn	3	223	Red Brass	None	None	None	1 Conc Trench Crossing
M-2	MH 283/V to Sht M-	Cond	Direct Bury	Conc Road	3	27	Red Brass	None	None	None	St Crossings, total LF
M-2	To Bldg 42	Cond	Conc Trench	Conc Trench	2	75	Red Brass	None	None	None	In trench with steam pipe
M-2	To Bldgs GHITUV	LPS	Conc Trench	Conc Trench	2	228	Sch 40 Black	1 1/2	FG	Wet	Building Services
M-2	To Bldgs J thru S	LPS	Conc Trench	Conc Trench	2	442	Sch 40 Black	1 1/2	FG	Wet	Building Services
M-2	East & West U	LPS	Conc Trench	Conc Trench	2 1/2	297	Sch 40 Black	2	FG	Wet	Branch LPS Main
M-2	East & West U	LPS	Conc Trench	Conc Trench	3	774	Sch 40 Black	2	FG	Wet	Branch LPS Main
M-2	A11&12 to Sht M-4	LPS	DB w/Gilulate	Lawn	3	292	Sch 40 Black	5	or Protexulate	LPS Main	
M-2	A11&12 to Sht M-4	LPS	DB w/Gilulate	Conc Road	3	48	Sch 40 Black	5	or Protexulate	LPS Main	
M-2	A11&12 to Sht M-4	LPS	DB w/Gilulate	Sidewalk	3	20	Sch 40 Black	5	or Protexulate	LPS Main	
M-2	MH A12 to A13	LPS	Conc Trench	Conc Trench	5	340	Sch 40 Black	2	FG	Wet	LPS Main
M-2	MH A12 to A13	LPS	Conc Trench	Conc Road	5	15	Sch 40 Black	2	FG	Wet	LPS Main
M-2	MH A11 to A12	LPS	Conc Trench	Conc Trench	6	200	Sch 40 Black	3	FG	Wet	LPS Main
M-2	MH A11 to A12	LPS	Conc Trench	Conc Road	6	40	Sch 40 Black	3	FG	Wet	LPS Main
M-2	Sht M-1 to MH A11	HPS	Conc Trench	Conc Trench	4	365	Sch 40 Black	3	FG	Wet	HPS Main
M-2	Sht M-1 to MH A11	HPS	Conc Trench	Conc Road	4	75	Sch 40 Black	3	FG	Wet	HPS Main
M-2	MH A10 to Bldg 42	HPS	Conc Trench	Conc Trench	2	75	Sch 40 Black	1 1/2	FG	FG	Steaming Building Service
M-4	Sht M-3 to M-1	Cond	Direct Bury	Conc Trench	2	1,020	FRP	None	None	Leaks	Frequent repairs needed
M-4	Sht M-3 to M-1	Cond	Direct Bury	Conc Road	2	78	FRP	None	None	Leaks	St Crossings, total LF
M-4	Red Brass Main	Cond	Direct Bury	Conc Trench	3	390	Red Brass	None	None	None	
M-4	Red Brass Main	Cond	Direct Bury	Conc Road	3	60	Red Brass	None	None	None	
M-4	Bldg 292-2 & Y/286	LPS	DB Conduit	Conc Trench	3	323	Sch 40 Black	2	FG	Preinsulated in Conduit	
M-4	Bldg 292-2 & Y/286	LPS	DB Conduit	Conc Road	3	15	Sch 40 Black	2	FG	Preinsulated in Conduit	
M-4	Bldg 292-2 & Y/286	LPS	DB Conduit	Sidewalk	3	12	Sch 40 Black	2	FG	Preinsulated in Conduit	
M-4	Bldg Z/287 - AA/288	LPS	DB Conduit	Lawn	2 1/2	40	Sch 40 Black	2	FG	Preinsulated in Conduit	
M-4	Bldg AA/288-BB/289	LPS	DB Conduit	Lawn	2	40	Sch 40 Black	2	FG	Preinsulated in Conduit	
M-4	Bldg W/284 - X/285	LPS	DB w/Gilulat	Lawn	2	40	Sch 40 Black	5	or Protexulate	Building Service	

Hawthorne Army Ammunition Depot - Industrial Area Steam Distribution and Condensate Collection System Piping Take-Offs

Sheet	Street Name	Service	Placement	Surface	Dia-Inch	LF	Material	Insul-Inch	Type	Ins Cond	Remarks
M-4	Sht M-2 to W/284	LPS	DB w/Gilsulat	Lawn	3	110	Sch 40 Black	5	or Protexulate	LPS Main	
M-4	Sht M-2 to W/284	LPS	DB w/Gilsulat	Conc Road	3	10	Sch 40 Black	5	or Protexulate	LPS Main	
M-4	Sht M-2 to W/284	LPS	DB w/Gilsulat	Sidewalk	3	5	Sch 40 Black	5	or Protexulate	LPS Main	
M-3	MH A13 to A18	LPS	Conc Trench	Conc Trench	4	351	Sch 40 Black	2	FG	Leaks	LPS Main
M-3	MH A13 to A18	LPS	Conc Trench	Conc Road	4	39	Sch 40 Black	2	FG	Leaks	LPS Main
M-3	MH A13 to MH A14	Cond	Conc Trench	Conc Trench	1	258	FRP	None	None		Pumped Cond
M-3	MH A13 to MH A14	Cond	Conc Trench	Conc Road	1	19	FRP	None	None		Pumped Cond
M-3	MH A14 to MH A15	Cond	Conc Trench	Conc Trench	2	100	FRP	None	None		Pumped Cond
M-3	MH A15 to MH A14	Cond	Conc Trench	Conc Trench	1 1/2	100	FRP	None	None		Gravity Cond to Pump
M-3	MH A15 to MH A16	Cond	Conc Trench	Conc Trench	2	95	FRP	None	None		Pumped Cond
M-3	MH A17-1 to A16	Cond	Conc Trench	Conc Trench	1	95	FRP	None	None		Pumped Cond
M-3	MH A17-1 to A16	Cond	Conc Trench	Conc Trench	1 1/2	95	FRP	None	None		Gravity Cond to Pump
M-3	MH A18 to A17-1	Cond	Conc Trench	Conc Trench	1	157	FRP	None	None		Pumped Cond
M-3	MH A18 to A17-1	Cond	Conc Trench	Conc Road	1	20	FRP	None	None		Pumped Cond
M-3	MH A14 to F/179	Cond	Conc Trench	Conc Trench	1 1/2	33	FRP	None	None		Service for Bldg F/179
M-3	MH A14 to F/179	LPS	Conc Trench	Conc Trench	2 1/2	33	Sch 40 Black	1 1/2	FG		Service for Bldg F/179
M-3	MH A15 to E/178	Cond	Conc Trench	Conc Trench	1 1/2	44	FRP	None	None		Service for Bldg E/178
M-3	MH A15 to E/178	LPS	Conc Trench	Conc Trench	2 1/2	33	Sch 40 Black	1 1/2	FG		Service for Bldg E/178
M-3	MH A16 to D/177	Cond	Conc Trench	Conc Trench	1 1/2	44	FRP	None	None		Service for Bldg D/177
M-3	MH A16 to D/177	LPS	Conc Trench	Conc Trench	2 1/2	33	Sch 40 Black	1 1/2	FG		Service for Bldg D/177
M-3	MH A17-1 to C/176	Cond	Conc Trench	Conc Trench	1 1/2	44	FRP	None	None		Service for Bldg C/176
M-3	MH A17-1 to C/176	LPS	Conc Trench	Conc Trench	2 1/2	33	Sch 40 Black	1 1/2	FG		Service for Bldg C/176
M-3	MH A17 to B/175	Cond	Conc Trench	Conc Trench	1 1/2	44	FRP	None	None		Service for Bldg B/175
M-3	MH A17 to B/175	LPS	Conc Trench	Conc Trench	2 1/2	33	Sch 40 Black	1 1/2	FG		Service for Bldg B/175
M-3	MH A18 to A/174	Cond	Conc Trench	Conc Trench	2	65	FRP	None	None		Service for Bldg A/174
M-3	MH A18 to A/174	LPS	Conc Trench	Conc Road	3	65	Sch 40 Black	1 1/2	FG		Service for Bldg A/174
M-3	MH A18 to A/174	Cond	Conc Trench	Conc Road	2	15	FRP	None	None		Service for Bldg A/174
M-3	MH A18 to A/174	LPS	Conc Trench	Conc Road	3	15	Sch 40 Black	1 1/2	FG		Service for Bldg A/174
M-3	MH A16 to A16-3	LPS	DB Conduit	Lawn	3	311	Sch 40 Black	1 1/2	FG		Branch Main
M-3	MH A16 to A16-3	LPS	DB Conduit	Conc Road	3	36	Sch 40 Black	1 1/2	FG		Branch Main
M-3	MH A16 to A16-3	LPS	DB Conduit	Sidewalk	3	5	Sch 40 Black	1 1/2	FG		Branch Main
M-3	MH A16-3 to A16-4	LPS	DB Conduit	Lawn	2	78	Sch 40 Black	1 1/2	FG		Branch Main
M-3	MH A16-3 to A16-4	LPS	DB Conduit	Sidewalk	2	10	Sch 40 Black	1 1/2	FG		Branch Main
M-3	MH A16-4 to CC/290	LPS	Direct Bury	Lawn	2	22	Sch 40 Black	1 1/2	FG	Poor	Service for Bldg CC/290

Hawthorne Army Ammunition Depot - Industrial Area Steam Distribution and Condensate Collection System Piping Take-Offs

Sheet	Street Name	Service	Placement	Surface	Dia-Inch	LF	Material	Insul-Inch	Type	Ins	Cond	Remarks
M-3	MH A16-3 to DD/291	LPS	Direct Bury	Lawn	2 1/2	22	Sch 40 Black	1 1/2	FG	Poor		Service for Bldg DD/291
M-3	MH A16 to Sht M-4	Cond	Direct Bury	Lawn	2	786	FRP	None	None			Condensate from A16
M-3	MH A16 to Sht M-4	Cond	Direct Bury	Conc Road	2	54	FRP	None	None			Condensate from A16
M-3	MH A16 to Sht M-4	Cond	Direct Bury	Sidewalk	2	5	FRP	None	None			Condensate from A16
M-1	MH A1 to Bldg 17	HPS	Direct Bury	Asphalt	2	105	Sch 40 Black	1 1/2	FG			Not Used
M-1	MH A1 to Bldg 17	Cond	Direct Bury	Asphalt	1	105	Sch 80 Black	1 1/2	FG			Not Used
M-1	MH R1 to MH A1	HPS	Direct Bury	Asphalt	2	52	Sch 40 Black	2	FG			From trench near MH R1
M-1	MH R1 to MH A1	HPS	Direct Bury	Conc Road	2	53	Sch 40 Black	2	FG			Concrete Road Crossing
M-1	MH R1 to MH A1	Cond	Direct Bury	Asphalt	1	30	Sch 80 Black	1 1/2	FG			
M-1	MH R1 to MH A1	Cond	Direct Bury	Conc Road	1	53	Sch 80 Black	1 1/2	FG			Concrete Road Crossing
M-1	MH R1 to Bldg 13	Cond	Direct Bury	Lawn	4	36	Sch 80 Black	1 1/2	FG			
M-1	MH R1 to Bldg 13	Cond	Direct Bury	Conc Road	4	24	Sch 80 Black	1 1/2	FG			Concrete Road Crossing
M-1	MH R2-1 to MH R1	Cond	Direct Bury	Asphalt	4	173	Red Brass	None	None			
M-1	MH R2-1 to MH R1	Cond	Conc Trench	Lawn	4	271	Sch 80 Black	1 1/2	FG			
M-1	Bldg 13 to MH A5	HPS	Conc Trench	Lawn	6	679	Sch 40 Black	2 1/2	FG			
M-1	Bldg 13 to MH A5	HPS	Conc Trench	Conc Road	6	38	Sch 40 Black	2 1/2	FG			
M-1	MH R6 to MH R2	Cond	Direct Bury	Asphalt	3	188	Red Brass	None	None	Old		
M-1	MH R6 to MH R2	Cond	Direct Bury	Conc Road	3	47	Red Brass	None	None	Old		
M-1	MH R6 to MH R2	Cond	Direct Bury	Lawn	3	274	Red Brass	None	None	Old		
M-1	MH R6 to MH R2	Cond	Direct Bury	Sidewalk	3	31	Red Brass	None	None	Old		
M-1	MH D1 to MH R2-1	Cond	Direct Bury	Lawn	3	412	Red Brass	None	None			
M-1	MH D1 to MH R2-1	Cond	Direct Bury	Conc Road	3	23	Red Brass	None	None			
M-1	MH D1 to MH R2-1	Cond	Direct Bury	Sidewalk	3	35	Red Brass	None	None			
M-1	Bldg 36 to MH D1-1	Cond	Direct Bury	Lawn	1 1/2	275	Sch 80 Black	None	None			Noted "Abandoned"
M-1	Bldg 36 to MH D1-1	Cond	Direct Bury	Conc Road	1 1/2	30	Sch 80 Black	None	None			Noted "Abandoned"
M-1	Bldg 3 to Bldg 35	HPS	Direct Bury	Lawn	2	71	Sch 40 Black	1 1/2	FG			
M-1	Bldg 3 to Bldg 35	HPS	Direct Bury	Conc Road	2	18	Sch 40 Black	1 1/2	FG			
M-1	Bldg 3 to Bldg 35	HPS	Direct Bury	Sidewalk	2	5	Sch 40 Black	1 1/2	FG			
M-1	MH A7 to Bldg 3	HPS	Conc Trench	Lawn	2	243	Sch 40 Black	1 1/2	FG			
M-1	MH A7 to Bldg 3	HPS	Conc Trench	Conc Road	2	22	Sch 40 Black	1 1/2	FG			
M-1	Bldg 3 to MH D1-1	Cond	Direct Bury	Lawn	2	58	Sch 80 Black	None	None			Noted "Abandoned"
M-1	Bldg 3 to MH D1-1	Cond	Direct Bury	Conc Road	2	25	Sch 80 Black	None	None			Noted "Abandoned"
M-1	Bldg 3 to MH D1-1	Cond	Direct Bury	Sidewalk	2	12	Sch 80 Black	None	None			Noted "Abandoned"
M-1	MH A7 to MH A9	HPS	Conc Trench	Conc Trench	5	298	Sch 40 Black	2	FG			HPS Main

Hawthorne Army Ammunition Depot - Industrial Area Steam Distribution and Condensate Collection System Piping Take-Offs

Sheet	Street Name	Service	Placement	Surface	Dia-Inch	LF	Material	Insul-Inch	Type	Ins Cond	Remarks
M-1	MH A7 to MH A9	HPS	Conc Trench	Conc Road	5	22	Sch 40 Black	2	FG		HPS Main
M-1	MH A7 to MH R12	Cond	Conc Trench	Conc Trench	2	35	Sch 80 Black	None			From HPS Drip Leg
M-1	Bldg 1 to MH R13	Cond	Direct Bury	Lawn	1 1/2	189	Sch 80 Black	None			
M-1	Bldg 1 to MH R13	Cond	Conc Trench	Conc Trench	1 1/2	122	Sch 80 Black	None			
M-1	Bldg 1 to MH R13	Cond	Conc Trench	Conc Road	1 1/2	22	Sch 80 Black	None			
M-1	MH R13 to MH R12	Cond	Direct Bury	Lawn	2	60	Sch 80 Black	None			
M-1	MH R13 to MH R12	Cond	Direct Bury	Sidewalk	2	5	Sch 80 Black	None			
M-1	MH A9 to MH EJ3	HPS	Conc Trench	Conc Trench	4	140	Sch 40 Black	2	FG		HPS Main
M-1	MH A9 to Bldg 1	HPS	Conc Trench	Conc Trench	2 1/2	100	Sch 40 Black	2	FG		
M-1	MH A8 to Bldg 2	HPS	Conc Trench	Conc Trench	2	130	Sch 40 Black	1	FG		
M-1	Bldg 2 to MH R13	Cond	Conc Trench	Conc Trench	1 1/2	130	Sch 80 Black	None			Pipe size assumed
M-1	MH A5 to MH A7	HPS	Conc Trench	Conc Trench	5	349	Sch 40 Black	2	FG		Pipe size assumed
M-1	MH A5 to MH A7	HPS	Conc Trench	Conc Road	5	51	Sch 40 Black	2	FG		HPS Main
M-1	MH R12 to MH R5	Cond	Conc Trench	Lawn	3	324	Sch 80 Black	None			
M-1	MH R12 to MH R5	Cond	Conc Trench	Conc Road	3	51	Sch 80 Black	None			
M-1	MH R12 to MH R5	Cond	Conc Trench	Sidewalk	3	25	Sch 80 Black	None			
M-1	MH R9 to MH R8	Cond	Direct Bury	Asphalt	2	221	Sch 80 Black				
M-1	MH R10 to MH R9	Cond	Direct Bury	Asphalt	1 1/2	135	Sch 80 Black				
M-1	MH R10 to MH R9	Cond	Direct Bury	Conc Road	1 1/2	35	Sch 80 Black				
M-1	MH R8 to MH R6	Cond	Direct Bury	Asphalt	2	271	Red Brass				
M-1	MH R8 to MH R6	Cond	Direct Bury	Conc Road	2	57	Red Brass				
M-1	MH A5 to MH B1	HPS	Conc Trench	Conc Trench	5	44	Sch 40 Black	2	FG		HPS Main
M-1	MH B1 to MH B2	HPS	Conc Trench	Conc Trench	4	102	Sch 40 Black	2	FG		HPS Main
M-1	MH B1 to MH B2	HPS	Conc Trench	Conc Road	4	25	Sch 40 Black	2	FG		HPS Main
M-1	MH B2 to MH B3	HPS	Conc Trench	Conc Trench	5	198	Sch 40 Black	2	FG		HPS Main
M-1	MH B2 to MH B3	HPS	Conc Trench	Conc Road	5	25	Sch 40 Black	2	FG		HPS Main
M-1	MH B3 to MH B4	HPS	Direct Bury	Asphalt	3	75	Sch 40 Black	1 1/2	FG		HPS Main
M-1	MH B3 to MH B4	HPS	Direct Bury	Conc Road	3	22	Sch 40 Black	1 1/2	FG		HPS Main
M-1	Bldg 39 to MH R7	Cond	Direct Bury	Asphalt	2	27	Red Brass	None			
M-1	MH B3 to Bldg 39	HPS	Direct Bury	Asphalt	2	19	Sch 40 Black	1 1/2	FG		
M-1	Bldg 9 to 2 1/2" Line	Cond	Direct Bury	Asphalt	2	12	Sch 80 Black	None			
M-1	MH B3 to Bldg 39	HPS	Conc Trench	Asphalt	2	37	Sch 40 Black	1 1/2	FG		
M-1	Bldg 5 to MH R5	Cond	Direct Bury	Asphalt	2	80	Sch 80 Black	None			
M-1	MH B1 to Bldg 5	HPS	Conc Trench	Conc Trench	2	42	Sch 40 Black	1 1/2	FG		

Hawthorne Army Ammunition Depot - Industrial Area Steam Distribution and Condensate Collection System Piping Take-Offs

Sheet	Street Name	Service	Placement	Surface	Dia-Inch	LF	Material	Insul-Inch	Type	Ins Cond	Remarks
M-1	MH B1 to Bldg 5	HPS	Conc Trench	Conc Road	2	20	Sch 40 Black	1 1/2	FG		
M-1	Bldg 6 to MH R5-1	Cond	Direct Bury	Lawn	2	15	Sch 80 Black	None			
M-1	MH B1 to Bldg 6	HPS	Conc Trench	Conc Trench	2	32	Sch 40 Black	1 1/2	FG		
M-1	Bldg 6 to MH R5-2	Cond	Direct Bury	Lawn	2	15	Sch 80 Black	None			
M-1	MH A4 to Bldg 47	HPS	Direct Bury	Conc Road	4	78	Sch 40 Black	2	FG		
M-1	Bldg 47 to MH R3	Cond	Direct Bury	Conc Road	1	85	Sch 80 Black	None			
M-1	Main to Bldg 396	HPS	Direct Bury	Asphalt	4	220	Sch 40 Black	2	FG		
M-1	Bldg 396 to MH R2	Cond	Direct Bury	Asphalt	2	198	Sch 80 Black	None			
M-1	Bldgs10,11,8,7-R5-2	Cond	Direct Bury	Lawn	2	337	Red Brass	None			
M-1	Bldgs10,11,8,7-R5-2	Cond	Direct Bury	Sidewalk	2	43	Red Brass	None			
M-1	Bldgs10,11,8,7-R5-2	Cond	Direct Bury	Conc Road	2	291	Red Brass	None			
M-1	Bldgs10,11,8,7-R5-2	Cond	Direct Bury	Asphalt	2	220	Red Brass	None			
M-1	MH R5-2 to R5	Cond	Direct Bury	Lawn	3	130	Red Brass	None			
M-1	Overhead Steam	HPS	Above Ground	Overhead	2	50	Sch 40 Black	2	FG		
M-1	Overhead Steam	HPS	Above Ground	Overhead	3	155	Sch 40 Black	2	FG		
M-1	Bldg 10 to MH R6	Cond	Direct Bury	Asphalt	2 1/2	265	Sch 80 Black	None			
M-1	MH C1 to 2 1/2" Line	Cond	Direct Bury	Asphalt	2	102	Sch 80 Black	None			
M-1	MH C1 to 2 1/2" Line	Cond	Direct Bury	Conc Road	2	38	Sch 80 Black	None			
M-1	MH C1 to 2 1/2" Line	Cond	Direct Bury	Sidewalk	2	50	Sch 80 Black	None			
M-1	Bldg 43 to MH C1	Cond	Conc Trench	Conc Trench	2	25	Sch 80 Black	None			
M-1	MH C3 to 2" Line	Cond	Direct Bury	Conc Road	2	171	Sch 80 Black	None			
M-1	MH C3 to 2" Line	Cond	Direct Bury	Asphalt	2	43	Sch 80 Black	None			
M-1	Bldg 64 to MH C3	Cond	Direct Bury	Conc Road	1 1/4	133	Sch 80 Black	None			
M-1	Bldg 12 to MH C1	Cond	Conc Trench	Conc Trench	2	158	Sch 80 Black	None			
M-1	MH C3 to Bldg 65	HPS	DB w/Gilsulat	Asphalt	2 1/2	700	Sch 40 Black	Gilsulate	Gilsulate		
M-1	MH C3 to Bldg 65	HPS	DB w/Gilsulat	Conc Road	2 1/2	100	Sch 40 Black	Gilsulate	Gilsulate		
M-1	C1 to Bldgs 12&43	HPS	Conc Trench	Conc Trench	2	188	Sch 40 Black	2	FG		
M-1	Bldg 10 to MH C1	HPS	Direct Bury	Conc Road	2	103	Sch 40 Black	2	FG		
M-1	Bldg 4 to MH R2A	Cond	Conc Trench	Conc Trench	2	31	Sch 80 Black	None			
M-1	MH A2 to Bldg 4	HPS	Conc Trench	Conc Trench	2	38	Sch 40 Black	1 1/2	FG		
M-1	MH B4 to Bldg 46	HPS	Direct Bury	Conc Road	2	40	Sch 40 Black	1 1/2	FG		
M-1	Bldg 46 to MH B4	Cond	Direct Bury	Conc Road	2	40	Sch 80 Black	None			
M-1	Bldg 46 to MH B4-1	HPS	Direct Bury	Asphalt	2	135	Sch 40 Black	1 1/2	FG		
M-1	MH B4-1 to Bldg 46	Cond	Direct Bury	Asphalt	1 1/2	135	Sch 80 Black	None			

Hawthorne Army Ammunition Depot - Industrial Area Steam Distribution and Condensate Collection System Piping Take-Offs

<u>Sheet</u>	<u>Street Name</u>	<u>Service</u>	<u>Placement</u>	<u>Surface</u>	<u>Dia-Inch</u>	<u>LF</u>	<u>Material</u>	<u>Insul-Inch</u>	<u>Type</u>	<u>Ins</u>	<u>Cond</u>	<u>Remarks</u>
M-1	Bldg 46 to MH B4-1	HPS	Direct Bury	Conc Road	2	15	Sch 40 Black	1 1/2	FG			
M-1	MH B4-1 to Bldg 46	Cond	Direct Bury	Conc Road	1 1/2	15	Sch 80 Black	None				
M-1	MH B4 to Bldg 146	HPS	Direct Bury	Asphalt	3	90	Sch 40 Black	1 1/2	FG			
M-1	Bldg 146 to MH B4	Cond	Direct Bury	Asphalt	1 1/2	90	Sch 80 Black	None				
M-1	MH B4 to Bldg 146	HPS	Direct Bury	Conc Road	3	60	Sch 40 Black	1 1/2	FG			
M-1	Bldg 146 to MH B4	Cond	Direct Bury	Conc Road	1 1/2	60	Sch 80 Black	None				
M-1	Bldg 65 to MH R10	Cond	DB w/Gilsulat	Asphalt	2	475	Sch 80 Black	Gilsulate	Gilsulate			
M-1	Bldg 65 to MH R10	Cond	DB w/Gilsulat	Conc Road	2	100	Sch 80 Black	Gilsulate	Gilsulate			
M-1	Bldg 65 to Bldg 66	HPS	DB Conduit	Asphalt	2	260	Sch 40 Black	1 1/2	FG			HPS & Cond in Conduit
M-1	Bldg 66 to Bldg 65	Cond	DB Conduit	Asphalt	1 1/4	260	Sch 80 Black	1	FG			HPS & Cond in Conduit
M-1	Bldg 35 to Bldg 36	HPS	Direct Bury	Lawn	2	73	Sch 40 Black	1	FG			
M-1	Bldg 35 to Bldg 36	HPS	Direct Bury	Conc Road	2	25	Sch 40 Black	1	FG			
M-1	Bldg 36 to MH D1-2	Cond	Direct Bury	Lawn	2	44	Sch 80 Black	None				
M-1	Bldg 36 to MH D1-2	Cond	Direct Bury	Conc Road	2	25	Sch 80 Black	None				
M-1	Bldg 36 to MH D1-2	Cond	Direct Bury	Asphalt	2	306	Sch 80 Black	None				
M-1	Bldg 13 to Bldg 38	HPS	Direct Bury	Asphalt	2 1/2	275	Sch 40 Black	1 1/2	FG			
M-1	Bldg 38 to Bldg 13	Cond	Direct Bury	Asphalt	2	275	Sch 80 Black	None				
M-1	MH to Bldg 155	HPS	DB Conduit	Asphalt	2 1/2	425	Sch 40 Black	1 1/2	FG			HPS & Cond in Conduit
M-1	Bldg 155 to MH	Cond	DB Conduit	Asphalt	1 1/2	425	Sch 80 Black	1	FG			HPS & Cond in Conduit
						24,886						

Hawthorne Army Ammunition Depot - Industrial Area

Steam Distribution and Condensate Collection System Manhole Take-Offs

Sheet	MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
M-2	EJ1	LPS	5	9	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	
M-2	P20	HPS	4	9	0	1	1	0	2	1	2	0	0	0	0	0	0	0	0	0	
M-2	P21	LPS	2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P22	LPS	2 1/2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P23	LPS	2 1/2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P24	LPS	2 1/2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P25	LPS	2 1/2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P26	LPS	2 1/2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P27	LPS	2 1/2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P28	LPS	2 1/2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P29	LPS	2 1/2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	P30	LPS	2	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	Branch Main nic
M-2	A12	LPS	3	10	2	1	0	3	0	0	0	1	0	0	0	0	0	0	0	0	Drip Nipple
M-2	A12	LPS	5	5	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	
M-2	A12	LPS	6	5	0	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	Drip Flange
M-2	A12	Cond	3/4	10	1	0	0	4	0	0	0	0	1	1	1	0	0	0	0	1	
M-2	A12-1	LPS	3	10	0	1	0	0	2	1	2	0	0	0	0	0	0	0	0	0	Service to G/180
M-2	A12-1	LPS	2	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Service to G/180
M-2	A11-1	LPS	3	10	0	1	0	0	2	1	2	0	0	0	0	0	0	0	0	0	Service to V/283
M-2	A11-1	LPS	2	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Service to V/283
M-2	A12-2	LPS	3	10	0	1	0	0	2	1	2	0	0	0	0	0	0	0	0	0	Service to I/182
M-2	A12-2	LPS	2	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Service to I/182
M-2	A11-2	LPS	3	10	0	1	0	0	2	1	2	0	0	0	0	0	0	0	0	0	Service to T/281
M-2	A11-2	LPS	2	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Service to T/281
M-2	A12-3	LPS	3	5	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	Service to K/184
M-2	A12-3	LPS	2	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Service to K/184
M-2	A12-3	LPS	2 1/2	5	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	Service to K/184
M-2	A11-3	LPS	3	5	0	1	0	0	2	1	2	0	0	0	0	0	0	0	0	0	Service to R/279
M-2	A11-3	LPS	2	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Service to R/279
M-2	A11-3	LPS	3	5	0	1	0	0	2	1	2	0	0	0	0	0	0	0	0	0	Service to R/279
M-2	A12-4	LPS	3	7	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	From A12 to Sht M-4
M-2	A11-4	LPS	3	7	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	From A11 to Sht M-4
M-2	A11	HPS	4	8	1	2	0	3	1	0	1	0	1	0	0	1	0	0	0	1	From A10
M-2	A11	HPS	1 1/2	10	1	1	0	1	0	0	0	0	0	0	0	1	1	0	0	1	Pressure Relief Piping
M-2	A11	LPS	6	11	2	2	0	1	1	1	1	0	0	0	0	0	1	0	0	0	To A13 on Sht M-3
M-2	A11	LPS	3	13	2	1	0	2	1	0	0	1	0	0	0	0	0	0	0	0	To A11-4 & A11-1
M-2	A11	Cond	1	6	1	0	0	3	0	0	0	0	0	1	1	0	0	0	0	0	Drip to Cond System
M-2	A10	HPS	4	9	0	2	0	0	2	1	2	0	1	0	0	0	0	0	0	1	Branch to Bldg 42 not in MH
M-2	A10	HPS	2	3	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	Service to Bldg 42
M-2	A10	Cond	1 1/2	12	0	0	0	5	0	0	0	0	0	1	1	0	0	0	0	1	Condensate to MH R2-3
M-4	None	Cond	2	-	0	4	3	28	0	0	0	0	0	0	0	0	0	0	0	0	FRP Fittings for DB System
M-4	None	Cond	3	-	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Red Brass Condensate Pipe
M-4	None	LPS	3	-	4	1	0	7	0	0	0	0	0	0	0	0	0	0	0	0	Bldg 292-2 & Y/286
M-4	None	LPS	2 1/2	-	2	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	Bldg Z/287 - AA/288
M-4	None	LPS	2	-	2	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	Bldg AA/288-BB/289
M-4	None	LPS	2	-	2	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	Bldg W/284 - X/285
M-4	None	LPS	3	-	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	Sht M-2 to W/284
M-3	A13	LPS	5	5	0	2	0	0	1	1	1	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A13	LPS	4	5	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	LPS Main

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Steam Distribution and Condensate Collection System Manhole Take-Offs

Sheet	MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
M-3	A13	Cond	1	12	3	2	1	6	0	0	0	0	1	1	1	0	0	0	0	1	Gravity & Drip Trap
M-3	A13	Cond	1	8	1	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	Pumped to MH A14
M-3	A13	LPS	3	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Service to Bldg 14, Theater
M-3	EJ2	LPS	4	9	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A14	LPS	4	10	0	2	0	1	2	1	2	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A14	Cond	1	4	2	1	0	1	0	0	0	0	1	1	1	0	0	1	1	1	Drip Trap
M-3	A14	Cond	1 1/2	8	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	From Bldg F/179
M-3	A14	Cond	1	13	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	Pumped from MH A14
M-3	A14	LPS	2 1/2	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Service to Bldg F/179
M-3	A15	LPS	4	5	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A15	Cond	2	5	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	Pumped from A14
M-3	A15	Cond	1 1/2	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	From Bldg F/179 to A14
M-3	A15	LPS	2 1/2	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Service to Bldg E/178
M-3	A16	LPS	4	10	0	2	0	1	2	1	2	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A16	Cond	1	4	2	1	0	5	0	0	0	0	1	1	1	0	0	1	1	1	Drip Trap
M-3	A16	Cond	2	8	0	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	From MH A14
M-3	A16	Cond	1	3	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	From MH A17-1
M-3	A16	Cond	1 1/2	12	1	2	1	5	0	0	0	0	0	0	1	0	0	0	0	0	From MH A17-1 & D/177
M-3	A16	LPS	2 1/2	7	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Svc to Bldg F/179 & Br Main
M-3	A17-1	LPS	4	5	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A17-1	Cond	1	5	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	Pumped from MH A17
M-3	A17-1	Cond	1 1/2	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	From Bldg F/179 to A14
M-3	A17-1	LPS	2 1/2	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Service to Bldg C/176
M-3	A17	LPS	4	10	0	2	0	1	2	1	2	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A17	LPS	2 1/2	7	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Svc to Bldg B/175
M-3	A17	Cond	1	3	2	1	0	2	0	0	0	0	1	1	1	0	0	1	1	1	Drip Trap
M-3	A17	Cond	1 1/2	8	1	0	0	2	0	0	0	0	0	1	1	0	0	0	0	0	From Bldg B/175
M-3	A17	Cond	3/4	7	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	Pumped from MH A18
M-3	A17	Cond	1	15	1	1	1	3	0	0	0	0	0	1	1	0	1	1	0	0	Pumped to MH A17-1
M-3	A18	Cond	3/4	12	1	0	0	4	0	0	0	0	0	0	1	0	0	0	0	0	Pumped Return
M-3	A18	Cond	1	3	2	1	0	4	0	0	0	0	1	1	1	0	1	1	1	1	Drip Trap
M-3	A18	LPS	4	5	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	LPS Branch Main (End)
M-3	A18	LPS	3	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Svc to Bldg A/174
M-3	A16-1	LPS	3	7	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A16-2	LPS	3	8	0	2	0	0	0	1	2	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A16-3	LPS	3	6	0	1	0	0	2	1	2	0	0	0	0	0	0	0	0	0	LPS Main
M-3	A16-3	LPS	2 1/2	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Svc to Bldg DD/291
M-3	A16-4	LPS	3	5	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	LPS Main (End)
M-3	A16-4	LPS	2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Svc to Bldg CC/290
M-3	A16-4	Cond	1	8	2	0	0	4	0	0	0	0	2	1	1	0	0	0	0	0	Drip Trap
M-1	D1	Cond	3	7	0	1	0	0	1	1	2	0	0	0	0	0	0	0	0	0	Needed components listed
M-1	D1-1	Cond	1 1/2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	D1-1	Cond	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	D1-1	Cond	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	D1-2	Cond	2	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Repair, assumed hard-piped
M-1	D1-2	Cond	3	7	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Repair, assumed hard-piped
M-1	R2-1	Cond	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R2-1	Cond	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R2-1	Cond	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"

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Steam Distribution and Condensate Collection System Manhole Take-Offs

Sheet	MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
M-1	R1-1	Cond	2	4	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R1-1	Cond	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R1	Cond	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R1	Cond	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	A1	HPS	2	10	1	2	0	2	0	1	2	1	0	0	0	1	1	1	0	0	To A11-4 & A11-1
M-1	A1	HPS	2	10	2	2	0	2	0	1	2	1	1	1	1	0	0	0	0	1	To A11-4 & A11-1
M-1	A2	HPS	6	8	0	2	0	0	1	1	2	1	0	0	0	0	0	0	0	0	
M-1	A2	HPS	2	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	A2	Cond	3	8	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	May be out of service
M-1	A2	Cond	2	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	A2	Cond	1 1/2	6	2	0	0	3	0	0	0	1	1	1	1	0	0	0	0	1	
M-1	A3	Cond	3	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	A4	Cond	3	7	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	
M-1	A5	HPS	5	8	2	0	0	1	2	0	2	0	0	0	0	0	0	0	0	0	
M-1	A5	HPS	6	4	0	2	0	0	1	1	1	1	0	0	0	0	0	0	0	0	
M-1	A5	Cond	1 1/2	10	2	0	0	3	0	0	0	0	1	1	1	0	0	0	0	1	
M-1	EJ4	HPS	5	8	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	
M-1	A7	HPS	2	7	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	A7	HPS	5	12	0	2	0	1	2	1	2	1	0	0	0	0	0	0	0	0	
M-1	A7	Cond	1 1/2	5	2	0	0	3	0	0	0	0	1	1	1	0	0	0	0	1	
M-1	A8	HPS	2	3	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	A8	HPS	5	8	0	2	0	1	2	1	2	1	0	0	0	0	0	0	0	0	
M-1	A8	Cond	1 1/2	5	2	0	0	3	0	0	0	0	1	1	1	0	0	0	0	1	
M-1	A9	HPS	2	7	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	A9	HPS	4	5	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
M-1	A9	HPS	5	7	0	2	0	0	1	1	1	1	0	0	0	0	0	0	0	0	
M-1	A9	Cond	1 1/2	8	2	1	0	3	0	0	0	0	1	1	1	0	0	0	0	1	
M-1	EJ3	HPS	4	8	0	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	
M-1	B1	HPS	2.5	7	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	B1	HPS	3	4	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	B1	HPS	4	4	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
M-1	B1	HPS	5	4	0	2	0	0	1	1	1	1	0	0	0	0	0	0	0	0	
M-1	B1	Cond	1 1/2	8	2	1	0	4	0	0	0	0	1	1	1	0	0	0	0	1	
M-1	V1	HPS	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	B2	HPS	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	B2	HPS	4	6	0	2	0	0	1	1	1	1	0	0	0	0	0	0	0	0	
M-1	B2	HPS	5	4	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
M-1	B2	Cond	1 1/2	8	2	1	0	3	0	0	0	0	1	1	1	0	0	0	0	1	
M-1	B3	HPS	1 1/2	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	B3	HPS	3	4	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	
M-1	B3	HPS	5	4	0	2	0	0	1	1	1	1	0	0	0	0	0	0	0	0	
M-1	B3	Cond	1 1/2	8	2	1	0	4	0	0	0	0	1	1	1	0	0	0	0	1	
M-1	B4	HPS	2	4	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	B4	HPS	3	9	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	B4	Cond	1 1/2	8	0	0	0	3	0	0	2	0	0	0	1	0	0	0	0	0	
M-1	B4	Cond	2	11	1	3	0	6	0	0	2	0	0	0	1	0	0	0	0	0	
M-1	R13	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R13	Cond	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R12	Cond	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"

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Steam Distribution and Condensate Collection System Manhole Take-Offs

Sheet	MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
M-1	R12	Cond	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R9	Cond	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R8	Cond	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R7	Cond	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R7	Cond	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R6	Cond	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R6	Cond	2 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R6	Cond	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5	Cond	3	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R4	Cond	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R3	Cond	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R3	Cond	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R2A	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R2A	Cond	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R2A	Cond	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R2	Cond	3	6	0	0	0	1	1	1	2	0	0	0	0	0	0	0	0	0	Not a Sand Trap
M-1	R2	Cond	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Outside MH R2, Junction
M-1	R2	Cond	4	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Outside MH R2, Junction
M-1	R5-1	Cond	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-1	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-2	Cond	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-2	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-3	Cond	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-3	Cond	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-4	Cond	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-4	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-5	Cond	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-5	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-6	Cond	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-6	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-8	Cond	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R5-8	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	C1	HPS	3	5	0	2	0	1	0	0	1	1	0	0	0	0	0	0	0	0	
M-1	C1	HPS	2	8	1	0	0	3	0	0	0	1	0	0	0	0	0	0	0	1	
M-1	C1	Cond	2	15	2	2	0	10	0	0	0	0	1	1	1	0	0	0	0	2	
M-1	C2	HPS	2	5	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	C3	HPS	1 1/2	6	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	3	
M-1	C3	HPS	2	3	0	3	0	0	1	1	1	1	0	0	0	0	0	0	0	0	
M-1	C3	HPS	2 1/2	4	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	
M-1	C3	Cond	2	4	1	1	0	3	1	1	1	0	0	0	0	0	0	0	0	2	
M-1	C3	Cond	1 1/2	7	2	1	0	4	0	0	0	0	1	1	1	0	0	0	0	2	
M-1	C3	Cond	1 1/4	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
M-1	C4	HPS	2	8	1	2	0	4	0	0	0	0	0	0	1	1	0	0	0	2	
M-1	C4	HPS	2 1/2	6	1	2	2	0	1	1	2	1	0	0	0	0	0	0	0	0	
M-1	C4	Cond	1 1/2	5	2	0	0	7	0	0	0	0	1	1	1	0	0	0	0	2	
M-1	C4	Cond	1 1/4	4	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	1	
M-1	38	HPS	2 1/2	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	38	Cond	1 1/2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
M-1	C5	HPS	2	6	2	1	0	6	0	0	0	1	0	1	1	1	0	1	0	1	

Hawthorne Army Ammunition Depot - Industrial Area **Steam Distribution and Condensate Collection System Manhole Take-Offs**

Sheet	MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
M-1	C5	Cond	1 1/4	6	2	1	0	5	0	0	0	0	2	1	1	0	0	0	0	2	
M-1	R10	Cond	1 1/2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	R10	Cond	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Assumed "Sand Trap"
M-1	B4-1	HPS	2	3	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	
M-1	B4-1	Cond	1 1/2	3	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	

Hawthorne Army Ammunition Depot - Ordinance Area Steam Distribution and Condensate Collection System Piping Take-Offs

Location	Service	Placement	Surface	Dia-Inch	LF	Material	Insul-Inch	Type	Ins Cond	Remarks
Bldg 103-6 to MH B5	HPS	DB Conduit	Asphalt	8	50	Sch 40 Black	3	FG	Aged	
Bldg 103-6 to MH B5	HPS	DB Conduit	Asphalt Road	8	30	Sch 40 Black	3	FG	Aged	
Bldg 103-6 to MH B5	HPS	DB Conduit	Bldg Fndn	8	20	Sch 40 Black	3	FG	Aged	
Bldg 103-6 to MH B5	HPS	DB Conduit	Rail Crossing	8	20	Sch 40 Black	3	FG	Aged	
Bldg 103-6 to MH B5	HPS	DB Cond-Exp	Natural	8	240	Sch 40 Black	3	FG	Aged	Expansion Loops
Bldg 103-6 to MH B5	HPS	DB Conduit	Natural	8	780	Sch 40 Black	3	FG	Aged	
Bldg 103-6 to MH B5	Cond	DB Conduit	Asphalt	4	50	Sch 80 Black	1 1/2	FG	Aged	
Bldg 103-6 to MH B5	Cond	DB Conduit	Asphalt Road	4	30	Sch 80 Black	1 1/2	FG	Aged	
Bldg 103-6 to MH B5	Cond	DB Conduit	Bldg Fndn	4	20	Sch 80 Black	1 1/2	FG	Aged	
Bldg 103-6 to MH B5	Cond	DB Conduit	Rail Crossing	4	20	Sch 80 Black	1 1/2	FG	Aged	
Bldg 103-6 to MH B5	Cond	DB Cond-Exp	Natural	4	240	Sch 80 Black	1 1/2	FG	Aged	Expansion Loops
Bldg 103-6 to MH B5	Cond	DB Conduit	Natural	4	780	Sch 80 Black	1 1/2	FG	Aged	
MH B5 to MH B6	HPS	DB Conduit	Natural	8	220	Sch 40 Black	2 1/2	FG	Aged	
MH B5 to MH B6	HPS	DB Conduit	Bldg Fndn	8	40	Sch 40 Black	2 1/2	FG	Aged	
MH B5 to MH B6	HPS	DB Cond-Exp	Natural	8	67	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops
MH B5 to MH B6	Cond	DB Conduit	Natural	2 1/2	220	Sch 80 Black	1	FG	Aged	
MH B5 to MH B6	Cond	DB Conduit	Bldg Fndn	2 1/2	40	Sch 80 Black	1	FG	Aged	
MH B5 to MH B6	Cond	DB Cond-Exp	Natural	2 1/2	67	Sch 80 Black	1	FG	Aged	Expansion Loops
MH B6 to MH B9	HPS	DB Conduit	Natural	6	415	Sch 40 Black	2 1/2	FG	Aged	
MH B6 to MH B9	HPS	DB Conduit	Bldg Fndn	6	20	Sch 40 Black	2 1/2	FG	Aged	
MH B6 to MH B9	HPS	DB Conduit	Asphalt Road	6	25	Sch 40 Black	2 1/2	FG	Aged	
MH B6 to MH B9	HPS	DB Cond-Exp	Natural	6	127	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops
MH B6 to MH B9	Cond	DB Conduit	Natural	3	415	Sch 80 Black	1	FG	Aged	
MH B6 to MH B9	Cond	DB Conduit	Bldg Fndn	3	20	Sch 80 Black	1	FG	Aged	
MH B6 to MH B9	Cond	DB Conduit	Asphalt Road	3	25	Sch 80 Black	1	FG	Aged	
MH B6 to MH B9	Cond	DB Cond-Exp	Natural	3	127	Sch 80 Black	1	FG	Aged	Expansion Loops
MH B9 to MH B9-1	HPS	DB Conduit	Natural	4	65	Sch 40 Black	2 1/2	FG	Aged	
MH B9 to MH B9-1	HPS	DB Conduit	Asphalt Road	4	45	Sch 40 Black	2 1/2	FG	Aged	
MH B9 to MH B9-1	HPS	DB Cond-Exp	Natural	4	28	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops
MH B9 to MH B9-1	Cond	DB Conduit	Natural	2	65	Sch 80 Black	1	FG	Aged	
MH B9 to MH B9-1	Cond	DB Conduit	Asphalt Road	2	45	Sch 80 Black	1	FG	Aged	
MH B9 to MH B9-1	Cond	DB Cond-Exp	Natural	2	28	Sch 80 Black	1	FG	Aged	Expansion Loops
Main to MH B1-1	HPS	DB Conduit	Natural	3	240	Sch 40 Black	1 1/2	FG	Aged	
Main to MH B1-1	HPS	DB Conduit	Rail Crossing	3	40	Sch 40 Black	1 1/2	FG	Aged	

Hawthorne Army Ammunition Depot - Ordinance Area Steam Distribution and Condensate Collection System Piping Take-Offs

Location	Service	Placement	Surface	Dia-Inch	LF	Material	Insul-Inch	Type	Ins Cond	Remarks
Main to MH B1-1	HPS	DB Cond-Exp	Natural	3	37	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
Main to MH B1-1	Cond	DB Conduit	Natural	2	240	Sch 80 Black	1	FG	Aged	
Main to MH B1-1	Cond	DB Conduit	Rail Crossing	2	40	Sch 80 Black	1	FG	Aged	
Main to MH B1-1	Cond	DB Cond-Exp	Natural	2	37	Sch 80 Black	1	FG	Aged	Expansion Loops
Main to MH B1-2	HPS	DB Conduit	Natural	2 1/2	70	Sch 40 Black	1 1/2	FG	Aged	
Main to MH B1-2	HPS	DB Cond-Exp	Natural	2 1/2	18	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
Main to MH B1-2	Cond	DB Conduit	Natural	1 1/4	70	Sch 80 Black	1	FG	Aged	
Main to MH B1-2	Cond	DB Cond-Exp	Natural	1 1/4	18	Sch 80 Black	1	FG	Aged	Expansion Loops
MH B4 to MH B4-1	HPS	DB Conduit	Natural	5	65	Sch 40 Black	2 1/2	FG	Aged	
MH B4 to MH B4-1	HPS	DB Cond-Exp	Natural	5	26	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops
MH B4 to MH B4-1	Cond	DB Conduit	Natural	2 1/2	65	Sch 80 Black	1	FG	Aged	
MH B4 to MH B4-1	Cond	DB Cond-Exp	Natural	2 1/2	26	Sch 80 Black	1	FG	Aged	Expansion Loops
MH B4 to MH B4-2	HPS	DB Conduit	Natural	3	50	Sch 40 Black	1 1/2	FG	Aged	
MH B4 to MH B4-2	HPS	DB Cond-Exp	Natural	3	16	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH B4 to MH B4-2	Cond	DB Conduit	Natural	1 1/2	50	Sch 80 Black	1	FG	Aged	
MH B4 to MH B4-2	Cond	DB Cond-Exp	Natural	1 1/2	16	Sch 80 Black	1	FG	Aged	Expansion Loops
MH B5 to MH B5-1	HPS	DB Conduit	Natural	3	60	Sch 40 Black	1 1/2	FG	Aged	
MH B5 to MH B5-1	HPS	DB Cond-Exp	Natural	3	18	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH B5 to MH B5-1	Cond	DB Conduit	Natural	1 1/2	60	Sch 80 Black	1	FG	Aged	
MH B5 to MH B5-1	Cond	DB Cond-Exp	Natural	1 1/2	18	Sch 80 Black	1	FG	Aged	Expansion Loops
MH B6 to MH B6-1	HPS	DB Conduit	Natural	5	80	Sch 40 Black	2 1/2	FG	Aged	
MH B6 to MH B6-1	HPS	DB Cond-Exp	Natural	5	28	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops
MH B6 to MH B6-1	Cond	DB Conduit	Natural	2 1/2	80	Sch 80 Black	1	FG	Aged	
MH B6 to MH B6-1	Cond	DB Cond-Exp	Natural	2 1/2	28	Sch 80 Black	1	FG	Aged	Expansion Loops
MH B7 to MH B7-1	HPS	DB Conduit	Natural	3	50	Sch 40 Black	1 1/2	FG	Aged	
MH B7 to MH B7-1	HPS	DB Cond-Exp	Natural	3	16	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH B7 to MH B7-1	Cond	DB Conduit	Natural	1 1/2	50	Sch 80 Black	1	FG	Aged	
MH B7 to MH B7-1	Cond	DB Cond-Exp	Natural	1 1/2	16	Sch 80 Black	1	FG	Aged	Expansion Loops
Bldg 103-6 to MH C6	HPS	DB Conduit	Natural	3	1,250	Sch 40 Black	1 1/2	FG	Aged	
Bldg 103-6 to MH C6	HPS	DB Conduit	Asphalt Road	3	80	Sch 40 Black	1 1/2	FG	Aged	
Bldg 103-6 to MH C6	HPS	DB Conduit	Rail Crossing	3	60	Sch 40 Black	1 1/2	FG	Aged	
Bldg 103-6 to MH C6	HPS	DB Cond-Exp	Natural	3	218	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
Bldg 103-6 to MH C6	Cond	DB Conduit	Natural	2	1,250	Sch 80 Black	1	FG	Aged	
Bldg 103-6 to MH C6	Cond	DB Cond-Exp	Asphalt Road	2	80	Sch 80 Black	1	FG	Aged	

Hawthorne Army Ammunition Depot - Ordinance Area Steam Distribution and Condensate Collection System Piping Take-Offs

Location	Service	Placement	Surface	Dia-Inch	LF	Material	Insul-Inch	Type	Ins	Cond	Remarks
Bldg 103-6 to MH C6	Cond	DB Conduit	Rail Crossing	2	60	Sch 80 Black	1	FG		Aged	
Bldg 103-6 to MH C6	Cond	DB Cond-Exp	Asphalt	2	218	Sch 80 Black	1	FG		Aged	Expansion Loops
MH C6 to MH C6-1	HPS	DB Conduit	Asphalt	3	100	Sch 40 Black	1 1/2	FG		Aged	
MH C6 to MH C6-1	HPS	DB Cond-Exp	Asphalt	3	22	Sch 40 Black	1 1/2	FG		Aged	Expansion Loops
MH C6 to MH C6-1	Cond	DB Conduit	Asphalt	1 1/2	100	Sch 80 Black	1	FG		Aged	
MH C6 to MH C6-1	Cond	DB Cond-Exp	Asphalt	1 1/2	22	Sch 80 Black	1	FG		Aged	Expansion Loops
MH C4 to Bldg 103-17	HPS	DB Conduit	Asphalt	1 1/2	40	Sch 40 Black	1 1/2	FG		Aged	
MH C4 to Bldg 103-17	HPS	DB Conduit	Asphalt	1 1/2	20	Sch 40 Black	1 1/2	FG		Aged	
MH C4 to Bldg 103-17	HPS	DB Cond-Exp	Rail Crossing	1 1/2	12	Sch 40 Black	1 1/2	FG		Aged	Expansion Loops
MH C4 to Bldg 103-17	Cond	DB Conduit	Asphalt	1 1/4	40	Sch 80 Black	1	FG		Aged	
MH C4 to Bldg 103-17	Cond	DB Conduit	Asphalt	1 1/4	20	Sch 80 Black	1	FG		Aged	
MH C4 to Bldg 103-17	Cond	DB Cond-Exp	Rail Crossing	1 1/4	12	Sch 80 Black	1	FG		Aged	Expansion Loops
Bldg 103-6 to MH A18	HPS	DB Conduit	Natural	8	4,210	Sch 40 Black	3	FG		Aged	
Bldg 103-6 to MH A18	HPS	DB Conduit	Asphalt Road	8	50	Sch 40 Black	3	FG		Aged	
Bldg 103-6 to MH A18	HPS	DB Conduit	Asphalt	8	40	Sch 40 Black	3	FG		Aged	
Bldg 103-6 to MH A18	HPS	DB Conduit	Rail Crossing	8	100	Sch 40 Black	3	FG		Aged	
Bldg 103-6 to MH A18	HPS	DB Cond-Exp	Natural	8	1,155	Sch 40 Black	3	FG		Aged	Expansion Loops
Bldg 103-6 to MH A18	Cond	DB Conduit	Natural	4	4,210	Sch 80 Black	1 1/2	FG		Aged	
Bldg 103-6 to MH A18	Cond	DB Conduit	Asphalt Road	4	50	Sch 80 Black	1 1/2	FG		Aged	
Bldg 103-6 to MH A18	Cond	DB Conduit	Asphalt	4	40	Sch 80 Black	1 1/2	FG		Aged	
Bldg 103-6 to MH A18	Cond	DB Conduit	Rail Crossing	4	100	Sch 80 Black	1 1/2	FG		Aged	
Bldg 103-6 to MH A18	Cond	DB Cond-Exp	Natural	4	1,155	Sch 80 Black	1 1/2	FG		Aged	Expansion Loops
MH A18 to Bldg 108-20	HPS	DB Conduit	Natural	8	240	Sch 40 Black	3	FG		Aged	
MH A18 to Bldg 108-20	HPS	DB Conduit	Asphalt	8	40	Sch 40 Black	3	FG		Aged	
MH A18 to Bldg 108-20	HPS	DB Cond-Exp	Natural	8	64	Sch 40 Black	3	FG		Aged	Expansion Loops
MH A18 to Bldg 108-20	Cond	DB Conduit	Natural	4	240	Sch 80 Black	1 1/2	FG		Aged	
MH A18 to Bldg 108-20	Cond	DB Conduit	Asphalt	4	40	Sch 80 Black	1 1/2	FG		Aged	
MH A18 to Bldg 108-20	Cond	DB Cond-Exp	Natural	4	64	Sch 80 Black	1 1/2	FG		Aged	Expansion Loops
MH A3 to MH A3-1	HPS	DB Conduit	Natural	5	120	Sch 40 Black	2 1/2	FG		Aged	
MH A3 to MH A3-1	HPS	DB Conduit	Rail Crossing	5	40	Sch 40 Black	2 1/2	FG		Aged	
MH A3 to MH A3-1	HPS	DB Cond-Exp	Natural	5	38	Sch 40 Black	2 1/2	FG		Aged	Expansion Loops
MH A3 to MH A3-1	Cond	DB Conduit	Natural	3	120	Sch 80 Black	1	FG		Aged	
MH A3 to MH A3-1	Cond	DB Conduit	Rail Crossing	3	40	Sch 80 Black	1	FG		Aged	
MH A3 to MH A3-1	Cond	DB Cond-Exp	Natural	3	38	Sch 80 Black	1	FG		Aged	Expansion Loops

Hawthorne Army Ammunition Depot - Ordinance Area Steam Distribution and Condensate Collection System Piping Take-Offs

Location	Service	Placement	Surface	Dia-Inch	LF	Material	Insul-Inch	Type	Ins Cond	Remarks
MH A5 to MH A5-1	HPS	DB Conduit	Natural	3	325	Sch 40 Black	1 1/2	FG	Aged	
MH A5 to MH A5-1	HPS	DB Cond-Exp	Natural	3	38	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH A5 to MH A5-1	Cond	DB Conduit	Natural	1 1/2	325	Sch 80 Black	1	FG	Aged	
MH A5 to MH A5-1	Cond	DB Cond-Exp	Natural	1 1/2	38	Sch 80 Black	1	FG	Aged	Expansion Loops
MH A9 to MH A9-1	HPS	DB Conduit	Natural	4	140	Sch 40 Black	1	FG	Aged	
MH A9 to MH A9-1	HPS	DB Conduit	Rail Crossing	4	20	Sch 40 Black	2 1/2	FG	Aged	
MH A9 to MH A9-1	HPS	DB Cond-Exp	Natural	4	32	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops
MH A9 to MH A9-1	Cond	DB Conduit	Natural	2	140	Sch 80 Black	1 1/2	FG	Aged	
MH A9 to MH A9-1	Cond	DB Conduit	Rail Crossing	2	40	Sch 80 Black	1 1/2	FG	Aged	
MH A9 to MH A9-1	Cond	DB Cond-Exp	Natural	2	32	Sch 80 Black	1 1/2	FG	Aged	Expansion Loops
MH A9-1 to MH A9-1a	HPS	DB Conduit	Natural	2 1/2	225	Sch 40 Black	1 1/2	FG	Aged	
MH A9-1 to MH A9-1a	HPS	DB Cond-Exp	Natural	2 1/2	29	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH A9-1 to MH A9-1a	Cond	DB Conduit	Natural	2	225	Sch 80 Black	1	FG	Aged	
MH A9-1 to MH A9-1a	Cond	DB Cond-Exp	Natural	2	29	Sch 80 Black	1	FG	Aged	Expansion Loops
MH A9-1 to MH A9-1a	Cond	DB Conduit	Natural	1 1/2	225	Sch 80 Black	1	FG	Aged	
MH A9-1 to MH A9-1a	Cond	DB Cond-Exp	Natural	1 1/2	29	Sch 80 Black	1	FG	Aged	Expansion Loops
MH A9-1a to Bldg 108-1	HPS	DB Conduit	Natural	2 1/2	90	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH A9-1a to Bldg 108-1	Cond	DB Conduit	Natural	1 1/2	90	Sch 80 Black	1	FG	Aged	Elbow Expn
MH A9-1a to Bldg 108-4	HPS	DB Conduit	Natural	2 1/2	80	Sch 40 Black	1 1/2	FG	Aged	Elbow Expn
MH A9-1a to Bldg 108-4	Cond	DB Conduit	Natural	2	80	Sch 80 Black	1	FG	Aged	Elbow Expn
MH A9-1 to Bldg 108-3	HPS	DB Conduit	Natural	2 1/2	600	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH A9-1 to Bldg 108-3	HPS	DB Cond-Exp	Natural	2 1/2	64	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH A9-1 to Bldg 108-3	Cond	DB Conduit	Natural	1 1/2	600	Sch 80 Black	1	FG	Aged	
MH A9-1 to Bldg 108-3	Cond	DB Cond-Exp	Natural	1 1/2	64	Sch 80 Black	1	FG	Aged	Expansion Loops
MH A11 to Bldg 108-13	HPS	DB Conduit	Natural	6	975	Sch 40 Black	2 1/2	FG	Aged	
MH A11 to Bldg 108-13	HPS	DB Conduit	Asphalt Road	6	20	Sch 40 Black	2 1/2	FG	Aged	
MH A11 to Bldg 108-13	HPS	DB Conduit	Rail Crossing	6	80	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops
MH A11 to Bldg 108-13	HPS	DB Cond-Exp	Natural	6	245	Sch 40 Black	2 1/2	FG	Aged	
MH A11 to Bldg 108-13	Cond	DB Conduit	Natural	3	975	Sch 80 Black	1 1/2	FG	Aged	
MH A11 to Bldg 108-13	Cond	DB Conduit	Asphalt Road	3	20	Sch 80 Black	1 1/2	FG	Aged	
MH A11 to Bldg 108-13	Cond	DB Conduit	Rail Crossing	3	80	Sch 80 Black	1 1/2	FG	Aged	Expansion Loops
MH A11 to Bldg 108-13	Cond	DB Cond-Exp	Natural	3	245	Sch 80 Black	1 1/2	FG	Aged	
MR-1 to MR-2, Bldg 108-13	HPS	DB Conduit	Natural	4	130	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops
MR-1 to MR-2, Bldg 108-13	HPS	DB Cond-Exp	Natural	4	31	Sch 40 Black	2 1/2	FG	Aged	Expansion Loops

Hawthorne Army Ammunition Depot - Ordinance Area Steam Distribution and Condensate Collection System Piping Take-Offs

<u>Location</u>	<u>Service</u>	<u>Placement</u>	<u>Surface</u>	<u>Dia-Inch</u>	<u>LF</u>	<u>Material</u>	<u>Insul-Inch</u>	<u>Type</u>	<u>Ins Cond</u>	<u>Remarks</u>
MR-1 to MR-2, Bldg 108-13	Cond	DB Conduit	Natural	2	130	Sch 80 Black	1	FG	Aged	
MR-1 to MR-2, Bldg 108-13	Cond	DB Cond-Exp	Natural	2	31	Sch 80 Black	1	FG	Aged	Expansion Loops
MH A15 to Bldg 108-22	HPS	DB Conduit	Natural	3	140	Sch 40 Black	1 1/2	FG	Aged	
MH A15 to Bldg 108-22	HPS	DB Cond-Exp	Natural	3	32	Sch 40 Black	1 1/2	FG	Aged	Expansion Loops
MH A15 to Bldg 108-22	Cond	DB Conduit	Natural	1 1/2	140	Sch 80 Black	1	FG	Aged	
MH A15 to Bldg 108-22	Cond	DB Cond-Exp	Natural	1 1/2	32	Sch 80 Black	1	FG	Aged	Expansion Loops

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Steam Distribution and Condensate Collection System Manhole Take-Offs

MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
Pump Pit	HPS	8	14	0	0	2	0	0	1	2	0	0	0	0	0	1	1	0	0	For Main Line "A"
Pump Pit	HPS	8	6	0	0	0	2	0	1	2	0	0	0	0	0	1	1	0	0	For Main Line "B"
Pump Pit	HPS	4	12	0	0	0	6	0	1	2	1	0	0	0	0	1	1	0	0	For Main Line "C"
Pump Pit	Cond	4	18	3	1	0	4	0	0	2	0	0	1	2	0	1	1	1	4	For Main Line "A"
Pump Pit	Cond	4	8	1	0	0	2	0	0	1	0	0	0	1	0	0	0	0	0	For Main Line "B"
Pump Pit	Cond	2	18	3	1	0	5	0	0	1	0	0	1	2	0	1	1	1	2	For Main Line "C"
MH A1	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A1	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A1	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A2	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A2	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A2	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A3	HPS	5	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	1	Branch to MH A3-1
MH A3	HPS	8	9	0	2	2	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A3	Cond	1 1/2	16	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A3	Cond	3	9	0	2	0	2	0	1	1	0	0	0	0	0	0	0	0	0	Branch to MH A3-1
MH A3-1	HPS	5	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-5
MH A3-1	Cond	3	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-5
MH A3-1	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	MH A3-1 Drip
MH A4	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A4	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A4	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A5	HPS	3	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	1	Service to Bldg 103-40
MH A5	HPS	8	9	0	2	2	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A5	Cond	1 1/2	16	3	0	0	10	0	1	1	0	1	1	1	0	0	0	0	2	Service to Bldg 103-40
MH A5	Cond	4	9	0	2	0	2	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A5-1	HPS	3	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-40
MH A5-1	Cond	1 1/2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-40
MH A5-1	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	MH A5-1 Drip
MH A6	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A6	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A6	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A7	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A7	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A7	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A8	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A8	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A8	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A9	HPS	4	6	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Branch to MH A9-1
MH A9	HPS	8	7	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A9	Cond	2	4	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Branch to MH A9-1
MH A9	Cond	4	7	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A9	Cond	1 1/2	6	3	1	0	7	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A9-1	HPS	2 1/2	7	2	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	To A9-1a & A9-2
MH A9-1	HPS	4	4	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Branch Main
MH A9-1	Cond	1 1/2	7	2	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Branch & from A9-1a
MH A9-1	Cond	2	4	0	3	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Branch & from A9-1a
MH A9-1	Cond	1 1/2	4	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Branch "A9" Drip Leg

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MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
MH A9-1a	HPS	2 1/2	12	3	3	0	0	0	0	1	1	0	0	0	0	0	0	0	0	To Bldgs 108-1 & 4
MH A9-1a	Cond	1 1/2	7	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	From Bldg 108-1
MH A9-1a	Cond	2	7	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	From Bldg 108-4
MH A9-1a	Cond	1 1/2	4	3	1	0	4	0	0	0	0	1	1	1	0	0	0	0	2	Branch "A9-1a" Drip
MH A9-2	HPS	2 1/2	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 108-3
MH A9-2	Cond	1 1/2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 108-3
MH A9-2	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	MH A9-2 Drip
MH A10	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A10	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A10	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A11	HPS	6	8	1	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	Branch to MH D1
MH A11	HPS	8	7	1	2	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A11	Cond	3	4	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Branch to MH D1
MH A11	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A11	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A12	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A12	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A12	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A13	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A13	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A13	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A14	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A14	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A14	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A15	HPS	3	4	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 108-22
MH A15	HPS	8	7	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A15	Cond	1 1/2	10	3	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	To Bldg 108-22 & Drip
MH A15	Cond	4	7	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A16	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A16	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A16	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A17	HPS	8	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A17	Cond	4	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A17	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH A18	HPS	6	8	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 108-20
MH A18	HPS	8	6	1	2	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "A"
MH A18	Cond	3	5	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 108-20
MH A18	Cond	4	6	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "A"
MH A18	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "A" Drip Leg
MH B1	HPS	8	8	0	3	2	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "B"
MH B1	HPS	3	6	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-28
MH B1	HPS	2 1/2	6	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-39
MH B1	Cond	4	8	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B1	Cond	2	6	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-28
MH B1	Cond	1 1/4	6	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-39
MH B1	Cond	1 1/2	7	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "B" Drip Leg
MH B1-1	HPS	3	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-28
MH B1-1	Cond	2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-28

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MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
MH B1-1	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Condensate Drip
MH B1-2	HPS	2 1/2	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-39
MH B1-2	Cond	1 1/4	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-39
MH B1-2	Cond	1 1/4	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	MH Condensate Drip
MH B2	HPS	8	8	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "B"
MH B2	Cond	4	8	1	2	1	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B2	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "B" Drip Leg
MH B3	HPS	8	8	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "B"
MH B3	Cond	4	8	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B3	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "B" Drip Leg
MH B4	HPS	8	8	0	3	2	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "B"
MH B4	HPS	5	6	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-8
MH B4	HPS	3	6	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-7
MH B4	Cond	4	8	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B4	Cond	2 1/2	6	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-8
MH B4	Cond	1 1/2	6	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-7
MH B4	Cond	1 1/2	7	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "B" Drip Leg
MH B4-1	HPS	5	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-8
MH B4-1	Cond	2 1/2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-8
MH B4-1	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Condensate Drip
MH B4-2	HPS	3	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-7
MH B4-2	Cond	1 1/2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-7
MH B4-2	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	MH Condensate Drip
MH B5	HPS	8	8	0	3	2	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "B"
MH B5	HPS	3	6	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-9
MH B5	Cond	4	4	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B5	Cond	2 1/2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B5	Cond	1 1/2	6	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-9
MH B5	Cond	1 1/2	7	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "B" Drip Leg
MH B5-1	HPS	3	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-9
MH B5-1	Cond	1 1/2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-9
MH B5-1	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Condensate Drip
MH B6	HPS	8	4	0	3	2	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "B"
MH B6	HPS	6	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B6	HPS	5	6	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-10
MH B6	Cond	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B6	Cond	2 1/2	4	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B6	Cond	2 1/2	6	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-10
MH B6	Cond	1 1/2	7	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "B" Drip Leg
MH B6-1	HPS	5	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-10
MH B6-1	Cond	2 1/2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-10
MH B6-1	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Condensate Drip
MH B7	HPS	6	8	0	3	2	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "B"
MH B7	HPS	3	6	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-11
MH B7	Cond	3	8	0	3	2	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B7	Cond	1 1/2	6	1	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-11
MH B7	Cond	1 1/2	7	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "B" Drip Leg
MH B7-1	HPS	3	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-11

Hawthorne Army Ammunition Depot - Ordinance Area

Steam Distribution and Condensate Collection System Manhole Take-Offs

MH No.	Service	Dia-Inch	Pipe LF	Valves	Tee	45° Ell	90° Ell	Expn Jt	Anchor	Guide	Drip Nipple	Trap	Strainer	Check Valve	PRV	Stm Gauge	Pres Gauge	Pump/Rcvr	Union	Remarks
MH B7-1	Cond	1 1/2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-11
MH B7-1	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Condensate Drip
MH B8	HPS	6	8	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "B"
MH B8	Cond	3	8	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "B"
MH B8	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "B" Drip Leg
MH B9	HPS	6	4	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	Main from MH B8
MH B9	Cond	3	4	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Main from MH B8
MH B9	HPS	4	6	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Main to MH B9-1
MH B9	Cond	2	6	4	1	0	6	0	0	1	0	1	1	1	0	0	0	0	2	Main to MH B9-1
MH B9-1	HPS	4	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 103-20
MH B9-1	Cond	2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-20
MH B9-1	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Condensate Drip
MH C2	HPS	4	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "C"
MH C2	Cond	2	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "C"
MH C2	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "C" Drip Leg
MH C3	HPS	4	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "C"
MH C3	Cond	2	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "C"
MH C3	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "C" Drip Leg
MH C4	HPS	1 1/2	4	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 103-17
MH C4	HPS	4	7	0	2	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "C"
MH C4	Cond	1 1/4	10	3	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	To Bldg 103-17 & Drip
MH C4	Cond	2	7	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "C"
MH C5	HPS	4	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "C"
MH C5	Cond	2	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Main Line "C"
MH C5	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "C" Drip Leg
MH C6	HPS	4	6	1	2	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Main Line "C"
MH C6	HPS	2	7	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	South Bldg 103-16
MH C6	HPS	3	6	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	North Bldg 103-16
MH C6	Cond	2	7	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	Main Line "C"
MH C6	Cond	1 1/2	10	2	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	To Bldg 103-16
MH C6	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "C" Drip Leg
MH C6-1	HPS	3	10	1	1	0	3	0	0	1	1	0	0	0	0	0	0	0	1	Service to Bldg 103-16
MH C6-1	Cond	1 1/2	12	3	2	0	9	0	0	1	0	1	1	1	0	0	0	0	2	Service to Bldg 103-16
MH D1	HPS	6	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Branch Line "D"
MH D1	Cond	3	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Branch Line "D"
MH D1	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "D" Drip Leg
MH D2	HPS	6	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Branch Line "D"
MH D2	Cond	3	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Branch Line "D"
MH D2	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "D" Drip Leg
MH D3	HPS	6	7	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	Branch Line "D"
MH D3	Cond	3	7	1	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	Branch Line "D"
MH D3	Cond	1 1/2	6	2	0	0	5	0	0	0	0	1	1	1	0	0	0	0	2	Main Line "D" Drip Leg
MH D4	HPS	2 1/2	8	1	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0	Service to Bldg 108-13
MH D4	Cond	1 1/2	8	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	Service to Bldg 108-13
MH D4	Cond	1 1/2	4	3	1	0	5	0	0	0	0	1	1	1	0	0	0	0	2	MH D4 Drip

APPENDIX C

Boiler Efficiency and Thermal Loss Calculations

APPENDIX C

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Hawthorne Army Ammunition Depot - Boiler Plant Name Plate Data

Boiler Building 13 - Industrial Area

Boilers: 3 Each Fire Tube Boilers Operating Pressure: 105 psig, at 341 °F
 $h_l = 312 \text{ BTU/LB}$ $h_{fg} = 877.9 \text{ BTU/Lb}$
Manufacturer: Nebraska Company, Inc.
Serial Nos.: 2D1637 2D1638 2D1639
National Board Nos.: 1599 1600 1601
Maximum AWP (psig): 250 250 250
Boiler Heating Surface: 2,007 SF 2,007 SF 2,007 SF
Year Built: 1974 1974 1974
Rated Steam Capacity: 18 KLB/HR 18 KLB/HR 18 KLB/HR
Boiler Fuel: No. 2 Diesel Fuel Oil (High Sulfur)

Boiler Feed Pumps: 2 Each, Myers Centrifugal, 15 HP each, 1-1/2-inch inlets

Boiler Efficiency Tests:	<u>Boiler No.</u>	<u>Oxygen %</u>	<u>Temp °F</u>	<u>Eff %</u>	<u>Condition</u>
	13-1	8.8%	290	86.0%	Boiler Cold
	13-1	5.1%	440	82.9%	High Fire
	13-2	1.0%	310	88.3%	Boiler Cold
	13-2	9.1%	-	84.2%	High Fire
	13-3	3.6%	350	86.6%	Boiler Cold
	13-3	4.6%	360	82.7%	High Fire

For plant efficiency calculations, the high firing efficiency is used since it more closely follows actual operations.

Boiler Building 103-6 - Ordnance Area

Boilers: 3 Each, Water Tube Boilers, Style 1 MV Operating Pressure: 112 psig
Boiler Fuel: No. 2 Diesel Fuel Oil (High Sulfur) 345 °F
 $h_l = 316.94 \text{ BTU/Lb}$ $h_{fg} = 874.4 \text{ BTU/Lb}$
Coen Burner Natural Gas or Oil at 19,700 CFH of 1,000 BTU/CF Natural Gas
Boiler No. 24 FYR Compak Packaged Burner, Coen File D-6210-1
Boiler No. 25 FYR Compak Packaged Burner, Coen File D-6437
Boiler No. 26 FYR Compak Packaged Burner, Coen File D-6210-2

Burner controls disconnected from flue sensor and automatic controls, burners are trimmed manually

Boiler Feed Pumps: 2 Each, at 20 HP, and 1 Each at 15 HP

Boiler Efficiency Tests:	<u>Boiler No.</u>	<u>Oxygen %</u>	<u>Temp °F</u>	<u>Eff %</u>	<u>Condition</u>
	24	9.4%	380	84.8%	Boiler Cold
	24	9.3%	480	80.2%	High Fire
	25	8.5%	270	85.4%	Boiler Cold
	25	7.2%	420	82.3%	High Fire
	25	8.5%	270	85.4%	Boiler Cold
	25	7.2%	400	82.5%	High Fire
	26		Not Operating		

For plant efficiency calculations, the high firing efficiency is used since it more closely follows actual operations.

Hawthorne Army Ammunition Depot - Boiler Plant Efficiency Calculations

(Refer to **Boiler Plant Efficiency Calculation Methods** in Appendix D for an explanation)

	Steam Plant	Steam Plant	
	Bldg 13	Bldg 103-6	
Firing (Combustion) Efficiency Test	83.2%	81.6%	Weighted average of efficiencies allowance for steam ejectors
Auxiliary Equipment Uses	-2.0%	-2.0%	
Radiation Losses @ Figure D-1	-2.0%	-2.0%	
Blowdown Losses (Continuous BD)	-1.5%	-1.5%	Not including distribution leakage
Leaks (Minimal at boiler houses)	-1.0%	-1.0%	
Conduction/Convection	-2.5%	-2.5%	
(Plant only, not including distribution piping; systems rated in "poor" condition due only to age, well maintained.)			
Shut-Down/Cycling Losses	-4.0%	-4.0%	Boilers oversized for current load.
General Equipment Condition	-3.0%	-3.0%	
(Plant only systems rated in "poor" condition due only to age, well maintained.)			
Overall Plant Efficiencies	67.2%	65.6%	

Steam Leakage and Condensate Energy Loss Calculations

Makeup water records are summarized for each of the two boiler systems investigated. Steam production data is not available.

	Steam Plant	
	Bldg 13	Bldg 103-6
Most recent calendar year May '94 through April '95:	3,429,870	1,503,591 Gallons
Calendar Year 1994:	3,090,330	1,138,040 Gallons

The most recent calendar year data is used in steam and condensate energy loss calculations.

These losses include both steam and condensate leaks. Steam leakage represents a much greater energy loss than does the leakage of condensate. This is illustrated below:

Energy needed to raise makeup water from 50°F (raw water temperature) to 200°F, the condensate return temperature: 150.0 BTU per pound water

Energy needed to raise the 200°F condensate to 341°F, the saturation temperature of 105 psig steam: 144.4 BTU per pound water

Energy needed to vaporize 341°F water at 105 psig (heat of evaporation): 877.9 BTU per pound water

Thus, a steam leak includes loss of the useful work the steam can perform (heat of evaporation) and the energy required to heat makeup water to the vaporization temperature, all three of the above elements, or 1,172.2 BTU per pound water

A condensate leak includes only the energy needed to raise raw makeup water to the condensate return temperature, or 150.0 BTU per pound water

The following calculation shows the percent of total steam plant fuel consumption represented by steam and condensate losses where total losses are attributed exclusively to either steam or condensate.

Energy Losses	Steam Plant Bldg 13		Steam Plant 103-6	
	KK BTU/Yr	% Total Fuel	KK BTU/Yr	% Total Fuel
If Leakage is 100% Steam:	33,572	55.4%	14,730	40.8%
If Leakage is 100% Condensate:	8,430	13.9%	3,752	10.4%
Assumes water temp of 50 °F, $h_l = 18.1$ BTU/LB ; Fuel Oil at 138,700 BTU/Gallon				

Based on field observations, it appears that most of the makeup water loss is composed of condensate that is not returned to the central plants. There are only a few steam leaks. Conservatively, then, assume 10% of the losses in the Industrial and Ordnance Areas are from condensate. Blowdown is included in makeup water requirements and constitutes about 2% of the total steam flow. This use is subtracted from the loss calculations below. The annual energy savings from repairs to the distribution systems are:

Energy Losses	Industrial Area Steam Plant Bldg 13	Ordnance Area Steam Plant 103-6
	KK BTU/Yr	KK BTU/Yr
Loss from Steam Leakage	3,357	1,473
Loss from Condensate Leakage	7,587	3,377
Thermal Losses	10,944	4,850
Boiler Plant Efficiency	67.2%	65.6%
Makeup Water Fuel Uses	16,290	7,396
Blowdown Loss (2% of fuel input)	1,213	721
Leakage Fuel Losses (No 2 Fuel Oil)	15,077	6,675

Significant additional losses occur from poorly insulated steam and condensate lines. Leakage of steam and condensate has wetted the insulation (if present) to such an extent that little insulating value remains.

Energy Savings from Piping Insulation Losses

Existing piping is deteriorated and leaks have destroyed the value of insulation installed on existing piping. Insulation thermal losses are determined for existing and proposed future piping systems. Detailed calculations follow. Results are summarized here:

Energy Savings	Industrial Area Steam Plant Bldg 13	Ordnance Area Steam Plant 103-6
	KK BTU/Yr	KK BTU/Yr
Load Saved (Heating Season Only)	5,809	6,475
Boiler Plant Efficiency	67.2%	65.6%
Insulation Savings (No 2 Fuel Oil)	8,646	9,875
Total Fuel Oil Savings	23,723	16,549

Operation and Maintenance Cost Savings

The proposed new piping systems will reduce operation and maintenance costs significantly. Cost savings for each area are determined below.

Ordinance Area

Proposed piping replacements will be predominantly above ground. Installation above ground should reduce the magnitude chronic breaks experienced along certain stretches of piping. Repairs will be performed on piping without having to either dig up conduit sections or to enter manholes.

With the newly enforced confined space entry procedures, limiting access requirements into manholes should significantly reduce costs as an extra worker will not be required to be present to assist in evacuations.

Overall, the piping replacements in the Ordinance Area are expected to save about 3/4 of present maintenance costs according to maintenance supervisors. During the last year for which records are available, about 4,300 hours per year were spent on preventive maintenance, service calls and on major repairs. Based on a steamfitter rate of \$42.33 per Hour and helper rate of \$31.63 (Means Steamfitter & Helper, location adjusted) and 3/4 of the total maintenance hours, savings are expected to total:

$$4,300 \text{ hours year} \times 3/4 \times \$36.98 \text{ per hour} = \$119,261 \text{ per year, including overhead.}$$

Industrial Area

Industrial area steam leaks and condensate piping breaks create a chronic problem for the maintenance staff. Service calls to repair the distribution system seem to be a daily occurrence. The proposed repairs will replace most of the fiber reinforced plastic (FRP) piping used for condensate return from the housing area. Repairs have been frequent because the piping is damaged every time steam bypasses a trap and enters the FRP piping inadvertently. The piping is not rated for service above 250°F. One incident of 100 psig steam entering FRP condensate piping exposes the material to a temperature of at least 340°F.

Other repairs proposed will consolidate steam and condensate piping into the shallow concrete trench system. Repairs to the condensate piping, currently direct buried, will be made more accessible (and less expensive).

Overall, the piping replacements in the Industrial Area are expected to save about 3/4 of present maintenance costs according to maintenance supervisors. During the last year for which records are available, about 3,700 hours per year were spent on preventive maintenance, service calls and on major repairs. Based on a steamfitter rate of \$42.33 per Hour and helper rate of \$31.63 (Means Steamfitter & Helper, location adjusted) and 3/4 of the total maintenance hours, savings are expected to total:

$$3,700 \text{ hours year} \times 3/4 \times \$36.98 \text{ per hour} = \$102,620 \text{ per year, including overhead.}$$

Thermal Loss Calculations for New and Deteriorated Existing Steam Distribution & Condensate Piping Piping Systems

Source: Siddiqui, M.K., Calculations for Insulated Piping Systems, Heating/Piping/Air Conditioning, November 1994

Piping Layout (1=AG; 2=UG):

1 for above ground installation

Outer Pipe Diameter (Inches):

See Table below for actual sizes

Service Temperature:

HP Steam 338°F, LP Steam 250°F, Condensate 200°F

Insulation Conductivity at TM1 (BTUH-IN/SF-°F):

0.31 at 200°F

Insulation Conductivity at TM2 (BTUH-IN/SF-°F):

0.36 at 300°F

Pipe Orientation (1=Horizontal; 2=Vertical):

Normally Horizontal

Ambient Air Temperature (°F):

Average Winter Temperature = 23.4°F from TM 5-785 Bin Data for temps below 72°F (winter)

Wind Speed (MPH):

3.3 from TM 5-785 Bin Data

Surface Emittance:

0.20 for oxidized aluminum jacket (Owens Corning advice)

Average Annual Soil Temperature:

40.0°F from 1989 HVAC Handbook (ASHRAE)

Thermal Conductivity of Soil (BTUH-IN/SF-°F):

12.0 assumed based on Table 6, 22.13 1993 ASHRAE Fundamentals Handbook

Burial Depth to Centerline of Pipe (FT):

4.0 FT

Insulation Thickness (Inches):

See below, based on CEGS's for above ground, trench systems and conduit systems.

Air Space (Inches):

See below for various pipe sizes

Inner Diameter of Pipe (Inches):

See below for pipe size and service

Thermal Conductivity for Direct Buried Pipe (BTU-IN/(Hr-SF-°F):

Red Brass = 2,784 FRP = 2.30

Nominal Pipe Size

Pipe Diameter Schedule 40 for Steam Service

	1	1.25	1.5	2	2.5	3	4	5	6	8
Pipe OD (Inches)	1.182	1.52	1.755	2.221	2.672	3.284	4.263	5.305	6.345	8.303
Pipe ID (Inches)	1.049	1.38	1.61	2.067	2.469	3.068	4.026	5.047	6.065	7.981

Insulation Thickness (Mineral Wool)

	2.5	2.5	2.5	3.5	3.5	4.0	4.0	4.0	4.5	4.5
Above Ground (Inches)	2.5	2.5	2.5	3.5	3.5	4.0	4.0	4.0	4.5	4.5
Pipe Trench (Inches)	2.0	2.0	2.5	2.5	2.5	3.0	3.0	3.0	3.5	3.5
UG Conduit (Inches)	2.0	2.0	2.0	2.5	2.5	3.0	3.0	3.0	3.5	3.5
Conduit Casing (Inch)	6.625	6.625	6.625	8.625	8.625	10.750	12.750	12.750	16.000	18.0
Air Space (Inches)	0.813	0.688	0.563	0.813	0.563	0.875	1.375	0.875	1.500	1.500

Pipe Diameter Schedule 80 for Condensate Service

	1.136	1.469	1.7	2.157	2.599	3.2	4.163	5.188	6.193	8.125
Pipe OD (Inches)	1.136	1.469	1.7	2.157	2.599	3.2	4.163	5.188	6.193	8.125
Pipe ID (Inches)	0.957	1.278	1.5	1.939	2.323	2.9	3.826	4.813	5.761	7.625

Insulation Thickness (Mineral Wool)

	2.0	2.0	2.0	2.0	2.0	2.5	2.5	-	-	-
Above Ground (Inches)	2.0	2.0	2.0	2.0	2.0	2.5	2.5	-	-	-
Pipe Trench (Inches)	1.5	1.5	1.5	1.5	1.5	2.0	2.0	-	-	-
UG Conduit (Inches)	1.5	1.5	1.5	1.5	1.5	2.0	2.0	-	-	-
Conduit Casing (Inch)	6.625	6.625	6.625	8.625	8.625	10.750	10.750	-	-	-
Air Space (Inches)	1.313	1.188	1.063	1.813	1.563	1.875	1.375	-	-	-

Thermal Loss Calculations for New and Deteriorated Existing Steam Distribution & Condensate Piping

[illegible]

Thermal Savings for Industrial Area Steam Distribution System Piping Replacements

Location	Service	Existing Placement	Proposed Placement	Surface	Quantity		Current BTUH/LF	Proposed BTUH/LF	Thermal Savings		
					No. Units	Unit Meas.			Heat Load Saved BTUH	KK BTU/Yr Saved	
Pipe Replacement Bldg 13 to MH B4 (Alternative 1)											
MH B1 to Bldg 6	2" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	32	120.9	47.3	2,355	10	
MH B2 to MH B3	2" (80) Cond	DB Red Brass	Conc Trench	Conc Trench	LF	198	244.9	33.9	41,778	183	
MH B2 to MH B3	2" (80) Cond	DB Red Brass	Conc Trench	Conc Road	LF	25	244.9	33.9	5,275	23	
MH B3 to MH B4	2" (80) Cond	DB Red Brass	DB Conduit	Asphalt	LF	75	244.9	30.1	16,110	71	
MH B3 to MH B4	2" (80) Cond	DB Red Brass	DB Conduit	Conc Road	LF	22	244.9	30.1	4,726	21	
MH B3 to MH B4	3" (40) HPS	Direct Bury	DB Conduit	Asphalt	LF	75	492.7	49.2	33,263	146	
MH B3 to MH B4	3" (40) HPS	Direct Bury	DB Conduit	Conc Road	LF	22	492.7	49.2	9,757	43	
MH A2-1 to MH A5	3" (80) Cond	DB Red Brass	Conc Trench	Lawn	LF	349	270.4	37.2	81,387	356	
MH A5 to MH B1	3" (80) Cond	DB Red Brass	Conc Trench	Conc Trench	LF	44	270.4	37.2	10,261	45	
MH B1 to MH B2	3" (80) Cond	DB Red Brass	Conc Trench	Conc Trench	LF	102	270.4	37.2	23,786	104	
MH B1 to MH B2	3" (80) Cond	DB Red Brass	Conc Trench	Conc Road	LF	25	270.4	37.2	5,830	26	
MH B1 to MH B2	4" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	102	207.0	63.5	14,637	64	
MH B1 to MH B2	4" (40) HPS	Conc Trench	Conc Trench	Conc Road	LF	25	207.0	63.5	3,588	16	
Bldg 13 to MH A2-1	4" (80) Cond	Conc Trench	Conc Trench	Lawn	LF	330	109.2	63.5	15,081	66	
MH A5 to MH B1	5" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	44	250.5	73.5	7,788	34	
MH B2 to MH B3	5" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	198	250.5	73.5	35,046	154	
MH B2 to MH B3	5" (40) HPS	Conc Trench	Conc Trench	Conc Road	LF	25	250.5	73.5	4,425	19	
Bldg 13 to MH A5	6" (40) HPS	Conc Trench	Conc Trench	Lawn	LF	679	293.5	75.3	148,158	649	
Bldg 13 to MH A5	6" (40) HPS	Conc Trench	Conc Trench	Conc Road	LF	38	293.5	75.3	8,292	36	
Pipe Replacement MH A7 to MH A9 (Alternative 2)											
MH A7 to MH A9	5" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	298	250.5	73.5	52,746	231	
MH A7 to MH A9	5" (40) HPS	Conc Trench	Conc Trench	Conc Road	LF	22	250.5	73.5	3,894	17	
MH A7 to MH A9	3" (80) Cond	DB Red Brass	Conc Trench	Conc Trench	LF	298	270.4	37.2	69,494	304	
MH A7 to MH A9	3" (80) Cond	DB Red Brass	Conc Trench	Conc Road	LF	22	270.4	37.2	5,130	22	
MH A9 to Bldg 1	2 1/2" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	100	140.1	52.7	8,740	38	
MH A9 to Bldg1	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	140	53.2	29.3	3,346	15	
MH A8 to Bldg 2	2" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	130	120.9	47.3	9,568	42	
MH A8 to Bldg 2	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	130	53.2	29.3	3,107	14	
MH A5 to MH A7	5" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	349	250.5	73.5	61,773	271	
MH A5 to MH A7	5" (40) HPS	Conc Trench	Conc Trench	Conc Road	LF	51	250.5	73.5	9,027	40	
MH A5 to MH A7	3" (80) Cond	DB Red Brass	Conc Trench	Conc Trench	LF	349	270.4	37.2	81,387	356	
MH A5 to MH A7	3" (80) Cond	DB Red Brass	Conc Trench	Conc Road	LF	51	270.4	37.2	11,893	52	

Thermal Savings for Industrial Area Steam Distribution System Piping Replacements

Location	Service	Existing Placement	Proposed Placement	Surface	Quantity		Current BTUH/LF	Proposed BTUH/LF	Thermal Savings	
					No. Units	Unit Meas.			Heat Load Saved BTUH	KK BTU/Yr Saved
Pipe Rerouting for Bldgs 3, 35 & 36 (Alternative 3)										
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	DB Conduit	Lawn	LF	71	120.9	43.3	5,510	24
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	DB Conduit	Conc Road	LF	18	120.9	43.3	1,397	6
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	DB Conduit	Sidewalk	LF	5	120.9	43.3	388	2
Bldg 3 to Bldg 35	2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	71	244.9	30.1	15,251	67
Bldg 3 to Bldg 35	2" (80) Cond	DB Red Brass	DB Conduit	Conc Road	LF	18	244.9	30.1	3,866	17
Bldg 3 to Bldg 35	2" (80) Cond	DB Red Brass	DB Conduit	Sidewalk	LF	5	244.9	30.1	1,074	5
MH A2-1 to MH A2-2	2" (40) HPS	Rerouted Pipe	DB Conduit	Asphalt	LF	185	0.0	43.3	(8,011)	(35)
MH A2-2 to MH A2-3	2" (40) HPS	Rerouted Pipe	DB Conduit	Asphalt	LF	241	0.0	43.3	(10,435)	(46)
MH A2-2 to MH A2-3	2" (40) HPS	Rerouted Pipe	DB Conduit	Conc Road	LF	42	0.0	43.3	(1,819)	(8)
MH A2-1 to MH A2-2	4" (80) Cond	DB Red Brass	DB Conduit	Asphalt	LF	185	290	38.7	46,491	204
MH A2-2 to MH A2-3	3" (80) Cond	DB Red Brass	DB Conduit	Asphalt	LF	241	270.4	32.7	57,286	251
MH A2-2 to MH A2-3	3" (80) Cond	DB Red Brass	DB Conduit	Conc Road	LF	42	270.4	32.7	9,983	44
Bldg 35 to Bldg 36	2" (40) HPS	Direct Bury	DB Conduit	Conc Road	LF	20	120.9	43.3	1,552	7
Bldg 35 to Bldg 36	2" (80) Cond	DB Red Brass	DB Conduit	Conc Road	LF	20	244.9	30.1	4,296	19
Bldg 35 to Bldg 36	2" (40) HPS	Direct Bury	DB Conduit	Lawn	LF	76	120.9	43.3	5,898	26
Bldg 35 to Bldg 36	2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	76	244.9	30.1	16,325	72
Rerouted Existing	2" (40) HPS	Conc Trench	rerouted, see above		LF	267	120.9	0	32,280	141
Steam Pipe Replacements for U Street - East (Alternative 4)										
MH A9 to MH EJ3	2 1/2" (80) Cond	Rerouted Pipe	Conc Trench	Conc Trench	LF	140	0	38.3	(5,362)	(23)
MH A10 to Bldg 42	2" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	75	120.9	47.3	5,520	24
MH A10 to Bldg 42	2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	75	63.8	33.9	2,243	10
MH A10 to MH A11	4" (40) HPS	Conc Trench	Conc Trench	Conc Trench	LF	300	207.0	63.5	43,050	189
MH A10 to MH A11	2 1/2" (80) Cond	Rerouted Pipe	Conc Trench	Conc Trench	LF	300	0	38.3	(11,490)	(50)
MH A11 to MH A11J	2 1/2" (80) Cond	Rerouted Pipe	Conc Trench	Conc Trench	LF	20	0	38.3	(766)	(3)
MH A11 to A11-3	2 1/2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	350	100.4	37.9	21,875	96
MH A11-3 to P26	2 1/2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	150	100.4	37.9	9,375	41
MH A11-1 to V	2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	40	86.6	34	2,104	9
MHr P21 to U	2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	40	86.6	34	2,104	9
MH A11-2 to T	2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	40	86.6	34	2,104	9
MH P22 To S	2 1/2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	40	100.4	37.9	2,500	11
MH A11-3 to R	2 1/2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	40	100.4	37.9	2,500	11
MH P23 to Q	2 1/2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	50	100.4	37.9	3,125	14

Thermal Savings for Industrial Area Steam Distribution System Piping Replacements

Location	Service	Existing Placement	Proposed Placement	Surface	Quantity		Current BTUH/LF	Proposed BTUH/LF	Thermal Savings	
					No. Units	Unit Meas.			Heat Load Saved BTUH	KK BTU/Yr Saved
MH P24 to P	2 1/2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	55	100.4	37.9	3,438	15
MH P25 to O	2 1/2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	40	100.4	37.9	2,500	11
MH P25 to MHP26	2 1/2" (40) LPS	Conc Trench	Conc Trench	Conc Trench	LF	80	100.4	37.9	5,000	22
Existing Red Brass Condensate Pipe	2" Brass Cond	DB Red Brass	rerouted, see above		LF	195	244.9	0	47,756	209
	3" Brass Cond	DB Red Brass	rerouted, see above		LF	908	270.4	0	245,523	1,075
Family Housing Condensate Piping Replacement (Alternative 5)										
MH A13 to MH A14	1" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	300	39.9	23.3	4,980	22
MH A13 to MH A14	1" (80) Cond	Conc Trench	Conc Trench	Conc Road	LF	19	39.9	23.3	315	1
MH A14 to MH A15	2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	100	63.8	33.9	2,990	13
MH A15 to MH A14	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	100	53.2	29.3	2,390	10
MH A15 to MH A16	2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	95	63.8	33.9	2,841	12
MH A17-1 to A16	1" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	95	39.9	23.3	1,577	7
MH A17-1 to A16	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	95	53.2	29.3	2,271	10
MH A18 to A17-1	1" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	330	39.9	23.3	5,478	24
MH A18 to A17-1	1" (80) Cond	Conc Trench	Conc Trench	Conc Road	LF	20	39.9	23.3	332	1
MH A14 to F/179	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	33	53.2	29.3	789	3
MH A15 to E/178	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	44	53.2	29.3	1,052	5
MH A16 to D/177	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	44	53.2	29.3	1,052	5
MH A17-1 to C/176	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	44	53.2	29.3	1,052	5
MH A17 to B/175	1 1/2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	44	53.2	29.3	1,052	5
MH A18 to A/174	2" (80) Cond	Conc Trench	Conc Trench	Conc Trench	LF	65	63.8	33.9	1,944	9
MH A18 to A/174	2" (80) Cond	Conc Trench	Conc Trench	Conc Road	LF	15	63.8	33.9	449	2
MH A16 to N-1	2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	311	221.6	30.1	59,557	261
MH A16 to N-1	2" (80) Cond	DB FRP Pipe	DB Conduit	Conc Road	LF	40	221.6	30.1	7,660	34
MH A16 to N-1	2" (80) Cond	DB FRP Pipe	DB Conduit	Sidewalk	LF	5	221.6	30.1	958	4
MH N-1 to DD/291	1 1/2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	35	201.4	26	6,139	27
MH N-1 to N-2	2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	120	221.6	30.1	22,980	101
MH N-1 to N-2	2" (80) Cond	DB FRP Pipe	DB Conduit	Sidewalk	LF	10	221.6	30.1	1,915	8
MH N-2 to CC/290	1 1/2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	35	201.4	26	6,139	27
MH N-2 to N-3	2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	514	221.6	30.1	98,431	431
MH N-2 to N-3	2" (80) Cond	DB FRP Pipe	DB Conduit	Conc Road	LF	20	221.6	30.1	3,830	17
MH N-3 to 292-2	1 1/2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	40	201.4	26	7,016	31
MH N-3 to N-4	2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	100	221.6	30.1	19,150	84

Thermal Savings for Industrial Area Steam Distribution System Piping Replacements

Location	Service	Existing Placement	Proposed Placement	Surface	Quantity		Current BTUH/LF	Proposed BTUH/LF	Thermal Savings	
					No. Units	Unit Meas.			Heat Load Saved BTUH	KK BTU/Yr Saved
MH N-3 to N-4	2" (80) Cond	DB FRP Pipe	DB Conduit	Conc Road	LF	20	221.6	30.1	3,830	17
MH N-4 to N-5	2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	362	221.6	30.1	69,323	304
MH N-4 to N-5	2" (80) Cond	DB FRP Pipe	DB Conduit	Conc Road	LF	40	221.6	30.1	7,660	34
MH N-4 to N-5	2" (80) Cond	DB FRP Pipe	DB Conduit	Sidewalk	LF	10	221.6	30.1	1,915	8
MH N-5 to N-6	2" (80) Cond	DB FRP Pipe	DB Conduit	Lawn	LF	454	221.6	30.1	86,941	381
MH N-5 to N-6	2" (80) Cond	DB FRP Pipe	DB Conduit	Conc Road	LF	40	221.6	30.1	7,660	34
Shop Area Condensate Piping Replacements (Alternative 6)										
MH A-5 to R5-1	3" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	75	270.4	32.7	17,828	78
MH R5-1 to R5-2	3" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	105	270.4	32.7	24,959	109
MH R5-1 to R5-2	2" (80) Cond	DB Red Brass	DB Conduit	Sidewalk	LF	5	244.9	30.1	1,074	5
MH R5-1 to Bldg 6	1 1/2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	15	232.2	26	3,093	14
MH R5-2 to Bldg 6	1 1/2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	15	232.2	26	3,093	14
MH R5-2 to R5-4	2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	25	244.9	30.1	5,370	24
MH R5-2 to R5-4	2" (80) Cond	DB Red Brass	DB Conduit	Concrete	LF	138	244.9	30.1	29,642	130
MH R5-4 to Bldg 7	1 1/2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	15	232.2	26	3,093	14
Bldg 6 to Bldg 7	3" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	20	270.4	32.7	4,754	21
Bldg 6 to Bldg 7	3" (80) Cond	DB Red Brass	DB Conduit	Concrete	LF	25	270.4	32.7	5,943	26
Bldg 7 to Bldg 8	3" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	50	270.4	32.7	11,885	52
MH R5-4 to R5-5	2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	140	244.9	30.1	30,072	132
MH R5-4 to R5-5	2" (80) Cond	DB Red Brass	DB Conduit	Concrete	LF	2	244.9	30.1	430	2
MH R5-4 to R5-5	2" (80) Cond	DB Red Brass	DB Conduit	Sidewalk	LF	5	244.9	30.1	1,074	5
MH R5-5 to R5-6	2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	100	244.9	30.1	21,480	94
MH R5-5 to R5-6	2" (80) Cond	DB Red Brass	DB Conduit	Concrete	LF	30	244.9	30.1	6,444	28
MH R5-6 to R5-8	2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	50	244.9	30.1	10,740	47
MH R5-6 to R5-8	2" (80) Cond	DB Red Brass	DB Conduit	Concrete	LF	45	244.9	30.1	9,666	42
MH R5-6 to R5-8	2" (80) Cond	DB Red Brass	DB Conduit	Building	LF	50	244.9	30.1	10,740	47
MH R5-8 to Bldg 11	1 1/2" (80) Cond	DB Red Brass	DB Conduit	Sidewalk	LF	5	232.2	26	1,031	5
MH R5-8 to Bldg 11	1 1/2" (80) Cond	DB Red Brass	DB Conduit	Lawn	LF	7	232.2	26	1,443	6
Total of Recommended Alternatives 2, 3, 4 and 5										5,809
Boiler Plant Efficiency										67.2%
Fuel Oil Savings of Piping Thermal Losses (kk BTU/Year)										8,646

Ordinance Area Thermal Loss Savings from Selected Piping Replacements

(Refer to results of Pipe Heat Loss Calculations)

Ordinance Area	Service	Placement	Dia	LF	BTU/H/UF	Current	Proposed	Heat Load	KK BTU/Yr
						BTU/H/UF	BTU/H/UF	BTU/H	Saved
MH A5 to Bldg 103-40	COND	AG	2	355	116.1	25.9		32,021	140.3
Bldg 103-6 to MH C3	COND	AG	2	627	139.8	29.8		68,970	302.1
MH D2 to MH D4	COND	AG	3	180	175.8	33.4		25,632	112.3
MH A5 to MH A11	COND	AG	4	1,769	197.0	39.7		278,264	1218.8
MH A18 to Bldg 108-20	COND	AG	2	30	116.1	25.9		2,706	11.9
MH B8 to MH B9-1	COND	AG	2	250	139.8	29.8		27,500	120.5
MH A5 to Bldg 103-40	STM	AG	3	355	134.7	46.6		31,276	137.0
Bldg 103-6 to MH C3	STM	AG	4	627	163.8	54.3		68,657	300.7
MH D2 to MH D4	STM	AG	6	180	322.3	65.0		46,314	202.9
MH A5 to MH A11	STM	AG	8	1,769	411.1	78.0		589,254	2580.9
MH A18 to Bldg 108-20	STM	AG	3	30	154.0	48.0		3,180	13.9
MH B8 to MH B9-1	STM	AG	4	250	163.8	54.3		27,375	119.9
Bldg 103-6 to MH C3	COND	UG Conduit	2	70	139.8	30.1		7,679	33.6
MH A18 to Bldg 108-20	COND	UG Conduit	3	280	175.8	32.7		40,068	175.5
MH D2 to MH D4	COND	UG Conduit	3	488	175.8	32.7		69,833	305.9
MH A5 to MH A11	COND	UG Conduit	4	90	197.0	38.7		14,247	62.4
MH B8 to MH B9-1	COND	UG Conduit	2	30	139.8	30.1		3,291	14.4
Bldg 103-6 to MH C3	STM	UG Conduit	4	70	163.8	57.7		7,427	32.5
MH A18 to Bldg 108-20	STM	UG Conduit	6	280	217.7	67.9		41,944	183.7
MH D2 to MH D4	STM	UG Conduit	6	488	217.7	67.9		73,102	320.2
MH A5 to MH A11	STM	UG Conduit	8	90	263.4	81.6		16,362	71.7
MH B8 to MH B9-1	STM	UG Conduit	4	30	163.8	57.7		3,183	13.9
Note: Current placement is buried conduit systems in very poor repair.									
Total Thermal Loss Load Saved from Replacing Piping (KK BTU/Year)									
Boiler Plant Efficiency									6,475
Fuel Oil Savings of Piping Thermal Losses (kk BTU/Year)									65.6%
									9,875

OUTER DIAMETER OF PIPE, INCHES =? 1.52
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	705.7	1773.4	338.0	0.0
0.5	98.2	148.9	67.0	86.1
1.0	64.3	69.7	48.0	90.9
1.5	51.0	43.1	41.0	92.8
2.0	43.8	30.3	37.5	93.8
2.5	39.2	22.9	35.5	94.5
3.0	35.9	18.2	34.0	94.9
3.5	33.4	15.0	33.0	95.3
4.0	31.5	12.6	32.5	95.5

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 1.755
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	799.0	1739.1	338.0	0.0
0.5	109.5	151.8	68.5	86.3
1.0	70.7	71.9	49.0	91.2
1.5	55.7	44.7	42.0	93.0
2.0	47.5	31.5	38.0	94.1
2.5	42.2	23.9	36.0	94.7
3.0	38.6	19.0	34.5	95.2
3.5	35.8	15.6	33.5	95.5
4.0	33.7	13.2	33.0	95.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 2.221
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225

INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =?

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	647.8	1114.0	338.0	0.0
0.5	120.9	143.3	89.0	81.3
1.0	79.4	71.9	61.0	87.7
1.5	62.6	45.8	50.0	90.3
2.0	53.3	32.7	44.0	91.8
2.5	47.3	25.0	40.5	92.7
3.0	43.0	20.0	38.0	93.4
3.5	39.9	16.5	36.5	93.8
4.0	37.4	14.0	35.0	94.2

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 2.221
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	979.8	1685.0	338.0	0.0
0.5	131.7	156.2	70.5	86.6
1.0	83.3	75.4	50.5	91.5
1.5	64.6	47.3	43.0	93.4
2.0	54.6	33.5	39.0	94.4
2.5	48.2	25.5	37.0	95.1
3.0	43.7	20.3	35.5	95.5
3.5	40.4	16.7	34.5	95.9
4.0	37.8	14.1	33.5	96.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 2.672
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	1150.3	1644.3	338.0	0.0
0.5	152.9	159.1	72.0	86.7
1.0	95.3	77.9	51.5	91.7
1.5	73.2	49.3	44.0	93.6
2.0	61.2	35.1	40.0	94.7
2.5	53.7	26.7	37.5	95.3
3.0	48.5	21.4	36.0	95.8
3.5	44.6	17.6	35.0	96.1
4.0	41.6	14.9	34.0	96.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 3.284
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	1376.2	1600.7	338.0	0.0
0.5	181.5	161.9	73.5	86.8
1.0	111.4	80.5	52.5	91.9
1.5	84.5	51.4	44.5	93.9
2.0	70.2	36.8	40.5	94.9
2.5	61.1	28.2	38.0	95.6
3.0	54.8	22.5	36.5	96.0
3.5	50.2	18.6	35.5	96.4
4.0	46.6	15.8	35.0	96.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 4.263
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	1727.6	1548.0	338.0	0.0

0.5	226.9	164.7	75.5	86.9
1.0	136.8	83.5	54.0	92.1
1.5	102.5	53.9	46.0	94.1
2.0	84.1	38.9	41.5	95.1
2.5	72.6	29.9	39.0	95.8
3.0	64.6	24.1	37.5	96.3
3.5	58.8	19.9	36.5	96.6
4.0	54.3	16.9	35.5	96.9

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
OUTER DIAMETER OF PIPE, INCHES =? 5.305
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
WIND SPEED, MPH =? 3.3
SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	2091.4	1505.9	338.0	0.0
0.5	274.8	166.5	77.5	86.9
1.0	163.7	85.6	55.5	92.2
1.5	121.3	55.8	47.0	94.2
2.0	98.7	40.5	42.5	95.3
2.5	84.6	31.4	40.0	96.0
3.0	74.9	25.3	38.5	96.4
3.5	67.7	21.0	37.0	96.8
4.0	62.3	17.9	36.5	97.0

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
OUTER DIAMETER OF PIPE, INCHES =? 6.345
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
WIND SPEED, MPH =? 3.3
SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	2446.4	1472.7	338.0	0.0
0.5	322.3	167.6	78.5	86.8
1.0	190.3	87.1	56.5	92.2
1.5	140.0	57.2	48.0	94.3
2.0	113.2	41.8	43.5	95.4
2.5	96.5	32.5	40.5	96.1
3.0	84.9	26.3	39.0	96.5

3.5	76.5	21.9	38.0	96.9
4.0	70.1	18.7	37.0	97.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 8.303
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	3097.8	1425.1	338.0	0.0
0.5	411.1	168.8	80.5	86.7
1.0	240.2	89.0	58.0	92.2
1.5	174.9	59.1	49.0	94.4
2.0	140.2	43.5	44.5	95.5
2.5	118.5	34.0	41.5	96.2
3.0	103.6	27.7	40.0	96.7
3.5	92.8	23.2	38.5	97.0
4.0	84.5	19.8	38.0	97.3

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 1.136
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	264.7	890.1	200.0	0.0
0.5	43.5	77.7	48.0	83.6
1.0	29.6	36.0	37.0	88.8
1.5	24.0	22.2	33.0	90.9
2.0	20.9	15.6	31.0	92.1
2.5	18.9	11.8	30.0	92.9
3.0	17.5	9.4	29.0	93.4
3.5	16.4	7.7	28.5	93.8
4.0	15.5	6.5	28.0	94.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1

OUTER DIAMETER OF PIPE, INCHES =? 1.469
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	329.4	856.4	200.0	0.0
0.5	52.3	80.9	49.0	84.1
1.0	34.7	38.2	38.0	89.5
1.5	27.8	23.7	33.5	91.6
2.0	23.9	16.7	31.5	92.7
2.5	21.4	12.7	30.5	93.5
3.0	19.7	10.1	29.5	94.0
3.5	18.4	8.3	29.0	94.4
4.0	17.3	7.0	28.5	94.7

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 1.7
 SERVICE TEMPERATURE, DEG. F =? 200+100

Go from start

SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	373.0	838.0	200.0	0.0
0.5	58.3	82.5	50.0	84.4
1.0	38.2	39.4	38.5	89.8
1.5	30.3	24.6	34.0	91.9
2.0	25.9	17.4	32.0	93.0
2.5	23.1	13.2	30.5	93.8
3.0	21.2	10.5	29.5	94.3
3.5	19.7	8.6	29.0	94.7
4.0	18.5	7.3	28.5	95.0

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 2.157
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE

IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft^2 hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft^2 hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	456.9	809.1	200.0	0.0
0.5	70.1	84.8	51.0	84.7
1.0	45.0	41.3	39.5	90.2
1.5	35.2	26.0	35.0	92.3
2.0	29.8	18.5	32.5	93.5
2.5	26.4	14.1	31.0	94.2
3.0	24.0	11.2	30.0	94.8
3.5	22.2	9.3	29.5	95.1
4.0	20.8	7.8	29.0	95.5

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 2.672
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft^2 hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft^2 hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	548.7	784.3	200.0	0.0
0.5	83.3	86.6	52.0	84.8
1.0	52.5	42.9	40.0	90.4
1.5	40.5	27.3	35.5	92.6
2.0	34.0	19.5	33.0	93.8
2.5	29.9	14.9	31.5	94.5
3.0	27.0	11.9	30.5	95.1
3.5	24.9	9.8	30.0	95.5
4.0	23.2	8.3	29.5	95.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 3.2
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft^2 hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft^2 hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5

WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	640.2	764.2	200.0	0.0
0.5	96.6	87.9	53.0	84.9
1.0	60.2	44.2	40.5	90.6
1.5	46.0	28.3	36.0	92.8
2.0	38.3	20.3	33.5	94.0
2.5	33.4	15.6	32.0	94.8
3.0	30.0	12.5	31.0	95.3
3.5	27.6	10.3	30.0	95.7
4.0	25.6	8.7	29.5	96.0

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 4.163
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? 3.3
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	802.3	736.2	200.0	0.0
0.5	120.8	89.4	54.0	84.9
1.0	73.9	45.8	41.5	90.8
1.5	55.7	29.7	36.5	93.1
2.0	45.9	21.5	34.0	94.3
2.5	39.7	16.6	32.5	95.0
3.0	35.4	13.3	31.5	95.6
3.5	32.3	11.0	30.5	96.0
4.0	29.9	9.4	30.0	96.3

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 1.182
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		

0.0	367.6	1188.0	338.0	0.0
0.5	75.6	132.4	82.0	79.4
1.0	52.6	63.1	56.0	85.7
1.5	43.0	39.3	46.0	88.3
2.0	37.6	27.7	41.0	89.8
2.5	34.0	21.0	38.0	90.7
3.0	31.5	16.7	35.5	91.4
3.5	29.5	13.8	34.0	92.0
4.0	28.0	11.7	33.0	92.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 1.52
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	460.6	1157.4	338.0	0.0
0.5	90.5	137.2	85.0	80.3
1.0	61.5	66.7	58.0	86.6
1.5	49.6	41.9	47.5	89.2
2.0	42.9	29.7	42.0	90.7
2.5	38.5	22.6	39.0	91.6
3.0	35.4	18.0	36.5	92.3
3.5	33.1	14.8	35.0	92.8
4.0	31.2	12.5	34.0	93.2

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 1.755
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	524.0	1140.6	338.0	0.0
0.5	100.8	139.7	86.5	80.8
1.0	67.6	68.7	59.5	87.1
1.5	54.0	43.4	48.5	89.7
2.0	46.4	30.8	43.0	91.1

2.5	41.5	23.5	39.5	92.1
3.0	38.0	18.7	37.0	92.7
3.5	35.4	15.4	35.5	93.2
4.0	33.3	13.1	34.5	93.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 2.221
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	647.8	1114.0	338.0	0.0
0.5	120.9	143.3	89.0	81.3
1.0	79.4	71.9	61.0	87.7
1.5	62.6	45.8	50.0	90.3
2.0	53.3	32.7	44.0	91.8
2.5	47.3	25.0	40.5	92.7
3.0	43.0	20.0	38.0	93.4
3.5	39.9	16.5	36.5	93.8
4.0	37.4	14.0	35.0	94.2

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 2.672
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	765.3	1094.1	338.0	0.0
0.5	140.1	145.8	90.5	81.7
1.0	90.7	74.2	62.5	88.1
1.5	70.8	47.7	51.0	90.8
2.0	59.8	34.2	45.0	92.2
2.5	52.7	26.2	41.5	93.1
3.0	47.7	21.0	39.0	93.8
3.5	44.0	17.4	37.0	94.2
4.0	41.1	14.7	36.0	94.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 3.284
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	922.2	1072.7	338.0	0.0
0.5	166.0	148.0	92.5	82.0
1.0	105.8	76.5	64.0	88.5
1.5	81.6	49.6	52.5	91.1
2.0	68.4	35.8	46.0	92.6
2.5	59.8	27.6	42.5	93.5
3.0	53.9	22.2	40.0	94.2
3.5	49.5	18.4	38.0	94.6
4.0	46.0	15.6	36.5	95.0

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 4.263
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	1168.3	1046.8	338.0	0.0
0.5	207.1	150.3	95.0	82.3
1.0	129.8	79.2	66.0	88.9
1.5	98.8	52.0	54.0	91.5
2.0	81.8	37.8	47.5	93.0
2.5	71.0	29.3	43.5	93.9
3.0	63.5	23.6	41.0	94.6
3.5	57.9	19.6	39.0	95.0
4.0	53.6	16.7	37.5	95.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 5.305
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED

ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	1425.1	1026.1	338.0	0.0
0.5	250.5	151.8	96.5	82.4
1.0	155.1	81.1	67.5	89.1
1.5	116.8	53.7	55.5	91.8
2.0	95.9	39.4	49.0	93.3
2.5	82.7	30.7	44.5	94.2
3.0	73.5	24.8	42.0	94.8
3.5	66.7	20.7	40.0	95.3
4.0	61.4	17.6	38.5	95.7

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 6.345
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	1677.5	1009.9	338.0	0.0
0.5	293.5	152.6	98.0	82.5
1.0	180.1	82.4	69.0	89.3
1.5	134.7	55.0	56.5	92.0
2.0	109.9	40.6	49.5	93.4
2.5	94.2	31.7	45.5	94.4
3.0	83.3	25.8	42.5	95.0
3.5	75.3	21.5	40.5	95.5
4.0	69.1	18.4	39.0	95.9

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 8.303
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2

SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	2144.4	986.5	338.0	0.0
0.5	374.0	153.6	100.0	82.6
1.0	226.9	84.1	70.5	89.4
1.5	168.0	56.8	58.0	92.2
2.0	135.9	42.2	51.0	93.7
2.5	115.6	33.2	46.5	94.6
3.0	101.6	27.1	43.5	95.3
3.5	91.2	22.8	41.5	95.7
4.0	83.3	19.5	40.0	96.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
OUTER DIAMETER OF PIPE, INCHES =? 1.136
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
WIND SPEED, MPH =? .2
SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	162.8	547.3	200.0	0.0
0.5	39.9	71.3	57.5	75.5
1.0	28.3	34.4	42.5	82.6
1.5	23.3	21.5	36.5	85.7
2.0	20.5	15.2	33.5	87.4
2.5	18.6	11.6	31.5	88.6
3.0	17.2	9.2	30.5	89.4
3.5	16.2	7.6	29.5	90.0
4.0	15.4	6.4	29.0	90.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
OUTER DIAMETER OF PIPE, INCHES =? 1.469
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
WIND SPEED, MPH =? .2
SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)

0.0	204.1	530.8	200.0	0.0
0.5	47.8	73.9	59.5	76.6
1.0	33.1	36.4	43.5	83.8
1.5	26.9	23.0	37.5	86.8
2.0	23.4	16.3	34.5	88.6
2.5	21.1	12.4	32.5	89.7
3.0	19.4	9.9	31.0	90.5
3.5	18.2	8.2	30.0	91.1
4.0	17.2	6.9	29.5	91.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
OUTER DIAMETER OF PIPE, INCHES =? 1.7
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
WIND SPEED, MPH =? .2
SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	232.2	521.8	200.0	0.0
0.5	53.2	75.2	60.0	77.1
1.0	36.3	37.5	44.5	84.4
1.5	29.3	23.8	38.0	87.4
2.0	25.3	17.0	34.5	89.1
2.5	22.7	12.9	32.5	90.2
3.0	20.8	10.3	31.0	91.0
3.5	19.4	8.5	30.5	91.6
4.0	18.3	7.2	29.5	92.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
OUTER DIAMETER OF PIPE, INCHES =? 2.157
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
WIND SPEED, MPH =? .2
SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	286.6	507.6	200.0	0.0
0.5	63.8	77.1	61.5	77.8
1.0	42.7	39.2	45.5	85.1
1.5	33.9	25.1	39.0	88.2
2.0	29.0	18.0	35.5	89.9
2.5	25.9	13.8	33.0	91.0

3.0	23.6	11.0	32.0	91.8
3.5	21.9	9.1	30.5	92.4
4.0	20.6	7.7	30.0	92.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 2.599
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	338.1	497.0	200.0	0.0
0.5	73.9	78.4	62.5	78.2
1.0	48.7	40.5	46.5	85.6
1.5	38.3	26.2	39.5	88.7
2.0	32.5	18.8	36.0	90.4
2.5	28.8	14.5	33.5	91.5
3.0	26.1	11.6	32.0	92.3
3.5	24.2	9.6	31.0	92.9
4.0	22.6	8.1	30.5	93.3

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 3.2
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	406.8	485.6	200.0	0.0
0.5	87.5	79.6	64.0	78.5
1.0	56.9	41.8	47.0	86.0
1.5	44.2	27.2	40.5	89.1
2.0	37.2	19.7	36.5	90.9
2.5	32.7	15.2	34.5	92.0
3.0	29.5	12.3	32.5	92.7
3.5	27.1	10.2	31.5	93.3
4.0	25.3	8.6	31.0	93.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 1
 OUTER DIAMETER OF PIPE, INCHES =? 4.163
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS BTU/hr per lin.ft	BTU/hr per sq.ft	SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
0.0	514.2	471.8	200.0	0.0
0.5	109.2	80.8	65.0	78.8
1.0	69.7	43.2	48.5	86.4
1.5	53.5	28.5	41.5	89.6
2.0	44.5	20.8	37.5	91.3
2.5	38.8	16.2	35.0	92.5
3.0	34.8	13.1	33.5	93.2
3.5	31.8	10.9	32.0	93.8
4.0	29.4	9.2	31.5	94.3

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
 OUTER DIAMETER OF PIPE, INCHES =? 1.182
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
 THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
 BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
 INSULATION THICKNESS, INCHES =? 2
 AIR SPACE, INCHES =? .813

SURFACE TEMPERATURE, DEG. F = 39.5
 HEAT LOSS, Btu/hr.ft = 57.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
 OUTER DIAMETER OF PIPE, INCHES =? 1.182
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
 THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
 BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
 INSULATION THICKNESS, INCHES =? .5
 AIR SPACE, INCHES =? .813

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 57.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.182
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? 0

HEAT GAIN OR LOSS AND SURFACE TEMPERATURE CALCULATIONS

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.182
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .01

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 350.3

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.182
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 2
AIR SPACE, INCHES =? .813

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 57.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.52
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 2
AIR SPACE, INCHES =? .688

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 73.7

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.52

SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
 THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
 BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
 INSULATION THICKNESS, INCHES =? .5
 AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
 HEAT LOSS, Btu/hr.ft = 219.0

 RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
 OUTER DIAMETER OF PIPE, INCHES =? 1.755
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
 THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
 BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
 INSULATION THICKNESS, INCHES =? 2
 AIR SPACE, INCHES =? .563

SURFACE TEMPERATURE, DEG. F = 39.5
 HEAT LOSS, Btu/hr.ft = 91.6

 RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
 OUTER DIAMETER OF PIPE, INCHES =? 1.755
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
 THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
 BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
 INSULATION THICKNESS, INCHES =? .5
 AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
 HEAT LOSS, Btu/hr.ft = 237.1

 RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
 OUTER DIAMETER OF PIPE, INCHES =? 2.221
 SERVICE TEMPERATURE, DEG. F =? 338
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 225

INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 2.5
AIR SPACE, INCHES =? .813

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 85.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 2.221
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 269.0

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 2.672
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 2.5
AIR SPACE, INCHES =? .563

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 121.9

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 2.672
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12

BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 296.2

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 3.284
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3
AIR SPACE, INCHES =? .875

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 106.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 3.284
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 328.9

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 3.284
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 328.9

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 4.263
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3
AIR SPACE, INCHES =? .375

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 213.7

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 4.263
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3
AIR SPACE, INCHES =? 1.25

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 101.5

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 4.263
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 374.3

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 5.305
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3
AIR SPACE, INCHES =? .875

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 149.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 5.305
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3
AIR SPACE, INCHES =? .875

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 149.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 5.305
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 416.3

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 6.345

SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3.5
AIR SPACE, INCHES =? .5

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 238.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 6.345
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3.5
AIR SPACE, INCHES =? 1.825

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 105.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 6.345
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 453.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 8.303
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225

INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 3.5
AIR SPACE, INCHES =? 1.35

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 156.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 8.303
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 516.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.136
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 1.5
AIR SPACE, INCHES =? 1.313

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 23.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.136
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12

BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 99.7

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.469
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 1.5
AIR SPACE, INCHES =? 1.188

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 28.2

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.469
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 115.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.7
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 1.5
AIR SPACE, INCHES =? 1.063

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 32.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.7
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 125.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 2.157
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 1.5
AIR SPACE, INCHES =? 1.813

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 27.9

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 2.157
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 142.2

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 2.599
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 1.5
AIR SPACE, INCHES =? 1.563

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 34.0

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 2.599
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 156.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 3.2
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 2
AIR SPACE, INCHES =? 1.875

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 34.8

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 3.2

SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 174.3

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 4.163
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? 2
AIR SPACE, INCHES =? 1.375

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 50.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 4.163
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .1

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 198.6

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =?
OUTER DIAMETER OF PIPE, INCHES =?
SERVICE TEMPERATURE, DEG. F =?
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =?

HEAT GAIN OR LOSS AND SURFACE TEMPERATURE CALCULATIONS

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 1.755
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? 1
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? 1
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .01
AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 227.5

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 2.221
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? 1
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? 1
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .1
AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 240.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 3.284
SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? 1
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? 1
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .1
AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 265.4

RERUN PROGRAM (1 = YES, 0 = NO) ? 2

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 4.263

SERVICE TEMPERATURE, DEG. F =? 200
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? 1
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? 1
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .1
AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 285.2

RERUN PROGRAM (1 = YES, 0 = NO) ?

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
 OUTER DIAMETER OF PIPE, INCHES =? 1.755
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
 THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
 BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
 INSULATION THICKNESS, INCHES =? .125
 AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
 HEAT LOSS, Btu/hr.ft = 226.2

 RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 12
 OUTER DIAMETER OF PIPE, INCHES =? 2.221
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
 THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
 BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
 INSULATION THICKNESS, INCHES =? .125
 AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
 HEAT LOSS, Btu/hr.ft = 239.3

 RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
 OUTER DIAMETER OF PIPE, INCHES =? 3.284
 SERVICE TEMPERATURE, DEG. F =? 200
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
 THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
 BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
 INSULATION THICKNESS, INCHES =? .125
 AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
 HEAT LOSS, Btu/hr.ft = 264.5

 RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
 OUTER DIAMETER OF PIPE, INCHES =? 2.221

SERVICE TEMPERATURE, DEG. F =? 250
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 314.1

RERUN PROGRAM (1 = YES, 0 = NO) ? 1

PIPING SYSTEM LAYOUT (1=ABOVEGROUND, 2=UNDERGROUND) =? 2
OUTER DIAMETER OF PIPE, INCHES =? 3.284
SERVICE TEMPERATURE, DEG. F =? 338
ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
IF SINGLE BURIED PIPE IS UNINSULATED
ASSUMED SURFACE TEMPERATURE, DEG.F =? 225
INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
AVERAGE ANNUAL SOIL TEMPERATURE, DEG. F =? 40
THERMAL CONDUCTIVITY OF SOIL, Btu-in/ft². hr F =? 12
BURIAL DEPTH TO CENTER LINE OF PIPE, FT =? 3
INSULATION THICKNESS, INCHES =? .5
AIR SPACE, INCHES =? .001

SURFACE TEMPERATURE, DEG. F = 39.5
HEAT LOSS, Btu/hr.ft = 492.7

RERUN PROGRAM (1 = YES, 0 = NO) ? 0

OUTER DIAMETER OF PIPE, INCHES =? 2.221
 SERVICE TEMPERATURE, DEG. F =? 250
 ENTER ASSUMED SURFACE TEMPERATURE = SERVICE TEMPERATURE
 IF SINGLE BURIED PIPE IS UNINSULATED
 ASSUMED SURFACE TEMPERATURE, DEG.F =? 100
 INSULATION, CONDUCTIVITY AT TM1, Btu-in /ft² hr F =? .31
 INSULATION, CONDUCTIVITY AT TM2, Btu-in /ft² hr F =? .36
 PIPE ORIENTATION (1=HORIZONTAL, 2=VERTICAL) =? 1
 AMBIENT AIR TEMPERATURE, DEG. F =? 23.5
 WIND SPEED, MPH =? .2
 SURFACE EMITTANCE =? .2

INSULATION THICKNESS (inches)	HEAT GAIN OR LOSS		SURFACE TEMPERATURE (deg. F)	INSULATION EFFICIENCY (percent)
	BTU/hr per lin.ft	BTU/hr per sq.ft		
0.0	408.4	702.4	250.0	0.0
0.5	83.1	98.6	71.0	79.6
1.0	55.6	50.3	51.0	86.4
1.5	44.2	32.3	43.0	89.2
2.0	37.8	23.2	38.5	90.7
2.5	33.6	17.8	36.0	91.8
3.0	30.7	14.2	34.0	92.5
3.5	28.4	11.8	33.0	93.0
4.0	26.7	10.0	32.0	93.5

RERUN PROGRAM (1 = YES, 0 = NO) ? 0

APPENDIX D

Boiler Efficiency Calculation Methods

Appendix D

Boiler Plant Efficiency Calculation Methods

Boiler Plant Efficiency

Boiler plant efficiency losses are a combination of the following losses:

- Combustion Efficiency Losses
- Auxiliary Equipment Energy Uses (2% to 6%)
- In-Plant Losses (7% to 15%), including:
 - Radiation losses (1% to 10%) (See Figure D-1)
 - Leaks in the boiler house (1% to 5%)
 - Equipment condition
 - Piping and tank insulation/conduction losses (2% to 5%)
 - Blowdown losses (1% to 5%)
 - Shutdown losses (1% to 4%)

Combustion Efficiency

Combustion efficiency can be determined by performing a heat and mass balance of the boiler. A complex methodology includes chemical analyses of flue gasses, the fuel and ash. A less complicated method involves measuring only CO₂ and temperature of flue gasses. The less complicated method gives results that are quite comparable to the complex method.

Combustion efficiency levels were conducted for oil fired boilers.

Auxiliary Equipment Uses

The range of losses is from 2% to 6% and includes such items as pumps, oil heating, steam tracing lines, etc. Assume most auxiliaries are power driven. These levels of consumption must be determined separately since electric power is used and the aim of these calculations is to determine fuel consumption levels. Assume only 10% of steam energy is used in auxiliaries.

In-Plant Losses

Radiation Losses: Use Figure D-1 on the following sheet for all boilers. Use a maximum value of 8% for these losses, since the graph is for delta T = 50 degrees F and most boiler rooms have high temperatures and stagnant air. Do not include additional losses due to less-than-maximum capacity operations.

EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada

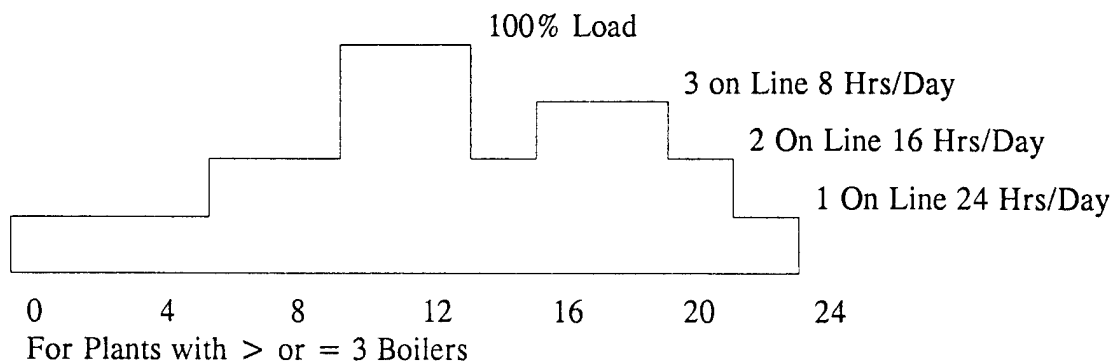
Blowdown Losses: Most of the boiler plants investigated have manual blowdown. All boilers are blowdown manually each operating day. Blowdown occurs for a period of about 1 minute, but is quite variable depending on the operator. Manual blowdown for a typical 1×10^6 BTUH boiler is about 2% (assuming a 50% load) for a hot water boiler as well as a steam boiler.

Leaks in Boiler House: Very few actual leaks have been found in steam, hot water or condensate piping. Assume only 0.5% for all installations. Combine with next item in "losses" listing.

Conduction/Convection Losses from Piping and Tanks: The following losses are based on a modeled typical boiler plant:

Condition of Installation	Good	Fair	Poor	None
Estimated Loss	1.0%	2.0%	2.5%	3.5%

Shutdown/Cycling Losses: Generally speaking, the more boilers shut down per day, the higher the losses will be. Assume the following demand per day:



For Plants with 2 Boilers, assume 1 on 24 Hours per day and 2 on 16 Hours per day

3% Composite Loss, All others assume 2% Losses

Equipment Condition: An allowance of 3% additional losses is estimated for those plants in poor condition, 2% for those in fair-to-poor conditions and 1% in good condition.

EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada

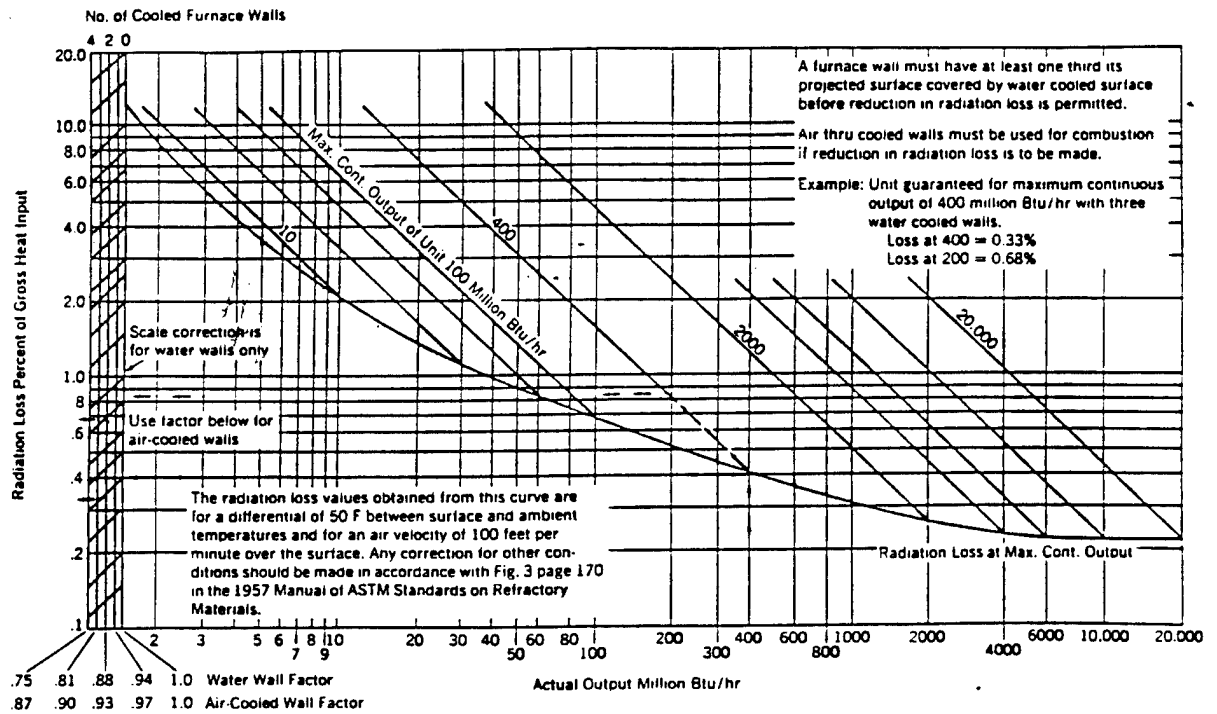


Figure D-1
Radiation Loss in Percent of Gross Heat Input

Source: American Boiler Manufacturers Association

APPENDIX E

Comparison of Replacement Piping Alternatives

APPENDIX E

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Comparison of Replacement Piping Alternatives for Ordnance and Industrial Areas, Hawthorne Army Ammunition Depot

A typical pipe section is evaluated for each area. The Ordnance Area is an explosives processing area with structures widely separated. All existing piping is underground. Alternatives evaluated for this area include consideration of both above and underground piping replacements. In the above ground option, all piping is above ground except at street and rail crossings. Nominal heights for above ground piping is between 2 and 4 feet to the bottoms of the pipe supports.

The Industrial Area is, nowadays, more of an administrative and maintenance yard area. Both assume the use of mineral fiber insulation. All but a few sections of pipe are underground. Existing installations include direct buried pipe, pipe in concrete trenches and some conduit encased direct buried piping. Only underground replacement piping is considered.

Alternatives consider both prefabricated piping systems and built-up piping systems. The costs summarized below are intended exclusively for comparing one type of system against another. Some cost elements that affect all alternatives equally are not considered.

Ordnance Area Piping System Alternatives

The predominant pipe run in the Ordnance Area, and the pipe sizes used to evaluate alternatives, consists of an 8-inch diameter steam pipe and a 4-inch diameter condensate return pipe. Cost estimates for comparison pipe segments follow.

Above Ground Alternatives

Comparison First Cost \$/LF

Alternative A1:	22-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation and 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation	\$361.58
Alternative A2:	16-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation & 10-3/4-inch Conduit with 4-inch FRP Condensate Pipe with 1-Inch Insulation	\$343.84
Alternative A3:	16-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation & 10-3/4-inch Conduit with 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation	\$373.59
Alternative A4:	8-inch Schedule 40 Steam Pipe with 2-inch Insulation and Aluminum Jacket - Built Up & 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation & Aluminum Jacket - Built Up	\$170.57

Underground Alternatives

Comparison First Cost \$/LF

Alternative U1:	22-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation and 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation	\$343.15
Alternative U2:	16-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation & 10-3/4-inch Conduit with 4-inch FRP Condensate Pipe with 1-Inch Insulation	\$350.47

Comparison of Replacement Piping Alternatives for Ordnance and Industrial Areas, Hawthorne Army Ammunition Depot

Alternative U3: 16-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation & 10-3/4-inch Conduit with 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation \$380.22

Industrial Area Piping System Alternatives

A common pipe run in the Industrial Area, and the pipe sizes used to evaluate alternatives, consists of a 4-inch diameter steam pipe and a 3-inch diameter condensate return pipe. Direct burial of single and double pipe conduit are considered. Replacement of pipes in concrete trenches with conduit systems and with built-up piping is considered. Unlike the alternatives shown for the Ordnance Area, the pipes in the Industrial Area do not include allowances for thermal expansion loops; expansion will be accommodated in expansion joints. Cost estimates for comparison pipe segments follow.

Direct Bury Alternatives

Comparison First Cost \$/LF

Alternative DB1:	14-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation and 3-inch Schedule 80 Condensate Pipe with 1-Inch Insulation Direct Bury	\$104.95
Alternative DB2:	10-3/4-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation & 6-inch Conduit with 3-inch FRP Condensate Pipe with 1-Inch Insulation Direct Bury	\$135.29
Alternative DB3:	10-3/4-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation & 8-5/8-inch Conduit with 3-inch Schedule 80 Cond Pipe with 1-Inch Insulation Direct Bury	\$125.87

Replace Pipes in Existing Concrete Trench Alternatives

Comparison First Cost \$/LF

Alternative CT1:	14-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation and 3-inch Schedule 80 Condensate Pipe with 1-Inch Insulation Conc Trench	\$102.10
Alternative CT2:	10-3/4-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation & 6-inch Conduit with 3-inch FRP Condensate Pipe with 1-Inch Insulation Conc Trench	\$130.90
Alternative CT3:	10-3/4-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation & 8-5/8-inch Conduit with 3-inch Schedule 80 Cond Pipe with 1-Inch Insulation Conc Trench	\$123.02
Alternative CT4:	4-inch Schedule 40 Steam Pipe with 2-inch Insulation and Aluminum Jacket & 3-inch Schedule 80 Condensate Pipe with 1-Inch Insulation & Aluminum Jacket	\$70.57

Comparison of Replacement Piping Alternatives for Ordnance and Industrial Areas, Hawthorne Army Ammunition Depot

Comparison of Repair Costs

Repairs are more difficult, and costly, for two-pipe conduit systems and for buried pipe systems. Repairs for conduit systems require that the conduit be opened up and the leaking section replaced. For two-pipe conduit systems, both pipes are replaced when one is found leaking. Repair costs are similar to original installation costs. Repairs to single pipe conduit systems are less costly, but still involve cutting through and repairing both the service pipe and the conduit. Repairs to piping in concrete trenches do not incur the expense of re-excavating, nor is there the same level of danger of accidentally digging into the pipe. Repairs to above ground piping systems are the least expensive.

Maintenance costs are higher for systems which contain FRP piping because thermal protective devices installed on all condensate entries must be maintained and defective parts replaced. The installed cost per L of these protective devices is expensed twice during the life of the piping to represent additional maintenance and repairs required for these systems. Results are indicated below.

For purposes of comparison, frequencies of repair during a pipe segment's lifetime are considered. Results are shown below. Recommended replacement piping configurations are indicated.

Ordnance Area Piping Alternatives

Descriptions of Alternatives	\$/LF	Repairs/ Life	Added Maint	Overall Cost/LF	
Above Ground Alternatives					
Alternative A1	\$361.58	1	\$0.00	\$723.16	
Alternative A2	\$343.84	0.75	\$28.10	\$629.82	
Alternative A3	\$373.59	0.5	\$0.00	\$560.38	
Alternative A4	\$170.57	0.25	\$0.00	\$213.22	← Predominant
Underground Alternatives					
Alternative U1	\$343.15	1	\$0.00	\$686.30	
Alternative U2	\$350.47	0.75	\$28.10	\$641.43	
Alternative U3	\$380.22	0.5	\$0.00	\$570.34	← For Road & Rail Crossings

Industrial Area Piping Alternatives

Descriptions of Alternatives	\$/LF	Repairs/ Life	Added Maint	Overall Cost/LF	
Direct Bury Alternatives					
Alternative DB1	\$104.95	1	\$0.00	\$209.91	
Alternative DB2	\$135.29	0.75	\$70.26	\$307.02	
Alternative DB3	\$125.87	0.5	\$0.00	\$188.80	←
Replace Pipes in Existing Concrete Trench Alternatives					
Alternative CT1	\$102.10	1	\$0.00	\$204.20	
Alternative CT2	\$130.90	0.75	\$70.26	\$299.33	
Alternative CT3	\$123.02	0.5	\$0.00	\$184.53	
Alternative CT4	\$70.57	0.25	\$0.00	\$88.22	←

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 1 of 2	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance Area - Alternatives				Estimator DLN		Checked By BIH		
Line Item		Quantity		Labor		Material		Total Cost
		No. Units	Unit Meas.	MH or \$ Per Unit	Total MH	Per Unit	Total	
Above Ground Replacement Piping Alternatives								
Alternative A1: 22-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation and 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation								
Piping Material Cost (Prefabricated)	317	LF	-	-	\$81.00	\$25,677	\$25,677	
Installation: 22-inch Conduit Casing	317	LF	3.715	1177.497	-	-	\$33,111	
Installation: 8-inch Steam Pipe	317	LF	1.263	400.371	-	-	\$11,258	
Installation: 4-inch Condensate Pipe	317	LF	0.762	241.554	-	-	\$6,792	
Elbows for Expansion Loop: 8 & 4 -inch Dia	4	EA	34.00	136.00	\$552	\$2,208	\$6,032	
Supports (see separate estimate, Page G-56)	12	EA	Material & Labor Included				\$7,524	
Subtotal (250 LF Typical Pipe Section including Expansion Loop)							\$90,395	
Alternative A1: Equivalent Unit Cost per Linear Foot							\$361.58	
Alternative A2: 16-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation 10-3/4-inch Conduit with 4-inch FRP Condensate Pipe with 1-Inch Insulation								
Steam Piping Material Cost (Prefabricated)	317	LF	-	-	\$50.84	\$16,116	\$16,116	
Cond Piping Material Cost (Prefabricated)	317	LF	-	-	\$13.27	\$4,207	\$4,207	
Installation: 16-inch Conduit Casing	317	LF	2.400	760.8	-	-	\$21,394	
Installation: 10-3/4-inch Conduit Casing	317	LF	1.500	475.5	-	-	\$13,371	
Installation: 8-inch Steam Pipe	317	LF	1.263	400.371	-	-	\$11,258	
Installation: 4-inch Condensate Pipe	317	LF	0.340	107.78	-	-	\$3,031	
Elbows for Expansion Loop: 8 -inch Dia	4	EA	21.00	84.00	\$384	\$1,536	\$3,898	
Elbows for Expansion Loop: 4 -inch Dia	4	EA	12.00	48.00	\$74.33	\$297	\$1,647	
Condensate System Protective Device	1	EA	59.637	59.63727	\$1,836	\$1,836	\$3,513	
Supports (see separate estimate, Page G-56)	12	EA	Material & Labor Included				\$7,524	
Subtotal							\$85,959	
Alternative A2: Equivalent Unit Cost per Linear Foot							\$343.84	
Alternative A3: 16-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation 10-3/4-inch Conduit with 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation								
Steam Piping Material Cost (Means)	317	LF	-	-	\$50.84	\$16,116	\$16,116	
Cond Piping Material Cost (Means)	317	LF	-	-	\$33.10	\$10,493	\$10,493	
Installation: 16-inch Conduit Casing	317	LF	2.400	760.8	-	-	\$21,394	
Installation: 10-3/4-inch Conduit Casing	317	LF	1.500	475.5	-	-	\$13,371	
Installation: 8-inch Steam Pipe	317	LF	1.263	400.371	-	-	\$11,258	
Installation: 4-inch Condensate Pipe	317	LF	0.762	241.554	-	-	\$6,792	
Elbows for Expansion Loop: 8 -inch Dia	4	EA	21.00	84.00	\$384	\$1,536	\$3,898	
Elbows for Expansion Loop: 4 -inch Dia	4	EA	14.00	56.00	\$244	\$976	\$2,551	
Supports (see separate estimate, Page G-56)	12	EA	Material & Labor Included				\$7,524	
Subtotal							\$93,397	
Alternative A3: Equivalent Unit Cost per Linear Foot							\$373.59	

Note: Costs include allowances for expansion loops. These estimates are for selection purposes only.

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CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 2 of 2	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance Area - Alternatives				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas.	MH or \$ Per Unit	Total MH	Per Unit	Total		
Alternative A4: 8-inch Schedule 40 Steam Pipe with 2-inch Insulation and Aluminum Jacket - Built Up & 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation & Aluminum Jacket - Built Up								
Steam Pipe: 8-inch Schedule 40 Welded	317	LF	\$21.39	\$6,782	\$26.60	\$8,432	\$15,214	
Cond Pipe: 4-inch Schedule 80 Welded	317	LF	\$13.54	\$4,291	\$12.76	\$4,045	\$8,336	
Steam Insulation: 8-inch Pipe, 2-inch Thick	335	LF	\$5.05	\$1,692	\$3.79	\$1,270	\$2,962	
Cond. Insulation: 4-inch Pipe, 1-inch Thick	335	LF	\$2.69	\$901	\$1.21	\$404	\$1,305	
Aluminum Jacket - 10 ga. steam & Cond	1316	SF	\$3.36	\$4,420	\$0.42	\$553	\$4,973	
Elbow 90° 8-inch Welded Steel Schedule 40	4	EA	\$177	\$709	\$77	\$308	\$1,017	
Elbow 90° 4-inch Welded Steel Schedule 80	4	EA	\$119	\$477	\$25	\$100	\$577	
Elbow 45° 8-inch Welded Steel Schedule 40	2	EA	\$177	\$354	\$55	\$109	\$463	
Elbow 45° 4-inch Welded Steel Schedule 80	2	EA	\$119	\$238	\$18	\$35	\$273	
Supports (see separate estimate, Page G-56)	12	EA	Material & Labor Included				\$7,524	
Subtotal							\$42,643	
Alternative A4: Equivalent Unit Cost per Linear Foot							\$170.57	

Note: Costs include allowances for expansion loops. These estimates are for selection purposes only.

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CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 1 of 2	
Project ECIP Facility Energy Improvements					Project No.		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance Area - Alternatives				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas.	MH or \$ Per Unit	Total MH	Per Unit	Total		
Underground Replacement Piping Alternatives								
Alternative U1: 22-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation and 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation								
Piping Material Cost (Prefabricated)	317	LF	-	-	\$81.00	\$25,677	\$25,677	
Installation: 22-inch Conduit Casing	317	LF	3.715	1177.5	-	-	\$33,111	
Installation: 8-inch Steam Pipe	317	LF	1.263	400.37	-	-	\$11,258	
Installation: 4-inch Condensate Pipe	317	LF	0.762	241.55	-	-	\$6,792	
Elbows for Expansion Loop: 8 & 4 -inch Dia	4	EA	34.00	136.00	\$552	\$2,208	\$6,032	
Pipe Trench Excavation/Backfill/Restoration	317	LF	\$9.20	\$2,916	-	-	\$2,916	
Steam Pits (Manholes) 1 per 250 LF Minimum	1	EA	\$1,450	\$1,450	\$4,816	\$4,816	\$6,266	
Subtotal (250 LF Typical Pipe Section including Expansion Loop)							\$85,788	
Alternative U1: Equivalent Unit Cost per Linear Foot							\$343.15	
Alternative U2: 16-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation 10-3/4-inch Conduit with 4-inch FRP Condensate Pipe with 1-Inch Insulation								
Steam Piping Material Cost (Prefabricated)	317	LF	-	-	\$50.84	\$16,116	\$16,116	
Cond Piping Material Cost (Prefabricated)	317	LF	-	-	\$13.27	\$4,207	\$4,207	
Installation: 16-inch Conduit Casing	317	LF	2.400	760.8	-	-	\$21,394	
Installation: 10-3/4-inch Conduit Casing	317	LF	1.500	475.5	-	-	\$13,371	
Installation: 8-inch Steam Pipe	317	LF	1.263	400.37	-	-	\$11,258	
Installation: 4-inch Condensate Pipe	317	LF	0.340	107.78	-	-	\$3,031	
Elbows for Expansion Loop: 8 -inch Dia	4	EA	21.00	84.00	\$384	\$1,536	\$3,898	
Elbows for Expansion Loop: 4 -inch Dia	4	EA	12.00	48.00	\$74.33	\$297	\$1,647	
Condensate System Protective Device	1	EA	59.637	59.637	\$1,836	\$1,836	\$3,513	
Pipe Trench Excavation/Backfill/Restoration	317	LF	\$9.20	\$2,916	-	-	\$2,916	
Steam Pits (Manholes) 1 per 250 LF Minimum	1	EA	\$1,450	\$1,450	\$4,816	\$4,816	\$6,266	
Subtotal							\$87,617	
Alternative U2: Equivalent Unit Cost per Linear Foot							\$350.47	

Note: Costs include allowances for expansion loops. Surfaces are assumed 10% Concrete Road and 90% Natural Surface.

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 2		of 2	
Project ECIP Facility Energy Improvements					Project No.		Basis for Estimate			
Location Hawthorne Army Ammunition Depot, Nevada							Code A (no design competed)			
Engineer-Architect Keller & Gannon										
Drawing No. Ordnance Area - Alternatives				Estimator DLN		Checked By BIH				
Line Item	Quantity		Labor		Material		Total Cost			
	No. Units	Unit Meas.	MH or \$ Per Unit	Total MH	Per Unit	Total				
Alternative U3: 16-inch Conduit containing 8-inch Schedule 40 Steam Pipe with 2-inch Insulation										
10-3/4-inch Conduit with 4-inch Schedule 80 Condensate Pipe with 1-Inch Insulation										
Steam Piping Material Cost (Means)	317	LF	-	-	\$50.84	\$16,116	\$16,116			
Cond Piping Material Cost (Means)	317	LF	-	-	\$33.10	\$10,493	\$10,493			
Installation: 16-inch Conduit Casing	317	LF	2.400	760.8	-	-	\$21,394			
Installation: 10-3/4-inch Conduit Casing	317	LF	1.500	475.5	-	-	\$13,371			
Installation: 8-inch Steam Pipe	317	LF	1.263	400.37	-	-	\$11,258			
Installation: 4-inch Condensate Pipe	317	LF	0.762	241.55	-	-	\$6,792			
Elbows for Expansion Loop: 8 -inch Dia	4	EA	21.00	84.00	\$384	\$1,536	\$3,898			
Elbows for Expansion Loop: 4 -inch Dia	4	EA	14.00	56.00	\$244	\$976	\$2,551			
Pipe Trench Excavation/Backfill/Restoration	317	LF	\$9.20	\$2,916	-	-	\$2,916			
Steam Pits (Manholes) 1 per 250 LF Minimum	1	EA	\$1,450	\$1,450	\$4,816	\$4,816	\$6,266			
Subtotal							\$95,056			
Alternative U3: Equivalent Unit Cost per Linear Foot							\$380.22			

Note: Costs include allowances for expansion loops. Surfaces are assumed 10% Concrete Road and 90% Natural Surface.

ALTERNATIVE COMPARISON COST ESTIMATE					Date Prepared July 1995		Sheet 1 of 3	
Project ECIP Facility Energy Improvements					Project No.		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Industrial Area - Alternatives					Estimator DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas.	MH or \$ Per Unit	Total MH or \$	Per Unit	Total		
Underground Replacement Piping Alternatives								
Alternative DB1: 14-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation and 3-inch Schedule 80 Condensate Pipe with 1-Inch Insulation Direct Bury								
Piping Material Cost (Prefabricated)	100	LF	-	-	\$52.52	\$5,252	\$5,252	
Conduit Gland Seal	2	EA	1.412	2.824	\$211	\$422	\$501	
Installation: 14-inch Conduit Casing	100	LF	0.615	61.5	-	-	\$1,729	
Installation: 4-inch Steam Pipe Sch 40	100	LF	0.380	38.02	-	-	\$1,069	
Installation: 3-inch Condensate Pipe Sch 80	100	LF	0.364	36.4	-	-	\$1,024	
Pipe Trench Excavation/Backfill/Restoration	100	LF	\$9.20	\$920	-	-	\$920	
Subtotal (100 LF Typical pipe section excluding expansion compensation)							\$10,495	
Alternative DB1: Equivalent Unit Cost per Linear Foot							\$104.95	
Alternative DB2: 10-3/4-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation 6-inch Conduit with 3-inch FRP Condensate Pipe with 1-Inch Insulation Direct Bury								
Steam Piping Material Cost (Prefabricated)	100	LF	-	-	\$33.10	\$3,310	\$3,310	
Cond Piping Material Cost (Prefabricated)	100	LF	-	-	\$10.03	\$1,003	\$1,003	
Conduit Gland Seal - 10-3/4-inch Casing	2	EA	1.412	2.824	\$185	\$370	\$449	
Installation: 10-3/4-inch Conduit Casing	100	LF	0.511	51.1	-	-	\$1,437	
Installation: 6-inch Conduit Casing	100	LF	0.400	40	-	-	\$1,125	
Installation: 4-inch Steam Pipe Sch 40	100	LF	0.380	38.02	-	-	\$1,069	
Installation: 3-inch Condensate Pipe FRP	100	LF	0.250	25	-	-	\$703	
Condensate System Protective Device	1	EA	59.637	59.637	\$1,836	\$1,836	\$3,513	
Pipe Trench Excavation/Backfill/Restoration	100	LF	\$9.20	\$920	-	-	\$920	
Subtotal							\$13,529	
Alternative DB2: Equivalent Unit Cost per Linear Foot							\$135.29	
Alternative DB3: 10-3/4-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation 8-5/8-inch Conduit with 3-inch Schedule 80 Cond Pipe with 1-Inch Insulation Direct Bury								
Steam Piping Material Cost (Prefabricated)	100	LF	-	-	\$33.10	\$3,310	\$3,310	
Cond Piping Material Cost (Prefabricated)	100	LF	-	-	\$28.00	\$2,800	\$2,800	
Conduit Gland Seal - 10-3/4-inch Casing	2	EA	1.412	2.824	\$185	\$370	\$449	
Conduit Gland Seal - 8-5/8-inch Casing	2	EA	1.043	2.086	\$127	\$254	\$313	
Installation: 10-3/4-inch Conduit Casing	100	LF	0.511	51.1	-	-	\$1,437	
Installation: 8-5/8-inch Conduit Casing	100	LF	0.450	45	-	-	\$1,265	
Installation: 4-inch Steam Pipe Sch 40	100	LF	0.380	38.02	-	-	\$1,069	
Installation: 3-inch Condensate Pipe Sch 80	100	LF	0.364	36.4	-	-	\$1,024	
Pipe Trench Excavation/Backfill/Restoration	100	LF	\$9.20	\$920	-	-	\$920	
Subtotal							\$12,587	
Alternative DB3: Equivalent Unit Cost per Linear Foot							\$125.87	

Note: Costs do not include allowances for expansion loops; expansion joints will be used. Surfaces are assumed 10% Concrete Road and 90% natural surface. Removal costs assume no asbestos contamination.

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ALTERNATIVE COMPARISON COST ESTIMATE					Date Prepared July 1995		Sheet 2 of 3	
Project ECIP Facility Energy Improvements					Project No.		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Industrial Area - Alternatives				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas.	MH or \$ Per Unit	Total MH or \$	Per Unit	Total		
Alternative CT1: 14-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation and 3-inch Schedule 80 Condensate Pipe with 1-Inch Insulation Conc Trench								
Piping Material Cost (Prefabricated)	100	LF	-	-	\$52.52	\$5,252	\$5,252	
Conduit Gland Seal	2	EA	1.412	2.824	\$211	\$422	\$501	
Installation: 14-inch Conduit Casing	100	LF	0.615	61.5	-	-	\$1,729	
Installation: 4-inch Steam Pipe Sch 40	100	LF	0.380	38.02	-	-	\$1,069	
Installation: 3-inch Condensate Pipe Sch 80	100	LF	0.364	36.4	-	-	\$1,024	
Demolish Extg: 4-inch Steam Pipe	100	LF	\$1.56	\$156	-	-	\$156	
Demolish Extg: 3-inch Condensate Pipe	100	LF	\$1.56	\$156	-	-	\$156	
Open Trench for Access / Caulk & Close Trench	100	LF	\$3.23	\$323	-	-	\$323	
Subtotal (100 LF Typical pipe section excluding expansion compensation)							\$10,210	
Alternative CT1: Equivalent Unit Cost per Linear Foot							\$102.10	
Alternative CT2: 10-3/4-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation 6-inch Conduit with 3-inch FRP Condensate Pipe with 1-Inch Insulation Conc Trench								
Steam Piping Material Cost (Prefabricated)	100	LF	-	-	\$33.10	\$3,310	\$3,310	
Cond Piping Material Cost (Prefabricated)	100	LF	-	-	\$10.03	\$1,003	\$1,003	
Conduit Gland Seal - 10-3/4-inch Casing	2	EA	1.412	2.824	\$185	\$370	\$449	
Installation: 10-3/4-inch Conduit Casing	100	LF	0.511	51.1	-	-	\$1,437	
Installation: 6-inch Conduit Casing	100	LF	0.400	40	-	-	\$1,125	
Installation: 4-inch Steam Pipe Sch 40	100	LF	0.380	38.02	-	-	\$1,069	
Installation: 3-inch Condensate Pipe FRP	100	LF	0.250	25	-	-	\$703	
Condensate System Protective Device	1	EA	59.637	59.637	\$1,836	\$1,836	\$3,513	
Demolish Extg: 4-inch Steam Pipe	1	LF	\$1.56	\$2	-	-	\$2	
Demolish Extg: 3-inch Condensate Pipe	100	LF	\$1.56	\$156	-	-	\$156	
Open Trench for Access / Caulk & Close Trench	100	LF	\$3.23	\$323	-	-	\$323	
Subtotal							\$13,090	
Alternative CT2: Equivalent Unit Cost per Linear Foot							\$130.90	

Note: Costs do not include allowances for expansion loops; expansion joints will be used. Surfaces are assumed 10% Concrete Road and 90% natural surface. Removal costs assume no asbestos contamination.

ALTERNATIVE COMPARISON COST ESTIMATE					Date Prepared July 1995		Sheet 3 of 3	
Project ECIP Facility Energy Improvements					Project No.	Basis for Estimate Code A (no design competed)		
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Industrial Area - Alternatives				Estimator DLN		Checked By BIH		
Line Item		Quantity		Labor		Material		Total Cost
		No. Units	Unit Meas.	MH or \$ Per Unit	Total MH or \$	Per Unit	Total	
Alternative CT3: 10-3/4-inch Conduit containing 4-inch Schedule 40 Steam Pipe with 2-inch Insulation 8-5/8-inch Conduit with 3-inch Schedule 80 Cond Pipe with 1-Inch Insulation Conc Trench								
Steam Piping Material Cost (Prefabricated)		100	LF	-	-	\$33.10	\$3,310	\$3,310
Cond Piping Material Cost (Prefabricated)		100	LF	-	-	\$28.00	\$2,800	\$2,800
Conduit Gland Seal - 10-3/4-inch Casing		2	EA	1.412	2.824	\$185	\$370	\$449
Conduit Gland Seal - 8-5/8-inch Casing		2	EA	1.043	2.086	\$127	\$254	\$313
Installation: 10-3/4-inch Conduit Casing		100	LF	0.511	51.1	-	-	\$1,437
Installation: 8-5/8-inch Conduit Casing		100	LF	0.450	45	-	-	\$1,265
Installation: 4-inch Steam Pipe Sch 40		100	LF	0.380	38.02	-	-	\$1,069
Installation: 3-inch Condensate Pipe Sch 80		100	LF	0.364	36.4	-	-	\$1,024
Demolish Extg: 4-inch Steam Pipe		100	LF	\$1.56	\$156	-	-	\$156
Demolish Extg: 3-inch Condensate Pipe		100	LF	\$1.56	\$156	-	-	\$156
Open Trench for Access / Caulk & Close Trench		100	LF	\$3.23	\$323	-	-	\$323
Subtotal								\$12,302
Alternative CT3: Equivalent Unit Cost per Linear Foot								\$123.02
Alternative CT4: 4-inch Schedule 40 Steam Pipe with 2-inch Insulation and Aluminum Jacket - Built Up & 3-inch Schedule 80 Condensate Pipe with 1-Inch Insulation & Aluminum Jacket - Built Up								
Steam Pipe: 4-inch Schedule 40 Welded		100	LF	\$11.28	\$1,128	\$8.98	\$898	\$2,026
Cond Pipe: 3-inch Schedule 80 Welded		100	LF	\$11.16	\$1,116	\$8.84	\$884	\$2,000
Steam Insulation: 4-inch Pipe, 2-inch Thick		100	LF	\$3.10	\$310	\$2.79	\$279	\$589
Cond. Insulation: 3-inch Pipe, 1-inch Thick		100	LF	\$2.24	\$224	\$0.99	\$99	\$323
Aluminum Jacket - 10 ga. steam & Cond		393	SF	\$3.36	\$1,319	\$0.42	\$165	\$1,484
Demolish Extg: 4-inch Steam Pipe		100	LF	\$1.56	\$156	-	-	\$156
Demolish Extg: 3-inch Condensate Pipe		100	LF	\$1.56	\$156	-	-	\$156
Open Trench for Access / Caulk & Close Trench		100	LF	\$3.23	\$323	-	-	\$323
Subtotal								\$7,057
Alternative CT4: Equivalent Unit Cost per Linear Foot								\$70.57

Note: Costs do not include allowances for expansion loops; expansion joints will be used. Surfaces are assumed 10% Concrete Road and 90% natural surface. Removal costs assume no asbestos contamination.

F:\PROJ\1640320\ENGR\PIP-ALTS.XLS Industrial-UG

COMPUTATION SHEET

KELLER & GANNON
Engineers & Architects
Quality Services Since 1941

COMPUTED BY DLN

CHECKED BY

DATE 7/7REV. 19

FRP PIPE
COOLING SYSTEM
COST ESTIMATE

PROJECT HAUTHERNESHEET NO. 1 OF 4 SHEETS

PER TM-5-652, STEAM SYSTEM
O + M MANUAL, A "PROTECTIVE
DEVICE" IS REQUIRED FOR
FRP CONDENSATE-RETURN SYSTEMS
TO ENSURE THAT MAXIMUM
SAFE TEMPERATURE FOR FRP
PIPE IS NOT EXCEEDED.

THIS IS A COST-ESTIMATE
FOR THIS SYSTEM

COMPUTATION SHEET

KELLER & GANNON
Engineers & Architects
Quality Services Since 1941

COMPUTED BY _____
CHECKED BY _____
DATE _____ 19____
REV. _____ 19____

PROJECT _____
SHEET NO. 2 OF 4 SHEETS

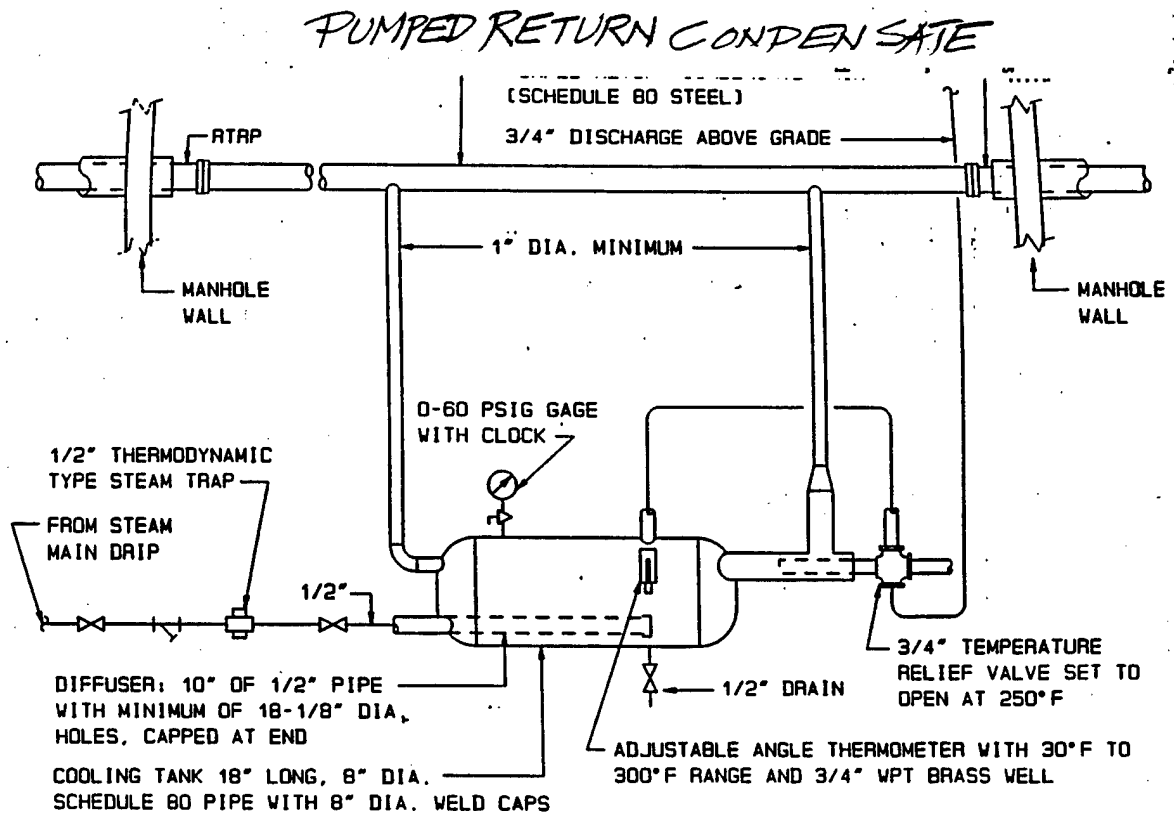


Figure 3-1
Protective Arrangement for RTRP Pipe

COMPUTATION SHEET

KELLER & GANNON
Engineers & Architects
Quality Services Since 1941

COMPUTED BY _____
CHECKED BY _____
DATE _____ 19____
REV. _____ 19____

COST OF
FIG 3.1 - Protective
ARRGT FOR RTRP

PROJECT _____
SHEET NO. 3 OF 4 SHEETS

ITEM	MTL	LABOR
- 4" STEEL / RTRP PIPE ADAPTORS	50	56
- PIPE SUPPORTS	150	145
- 4" SCH 80 STEEL PIPE		
W/ 2" INSULATION - <u>8'</u>	122	156
- 4x4x1" TEE - (2) QUAN	162	229
- 1" ϕ , SCH 80 STEEL PIPE, INSULATED <u>12'</u>	30	84
- 8" ϕ SCH 80 PIPE, 18" LONG (1)	84	61
W/ 8" ϕ WELD CAPS (2)	66	222
- 1/2" ϕ SCH ⁸⁰ PIPE <u>12'</u>	20	73
- 1/2" ϕ Ball Valves (2)	12	40
- 1/2" STRAINER (1)	123	30
- 1/2" STEAM TRAP (1)	136	38
- PRESS GAGE (1)	7	43
- THERMOMETER (1)	50	30
- 3/4" T/P VALVE (1)	600	35
- 3/4" SCH 80 PIPE <u>12'</u>	24	75
- 90° elbows - SCH 80 (4)	29	85
ST (1) =	1665	1402

COMPUTATION SHEET

KELLER & GANNON
Engineers & Architects
Quality Services Since 1941

COMPUTED BY _____
CHECKED BY _____
DATE _____ 19____
REV. _____ 19____

PROJECT _____
SHEET NO. 4 OF 4 SHEETS

<u>ITEM</u>	<u>MTL</u>	<u>LABOR</u>
1/2" DRAIN	10	25
4 - 1/2 (3/4") PENETRATION INTO COOLING TANKS	36	100
1/2 PIPE DIFFUSER, w/ 18-1/8" ϕ holes (x10" LONG)	15	25
1/2" CAP	10	25
INSULATION	<u>100</u>	<u>100</u>
ST2	174	275
(from p. 6) ST1	<u>1665</u>	<u>1402</u>
	1836	1677
	3513	

NE: 815-741-6700
X: 815-741-4229

F A C S I M I L E C O V E R P A G E

DATE: 6/14 PERSON TO: Blair Horst
TIME: AM COPY TO: Ron Johnson @ DEA
COMPANY: KELLER & GANNON FAX NUMBER TO: (415) 364-3631
PERSON FROM: SANDY HOYT NUMBER OF PAGES: 19
(INCLUDING THIS PAGE)

REFERENCE: HAWTHORNE Army Depot Steam Distribution.

ENCLOSED ARE THREE PROPOSALS per your FAX'D
REQUEST OF LAST WEEK

Price #1 is for STEAM & CONDENSATE piping in a CONDUIT

Price #2 is for STEAM & CONDENSATE piping in INDIVIDUAL CONDUITS.

Price #3 is for STEAM CONDUIT AND CONDENSATE in FIBERGLASS
PIPE w/ FOAM INSULATION AND PVC DACKET.

WE HAVE SHOWN INSULATION TYPE AND THICKNESS AS WELL
AS PIPING MATERIALS.

WE FELT THAT PROVIDING UNIT PRICES FOR EACH COMBINATION
WOULD ALLOW YOU TO MAKE ADJUSTMENTS per QUANTITIES REQUIRED.

WE ARE TRANSMITTING FROM A SANFAX 625 (815-741-4229). IF YOU ARE HAVING DIFFICULTY WITH THIS TRANSMISSION, PLEASE
CALL 815-741-6700 IMMEDIATELY.

P. 1

TEL 1-815-741-4229

0000 ROYANCO

Jun. 14 '95 13:39

PRICE NO.1

QUOTE NO. 036579 PAGE 1
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. JB6065
PROJECT HAWTHORNE ARMY DEPOT - BUDGE

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA	
6-- 8 WEEKS		1.5/10 NET 30	SEE BELOW	TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOUNT
		LIST PRICE			
		PRICE NO.1			
		BUDGET PRICING			
		CONDUIT PIPE PRODUCTS:			
		DUAL LINE -- BELOW GROUND			
		STEAM & CONDENSATE			
1	XX06	ONE - 8" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL AND ONE - 4" SCH 80 A53B ERW STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 22" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT	FT	80.34	80.34
1	XX08	8" & 4" X 22" DUAL LINE CONDUIT 90 DEG ELBOW	EA	552.00	552.00
1	XX09	8" & 4" X 22" DUAL LINE CONDUIT GLAND SEAL	EA	344.00	344.00
1	XX10	ONE - 8" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL AND ONE - 2-1/2" SCH 80 A53B ERW	FT	71.21	71.21
		*** CONTINUED ***			

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said approval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS
QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THE ACKNOWLEDGMENT COPY HEREOF.

PURCHASER: _____

See refer to the above Quotation/Number when placing your order.
OFFERS GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

BY: _____

QUOTATION

TEL 1-815-741-4229

ROVANCO 0000

Jun. 14 '95 13:40

O: PRICE NO.1

QUOTE NO. 036579 PAGE 2
 DATE 6/14/95
 SALES REP. JOHNSON-EMERSON ASSOC.
 JOB NO. J86063
 PROJECT HAWTHORNE ARMY DEPOT - BUDGE

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION:

QUOTED SHIPPING DATE	TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA
6- 8 WEEKS	1.5/10 NET 30	SEE BELOW	TRUCK

QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOUNT
		STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 20" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT			
1	XX12	8" & 2-1/2" X 20" DUAL LINE CONDUIT 90 DEG ELBOW	EA	493.00	493.00
1	XX13	8" & 2-1/2" X 20" DUAL LINE CONDUIT GLAND SEAL	EA	336.00	336.00
1	XX14	ONE - 6" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL AND ONE - 3" SCH 80 A53B ERW STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 18" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT	FT	66.38	66.38
1	XX16	6" & 3" X 18" DUAL LINE CONDUIT 90 DEG ELBOW	EA	427.00	427.00
1	XX17	6" & 3" X 18" DUAL LINE CONDUIT GLAND SEAL	EA	231.00	231.00
1	XX18	ONE - 4" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL AND	FT	52.48	52.48
		*** CONTINUED ***			

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said approval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party, in which event, Purchaser shall be committed to purchase the products as aforesaid.

VANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS QUOTATION AND AGREEMENT BY SIGNING AND RETURNING THE ACKNOWLEDGMENT COPY HEREOF.

PURCHASER: _____

See refer to the above Quotation/Number when placing your order.
 QUOTE GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS OTHERWISE STATED.

BY: _____

QUOTATION

P. 3

TEL 1-815-741-4229

ROVANCO 0000

Jun. 14 '95 13:40

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60436

PHONE: 815-741-6700
FAX: 315-741-4228

O: PRICE NO. 1

QUOTE NO. 036579 PAGE 3
DATE 8/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. JB6065
PROJECT HAWTHORNE ARMY DEPOT - BUDGE

IN RESPONSE TO YOUR REQUEST, WE SUBMIT THE FOLLOWING QUOTATION

ESTIMATED SHIPPING DATE	TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA
6- 8 WEEKS	1.5/10 NET 30	SEE BELOW	TRUCK

QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOUNT
		ONE - 2" SCH 80 A53B ERW STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 16" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT			
1	XX20	4" & 2" X 16" DUAL LINE CONDUIT 90 DEG ELBOW	EA	334.00	334.00
1	XX21	4" & 2" X 16" DUAL LINE CONDUIT GLAND SEAL	EA	224.00	224.00
1	XX22	ONE - 4" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL AND ONE - 3" SCH 80 A53B ERW STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 14" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT	FT	52.51	52.51
1	XX24	4" & 3" X 14" DUAL LINE CONDUIT 90 DEG ELBOW	EA	339.00	339.00
1	XX25	4" & 3" X 14" DUAL LINE CONDUIT GLAND SEAL	EA	211.00	211.00
1	XX26	ONE - 2-1/2" SCH 40 A53B ERW	FT	45.74	45.74
		*** CONTINUED ***			

TERMS INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said approval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS
QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THE ACKNOWLEDGMENT COPY HEREOF.

PURCHASER: _____

we refer to the above Quotation/Number when placing your order.
THIS QUOTE IS GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

BY: _____

QUOTATION

P. 4

TEL 1-815-741-4229

ROVANCO 0000

Jun. 14 '95 13:41

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION:

MATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA		
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK		
IAANTITY	ITEM NUMBER	DESCRIPTION			U/M	UNIT PRICE	EXTENDED AMOUNT
		STEEL PIPW W/2" MINERAL WOOL & ONE - 1-1/4" SCH 80 A106B SMLS STEEL W/1" MINERAL WOOL BOTH INSIDE OF A 12-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT					
1	XX28	2-1/2" & 1-1/4" X 12-3/4" DUAL LINE CONDUIT 90 DEG ELBOW			EA	275.00	275.00
1	XX29	2-1/2" & 1-1/4" X 12-3/4" DUAL LINE CONDUIT GLAND SEAL			EA	206.00	206.00
1	XX30	ONE - 5" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL AND ONE - 2-1/2" SCH 80 A53B ERW STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 18" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT			FT	61.77	61.77
1	XX32	5" & 2-1/2" X 18" DUAL LINE CONDUIT 90 DEG ELBOW			EA	393.00	393.00
1	XX33	5" & 2-1/2" X 18" DUAL LINE CONDUIT GLAND SEAL			EA	231.00	231.00
1	XX34	ONE - 3" SCH 40 A53B ERW STEEL			FT	48.22	48.22
*** CONTINUED ***							

FOR INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said approval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party, in which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS QUOTATION AND AGREEMENT BY SIGNING AND RETURNING THE ACKNOWLEDGMENT COPY HEREOF.

PURCHASER: _____

BY: _____

See refer to the above Quotation/Number when placing your order.
THIS QUOTE IS GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS OTHERWISE STATED.

QUOTATION

1 815 741 4226

06-14-95 12:39PM P035 #10

TO:

PRICE NO.1

QUOTE NO. 036579 PAGE 3
 DATE 6/14/95
 SALES REP. JOHNSON-EMERSON ASSOC.
 JOB NO. JB6065
 PROJECT HAWTHORNE ARMY DEPOT - BUDGET

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION.

MATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK	
ANITY	ITEM NUMBER	DESCRIPTION		U/M	UNIT PRICE	EXTENDED AMOUNT
		PIPE W/2" MINERAL WOOL AND ONE - 1-1/2" SCH 80 A106B SMLS STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 14" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT				
1	XX35	3" & 1-1/2" X 14" DUAL LINE CONDUIT 90 DEG ELBOW		EA	296.00	296.00
1	XX37	3" & 1-1/2" X 14" DUAL LINE CONDUIT GLAND SEAL		EA	211.00	211.00
1	XX38	1-1/2" SCH 40 A106B SMLS STEEL PIPE W/2" MINERAL WOOL AND ONE - 1-1/4" SCH 80 A106B SMLS STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 10-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	42.07	42.07
1	XX40	1-1/2" & 1-1/4" X 10-3/4" DUAL LINE CONDUIT 90 DEG ELBOW		EA	248.00	248.00
1	XX41	1-1/2" & 1-1/4" X 10-3/4" DUAL LINE CONDUIT GLAND SEAL		EA	206.00	206.00
1	XX42	ONE - 5" SCH 40 A53B ERW STEEL		FT	62.82	62.82
		*** CONTINUED ***				

FOR INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of such approval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS
 QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
 THE ACKNOWLEDGMENT COPY HEREOF.

PURCHASER: _____

we refer to the above Quotation/Number when placing your order.
 THIS GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
 OTHERWISE STATED.

BY: _____

QUOTATION

P. 6

TEL 1-815-741-4229

ROVANCO 0000

Jun. 14 '95 13:42

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60435

PHONE: 815-741-8700
FAX: 815-741-4229

TO: PRICE NO.1

QUOTE NO. 036579 PAGE 6
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPOT -- BUDG

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION.

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION		U/M	UNIT PRICE	EXTENDED AMOUNT
		PIPE W/2" MINERAL WOOL AND ONE - 3" SCH 80 A53B ERW STEEL PIPE W/1" MINERLA WOOL BOTH INSIDE OF A 18" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT				
1	XX44	5' & 3" X 18" DUAL LINE CONDUIT 90 DEG ELBOW		EA	405.00	405.0
1	XX45	5' & 3" X 18" DUAL LINE CONDUIT GLAND SEAL		EA	231.00	231.0
1	XX46	TRI LINE: ONE - 5' SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL AND ONE - 2' SCH 80 A106B SMLS STEEL PIPE W/1" MINERAL WOOL AND ONE - 1-1/2" SCH 80 A106B SMLS STEEL PIPE W/1" MINERAL WOOL ALL INSIDE OF A 20" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	64.77	64.7
1	XX48	5' & 2" & 1-1/2" X 20" TRI LINE CONDUIT 90 DEG ELBOW		EA	457.00	457.0
1	XX49	5' & 2" & 1-1/2" X 20" TRI		EA	311.00	311.0
*** CONTINUED ***						

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS QUOTATION AND AGREEMENT BY SIGNING AND RETURNING THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

*Please refer to the above Quotation Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS OTHERWISE STATED.*

BY: _____

QUOTATION

JUL 14 1995

TEL 1 815 741 4229

ROVANCO 0000

JUL 14 1995

ROVANCO

Piping Systems

20333 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60430

PHONE: 815-741-3700
FAX: 815-741-4229

TO: PRICE NO. 1

QUOTE NO. 036579 PAGE 7
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPOT - BUDG.

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION.

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA		
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW	TRUCK		
QUANTITY	ITEM NUMBER	DESCRIPTION		U/M	UNIT PRICE	EXTENDED AMOUNT
1	XX50	LINE CONDUIT GLAND SEAL ONE - 2-1/2" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL & ONE - 1-1/2" SCH 80 A106B SMLS STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 12-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	45.74	45.7
1	XX52	2-1/2" & 1-1/2" X 12-3/4" DUAL LINE CONDUIT 90 DEG ELBOW		EA	275.00	275.0
1	XX53	2-1/2" & 1-1/2" X 12-3/4" DUAL LINE CONDUIT GLAND SEAL		EA	206.00	206.0
1	XX54	ONE - 2-1/2" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL & ONE - 2" SCH 80 A53B ERW STEEL PIPE W/1" MINERAL WOOL BOTH INSIDE OF A 12-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	45.48	45.4
1	XX56	2-1/2" & 2" X 12-3/4" DUAL LINE CONDUIT 90 DEG ELBOW		EA	275.00	275.0
1	XX57	2-1/2" & 2" X 12-3/4" DUAL		EA	206.00	206.0
*** CONTINUED ***						

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS
QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THE ACKNOWLEDGMENT COPY HEREON.

BY: _____

PURCHASER: _____

Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

BY: _____

QUOTATION

P. 8

TEL 1-815-741-4225

ROVANCO 0000

Jun. 14. 95 13:44

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60436

PHONE: 815-741-6700
FAX: 815-741-4229

PRICE NO. 1

QUOTE NO. 036579 PAGE 8
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPOT - BUDGE

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION:

ESTIMATED SHIPPING DATE	TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA		
6- 8 WEEKS	1.5/10 NET 30	SEE BELOW	TRUCK		
QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOUNT
		LINE CONDUIT GLAND SEAL			
		FREIGHT FIGURED PER TRUCK WILL COST \$3,000.00 EACH.			
		*** QUOTE TOTAL ***			
		QUOTE TOTAL MARK-UP %			
		THE ABOVE QUOTE CONTAINS BUDGET PRICING WHICH IS TO BE USED FOR ESTIMATING PURPOSES ONLY.			
		PRICES MAY VARYING DEPENDING ON QUANTITIES ORDERED.			

DISCLAIMER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said approval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS QUOTATION AND AGREEMENT BY SIGNING AND RETURNING THE ACKNOWLEDGMENT COPY HEREOF.

PURCHASER: _____

BY: _____

Refer to the above Quotation/Number when placing your order.
THIS QUOTE IS GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS OTHERWISE STATED.

QUOTATION

TO: PRICE NO.2

QUOTE NO. 036609 PAGE 1
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. JB6065
PROJECT HAWTHORNE ARMY DEPOT - BUD

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION

ESTIMATED SHIPPING DATE	TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA
6- 8 WEEKS	1.5/10 NET 30	SEE BELOW	TRUCK

QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOUNT
		LIST PRICE			
		PRICE NO.2			
		BUDGET PRICING			
		CONDUIT PIPE PRODUCTS:			
		SINGLE LINE - BELOW GROUND			
		STEAM & CONDENSATE			
1	XX06	8" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 16" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT	FT	50.84	50.8
1	XX07	8" X 16" CONDUIT 90 DEG EL	EA	384.00	384.0
1	XX08	8" X 16" CONDUIT GLAND SEAL	EA	213.00	213.0
1	XX09	6" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 14" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT	FT	42.71	42.7
1	XX10	6" X 14" CONDUIT 90 DEG EL	EA	305.00	305.0
1	XX11	6" X 14" CONDUIT GLAND SEAL	EA	186.00	186.0
		*** CONTINUED ***			

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said approval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS
QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THE ACKNOWLEDGMENT COPY HEREOF.

PURCHASER: _____

BY: _____

PLEASE refer to the above Quotation/Number when placing your order.
THIS QUOTE IS GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

QUOTATION

P. 10

TEL 1-815-741-4229

ROVANCO 0000

Jun. 14 '95 13:45

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60436

PHONE: 815-741-6700
FAX: 815-741-4228

TO: PRICE NO.2

QUOTE NO. 036697 PAGE 2
DATE 8/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPORT - BUD

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA		
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW	TRUCK		
QUANTITY	ITEM NUMBER	DESCRIPTION		U/M	UNIT PRICE	EXTENDED AMOUNT
1	XX12	5" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 12-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	39.75	39.7
1	XX13	5" X 12-3/4" CONDUIT 90 DEG EL		EA	272.00	272.0
1	XX14	5" X 12-3/4" CONDUIT GLAND SEAL		EA	182.00	182.0
1	XX15	4" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 10-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	33.10	33.1
1	XX16	4" X 12-3/4" CONDUIT 90 DEG EL		EA	244.00	244.0
1	XX17	4" X 12-3/4" CONDUIT GLAND SEAL		EA	182.00	182.0
1	XX18	3" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 10-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	31.77	31.7
1	XX19	3" X 10-3/4" CONDUIT 90 DEG EL		EA	206.00	206.0
*** CONTINUED ***						

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as stored.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS QUOTATION AND AGREEMENT BY SIGNING AND RETURNING THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

*Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS OTHERWISE STATED.

BY: _____

QUOTATION

P.11

TEL 1-815-741-4228

ROVANCO 0000

Aug 14 1995 13:46

ROVANCO**Piping Systems**20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60438PHONE: 815-741-8700
FAX: 815-741-4229

TO: PRICE NO. 2

QUOTE NO. 036609 PAGE 3
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPT - BUD

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION.

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION		U/M	UNIT PRICE	EXTENDED AMOUNT
1	XX20	3" X 10-3/4" CONDUIT GLAND SEAL		EA	185.00	185.0
1	XX21	3" SCH 80 A53B ERW STEEL PIPE W/1" MINERAL WOOL IN A 8-5/8" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	28.00	28.0
1	XX22	3" X 8-5/8" CONDUIT 90 DEG EL		EA	192.00	192.0
1	XX23	3" X 8-5/8" CONDUIT GLAND SEAL		EA	127.00	127.0
1	XX24	2-1/2" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 10-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	31.63	31.6
1	XX225	2-1/2" X 10-3/4" CONDUIT 90 DEG EL		EA	196.00	196.0
1	XX26	2-1/2" X 10-3/4" CONDUIT GLAND SEAL		EA	185.00	185.0
1	XX27	2" SCH 80 A53B ERW STEEL PIPE W/1" MINERAL WOOL IN A 6-5/8" 10 GA FUSION BONDED EPOXY		FT	23.19	23.1
*** CONTINUED ***						

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS QUOTATION AND AGREEMENT BY SIGNING AND RETURNING THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

*Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS OTHERWISE STATED.

BY: _____

QUOTATION

P. 12

TEL 1-815-741-4229

ROVANCO 0000

Jun. 14 95 13:46

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60438

PHONE: 815-741-5700
FAX: 815-741-4229

TO: PRICE NO.2

QUOTE NO. 036607 PAGE 4
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. JB6065
PROJECT HAWTHURNE ARMY DEPORT - BUD

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOUNT	
		COATED STEEL CONDUIT				
1	XX28	2" X 6-5/8" CONDUIT 90 DEG EL	EA	150.00	150.0	
1	XX29	2" X 6-5/8" CONDUIT GLAND SEAL	EA	88.00	88.0	
1	XX30	1-1/2" SCH 80 A106B SMLS STEEL PIPE W/1" MINERAL WOOL IN A 6-5/8" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT	FT	23.45	23.4	
1	XX31	1-1/2" X 6-5/8" CONDUIT 90 DEG EL	EA	150.00	150.0	
1	XX32	1-1/2" X 6-5/8" CONDUIT GLAND SEAL	EA	88.00	88.0	
1	XX33	1-1/4" SCH 80 A106B SMLS STEEL PIPE W/1" MINERAL WOOL IN A 6-5/8" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT	FT	23.45	23.4	
1	XX34	1-1/4" X 6-5/8" CONDUIT 90 DEG EL	EA	150.00	150.0	
1	XX35	1-1/4" X 6-5/8" CONDUIT GLAND SEAL	EA	88.00	88.0	
*** CONTINUED ***						

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party, in which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

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QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

"Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

BY: _____

QUOTATION

ET U

6224 142 STO 1 TEL

ROVANCO 0000

JUN 14 05 14 PM

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60438

PHONE: 815 741 8700
FAX: 815-741-4229

TO: PRICE NO.2

QUOTE NO. 036609 PAGE 3
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. JB6065
PROJECT HAWTHORNE ARMY DEPORT - BUD

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION.

ESTIMATED SHIPPING DATE	TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA		
6- 8 WEEKS	1.5/10 NET 30	SEE BELOW	TRUCK		
QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOUNT
		FREIGHT FIGURED PER TRUCK WILL COST \$3,000.00 EACH.			
		*** QUOTE TOTAL ***			
		QUOTE TOTAL MARK-UP %			
		THE ABOVE QUOTE CONTAINS BUDGET PRICING WHICH IS TO BE USED FOR ESTIMATING PURPOSES ONLY.			
		PRICES MAY VARY DEPENDING ON QUANTITIES ORDERED.			

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ROVANCO PIPING SYSTEMS

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THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

*Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

BY: _____

QUOTATION

P.14

TEL 1-815-741-4229

ROVANCO 0000

June 14 1995 13:48

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60438

PHONE: 815-741-6700
FAX: 015-741-4229

TO: PRICE NO. 3

QUOTE NO. 036610 PAGE 1
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPOT - BUDG

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION:

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION		U/M	UNIT PRICE	EXTENDED AMOUNT
		LIST PRICE				
		PRICE NO. 3				
		BUDGET PRICING				
		CONDUIT PIPE PRODUCTS.				
		STEAM - BELOW GROUND				
1	XX06	8" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 16" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	30.84	30.8
1	XX07	8" X 16" CONDUIT 90 DEG EL		EA	384.00	384.0
1	XX08	8" X 16" CONDUIT GLAND SEAL		EA	213.00	213.0
1	XX09	6" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 14" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	42.71	42.7
1	XX10	6" X 14" CONDUIT 90 DEG EL		EA	305.00	305.0
1	XX11	6" X 14" CONDUIT GLAND SEAL		EA	186.00	186.0
1	XX12	5" SCH 40 A53B ERW STEEL PIPE		FT	39.75	39.7
		*** CONTINUED ***				

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS
QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THIS ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

"Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED."

BY: _____

QUOTATION

P.15

TEL 1-815-741-4229

ROVANCO 0000

Jun. 14, 95 13:18

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60436

PHONE: 815-741-6700
FAX: 815-741-4229

TO: PRICE NO. 3

QUOTE NO. 036610 PAGE 2
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPOT - BUDG.

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION.

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION		U/M	UNIT PRICE	EXTENDED AMOUN
		W/2" MINFRAL WOOL IN A 12-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUITT				
1	XX13	5" X 12-3/4" CONDUIT 90 DEG EL		EA	272.00	272.0
1	XX14	5" X 12-3/4" CONDUIT GLAND SEAL		EA	182.00	182.0
1	XX15	4" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 10-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	33.10	33.1
1	XX16	4" X 10-3/4" CONDUIT 90 DEG EL		EA	225.00	225.0
1	XX17	4" X 10-3/4" CONDUIT GLAND SEAL		EA	185.00	185.0
1	XX18	3" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 10-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	31.77	31.7
1	XX19	3" X 10-3/4" CONDUIT 90 DEG EL		EA	206.00	206.0
1	XX20	3" X 10-3/4" CONDUIT GLAND		EA	185.00	185.0
*** CONTINUED ***						

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS
QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

*Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

BY: _____

QUOTATION

01.1

2221 141 518 1

0000 ROVANCO

June 14 1995

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60438

PHONE: 815-741-8700
FAX: 815-741-4229

TO: PRICE NO. 3

QUOTE NO. 036610 PAGE 3
DATE 6/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPOT - BUDG

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION		U/M	UNIT PRICE	EXTENDED AMOUNT
		SEAL				
1	XX21	2-1/2" SCH 40 A53B ERW STEEL PIPE W/2" MINERAL WOOL IN A 10-3/4" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	31.63	31.6
1	XX22	2-1/2" X 10-3/4" CONDUIT 90 DEG EL		EA	196.00	196.0
1	XX23	2-1/2" X 10-3/4" CONDUIT GLAND SEAL		EA	183.00	183.0
1	XX24	1-1/2" SCH 40 A106B 3MLS STEEL PIPE W/2" MINERAL WOOL IN A 8-5/8" 10 GA FUSION BONDED EPOXY COATED STEEL CONDUIT		FT	26.62	26.6
1	XX25	1-1/2" X 8-5/8" CONDUIT 90 DEG EL		EA	161.00	161.0
1	XX26	1-1/2" X 8-5/8" CONDUIT GLAND SEAL		EA	127.00	127.0
		POLYURETHANE FOAM PRODUCTS: CONDENSATE - BELOW GROUND				
1	FB2043-PA0B	4" BONDSTRAND 2000 X 8" PVC		FT	13.27	13.2
		*** CONTINUED ***				

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party. In which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS
QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

*Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

BY: _____

QUOTATION

P. 17

TEL 1-815-741-4229

ROVANCO 2000

June 14 1995 13:50

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60438

PHONE: 815-741-6700
FAX: 815-741-1229

TO: PRICE NO. 3

QUOTE NO. 036610 PAGE 4
DATE 8/14/95
SALES REP. JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPOT - BUDG

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION.

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS		SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW		TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOU	
		CASING 30'RL W/JOINT KIT				
1	FB2033-PA06	3" BONDSTRAND 2000 X 6" PVC CASING 30'RL W/JOINT KIT	FT	10.03		10.0
1	FB2023-PA06	2" BONDSTRAND 2000 X 6" PVC CASING 30'RL W/JOINT KIT	FT	8.46		8.4
1	FB2904	4" SERIES 2000 90 DEGREE ELBOW	EA	74.33		74.3
1	FB2903	3" SERIES 2000 90 DEGREE ELBOW	EA	58.23		58.2
1	FB2902	2" SERIES 2000 90 DEGREE ELBOW	EA	43.02		43.0
FREIGHT FIGURED PER TRUCK WILL COST \$3,000.00 EACH.						
*** QUOTE TOTAL ***						
QUOTE TOTAL MARK-UP %						
THE ABOVE QUOTE CONTAINS BUDGET PRICING WHICH IS TO BE USED FOR ESTIMATING PURPOSES						

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of such disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party, in which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

PLEASE ACKNOWLEDGE YOUR ACCEPTANCE OF THIS QUOTATION AND AGREEMENT BY SIGNING AND RETURNING THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

*Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS OTHERWISE STATED.

BY: _____

QUOTATION

P 18

TEL 1-815-741-4229

ROVANCO 0000

Aug 14 '95 13:55

ROVANCO

Piping Systems

20535 S.E. FRONTAGE ROAD
JOLIET, ILLINOIS 60438

PHONE: 815-741-0700
FAX: 815-741-4229

TO: PRICE NO. 3

QUOTE NO. 036610
DATE 6/14/95
SALES REP JOHNSON-EMERSON ASSOC.
JOB NO. J86065
PROJECT HAWTHORNE ARMY DEPOT -- BUDG

PAGE 5

IN RESPONSE TO YOUR INQUIRY, WE SUBMIT THE FOLLOWING QUOTATION:

ESTIMATED SHIPPING DATE		TERMS	F.O.B. JOLIET, ILLINOIS	SHIP VIA	
6- 8 WEEKS		1.5/10 NET 30	SEE BELOW	TRUCK	
QUANTITY	ITEM NUMBER	DESCRIPTION	U/M	UNIT PRICE	EXTENDED AMOUNT
		ONLY. PRICES MAY VARYING DEPENDING ON QUANTITIES ORDERED.			

OTHER INFORMATION: This Quotation is being made upon the condition that, in the event this Quotation is incorporated by Purchaser in a bid that is accepted, Purchaser shall be committed to purchase the products described herein upon the terms and conditions stated herein and on the reverse side hereof. In the event that the products described herein are not approved by the party accepting Purchaser's bid, Purchaser agrees to notify Rovanco Piping Systems in writing of said disapproval and Rovanco Piping Systems shall have ten (10) days after the receipt of said notice to obtain the approval of said party, in which event, Purchaser shall be committed to purchase the products as aforesaid.

ROVANCO PIPING SYSTEMS

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QUOTATION AND AGREEMENT BY SIGNING AND RETURNING
THE ACKNOWLEDGMENT COPY HEREOF.

BY: _____

PURCHASER: _____

*Please refer to the above Quotation/Number when placing your order.
PRICES GOOD FOR 30 DAYS FROM DATE OF QUOTE UNLESS
OTHERWISE STATED.

BY: _____

QUOTATION

P. 19

TEL 1-815-741-4229

ROVANCO 0000

June 14 95 13:51

APPENDIX F

Construction Cost Estimates - Industrial Area

**EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada**

APPENDIX F

Table of Contents

Industrial Area Cost Estimates	F-1
(18 Sheets)	
Industrial Area Pipe-In-Conduit Unit Cost Estimates	F-19
(2 Sheets)	
Industrial Area Built-Up Pipe Unit Cost Estimates	F-21
(2 Sheets)	
Industrial Area Trench Excavation Unit Cost Estimates	F-23
(6 Sheets)	
Concrete Pit (Manhole) Unit Cost Estimate	F-29

Note: See Appendix G For Pipe Fitting Unit Cost Estimates

G. Sheet: APP F

Did not find cost for
exp. in joints which would
have to be used in Industrial
Area. Unit cost was developed
in App G, but can't see where
they were applied in App F.

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 1 of 18	
Project ECIP Modernize Industrial Area Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Pipe Replacement Bldg 13 to MH B4					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
Piping cost								
Bldg 13 to MH A5	6" (40) HPS	Conc Trench	Lawn	679	LF	\$65.58	\$44,528	
Bldg 13 to MH A2-1	4" (80) Cond	Conc Trench	Lawn	330	LF	\$46.19	\$15,244	
MH A2-1 to MH A5	3" (80) Cond	Conc Trench	Lawn	349	LF	\$37.91	\$13,232	
Bldg 13 to MH A5	6" (40) HPS	Conc Trench	Conc Road	38	LF	\$65.58	\$2,492	
MH A5 to MH B1	3" (80) Cond	Conc Trench	Conc	44	LF	\$37.91	\$1,668	
MH B1 to MH B2	3" (80) Cond	Conc Trench	Conc	102	LF	\$37.91	\$3,867	
MH B1 to MH B2	3" (80) Cond	Conc Trench	Conc Road	25	LF	\$37.91	\$948	
MH B2 to MH B3	2" (80) Cond	Conc Trench	Conc	198	LF	\$25.01	\$4,951	
MH B2 to MH B3	2" (80) Cond	Conc Trench	Conc Road	25	LF	\$25.01	\$625	
MH B3 to MH B4	2" (80) Cond	Direct Bury	Asphalt	75	LF	\$48.67	\$3,650	
MH B3 to MH B4	2" (80) Cond	Direct Bury	Conc Road	22	LF	\$48.67	\$1,071	
MH A5 to MH B1	5" (40) HPS	Conc Trench	Conc	44	LF	\$65.58	\$2,885	
MH B1 to MH B2	4" (40) HPS	Conc Trench	Conc	102	LF	\$44.37	\$4,526	
MH B1 to MH B2	4" (40) HPS	Conc Trench	Conc Road	25	LF	\$44.37	\$1,109	
MH B2 to MH B3	5" (40) HPS	Conc Trench	Conc	198	LF	\$65.58	\$12,985	
MH B2 to MH B3	5" (40) HPS	Conc Trench	Conc Road	25	LF	\$65.58	\$1,639	
MH B3 to MH B4	3" (40) HPS	Direct Bury	Asphalt	75	LF	\$63.77	\$4,783	
MH B3 to MH B4	3" (40) HPS	Direct Bury	Conc Road	22	LF	\$63.77	\$1,403	
MH B1 to Bldg 6	2" (40) HPS	Conc Trench	Conc	32	LF	\$26.71	\$855	
						Total =	\$122,462	
Demolition cost (Assumed existing abandoned condensate pipe in trench is the same size as in parallel return line.)								
Bldg 13 to MH A5	6" (40) HPS	Conc Trench	Lawn	679	LF	\$4.69	\$3,185	
Bldg 13 to MH A5	6" (40) HPS	Conc Trench	Conc Road	38	LF	\$4.69	\$178	
MH A5 to MH B1	3" (80) Cond	Conc Trench	Conc	44	LF	\$1.56	\$69	
MH B1 to MH B2	3" (80) Cond	Conc Trench	Conc	102	LF	\$1.56	\$159	
MH B1 to MH B2	3" (80) Cond	Conc Trench	Conc Road	25	LF	\$1.56	\$39	
MH B2 to MH B3	2" (80) Cond	Conc Trench	Conc	198	LF	\$1.17	\$232	
MH B2 to MH B3	2" (80) Cond	Conc Trench	Conc Road	25	LF	\$1.17	\$29	
MH B3 to MH B4	2" (80) Cond	Direct Bury	Asphalt	75	LF	\$1.17	\$88	
MH B3 to MH B4	2" (80) Cond	Direct Bury	Conc Road	22	LF	\$1.17	\$26	
MH A5 to MH B1	5" (40) HPS	Conc Trench	Conc	44	LF	\$4.69	\$206	
MH B1 to MH B2	4" (40) HPS	Conc Trench	Conc	102	LF	\$1.56	\$159	
MH B1 to MH B2	4" (40) HPS	Conc Trench	Conc Road	25	LF	\$1.56	\$39	
MH B2 to MH B3	5" (40) HPS	Conc Trench	Conc	198	LF	\$4.69	\$929	
MH B2 to MH B3	5" (40) HPS	Conc Trench	Conc Road	25	LF	\$4.69	\$117	
MH B3 to MH B4	3" (40) HPS	Direct Bury	Asphalt	75	LF	\$1.56	\$117	
MH B3 to MH B4	3" (40) HPS	Direct Bury	Conc Road	22	LF	\$1.56	\$34	
MH B1 to Bldg 6	2" (40) HPS	Conc Trench	Conc	32	LF	\$1.17	\$37	
						Total =	\$5,643	

CONSTRUCTION COST ESTIMATE				Date Prepared July 1995		Sheet 2 of 18	
Project ECIP Modernize Industrial Area Steam Distribution				Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada				Code A (no design completed)			
Engineer-Architect Keller & Gannon							
Drawing No. Pipe Replacement Bldg 13 to MH B4				Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost
				No. Units	Unit Meas.		
Placement cost							
Bldg 13 to MH A5	6" (40) HPS	Conc Trench	Lawn	679	LF	\$3.18	\$2,157
Bldg 13 to MH A2-1	4" (80) Cond	Conc Trench	Lawn	330	LF	\$3.18	\$1,048
MH A2-1 to MH A5	3" (80) Cond	Conc Trench	Lawn	349	LF	\$3.18	\$1,109
Bldg 13 to MH A5	6" (40) HPS	Conc Trench	Conc Road	38	LF	\$17.62	\$670
MH A5 to MH B1	3" (80) Cond	Conc Trench	Conc	44	LF	\$3.18	\$140
MH B1 to MH B2	3" (80) Cond	Conc Trench	Conc	102	LF	\$3.18	\$324
MH B1 to MH B2	3" (80) Cond	Conc Trench	Conc Road	25	LF	\$3.18	\$79
MH B2 to MH B3	2" (80) Cond	Conc Trench	Conc	198	LF	\$3.18	\$629
MH B2 to MH B3	2" (80) Cond	Conc Trench	Conc Road	25	LF	\$3.18	\$79
MH B3 to MH B4	2" (80) Cond	Direct Bury	Asphalt	75	LF	\$3.18	\$238
MH B3 to MH B4	2" (80) Cond	Direct Bury	Conc Road	22	LF	\$3.18	\$70
MH A5 to MH B1	5" (40) HPS	Conc Trench	Conc	44	LF	\$3.18	\$140
MH B1 to MH B2	4" (40) HPS	Conc Trench	Conc	102	LF	\$3.18	\$324
MH B1 to MH B2	4" (40) HPS	Conc Trench	Conc Road	25	LF	\$3.18	\$79
MH B2 to MH B3	5" (40) HPS	Conc Trench	Conc	198	LF	\$3.18	\$629
MH B2 to MH B3	5" (40) HPS	Conc Trench	Conc Road	25	LF	\$3.18	\$79
MH B3 to MH B4	3" (40) HPS	Direct Bury	Asphalt	75	LF	\$17.77	\$1,333
MH B3 to MH B4	3" (40) HPS	Direct Bury	Conc Road	22	LF	\$23.96	\$527
MH B1 to Bldg 6	2" (40) HPS	Conc Trench	Conc	32	LF	\$3.18	\$102
						Total =	\$9,758
New Manhole cost							
MH A2-1				1	EA	\$6,266	\$6,266
MH A2-2				1	EA	\$6,266	\$6,266
MH A2-3				1	EA	\$6,266	\$6,266
						Total =	\$18,798
Fittings cost							
Bldg 13 to Bldg 18	6" (80) HPS ' T '			1	EA	\$416	\$416
	6" (80) HPS ' 45° EL '			1	EA	\$296	\$296
	6" (80) HPS ' 90° EL '			1	EA	\$306	\$306
	4" (40) Cond ' T '			1	EA	\$336	\$336
	4" (40) Cond ' 90° EL '			1	EA	\$241	\$241
MH A2-1 to Bldg 13	6" (80) HPS ' 90° EL '			1	EA	\$306	\$306
	6" HPS ' Valve '			1	EA	\$1,742	\$1,742
	4" (40) Cond ' 90° '			1	EA	\$241	\$241
	4" Cond ' Valve '			1	EA	\$1,132	\$1,132
MH A2-1	6" (80) HPS ' T '			1	EA	\$416	\$416
	6" (80) HPS ' 45° EL '			1	EA	\$296	\$296
	3" (40) Cond ' T '			1	EA	\$247	\$247
	3" (40) Cond Anchor			1	EA	\$43	\$43
MH A2	6" (80) HPS ' T '			2	EA	\$416	\$832
	6" (80) HPS ' 45° EL '			2	EA	\$296	\$591
	1 1/2" Drip Trap Ass.			1	EA	\$1,999	\$1,999

CONSTRUCTION COST ESTIMATE				Date Prepared July 1995		Sheet 3 of 18	
Project ECIP Modernize Industrial Area Steam Distribution				Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada				Code A (no design completed)			
Engineer-Architect Keller & Gannon							
Drawing No. Pipe Replacement Bldg 13 to MH B4				Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost
				No. Units	Unit Meas.		
	2" HPS ' Valve '			1	EA	\$282	\$282
	3" (40) Cond ' T '			2	EA	\$247	\$494
	3" (40) Cond ' 90° EL '			1	EA	\$241	\$241
	2" Cond ' Valve '			1	EA	\$282	\$282
MH A4	6" (80) HPS ' T '			1	EA	\$416	\$416
	6" (80) HPS ' 45° EL '			1	EA	\$296	\$296
	3" (40) Cond ' T '			1	EA	\$247	\$247
MH A5	6" (80) HPS ' T '			2	EA	\$416	\$832
	6" (80) HPS ' 45° EL '			2	EA	\$296	\$591
	1 1/2" Drip Trap Ass.			1	EA	\$1,999	\$1,999
	3" (40) Cond ' T '			2	EA	\$247	\$494
	3" (40) Cond ' 90° EL '			1	EA	\$241	\$241
MH B1	4" (80) HPS ' T '			1	EA	\$286	\$286
	4" (80) HPS ' 45° EL '			1	EA	\$206	\$206
	3" HPS ' Valve '			1	EA	\$874	\$874
	2 1/2" HPS ' Valve '			1	EA	\$858	\$858
	3" (40) Cond ' T '			1	EA	\$247	\$247
	2" Cond ' Valve '			1	EA	\$282	\$282
MH B2	5" (80) HPS ' T '			2	EA	\$416	\$832
	5" (80) HPS ' 45° EL '			2	EA	\$296	\$591
	1 1/2" Drip Trap Ass.			1	EA	\$1,999	\$1,999
	3" HPS Valve			1	EA	\$874	\$874
	2" (40) Cond ' T '			2	EA	\$217	\$435
	2" (40) Cond ' 90° EL '			1	EA	\$135	\$135
	2 1/2" Cond Valve			1	EA	\$858	\$858
MH B3	3" (80) HPS ' T '			1	EA	\$341	\$341
	3" (80) HPS ' 45° EL '			1	EA	\$157	\$157
	1 1/2" HPS ' Valve '			1	EA	\$217	\$217
	2" (40) Cond ' T '			1	EA	\$240	\$240
	1" Cond ' Valve '			1	EA	\$142	\$142
Expansion Joints	6" Steam or Condensate			2	EA	\$748	\$1,496
	5" Steam or Condensate			4	EA	\$724	\$2,895
	4" Steam or Condensate			2	EA	\$575	\$1,151
	3" Steam or Condensate			4	EA	\$481	\$1,924
	2" Steam or Condensate			1	EA	\$414	\$414
Total =						\$33,307	
Subtotal							\$189,967
Nevada Sales Tax	3.75%	Based on average of materials costs				54%	\$3,846
Subtotal							\$193,813
Contractor OH & Profit	25.0%						48,453
Subtotal							\$242,266
Estimating Contingency	10.0%						24,227
Total Probable Construction Cost							\$266,492
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings							\$110.58

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 4 of 18	
Project ECIP Modernize Industrial Area Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Pipe Replacement MH A5 to MH A9					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
Piping cost								
MH A7 to MH A9	5" (40) HPS	Conc Trench	Conc	298	LF	\$65.58	\$19,543	
MH A7 to MH A9	5" (40) HPS	Conc Trench	Conc Road	22	LF	\$65.58	\$1,443	
MH A7 to MH A9	3" (80) Cond	Conc Trench	Conc	298	LF	\$37.91	\$11,298	
MH A7 to MH A9	3" (80) Cond	Conc Trench	Conc Road	22	LF	\$37.91	\$834	
MH A9 to Bldg 1	2 1/2" (40)	Conc Trench	Conc	100	LF	\$31.26	\$3,126	
MH A9 to Bldg1	1 1/2" (80)	Conc Trench	Conc	140	LF	\$37.91	\$5,308	
MH A8 to Bldg 2	2" (40) HPS	Conc Trench	Conc	130	LF	\$26.71	\$3,472	
MH A8 to Bldg 2	1 1/2" (80)	Conc Trench	Conc	130	LF	\$20.00	\$2,599	
MH A5 to MH A7	5" (40) HPS	Conc Trench	Conc	349	LF	\$65.58	\$22,887	
MH A5 to MH A7	5" (40) HPS	Conc Trench	Conc Road	51	LF	\$65.58	\$3,345	
MH A5 to MH A7	3" (80) Cond	Conc Trench	Conc	349	LF	\$37.91	\$13,232	
MH A5 to MH A7	3" (80) Cond	Conc Trench	Conc Road	51	LF	\$37.91	\$1,934	
						Total =	\$89,020	
Demolition cost size as in parallel return line.)								
MH A7 to MH A9	5" (40) HPS	Conc Trench	Conc	298	LF	\$4.69	\$1,398	
MH A7 to MH A9	5" (40) HPS	Conc Trench	Conc Road	22	LF	\$4.69	\$103	
MH A7 to MH A9	3" (80) Cond	Conc Trench	Conc	298	LF	\$0.00	\$0	
MH A7 to MH A9	3" (80) Cond	Conc Trench	Conc Road	22	LF	\$0.00	\$0	
MH A9 to Bldg 1	2 1/2" (40)	Conc Trench	Conc	100	LF	\$3.18	\$318	
MH A9 to Bldg1	1 1/2" (80)	Conc Trench	Conc	140	LF	\$1.17	\$164	
MH A8 to Bldg 2	2" (40) HPS	Conc Trench	Conc	130	LF	\$1.17	\$152	
MH A8 to Bldg 2	1 1/2" (80)	Conc Trench	Conc	130	LF	\$0.00	\$0	
MH A5 to MH A7	5" (40) HPS	Conc Trench	Conc	349	LF	\$4.69	\$1,637	
MH A5 to MH A7	5" (40) HPS	Conc Trench	Conc Road	51	LF	\$4.69	\$239	
MH A5 to MH A7	3" (80) Cond	Conc Trench	Conc	349	LF	\$0.00	\$0	
MH A5 to MH A7	3" (80) Cond	Conc Trench	Conc Road	51	LF	\$0.00	\$0	
						Total =	\$4,010	
Construction cost								
MH A7 to MH A9	5" (40) HPS	Conc Trench	Conc	298	LF	\$3.18	\$947	
MH A7 to MH A9	5" (40) HPS	Conc Trench	Conc Road	22	LF	\$17.62	\$388	
MH A7 to MH A9	3" (80) Cond	Conc Trench	Conc	298	LF	\$3.18	\$947	
MH A7 to MH A9	3" (80) Cond	Conc Trench	Conc Road	22	LF	\$17.62	\$388	
MH A9 to Bldg 1	2 1/2" (40)	Conc Trench	Conc	100	LF	\$3.18	\$318	
MH A9 to Bldg1	1 1/2" (80)	Conc Trench	Conc	140	LF	\$3.18	\$445	
MH A8 to Bldg 2	2" (40) HPS	Conc Trench	Conc	130	LF	\$3.18	\$413	
MH A8 to Bldg 2	1 1/2" (80)	Conc Trench	Conc	130	LF	\$3.18	\$413	
MH A5 to MH A7	5" (40) HPS	Conc Trench	Conc	349	LF	\$3.18	\$1,109	
MH A5 to MH A7	5" (40) HPS	Conc Trench	Conc Road	51	LF	\$17.62	\$899	
MH A5 to MH A7	3" (80) Cond	Conc Trench	Conc	349	LF	\$3.18	\$1,109	
MH A5 to MH A7	3" (80) Cond	Conc Trench	Conc Road	51	LF	\$17.62	\$899	
						Total =	\$8,273	
Fittings cost								

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 6 18	
Project ECIP Modernize Industrial Areas Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Pipe Rerouting for Buildings 3, 35 & 36					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
Piping cost								
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Lawn	71	LF	\$55.50	\$3,940	
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Conc Road	18	LF	\$55.50	\$999	
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Sidewalk	5	LF	\$55.50	\$277	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Lawn	71	LF	\$48.67	\$3,456	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Conc Road	18	LF	\$48.67	\$876	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$48.67	\$243	
MH A2-1 to MH A2-2	2" (40) HPS	Direct Bury	Asphalt	185	LF	\$55.50	\$10,267	
MH A2-2 to MH A2-3	2" (40) HPS	Direct Bury	Asphalt	241	LF	\$55.50	\$13,374	
MH A2-2 to MH A2-3	2" (40) HPS	Direct Bury	Conc Road	42	LF	\$55.50	\$2,331	
MH A2-1 to MH A2-2	4" (80) Cond	Direct Bury	Asphalt	185	LF	\$66.75	\$12,349	
MH A2-2 to MH A2-3	3" (80) Cond	Direct Bury	Asphalt	241	LF	\$59.70	\$14,388	
MH A2-2 to MH A2-3	3" (80) Cond	Direct Bury	Conc Road	42	LF	\$59.70	\$2,507	
Through Bldg 3	2" (80) Cond	0	0	60	LF	\$48.67	\$2,920	
Through Bldg 35	2" (80) Cond	0	0	135	LF	\$48.67	\$6,570	
Bldg 35 to Bldg 36	2" (40) HPS	Direct Bury	Conc Road	20	LF	\$55.50	\$1,110	
Bldg 35 to Bldg 36	2" (80) Cond	Direct Bury	Conc Road	20	LF	\$48.67	\$973	
Bldg 35 to Bldg 36	2" (40) HPS	Direct Bury	Lawn	76	LF	\$55.50	\$4,218	
Bldg 35 to Bldg 36	2" (80) Cond	Direct Bury	Lawn	76	LF	\$48.67	\$3,699	
						Total =	\$84,498	
Demolition cost Existing piping is to be abandoned in place; demolition cost =								
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Lawn	71	LF	\$0.00	\$0	
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Conc Road	18	LF	\$0.00	\$0	
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Sidewalk	5	LF	\$0.00	\$0	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Lawn	71	LF	\$0.00	\$0	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Conc Road	18	LF	\$0.00	\$0	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$0.00	\$0	
MH A2-1 to MH A2-2	2" (40) HPS	Direct Bury	Asphalt	185	LF	\$0.00	\$0	
MH A2-2 to MH A2-3	2" (40) HPS	Direct Bury	Asphalt	241	LF	\$0.00	\$0	
MH A2-2 to MH A2-3	2" (40) HPS	Direct Bury	Conc Road	42	LF	\$0.00	\$0	
MH A2-1 to MH A2-2	4" (80) Cond	Direct Bury	Asphalt	185	LF	\$0.00	\$0	
MH A2-2 to MH A2-3	3" (80) Cond	Direct Bury	Asphalt	241	LF	\$0.00	\$0	
MH A2-2 to MH A2-3	3" (80) Cond	Direct Bury	Conc Road	42	LF	\$0.00	\$0	
Through Bldg 3	2" (80) Cond	0	0	60	LF	\$0.00	\$0	
Through Bldg 35	2" (80) Cond	0	0	135	LF	\$0.00	\$0	
Bldg 35 to Bldg 36	2" (40) HPS	Direct Bury	Conc Road	20	LF	\$0.00	\$0	
Bldg 35 to Bldg 36	2" (80) Cond	Direct Bury	Conc Road	20	LF	\$0.00	\$0	
Bldg 35 to Bldg 36	2" (40) HPS	Direct Bury	Lawn	76	LF	\$0.00	\$0	
Bldg 35 to Bldg 36	2" (80) Cond	Direct Bury	Lawn	76	LF	\$0.00	\$0	
						Total =	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 7 18	
Project ECIP Modernize Industrial Areas Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Pipe Rerouting for Buildings 3, 35 & 36					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
Construction cost								
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Lawn	71	LF	\$4.77	\$339	
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Conc Road	18	LF	\$18.02	\$324	
Bldg 3 to Bldg 35	2" (40) HPS	Direct Bury	Sidewalk	5	LF	\$12.87	\$64	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Lawn	71	LF	\$4.77	\$339	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Conc Road	18	LF	\$18.02	\$324	
Bldg 3 to Bldg 35	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$12.87	\$64	
MH A2-1 to MH A2-2	2" (40) HPS	Direct Bury	Asphalt	185	LF	\$12.87	\$2,380	
MH A2-2 to MH A2-3	2" (40) HPS	Direct Bury	Asphalt	241	LF	\$12.87	\$3,101	
MH A2-2 to MH A2-3	2" (40) HPS	Direct Bury	Conc Road	42	LF	\$18.02	\$757	
MH A2-1 to MH A2-2	4" (80) Cond	Direct Bury	Asphalt	185	LF	\$12.87	\$2,380	
MH A2-2 to MH A2-3	3" (80) Cond	Direct Bury	Asphalt	241	LF	\$12.87	\$3,101	
MH A2-2 to MH A2-3	3" (80) Cond	Direct Bury	Conc Road	42	LF	\$18.02	\$757	
Through Bldg 3	2" (80) Cond	-	-	1	EA	\$62.25	\$62	
Through Bldg 35	2" (80) Cond	-	-	1	EA	\$62.25	\$62	
Bldg 35 to Bldg 36	2" (40) HPS	Direct Bury	Conc Road	20	LF	\$18.02	\$360	
Bldg 35 to Bldg 36	2" (80) Cond	Direct Bury	Conc Road	20	LF	\$18.02	\$360	
Bldg 35 to Bldg 36	2" (40) HPS	Direct Bury	Lawn	76	LF	\$4.77	\$363	
Bldg 35 to Bldg 36	2" (80) Cond	Direct Bury	Lawn	76	LF	\$4.77	\$363	
						Total =	\$15,502	
Elbow cost								
MH A2-1 to MH A2-2	2" (40) HPS ELB	Direct Bury	Asphalt	4	EA	\$276	\$1,103	
MH A2-2 to MH A2-3	2" (40) HPS ELB	Direct Bury	Asphalt	4	EA	\$276	\$1,103	
MH A2-1 to MH A2-2	3" (80) Cond	Direct Bury	Asphalt	4	EA	\$392	\$1,567	
MH A2-2 to MH A2-3	4" (80) Cond	Direct Bury	Asphalt	4	EA	\$456	\$1,824	
						Total =	\$5,598	
Core Drill cost								
Through Bldg 3	2" (40) HPS			2	EA	\$351	\$701	
Through Bldg 3	2" (80) Cond			2	EA	\$351	\$701	
Through Bldg 35	2" (40) HPS			2	EA	\$351	\$701	
Through Bldg 35	2" (80) Cond			2	EA	\$351	\$701	
						Total =	\$2,806	

CONSTRUCTION COST ESTIMATE				Date Prepared July 1995		Sheet of 8 18	
Project ECIP Modernize Industrial Areas Steam Distribution				Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada				Code A (no design completed)			
Engineer-Architect Keller & Gannon							
Drawing No. Pipe Rerouting for Buildings 3, 35 & 36				Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost
				No. Units	Unit Meas.		
Fittings cost							
MH A2-2	2" (40) HPS ' T '			2	EA	\$163	\$325
	2" (40) HPS ' 45° EL '			1	EA	\$121	\$121
	1 1/2" Drip Trap Ass.			1	EA	\$1,999	\$1,999
	3" (80) Cond ' T '			2	EA	\$247	\$494
	3" (80) Cond ' 90° EL '			1	EA	\$171	\$171
	Anchors			2	EA	\$39	\$78
MH A2-3	2" (40) HPS ' T '			1	EA	\$41	\$41
	2" HPS Valve			1	EA	\$282	\$282
	2" (80) Cond ' T '			1	EA	\$217	\$217
	2" Cond Valve			1	EA	\$282	\$282
Expansion Joints	None Required, Loops are installed						\$0
						Total =	\$4,010
Subtotal							\$112,413
Nevada Sales Tax	3.75%	Based on average of materials costs				54%	\$2,276
Subtotal							\$114,688
Contractor OH & Profit	25.0%						\$28,672
Subtotal							\$143,360
Estimating Contingency	10.0%						\$14,336
Total Probable Construction Cost							\$157,696
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings							\$119.83

CONSTRUCTION COST ESTIMATE				Date Prepare July 1995		Sheet of 9 18	
Project ECIP Modernize Industrial Area Steam Distribution				Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada				Code A (no design completed)			
Engineer-Architect Keller & Gannon							
Drawing No. Steam Pipe Replacements for U Street - East				Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost
				No. Units	Unit Meas.		
Piping cost							
MH A9 to MH EJ3	2 1/2" (80) Cond	Conc Trench	Conc	140	LF	\$32.19	\$4,506
MH A10 to Bldg 42	2" (40) HPS	Conc Trench	Conc	75	LF	\$26.71	\$2,003
MH A10 to Bldg 42	2" (80) Cond	Conc Trench	Conc	75	LF	\$25.01	\$1,875
MH A10 to MH A11	4" (40) HPS	Conc Trench	Conc	300	LF	\$44.37	\$13,312
MH A10 to MH A11	2 1/2" (80) Cond	Conc Trench	Conc	300	LF	\$32.19	\$9,657
MH A11 to MH A11J	2 1/2" (80) Cond	Conc Trench	Conc	20	LF	\$32.19	\$644
MH A11 to A11-3	2 1/2" (40) LPS	Conc Trench	Conc	350	LF	\$31.26	\$10,940
MH A11-3 to P26	2 1/2" (40) LPS	Conc Trench	Conc	150	LF	\$31.26	\$4,689
MH A11-1 to V	2" (40) LPS	Conc Trench	Conc	40	LF	\$26.71	\$1,068
MH P21 to U	2" (40) LPS	Conc Trench	Conc	40	LF	\$26.71	\$1,068
MH A11-2 to T	2" (40) LPS	Conc Trench	Conc	40	LF	\$26.71	\$1,068
MH P22 To S	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$31.26	\$1,250
MH A11-3 to R	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$31.26	\$1,250
MH P23 to Q	2 1/2" (40) LPS	Conc Trench	Conc	50	LF	\$31.26	\$1,563
MH P24 to P	2 1/2" (40) LPS	Conc Trench	Conc	55	LF	\$31.26	\$1,719
MH P25 to O	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$31.26	\$1,250
MH P25 to MH P26	2 1/2" (40) LPS	Conc Trench	Conc	80	LF	\$31.26	\$2,501
						Total =	\$60,366
Demolition cost (Assumed existing abandoned condensate pipe in trench is the							
MH A9 to MH EJ3	2 1/2" (80) Cond	Conc Trench	Conc	140	LF	\$0.00	\$0
MH A10 to Bldg 42	2" (40) HPS	Conc Trench	Conc	75	LF	\$1.56	\$117
MH A10 to Bldg 42	2" (80) Cond	Conc Trench	Conc	75	LF	\$1.17	\$88
MH A10 to MH A11	4" (40) HPS	Conc Trench	Conc	300	LF	\$1.56	\$468
MH A10 to MH A11	2 1/2" (80) Cond	Conc Trench	Conc	300	LF	\$0.00	\$0
MH A11 to MH A11J	2 1/2" (80) Cond	Conc Trench	Conc	20	LF	\$0.00	\$0
MH A11 to A11-3	2 1/2" (40) LPS	Conc Trench	Conc	350	LF	\$1.56	\$546
MH A11-3 to P26	2 1/2" (40) LPS	Conc Trench	Conc	150	LF	\$1.56	\$234
MH A11-1 to V	2" (40) LPS	Conc Trench	Conc	40	LF	\$1.56	\$62
MH P21 to U	2" (40) LPS	Conc Trench	Conc	40	LF	\$1.56	\$62
MH A11-2 to T	2" (40) LPS	Conc Trench	Conc	40	LF	\$1.56	\$62
MH P22 To S	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$1.56	\$62
MH A11-3 to R	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$1.56	\$62
MH P23 to Q	2 1/2" (40) LPS	Conc Trench	Conc	50	LF	\$1.56	\$78
MH P24 to P	2 1/2" (40) LPS	Conc Trench	Conc	55	LF	\$1.56	\$86
MH P25 to O	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$1.56	\$62
MH P25 to MH P26	2 1/2" (40) LPS	Conc Trench	Conc	80	LF	\$1.56	\$125
						Total =	\$2,116

CONSTRUCTION COST ESTIMATE					Date Prepare July 1995		Sheet of 10 18	
Project ECIP Modernize Industrial Area Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Steam Pipe Replacements for U Street - East					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
Construction cost								
MH A9 to MH EJ3	2 1/2" (80) Cond	Conc Trench	Conc	140	LF	\$3.18	\$445	
MH A10 to Bldg 42	2" (40) HPS	Conc Trench	Conc	75	LF	\$3.18	\$238	
MH A10 to Bldg 42	2" (80) Cond	Conc Trench	Conc	75	LF	\$3.18	\$238	
MH A10 to MH A11	4" (40) HPS	Conc Trench	Conc	300	LF	\$3.18	\$953	
MH A10 to MH A11	2 1/2" (80) Cond	Conc Trench	Conc	300	LF	\$3.18	\$953	
MH A11 to MH A11J	2 1/2" (80) Cond	Conc Trench	Conc	20	LF	\$3.18	\$64	
MH A11 to A11-3	2 1/2" (40) LPS	Conc Trench	Conc	350	LF	\$3.18	\$1,112	
MH A11-3 to P26	2 1/2" (40) LPS	Conc Trench	Conc	150	LF	\$3.18	\$477	
MH A11-1 to V	2" (40) LPS	Conc Trench	Conc	40	LF	\$3.18	\$127	
MH P21 to U	2" (40) LPS	Conc Trench	Conc	40	LF	\$3.18	\$127	
MH A11-2 to T	2" (40) LPS	Conc Trench	Conc	40	LF	\$3.18	\$127	
MH P22 To S	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$3.18	\$127	
MH A11-3 to R	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$3.18	\$127	
MH P23 to Q	2 1/2" (40) LPS	Conc Trench	Conc	50	LF	\$3.18	\$159	
MH P24 to P	2 1/2" (40) LPS	Conc Trench	Conc	55	LF	\$3.18	\$175	
MH P25 to O	2 1/2" (40) LPS	Conc Trench	Conc	40	LF	\$3.18	\$127	
MH P25 to MH P26	2 1/2" (40) LPS	Conc Trench	Conc	80	LF	\$3.18	\$254	
						Total =	\$5,830	
Fittings cost								
MH A10	4"(40) HPS ' T '			2	EA	\$286	\$572	
	4"(40) HPS ' 45° EL '			2	EA	\$206	\$412	
	1 1/2" Drip Trap ASS.			1	EA	\$1,999	\$1,999	
	2" HPS Valve			1	EA	\$282	\$282	
	2 1/2" (80) Cond ' T '			2	EA	\$217	\$435	
	2 1/2" (80) Cond ' 90° EL '			1	EA	\$153	\$153	
	2" Cond Valve			1	EA	\$282	\$282	
MH A11	6"(40) HPS ' 45° EL '			2	EA	\$206	\$412	
	6"(40) HPS Guide			1	EA	\$155	\$155	
	6" HPS Valve			1	EA	\$1,742	\$1,742	
	8" (40) HPS ' T '			2	EA	\$2,627	\$5,253	
	8" (40) HPS ' Guide '			1	EA	\$293	\$293	
	Anchor			1	EA	\$47	\$47	
	8" HPS Valve			1	EA	\$2,627	\$2,627	
	1 1/2" Drip Trap ASS.			1	EA	\$1,999	\$1,999	
	1 1/2" (80) Cond ' 90° EL '			5	EA	\$110	\$551	
	3" (80) Cond ' 90° EL '			1	EA	\$174	\$174	
	3" (80) Cond ' Guide '			1	EA	\$92	\$92	
	3" Cond Valve			1	EA	\$874	\$874	
	4" (80) Cond ' T '			2	EA	\$336	\$673	
	4" (80) Cond ' Guide '			1	EA	\$155	\$155	
	Anchor			1	EA	\$43	\$43	
	4" Cond Valve			1	EA	\$1,132	\$1,132	
MH A11-1	3" (40) LPS ' T '			1	EA	\$341	\$341	

CONSTRUCTION COST ESTIMATE				Date Prepare July 1995		Sheet of 11 18	
Project ECIP Modernize Industrial Area Steam Distribution				Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada				Code A (no design completed)			
Engineer-Architect Keller & Gannon							
Drawing No. Steam Pipe Replacements for U Street - East				Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost
				No. Units	Unit Meas.		
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	1 1/2" Drip Trap ASS.			1	EA	\$1,999	\$1,999
	2" LPS Valve			1	EA	\$282	\$282
MH P21	3" (40) LPS ' T '			1	EA	\$341	\$341
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	2" LPS Valve			1	EA	\$282	\$282
MH A11-2	3" (40) LPS ' T '			1	EA	\$341	\$341
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	2" LPS Valve			1	EA	\$282	\$282
MH P22	3" (40) LPS ' T '			1	EA	\$341	\$341
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	2 1/2" LPS Valve			1	EA	\$858	\$858
MH A11-3	3" (40) LPS ' T '			1	EA	\$341	\$341
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	2 1/2" LPS Valve			1	EA	\$858	\$858
MH P23	3" (40) LPS ' T '			1	EA	\$341	\$341
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	2 1/2" LPS Valve			1	EA	\$858	\$858
MH P24	3" (40) LPS ' T '			1	EA	\$341	\$341
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	2 1/2" LPS Valve			1	EA	\$858	\$858
MH P25	3" (40) LPS ' T '			1	EA	\$341	\$341
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	2 1/2" LPS Valve			1	EA	\$858	\$858
MH P26	3" (40) LPS ' T '			1	EA	\$341	\$341
	3" (40) LPS ' 45° EL '			1	EA	\$157	\$157
	2 1/2" LPS Valve			1	EA	\$858	\$858
Expansion Joints	6" Steam or Condensate			1	EA	\$748	\$748
	5" Steam or Condensate			2	EA	\$724	\$1,448
	4" Steam or Condensate			7	EA	\$575	\$4,028
	3" Steam or Condensate			11	EA	\$481	\$5,291
Total =						\$44,341	
Subtotal							\$112,653
Nevada Sales Tax	3.75%	Based on average of materials costs					54% \$2,280
Subtotal							\$114,933
Contractor OH & Profit	25.0%						\$28,733
Subtotal							\$143,666
Estimating Contingency	10.0%						\$14,367
Total Probable Construction Cost							\$158,033
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings						\$86.12	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 12 of 18	
Project ECIP Modernize Industrial Area Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Family Housing Condensate Piping Replacement					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
Piping cost								
MH A13 to MH A14	1" (80) Cond	Conc Trench	Conc	300	LF	\$18.20	\$5,461	
MH A13 to MH A14	1" (80) Cond	Conc Trench	Conc Road	19	LF	\$18.20	\$346	
MH A14 to MH A15	2" (80) Cond	Conc Trench	Conc	100	LF	\$25.01	\$2,501	
MH A15 to MH A14	1 1/2" (80) Cond	Conc Trench	Conc	100	LF	\$20.00	\$2,000	
MH A15 to MH A16	2" (80) Cond	Conc Trench	Conc	95	LF	\$25.01	\$2,376	
MH A17-1 to A16	1" (80) Cond	Conc Trench	Conc	95	LF	\$18.20	\$1,729	
MH A17-1 to A16	1 1/2" (80) Cond	Conc Trench	Conc	95	LF	\$20.00	\$1,900	
MH A18 to A17-1	1" (80) Cond	Conc Trench	Conc	330	LF	\$18.20	\$6,007	
MH A18 to A17-1	1" (80) Cond	Conc Trench	Conc Road	20	LF	\$18.20	\$364	
MH A14 to F/179	1 1/2" (80) Cond	Conc Trench	Conc	33	LF	\$20.00	\$660	
MH A15 to E/178	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$20.00	\$880	
MH A16 to D/177	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$20.00	\$880	
MH A17-1 to C/176	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$20.00	\$880	
MH A17 to B/175	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$20.00	\$880	
MH A18 to A/174	2" (80) Cond	Conc Trench	Conc	65	LF	\$25.01	\$1,625	
MH A18 to A/174	2" (80) Cond	Conc Trench	Conc Road	15	LF	\$25.01	\$375	
MH A16 to N-1	2" (80) Cond	Direct Bury	Lawn	311	LF	\$48.67	\$15,136	
MH A16 to N-1	2" (80) Cond	Direct Bury	Conc Road	40	LF	\$48.67	\$1,947	
MH A16 to N-1	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$48.67	\$243	
MH N-1 to DD/291	1 1/2" (80) Cond	Direct Bury	Lawn	35	LF	\$48.34	\$1,692	
MH N-1 to N-2	2" (80) Cond	Direct Bury	Lawn	120	LF	\$48.67	\$5,840	
MH N-1 to N-2	2" (80) Cond	Direct Bury	Sidewalk	10	LF	\$48.67	\$487	
MH N-2 to CC/290	1 1/2" (80) Cond	Direct Bury	Lawn	35	LF	\$48.34	\$1,692	
MH N-2 to N-3	2" (80) Cond	Direct Bury	Lawn	514	LF	\$48.67	\$25,016	
MH N-2 to N-3	2" (80) Cond	Direct Bury	Conc Road	20	LF	\$48.67	\$973	
MH N-3 to 292-2	1 1/2" (80) Cond	Direct Bury	Lawn	40	LF	\$48.34	\$1,934	
MH N-3 to N-4	2" (80) Cond	Direct Bury	Lawn	100	LF	\$48.67	\$4,867	
MH N-3 to N-4	2" (80) Cond	Direct Bury	Conc Road	20	LF	\$48.67	\$973	
MH N-4 to N-5	2" (80) Cond	Direct Bury	Lawn	362	LF	\$48.67	\$17,619	
MH N-4 to N-5	2" (80) Cond	Direct Bury	Conc Road	40	LF	\$48.67	\$1,947	
MH N-4 to N-5	2" (80) Cond	Direct Bury	Sidewalk	10	LF	\$48.67	\$487	
MH N-5 to N-6	2" (80) Cond	Direct Bury	Lawn	454	LF	\$48.67	\$22,096	
MH N-5 to N-6	2" (80) Cond	Direct Bury	Conc Road	40	LF	\$48.67	\$1,947	
						Total =	\$133,759	
Demolition cost (Assumed existing abandoned condensate pipe in trench is the								
MH A13 to MH A14	1" (80) Cond	Conc Trench	Conc	300	LF	\$1.17	\$351	
MH A15 to MH A14	1 1/2" (80) Cond	Conc Trench	Conc	100	LF	\$1.17	\$117	
MH A15 to MH A16	2" (80) Cond	Conc Trench	Conc	95	LF	\$1.17	\$111	
MH A17-1 to A16	1" (80) Cond	Conc Trench	Conc	95	LF	\$1.17	\$111	
MH A17-1 to A16	1 1/2" (80) Cond	Conc Trench	Conc	95	LF	\$1.17	\$111	
MH A18 to A17-1	1" (80) Cond	Conc Trench	Conc	330	LF	\$1.17	\$386	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 13 18	
Project ECIP Modernize Industrial Area Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Family Housing Condensate Piping Replacement					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
MH A18 to A17-1	1" (80) Cond	Conc Trench	Conc Road	20	LF	\$1.17	\$23	
MH A14 to F/179	1 1/2" (80) Cond	Conc Trench	Conc	33	LF	\$1.17	\$39	
MH A15 to E/178	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$1.17	\$51	
MH A16 to D/177	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$1.17	\$51	
MH A17-1 to C/176	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$1.17	\$51	
MH A17 to B/175	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$1.17	\$51	
MH A18 to A/174	2" (80) Cond	Conc Trench	Conc	65	LF	\$1.17	\$76	
MH A18 to A/174	2" (80) Cond	Conc Trench	Conc Road	15	LF	\$1.17	\$18	
						Total =	\$1,549	
Construction total cost								
MH A13 to MH A14	1" (80) Cond	Conc Trench	Conc	300	LF	\$3.18	\$953	
MH A13 to MH A14	1" (80) Cond	Conc Trench	Conc Road	19	LF	\$17.62	\$335	
MH A14 to MH A15	2" (80) Cond	Conc Trench	Conc	100	LF	\$3.18	\$318	
MH A15 to MH A14	1 1/2" (80) Cond	Conc Trench	Conc	100	LF	\$3.18	\$318	
MH A15 to MH A16	2" (80) Cond	Conc Trench	Conc	95	LF	\$3.18	\$302	
MH A17-1 to A16	1" (80) Cond	Conc Trench	Conc	95	LF	\$3.18	\$302	
MH A17-1 to A16	1 1/2" (80) Cond	Conc Trench	Conc	95	LF	\$3.18	\$302	
MH A18 to A17-1	1" (80) Cond	Conc Trench	Conc	330	LF	\$3.18	\$1,048	
MH A18 to A17-1	1" (80) Cond	Conc Trench	Conc Road	20	LF	\$17.62	\$352	
MH A14 to F/179	1 1/2" (80) Cond	Conc Trench	Conc	33	LF	\$3.18	\$105	
MH A15 to E/178	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$3.18	\$140	
MH A16 to D/177	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$3.18	\$140	
MH A17-1 to C/176	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$3.18	\$140	
MH A17 to B/175	1 1/2" (80) Cond	Conc Trench	Conc	44	LF	\$3.18	\$140	
MH A18 to A/174	2" (80) Cond	Conc Trench	Conc	65	LF	\$3.18	\$207	
MH A18 to A/174	2" (80) Cond	Conc Trench	Conc Road	15	LF	\$17.62	\$264	
MH A16 to N-1	2" (80) Cond	Direct Bury	Lawn	311	LF	\$4.77	\$1,483	
MH A16 to N-1	2" (80) Cond	Direct Bury	Conc Road	40	LF	\$18.02	\$721	
MH A16 to N-1	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$12.87	\$64	
MH N-1 to DD/291	1 1/2" (80) Cond	Direct Bury	Lawn	35	LF	\$4.77	\$167	
MH N-1 to N-2	2" (80) Cond	Direct Bury	Lawn	120	LF	\$4.77	\$572	
MH N-1 to N-2	2" (80) Cond	Direct Bury	Sidewalk	10	LF	\$12.87	\$129	
MH N-2 to CC/290	1 1/2" (80) Cond	Direct Bury	Lawn	35	LF	\$4.77	\$167	
MH N-2 to N-3	2" (80) Cond	Direct Bury	Lawn	514	LF	\$4.77	\$2,452	
MH N-2 to N-3	2" (80) Cond	Direct Bury	Conc Road	20	LF	\$18.02	\$360	
MH N-3 to 292-2	1 1/2" (80) Cond	Direct Bury	Lawn	40	LF	\$4.77	\$191	
MH N-3 to N-4	2" (80) Cond	Direct Bury	Lawn	100	LF	\$4.77	\$477	
MH N-3 to N-4	2" (80) Cond	Direct Bury	Conc Road	20	LF	\$18.02	\$360	
MH N-4 to N-5	2" (80) Cond	Direct Bury	Lawn	362	LF	\$4.77	\$1,727	
MH N-4 to N-5	2" (80) Cond	Direct Bury	Conc Road	40	LF	\$18.02	\$721	
MH N-4 to N-5	2" (80) Cond	Direct Bury	Sidewalk	10	LF	\$12.87	\$129	
MH N-5 to N-6	2" (80) Cond	Direct Bury	Lawn	454	LF	\$4.77	\$2,166	
MH N-5 to N-6	2" (80) Cond	Direct Bury	Conc Road	40	LF	\$18.02	\$721	
						Total =	\$11,120	

CONSTRUCTION COST ESTIMATE				Date Prepared July 1995		Sheet of 15 18	
Project ECIP Modernize Industrial Area Steam Distribution				Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada				Code A (no design completed)			
Engineer-Architect Keller & Gannon							
Drawing No. Family Housing Condensate Piping Replacement				Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost
				No. Units	Unit Meas.		
	2" (80) Cond ' 90° EL '			1	EA	\$135	\$135
	Anchors			1	EA	\$35	\$35
	2" Cond Valve			1	EA	\$282	\$282
MH N-4	2" Cond (80) ' T '			2	EA	\$181	\$362
	Anchors			1	EA	\$35	\$35
	2" Cond Valve			2	EA	\$282	\$564
MH N-4 to MH N-5	Anchors			2	EA	\$35	\$69
Mh N-5	2" Cond (80) ' T '			1	EA	\$181	\$181
	Anchors			2	EA	\$35	\$69
	2" Cond Valve			1	EA	\$282	\$282
MH N-6	2" Cond (80) ' T '			2	EA	\$181	\$362
	2" (80) Cond ' 90° EL '			1	EA	\$135	\$135
	Anchors			1	EA	\$35	\$35
Expansion Joints	None Required, Loops are installed						\$0
						Total =	\$8,007
Subtotal				\$201,041			
Nevada Sales Tax	3.75%	Based on average of materials costs				54%	\$4,070
Subtotal							\$205,110
Contractor OH & Profit	25.0%						\$51,278
Subtotal							\$256,388
Estimating Contingency	10.0%						\$25,639
Total Probable Construction Cost							\$282,027
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings							\$78.36

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 16 18	
Project ECIP Modernize Industrial Area Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Shop Area Condensate Piping Replacements					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
Piping cost								
MH A-5 to R5-1	3" (80) Cond	Direct Bury	Lawn	75	LF	\$59.70	\$4,478	
MH R5-1 to R5-2	3" (80) Cond	Direct Bury	Lawn	105	LF	\$59.70	\$6,269	
MH R5-1 to R5-2	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$48.67	\$243	
MH R5-1 to Bldg 6	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$48.34	\$725	
MH R5-2 to Bldg 6	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$48.34	\$725	
MH R5-2 to R5-4	2" (80) Cond	Direct Bury	Lawn	25	LF	\$48.67	\$1,217	
MH R5-2 to R5-4	2" (80) Cond	Direct Bury	Concrete	138	LF	\$48.67	\$6,716	
MH R5-4 to Bldg 7	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$48.34	\$725	
Bldg 6 to Bldg 7	3" (80) Cond	Direct Bury	Lawn	20	LF	\$59.70	\$1,194	
Bldg 6 to Bldg 7	3" (80) Cond	Direct Bury	Concrete	25	LF	\$59.70	\$1,493	
Bldg 7 to Bldg 8	3" (80) Cond	Direct Bury	Lawn	50	LF	\$59.70	\$2,985	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Lawn	140	LF	\$48.67	\$6,814	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Concrete	2	LF	\$48.67	\$97	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$48.67	\$243	
MH R5-5 to R5-6	2" (80) Cond	Direct Bury	Lawn	100	LF	\$48.67	\$4,867	
MH R5-5 to R5-6	2" (80) Cond	Direct Bury	Concrete	30	LF	\$48.67	\$1,460	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Lawn	50	LF	\$48.67	\$2,434	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Concrete	45	LF	\$48.67	\$2,190	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Building	50	LF	\$48.67	\$2,434	
MH R5-8 to Bldg 11	1 1/2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$48.34	\$242	
MH R5-8 to Bldg 11	1 1/2" (80) Cond	Direct Bury	Lawn	7	LF	\$48.34	\$338	
						Total =	\$47,888	
Demolition cost (Existing condensate pipe is to be abandoned in place)								
MH A-5 to R5-1	3" (80) Cond	Direct Bury	Lawn	75	LF	\$0.00	\$0	
MH R5-1 to R5-2	3" (80) Cond	Direct Bury	Lawn	105	LF	\$0.00	\$0	
MH R5-1 to R5-2	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$0.00	\$0	
MH R5-1 to Bldg 6	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$0.00	\$0	
MH R5-2 to Bldg 6	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$0.00	\$0	
MH R5-2 to R5-4	2" (80) Cond	Direct Bury	Lawn	25	LF	\$0.00	\$0	
MH R5-2 to R5-4	2" (80) Cond	Direct Bury	Concrete	138	LF	\$0.00	\$0	
MH R5-4 to Bldg 7	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$0.00	\$0	
Bldg 6 to Bldg 7	3" (80) Cond	Direct Bury	Lawn	20	LF	\$0.00	\$0	
Bldg 6 to Bldg 7	3" (80) Cond	Direct Bury	Concrete	25	LF	\$0.00	\$0	
Bldg 7 to Bldg 8	3" (80) Cond	Direct Bury	Lawn	50	LF	\$0.00	\$0	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Lawn	140	LF	\$0.00	\$0	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Concrete	2	LF	\$0.00	\$0	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$0.00	\$0	
MH R5-5 to R5-6	2" (80) Cond	Direct Bury	Lawn	100	LF	\$0.00	\$0	
MH R5-5 to R5-6	2" (80) Cond	Direct Bury	Concrete	30	LF	\$0.00	\$0	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Lawn	50	LF	\$0.00	\$0	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Concrete	45	LF	\$0.00	\$0	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Building	50	LF	\$0.00	\$0	
MH R5-8 to Bldg 11	1 1/2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$0.00	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 17 of 18	
Project ECIP Modernize Industrial Area Steam Distribution					Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Shop Area Condensate Piping Replacements					Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost	
				No. Units	Unit Meas.			
MH R5-8 to Bldg 11	1 1/2" (80) Cond	Direct Bury	Lawn	7	LF	\$0.00	\$0	
						Total =	\$0	
Construction cost								
MH A-5 to R5-1	3" (80) Cond	Direct Bury	Lawn	75	LF	\$4.77	\$358	
MH R5-1 to R5-2	3" (80) Cond	Direct Bury	Lawn	105	LF	\$4.77	\$501	
MH R5-1 to R5-2	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$12.87	\$64	
MH R5-1 to Bldg 6	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$4.77	\$72	
MH R5-2 to Bldg 6	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$4.77	\$72	
MH R5-2 to R5-4	2" (80) Cond	Direct Bury	Lawn	25	LF	\$4.77	\$119	
MH R5-2 to R5-4	2" (80) Cond	Direct Bury	Concrete	138	LF	\$18.02	\$2,487	
MH R5-4 to Bldg 7	1 1/2" (80) Cond	Direct Bury	Lawn	15	LF	\$4.77	\$72	
Bldg 6 to Bldg 7	3" (80) Cond	Direct Bury	Lawn	20	LF	\$4.77	\$95	
Bldg 6 to Bldg 7	3" (80) Cond	Direct Bury	Concrete	25	LF	\$18.02	\$451	
Bldg 7 to Bldg 8	3" (80) Cond	Direct Bury	Lawn	50	LF	\$4.77	\$239	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Lawn	140	LF	\$4.77	\$668	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Concrete	2	LF	\$18.02	\$36	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$12.87	\$64	
MH R5-5 to R5-6	2" (80) Cond	Direct Bury	Lawn	100	LF	\$4.77	\$477	
MH R5-5 to R5-6	2" (80) Cond	Direct Bury	Concrete	30	LF	\$18.02	\$541	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Lawn	50	LF	\$4.77	\$239	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Concrete	45	LF	\$18.02	\$811	
MH R5-6 to R5-8	2" (80) Cond	Direct Bury	Bldg / Conc	50	LF	\$18.02	\$901	
MH R5-8 to Bldg 11	1 1/2" (80) Cond	Direct Bury	Sidewalk	5	LF	\$12.87	\$64	
MH R5-8 to Bldg 11	1 1/2" (80) Cond	Direct Bury	Lawn	7	LF	\$4.77	\$33	
						Total =	\$8,362	
Elbow cost								
MH R5-1 to R5-2	3" (80) Cond	Direct Bury	Lawn	4	EA	\$392	\$1,567	
MH R5-2 to R5-4	2" (80) Cond	Direct Bury	Concrete	4	EA	\$322	\$1,287	
MH R5-4 to R5-5	2" (80) Cond	Direct Bury	Lawn	4	EA	\$322	\$1,287	
MH R5-5 to R5-6	2" (80) Cond	Direct Bury	Lawn	4	EA	\$322	\$1,287	
						Total =	\$5,428	
Core Drill cost								
MH R5-1	3" (80) Cond			2	EA	\$461	\$923	
MH R5-1	1 1/2" (80) Cond			1	EA	\$351	\$351	
MH R5-2	3" (80) Cond			1	EA	\$461	\$461	
MH R5-2	2" (80) Cond			1	EA	\$351	\$351	
MH R5-2	1 1/2" (80) Cond			1	EA	\$351	\$351	
MH R5-4	2" (80) Cond			2	EA	\$351	\$701	
MH R5-4	1 1/2" (80) Cond			1	EA	\$351	\$351	
MH R5-5	2" (80) Cond			2	EA	\$351	\$701	
MH R5-5	1 1/2" (80) Cond			1	EA	\$351	\$351	
MH R5-6	2" (80) Cond			2	EA	\$351	\$701	
MH R5-6	1 1/2" (80) Cond			1	EA	\$351	\$351	

CONSTRUCTION COST ESTIMATE				Date Prepared July 1995		Sheet 18 of 18	
Project ECIP Modernize Industrial Area Steam Distribution				Project No. PN-40667		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada				Code A (no design completed)			
Engineer-Architect Keller & Gannon							
Drawing No. Shop Area Condensate Piping Replacements				Estimator BIH		Checked By RCL	
Location	Service	Placement	Surface	Quantity		Unit Cost	Total Cost
				No. Units	Unit Meas.		
MH R5-8	2" (80) Cond			2	EA	\$351	\$701
MH R5-8	1 1/2" (80) Cond			1	EA	\$351	\$351
						Total =	\$6,645
Fittings cost							
MH R5-1	3" (80) Cond ' T '			1	EA	\$247	\$247
	1 1/2" Cond Vlave			1	EA	\$217	\$217
MH R5-2	3" (80) Cond ' T '			1	EA	\$247	\$247
	1 1/2" Cond Vlave			1	EA	\$217	\$217
Bldg 6 to Bldg 7	3" Cond Vlave			1	EA	\$874	\$874
MH R5-4	2" (80) Cond ' T '			1	EA	\$181	\$181
	1 1/2" Cond Vlave			1	EA	\$217	\$217
MH R5-5	2" (80) Cond ' T '			1	EA	\$181	\$181
	1 1/2" Cond Vlave			1	EA	\$217	\$217
Bldg 7 to bldg 8	3" Cond Vlave			1	EA	\$1,619	\$1,619
MH R5-6	2" (80) Cond ' T '			1	EA	\$181	\$181
	1 1/2" Cond Vlave			1	EA	\$217	\$217
MH R5-8	2" (80) Cond ' T '			1	EA	\$181	\$181
	1 1/2" Cond Vlave			1	EA	\$217	\$217
Expansion Joints	2" Steam or Condensate			7	EA	\$414	\$2,896
						Total =	\$7,907
Subtotal							\$76,231
Nevada Sales Tax	3.75%	Based on average of materials costs					54% \$1,543
Subtotal							\$77,774
Contractor OH & Profit	25.0%						\$19,444
Subtotal							\$97,218
Estimating Contingency	10.0%						\$9,722
Total Probable Construction Cost							\$106,940
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings							\$115.99

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 1 of 2	
Project ECIP Modernize Steam Distribution System					Project No. PN-40667		Basis for Estimate Code A (no design completed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Industrial Area Pipe-in-Conduit Unit Costs					Estimator DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Condensate: 1-inch in 6-5/8-inch Conduit	1	LF	-	-	\$21.85	\$21.85	\$21.85	
Installation: 1-inch Condensate Pipe Sch 80	1	LF	\$10.07	\$10.07	-	-	\$10.07	
Condensate Installation: 6-5/8-inch Conduit	1	LF	\$13.61	\$13.61	-	-	\$13.61	
Unit Cost - 1-inch Cond Pipe in Conduit				\$23.68		\$21.85	\$45.53	
Condensate: 1-1/4-inch in 6-5/8-inch Conduit	1	LF	-	-	\$23.45	\$23.45	\$23.45	
Installation: 1-1/4-inch Condensate Pipe Sch 80	1	LF	\$10.75	\$10.75	-	-	\$10.75	
Condensate Installation: 6-5/8-inch Conduit	1	LF	\$13.61	\$13.61	-	-	\$13.61	
Unit Cost - 1-1/4-inch Cond Pipe in Conduit				\$24.36		\$23.45	\$47.81	
Condensate: 1-1/2-inch in 6-5/8-inch Conduit	1	LF	-	-	\$23.43	\$23.43	\$23.43	
Installation: 1-1/2-inch Condensate Pipe Sch 80	1	LF	\$11.30	\$11.30	-	-	\$11.30	
Condensate Installation: 6-5/8-inch Conduit	1	LF	\$13.61	\$13.61	-	-	\$13.61	
Unit Cost - 1-1/2-inch Cond Pipe in Conduit				\$24.91		\$23.43	\$48.34	
Condensate: 2-inch in 6-5/8-inch Conduit	1	LF	-	-	\$23.19	\$23.19	\$23.19	
Installation: 2-inch Condensate Pipe Sch 80	1	LF	\$11.87	\$11.87	-	-	\$11.87	
Condensate Installation: 6-5/8-inch Conduit	1	LF	\$13.61	\$13.61	-	-	\$13.61	
Unit Cost - 2-inch Cond Pipe in Conduit				\$25.48		\$23.19	\$48.67	
Condensate: 2-1/2-inch in 6-5/8-inch Conduit	1	LF	-	-	\$23.19	\$23.19	\$23.19	
Installation: 2-1/2-inch Condensate Pipe Sch 80	1	LF	\$15.30	\$15.30	-	-	\$15.30	
Condensate Installation: 6-5/8-inch Conduit	1	LF	\$13.61	\$13.61	-	-	\$13.61	
Unit Cost - 2-1/2-inch Cond Pipe in Conduit				\$28.91		\$23.19	\$52.10	
Condensate: 3-inch in 8-5/8-inch Conduit	1	LF	-	-	\$28.00	\$28.00	\$28.00	
Installation: 3-inch Condensate Pipe Sch 80	1	LF	\$17.55	\$17.55	-	-	\$17.55	
Condensate Installation: 8-5/8-inch Conduit	1	LF	\$14.15	\$14.15	-	-	\$14.15	
Unit Cost - 3-inch Cond Pipe in Conduit				\$31.70		\$28.00	\$59.70	
Condensate: 4-inch in 10-3/4-inch Conduit	1	LF	-	-	\$29.17	\$29.17	\$29.17	
Installation: 4-inch Condensate Pipe Sch 80	1	LF	\$22.51	\$22.51	-	-	\$22.51	
Condensate Installation: 10-3/4-inch Conduit	1	LF	\$15.07	\$15.07	-	-	\$15.07	
Unit Cost - 4-inch Cond Pipe in Conduit				\$37.58		\$29.17	\$66.75	
Condensate: 6-inch in 14-inch Conduit	1	LF	-	-	\$37.64	\$37.64	\$37.64	
Installation: 6-inch Condensate Pipe Sch 80	1	LF	\$32.39	\$32.39	-	-	\$32.39	
Condensate Installation: 14-inch Conduit	1	LF	\$17.28	\$17.28	-	-	\$17.28	
Unit Cost - 6-inch Cond Pipe in Conduit				\$49.67		\$37.64	\$87.31	
Condensate: 8-inch in 16-inch Conduit	1	LF	-	-	\$44.81	\$44.81	\$44.81	
Installation: 8-inch Condensate Pipe Sch 80	1	LF	\$39.42	\$39.42	-	-	\$39.42	
Condensate Installation: 16-inch Conduit	1	LF	\$18.15	\$18.15	-	-	\$18.15	
Unit Cost - 8-inch Cond Pipe in Conduit				\$57.57		\$44.81	\$102.38	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 2 of 2	
Project ECIP Modernize Steam Distribution System				Project No. PN-40667		Basis for Estimate Code A (no design completed)		
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Industrial Area Pipe-in-Conduit Unit Costs				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Steam: 1-inch in 8-5/8-inch Conduit	1	LF	-	-	\$24.82	\$24.82	\$24.82	
Installation: 1-inch Steam Pipe Sch 40	1	LF	\$9.50	\$9.50	-	-	\$9.50	
Steam Installation: 8-5/8-inch Conduit	1	LF	\$14.15	\$14.15	-	-	\$14.15	
Unit Cost - 1-inch Steam Pipe in Conduit				\$23.65		\$24.82	\$48.47	
Steam: 1-1/4-inch in 8-5/8-inch Conduit	1	LF	-	-	\$25.80	\$25.80	\$25.80	
Installation: 1-1/4-inch Steam Pipe Sch 40	1	LF	\$10.07	\$10.07	-	-	\$10.07	
Steam Installation: 8-5/8-inch Conduit	1	LF	\$14.15	\$14.15	-	-	\$14.15	
Unit Cost - 1-1/4-inch Steam Pipe in Conduit				\$24.22		\$25.80	\$50.02	
Steam: 1-1/2-inch in 8-5/8-inch Conduit	1	LF	-	-	\$26.62	\$26.62	\$26.62	
Installation: 1-1/2-inch Steam Pipe Sch 40	1	LF	\$10.52	\$10.52	-	-	\$10.52	
Steam Installation: 8-5/8-inch Conduit	1	LF	\$14.15	\$14.15	-	-	\$14.15	
Unit Cost - 1-1/2-inch Steam Pipe in Conduit				\$24.67		\$26.62	\$51.29	
Steam: 2-inch in 10-3/4-inch Conduit	1	LF	-	-	\$29.13	\$29.13	\$29.13	
Installation: 2-inch Steam Pipe Sch 40	1	LF	\$11.30	\$11.30	-	-	\$11.30	
Steam Installation: 10-3/4-inch Conduit	1	LF	\$15.07	\$15.07	-	-	\$15.07	
Unit Cost - 2-inch Steam Pipe in Conduit				\$26.37		\$29.13	\$55.50	
Steam: 2-1/2-inch in 10-3/4-inch Conduit	1	LF	-	-	\$31.63	\$31.63	\$31.63	
Installation: 2-1/2-inch Steam Pipe Sch 40	1	LF	\$13.95	\$13.95	-	-	\$13.95	
Steam Installation: 10-3/4-inch Conduit	1	LF	\$15.07	\$15.07	-	-	\$15.07	
Unit Cost - 2-1/2-inch Steam Pipe in Conduit				\$29.02		\$31.63	\$60.65	
Steam: 3-inch in 10-3/4-inch Conduit	1	LF	-	-	\$31.77	\$31.77	\$31.77	
Installation: 3-inch Steam Pipe Sch 40	1	LF	\$16.93	\$16.93	-	-	\$16.93	
Steam Installation: 10-3/4-inch Conduit	1	LF	\$15.07	\$15.07	-	-	\$15.07	
Unit Cost - 3-inch Steam Pipe in Conduit				\$32.00		\$31.77	\$63.77	
Steam: 4-inch in 10-3/4-inch Conduit	1	LF	-	-	\$33.10	\$33.10	\$33.10	
Installation: 4-inch Steam Pipe Sch 40	1	LF	\$21.54	\$21.54	-	-	\$21.54	
Steam Installation: 10-3/4-inch Conduit	1	LF	\$15.07	\$15.07	-	-	\$15.07	
Unit Cost - 4-inch Steam Pipe in Conduit				\$36.61		\$33.10	\$69.71	
Steam: 6-inch in 14-inch Conduit	1	LF	-	-	\$42.71	\$42.71	\$42.71	
Installation: 6-inch Steam Pipe Sch 40	1	LF	\$30.79	\$30.79	-	-	\$30.79	
Steam Installation: 14-inch Conduit	1	LF	\$17.28	\$17.28	-	-	\$17.28	
Unit Cost - 6-inch Steam Pipe in Conduit				\$48.07		\$42.71	\$90.78	
Steam: 8-inch in 16-inch Conduit	1	LF	-	-	\$50.84	\$50.84	\$50.84	
Installation: 8-inch Steam Pipe Sch 40	1	LF	\$37.27	\$37.27	-	-	\$37.27	
Steam Installation: 16-inch Conduit	1	LF	\$18.15	\$18.15	-	-	\$18.15	
Unit Cost - 8-inch Steam Pipe in Conduit				\$55.42		\$50.84	\$106.26	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 1 of 2	
Project ECIP Modernize Steam Distribution System				Project No. PN-40667		Basis for Estimate Code A (no design competed)		
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Industrial Area Built-Up Pipe Unit Costs				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Condensate Pipe:1-inch Schedule 80 Welded	1	LF	\$4.81	\$4.81	\$2.11	\$2.11	\$6.92	
Insulation: 1-inch Cond Pipe, 2-inch Thick	1	LF	\$2.99	\$2.99	\$2.85	\$2.85	\$5.84	
Aluminum Jacket - 10 ga. Cond	1.44	SF	\$3.36	\$4.84	\$0.42	\$0.60	\$5.44	
Unit Cost - 1-inch Cond Pipe - Built Up				\$12.64		\$5.57	\$18.20	
Condensate Pipe:1-1/4-inch Schedule 80 Welded	1	LF	\$5.18	\$5.18	\$2.76	\$2.76	\$7.94	
Insulation: 1-1/4-inch Cond Pipe, 2-inch Thick	1	LF	\$3.10	\$3.10	\$3.08	\$3.08	\$6.18	
Aluminum Jacket - 10 ga. Cond	1.512	SF	\$3.36	\$5.08	\$0.42	\$0.63	\$5.71	
Unit Cost - 1-1/4-inch Cond Pipe - Built Up				\$13.36		\$6.47	\$19.83	
Condensate Pipe:1-1/2-inch Schedule 80 Welded	1	LF	\$5.66	\$5.66	\$3.11	\$3.11	\$8.77	
Insulation: 1-1/2-inch Cond Pipe, 2-inch Thick	1	LF	\$3.10	\$3.10	\$3.23	\$3.23	\$6.33	
Aluminum Jacket - 10 ga. Cond	1.30	SF	\$3.36	\$4.35	\$0.42	\$0.54	\$4.90	
Unit Cost - 1-1/2-inch Cond Pipe - Built Up				\$13.11		\$6.88	\$20.00	
Condensate Pipe:2-inch Schedule 80 Welded	1	LF	\$7.57	\$7.57	\$4.27	\$4.27	\$11.84	
Insulation: 2-inch Cond Pipe, 2-inch Thick	1	LF	\$3.23	\$3.23	\$3.40	\$3.40	\$6.63	
Aluminum Jacket - 10 ga. Cond	1.728	SF	\$3.36	\$5.81	\$0.42	\$0.73	\$6.53	
Unit Cost - 2-inch Cond Pipe - Built Up				\$16.61		\$8.40	\$25.01	
Condensate Pipe:2-1/2-inch Schedule 80 Welded	1	LF	\$9.83	\$9.83	\$6.16	\$6.16	\$15.99	
Insulation: 2-1/2-inch Cond Pipe, 2-in Thick	1	LF	\$4.04	\$4.04	\$5.09	\$5.09	\$9.13	
Aluminum Jacket - 10 ga. Cond	1.872	SF	\$3.36	\$6.29	\$0.42	\$0.79	\$7.08	
Unit Cost - 2-1/2-inch Cond Pipe - Built Up				\$20.15		\$12.03	\$32.19	
Condensate Pipe:3-inch Schedule 80 Welded	1	LF	\$10.62	\$10.62	\$9.51	\$9.51	\$20.13	
Insulation: 3-inch Cond Pipe, 2.5-inch Thick	1	LF	\$4.20	\$4.20	\$4.88	\$4.88	\$9.08	
Aluminum Jacket - 10 ga. Cond	2.30	SF	\$3.36	\$7.74	\$0.42	\$0.97	\$8.71	
Unit Cost - 3-inch Cond Pipe - Built Up				\$22.56		\$15.35	\$37.91	
Condensate Pipe:4-inch Schedule 80 Welded	1	LF	\$13.54	\$13.54	\$12.76	\$12.76	\$26.30	
Insulation: 4-inch Cond Pipe, 2.5-inch Thick	1	LF	\$4.39	\$4.39	\$5.71	\$5.71	\$10.10	
Aluminum Jacket - 10 ga. Cond	2.592	SF	\$3.36	\$8.71	\$0.42	\$1.09	\$9.80	
Unit Cost - 4-inch Cond Pipe - Built Up				\$26.63		\$19.56	\$46.19	
Condensate Pipe:6-inch Schedule 80 Welded	1	LF	\$22.33	\$22.33	\$28.60	\$28.60	\$50.93	
Insulation: 6-inch Cond Pipe, 3-inch Thick	1	LF	\$5.05	\$5.05	\$9.10	\$9.10	\$14.15	
Aluminum Jacket - 10 ga. Cond	3.456	SF	\$3.36	\$11.61	\$0.42	\$1.45	\$13.06	
Unit Cost - 6-inch Cond Pipe - Built Up				\$38.99		\$39.15	\$78.14	
Condensate Pipe:8-inch Schedule 80 Welded	1	LF	\$27.17	\$27.17	\$49.28	\$49.28	\$76.45	
Insulation: 8-inch Cond Pipe, 3-inch Thick	1	LF	\$5.40	\$5.40	\$10.75	\$10.75	\$16.15	
Aluminum Jacket - 10 ga. Cond	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$21.77	
Unit Cost - 8-inch Cond Pipe - Built Up				\$51.92		\$62.45	\$114.37	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 2 of 2	
Project ECIP Modernize Steam Distribution System				Project No. PN-40667		Basis for Estimate Code A (no design competed)		
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Industrial Area Built-Up Pipe Unit Costs				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Steam Pipe:1-inch Schedule 40 Welded	1	LF	\$3.37	\$3.37	\$2.12	\$2.12	\$5.49	
Insulation: 1-inch Steam Pipe, 2-inch Thick	1	LF	\$2.99	\$2.99	\$2.85	\$2.85	\$5.84	
Aluminum Jacket - 10 ga. Steam	1.44	SF	\$3.36	\$4.84	\$0.42	\$0.60	\$5.44	
Unit Cost - 1-inch Steam Pipe - Built Up				\$11.20		\$5.57	\$16.77	
Steam Pipe:1-1/4-inch Schedule 40 Welded	1	LF	\$3.72	\$3.72	\$2.66	\$2.66	\$6.38	
Insulation: 1-1/4-inch Steam Pipe, 2-inch Thick	1	LF	\$3.10	\$3.10	\$3.08	\$3.08	\$6.18	
Aluminum Jacket - 10 ga. Steam	1.512	SF	\$3.36	\$5.08	\$0.42	\$0.63	\$5.71	
Unit Cost - 1-1/4-inch Steam Pipe - Built Up				\$11.90		\$6.38	\$18.27	
Steam Pipe:1-1/2-inch Schedule 40 Welded	1	LF	\$4.12	\$4.12	\$2.91	\$2.91	\$7.03	
Insulation: 1-1/2-inch Steam Pipe, 2-inch Thick	1	LF	\$3.10	\$3.10	\$3.23	\$3.23	\$6.33	
Aluminum Jacket - 10 ga. Steam	1.584	SF	\$3.36	\$5.32	\$0.42	\$0.67	\$5.99	
Unit Cost - 1-1/2-inch Steam Pipe - Built Up				\$12.54		\$6.80	\$19.34	
Steam Pipe:2-inch Schedule 40 Welded	1	LF	\$6.13	\$6.13	\$3.75	\$3.75	\$9.88	
Insulation: 2-inch Steam Pipe, 2.5-inch Thick	1	LF	\$4.24	\$4.24	\$4.97	\$4.97	\$9.21	
Aluminum Jacket - 10 ga. Steam	2.016	SF	\$3.36	\$6.77	\$0.42	\$0.85	\$7.62	
Unit Cost - 2-inch Steam Pipe - Built Up				\$17.14		\$9.57	\$26.71	
Steam Pipe:2-1/2-inch Schedule 40 Welded	1	LF	\$7.99	\$7.99	\$4.96	\$4.96	\$12.95	
Insulation: 2-1/2-inch Steam Pipe, 2.5-in Thick	1	LF	\$4.24	\$4.24	\$5.90	\$5.90	\$10.14	
Aluminum Jacket - 10 ga. Steam	2.16	SF	\$3.36	\$7.26	\$0.42	\$0.91	\$8.16	
Unit Cost - 2-1/2-inch Steam Pipe - Built Up				\$19.49		\$11.77	\$31.26	
Steam Pipe:3-inch Schedule 40 Welded	1	LF	\$8.63	\$8.63	\$6.01	\$6.01	\$14.63	
Insulation: 3-inch Steam Pipe, 3-inch Thick	1	LF	\$4.48	\$4.48	\$5.75	\$5.75	\$10.23	
Aluminum Jacket - 10 ga. Steam	2.592	SF	\$3.36	\$8.71	\$0.42	\$1.09	\$9.80	
Unit Cost - 3-inch Steam Pipe - Built Up				\$21.82		\$12.84	\$34.66	
Steam Pipe:4-inch Schedule 40 Welded	1	LF	\$11.28	\$11.28	\$8.98	\$8.98	\$20.26	
Insulation: 4-inch Steam Pipe, 3-inch Thick	1	LF	\$4.74	\$4.74	\$7.40	\$7.40	\$12.14	
Aluminum Jacket - 10 ga. Steam	3.168	SF	\$3.36	\$10.64	\$0.42	\$1.33	\$11.97	
Unit Cost - 4-inch Steam Pipe - Built Up				\$26.67		\$17.71	\$44.37	
Steam Pipe:6-inch Schedule 40 Welded	1	LF	\$17.34	\$17.34	\$17.58	\$17.58	\$34.92	
Insulation: 6-inch Steam Pipe, 3.5-inch Thick	1	LF	\$5.89	\$5.89	\$10.62	\$10.62	\$16.51	
Aluminum Jacket - 10 ga. Steam	3.744	SF	\$3.36	\$12.58	\$0.42	\$1.57	\$14.15	
Unit Cost - 6-inch Steam Pipe - Built Up				\$35.82		\$29.76	\$65.58	
Steam Pipe:8-inch Schedule 40 Welded	1	LF	\$21.39	\$21.39	\$26.60	\$26.60	\$47.99	
Insulation: 8-inch Steam Pipe, 3.5-inch Thick	1	LF	\$6.30	\$6.30	\$12.54	\$12.54	\$18.84	
Aluminum Jacket - 10 ga. Steam	4.32	SF	\$3.36	\$14.51	\$0.42	\$1.81	\$16.33	
Unit Cost - 8-inch Steam Pipe - Built Up				\$42.21		\$40.96	\$83.16	

Industrial Area Trench Excavation Unit Cost Estimates

Direct bury with lawn surface

Cost based on a cost per linear foot basis. The systems include: excavation; backfill and removal of spoil; and compaction for various depths and trench bottom widths. The backfill has been reduced to accomodate a pipe of suitable diameter and bedding. The trench shall be 2' wide and 4' deep, a 3/8 C.Y. bucket shall be used

	Cost per linear foot		
	Matl	Equip.	Labor
excavation & backfill		\$1.32	\$2.35
pipe bed	<u>\$0.57</u>		<u>\$0.85</u>
	\$0.57	\$1.32	\$3.20
			<u>\$5.09</u>

Ref: Means Site work A12.3 -110 1330,
Trenching

Means Labor rate adjustment for location = 90% Total= \$4.77 per linear foot of 2' wide trench

The cost of a 3' wide, 4' deep trench is:

	Cost per linear foot		
	Matl	Equip.	Labor
		\$1.98	\$3.02
pipe bed	<u>\$1.04</u>	<u>\$0.00</u>	<u>\$1.54</u>
	\$1.04	\$1.98	\$4.56
			<u>\$7.58</u>

Means Labor rate adjustment for location = 90% Total= \$7.12 per linear foot of 3' wide trench

Direct bury with concrete surface

Cost for direct bury with concrete surface is based on Means 020-728-0010 Saw cutting, Means 020-754-2420, Concrete removal and Means 025-120-0100, Paving and surfacing.

Saw cutting: (8" deep concrete, roads)
(4" deep concrete, sidewalks)

	Crew	Man hrs.	Unit	Mat	Labor	Equip
Roads	B-89	0.086	L.F.	\$0.46	\$1.86	\$1.46
Sidewalks	B-89	0.034	L.F.	\$0.26	\$0.74	\$0.58

B-89 Crew:	Means		Davis-Bacon	
	1 Equip. operator		\$24.15 Information not available	
	1 Truck driver		\$20.00 \$11.00 (fringe benefits for Davis-Bacon	
	1 Truck, stake body, 3 ton		=\$2.81/hr)	
	1 concrete saw			
	1 water tank, 65 gal			

	Mat	Labor	Equip		Mat	Labor	Equip
Saw cutting per linear foot (Roads)	\$0.46	\$1.86	\$1.46	(Sidewalks)	\$0.26	\$0.74	\$0.58
	<u>100%</u>	<u>*90%</u>	<u>100%</u>		<u>100%</u>	<u>90%</u>	<u>100%</u>
	\$0.36	\$1.67	\$1.02		\$0.26	\$0.67	\$0.58
Total	<u>\$3.05</u>	(roads)		Total	<u>\$1.51</u>	(sidewalks)	

Concrete removal:

	Crew	Man hrs.	Unit	Mat	Labor	Equip
Road	B-9	0.11	S.F.		\$2.11	\$0.41
Sidewalk	B-9	0.08	S.F.		\$1.58	\$0.30

B-9 Crew	1 Labor foreman	Means	Davis-Bacon
	4 Laborers	\$21.40	Information not available
	1 Air compressor, 250 cfm	\$19.40	\$11.35 (fringe benefits for Davis-Bacon = \$2.81/hr)
	2 Air tools and accessories		
	2-50 foot air hoses, 1.5" dia		

Concrete removal cost per square foot:			Sidewalk	
		\$2.11	\$0.41	\$1.58
		<u>90%</u>	<u>100%</u>	<u>90%</u>
		\$1.90	\$0.41	\$1.42

Total **\$2.31** (demo roads/SF) Total **\$1.72** (demo sidewalks/SF)

Paving and surfacing:

	Crew	Man hrs.	Unit	Mat	Labor	Equip
road	B-26	0.033	S.Y.	\$18.70	\$1.42	\$0.68
sidewalk	B-24	0.360	S.Y.	\$8.37	\$8.19	

B-26 Crew	1 Labor foreman	Means	Davis-Bacon	Davis-Bacon Act	Fringe Benefits
	6 Laborers	\$21.40	Information not available		
	2 Equip. oper	\$19.40	\$11.35	\$2.81/hr	
	1 Rodman (reinf)	\$25.15	Information not available		
	1 Cement finisher	\$27.10	\$21.58	\$11.92/hr	
	1 Grader, 30,000 lbs	\$23.90	\$18.46	\$2.80/hr	
	1 Paving Mach & Equip				

	Mat	Roads \$/SY			Sidewalks \$/SY		
		Labor	Equip		Mat	Labor	Equip
		\$18.70	\$1.42	\$0.68	\$8.37	\$8.19	\$0.00
		<u>100%</u>	<u>90%</u>	<u>100%</u>	<u>100%</u>	<u>90%</u>	<u>100%</u>
Paving and surfacing cost per square yard:		\$18.70	\$1.28	\$0.68	\$8.37	\$7.37	\$0.00
Total		<u>\$20.66</u>	per SY		Total	<u>\$15.74</u>	per SY

Total cost to direct bury with concrete pavement, 2' wide trench 1' long

2 saw cuts required @	\$3.05	per linear foot	total
2 square feet of concrete removal	\$2.31	per square foot	\$6.11
0.18 square yards of paving and surfacing	\$20.66	per square yard	\$4.62
Excavation & Backfill, 75% direct bury - lawn	\$3.58	per linear foot (adjustment @ depth)	\$3.72
			<u>\$3.58</u>

Total cost per 2' wide trench 1' long (Roads) \$18.02

2 saw cuts required @	\$1.51	per linear foot	total
2 square feet of concrete removal	\$1.72	per square foot	\$3.01
0.18 square yards of paving and surfacing	\$15.74	per square yard	\$3.44
Excavation & Backfill, 75% direct bury - lawn	\$3.58	per linear foot (adjustment @ depth)	\$2.83
			<u>\$3.58</u>

Total cost per 2' wide trench 1' long (Sidewalks and asphalt surface) \$12.87

Total cost to direct bury with concrete pavement, 3' wide trench 1' long

2 saw cuts required @	\$3.05	per linear foot	total
3 square feet of concrete removal	\$2.31	per square foot	\$6.11
0.27 square yards of paving and surfacing	\$20.66	per square yard	\$6.93
Excavation & Backfill, 75% direct bury - lawn	\$5.34	per linear foot (adjustment @ depth)	\$5.58
			<u>\$5.34</u>

Total cost per 3' wide trench 1' long (Roads) \$23.96

2 saw cuts required @	\$1.51	per linear foot	total
3 square feet of concrete removal	\$1.72	per square foot	\$3.01
0.27 square yards of paving and surfacing	\$15.74	per square yard	\$5.17
Excavation & Backfill, 75% direct bury - lawn	\$5.34	per linear foot (adjustment @ depth)	\$4.25
			<u>\$5.34</u>

9.20

Total cost per 3' wide trench 1' long (Sidewalks and asphalt surface) \$17.77

Placement in a concrete trench with concrete slab covers:

Equipment rental, Means 016-460-2400, Lifting and hoisting equipment, truck mounted, hydraulic, 12 ton capacity:

Rent per week =	\$1,240
Equipment required for 5 weeks	\$6,200
Equipment operators=	\$418.60 per week
Total for 5 weeks	\$2,093.00

Equipment Rental Cost	\$8,293	5 weeks, 5 day/week, 8 hours/day, 30 LF/Hr =	\$1.38	\$1.38
Skilled Operator Labor Rate (Bare)	\$26.85	per hour x 1 for removing & resetting =	\$0.90	
Helper Labor Rate (Bare)	\$18.00	per hour x 1 for removing & 2 for resetting =	\$0.90	
Labor Cost Assuming 30 LF of Trench can be removed and replaced & caulked per hour =			\$1.80	\$1.80
Cost per linear foot to remove & to re-install concrete slab covers (labor and equipment rental)				\$3.18

Placement in a concrete trench with road surface:

Remove & to re-install concrete slab covers	\$3.18	per linear foot	Total
2 saw cuts required @	\$3.05	per linear foot	\$3.18
2 square feet of concrete removal	\$2.31	per square foot	\$6.11
0.18 square yards of paving and surfacing	\$20.66	per square yard	\$4.62
			<u>\$3.72</u>

Total cost to remove and reinstall in road over trench \$17.62

Placement in a concrete trench with sidewalk/asphalt surface:

Remove & to re-install concrete slab covers	\$3.18	per linear foot	Total
2 saw cuts required @	\$1.51	per linear foot	\$3.18
2 square feet of concrete removal	\$1.72	per square foot	\$3.01
.18 square yards of paving and surfacing	\$15.74	per square yard	\$3.44
			<u>\$2.83</u>

Total cost to remove and reinstall in sidewalk over trench \$12.47

Comparing Davis Bacon plumbing\pipefitter rates with Means rates

Crew	Q-1		Means	Davis-Bacon		
		1 Plumber	\$29.30	\$23.00	(\$5.12 fringe benefits)	\$28.12
		1 Plumber apprentice	\$23.45	Not available		

Unit costs are developed for each pipe size represented in the installed systems. Two types of installation are considered:

- Installation of built-up piping (pipe, insulation and jacket installed separately) for placement in existing concrete trenches.
- Installation of separate steam and condensate pre-fabricated pipe in conduit for direct buried applications.

Results of detailed unit cost estimates are summarized below for each pipe size and placement method.

In-Trench Construction (Built-Up Piping System)

	Materials	Labor	Total
To install 1" pipe on sand bed (schedule 40)	\$11.20	\$5.57	\$16.77
To install 1 1/4" pipe on sand bed (schedule 40)	\$11.90	\$6.38	\$18.27
To install 1 1/2" pipe on sand bed (schedule 40)	\$12.54	\$6.80	\$19.34
To install 2" pipe on sand bed (schedule 40)	\$17.14	\$9.57	\$26.71
To install 2 1/2" pipe on sand bed (schedule 40)	\$19.49	\$11.77	\$31.26
To install 3" pipe on sand bed (schedule 40)	\$21.82	\$12.84	\$34.66
To install 4" pipe on sand bed (schedule 40)	\$26.67	\$17.71	\$44.37
To install 6" pipe on sand bed (schedule 40)	\$35.82	\$29.76	\$65.58
To install 8" pipe on sand bed (schedule 40)	\$42.21	\$40.96	\$83.16

	Materials	Labor	Total
To install 1" pipe on sand bed (schedule 80)	\$12.64	\$5.57	\$18.20
To install 1 1/4" pipe on sand bed (schedule 80)	\$13.36	\$6.47	\$19.83
To install 1 1/2" pipe on sand bed (schedule 80)	\$13.11	\$6.88	\$20.00
To install 2" pipe on sand bed (schedule 80)	\$16.61	\$8.40	\$25.01
To install 2 1/2" pipe on sand bed (schedule 80)	\$20.15	\$12.03	\$32.19
To install 3" pipe on sand bed (schedule 80)	\$22.56	\$15.35	\$37.91
To install 4" pipe on sand bed (schedule 80)	\$26.63	\$19.56	\$46.19
To install 6" pipe on sand bed (schedule 80)	\$38.99	\$39.15	\$78.14
To install 8" pipe on sand bed (schedule 80)	\$51.92	\$62.45	\$114.37

Direct Burial Conduit Systems

To install 1" pipe in conduit (schedule 40)	\$23.65	\$24.82	\$48.47
To install 1 1/4" pipe in conduit (schedule 40)	\$24.22	\$25.80	\$50.02
To install 1 1/2" pipe in conduit (schedule 40)	\$24.67	\$26.62	\$51.29
To install 2" pipe in conduit (schedule 40)	\$26.37	\$29.13	\$55.50
To install 2 1/2" pipe in conduit (schedule 40)	\$29.02	\$31.63	\$60.65
To install 3" pipe in conduit (schedule 40)	\$32.00	\$31.77	\$63.77
To install 4" pipe in conduit (schedule 40)	\$36.61	\$33.10	\$69.71
To install 6" pipe in conduit (schedule 40)	\$48.07	\$42.71	\$90.78
To install 8" pipe in conduit (schedule 40)	\$55.42	\$50.84	\$106.26

				Total system cost
To install 1" pipe in conduit (schedule 80)	\$23.68	\$21.85	\$45.53	\$94.00
To install 1 1/4" pipe in conduit (schedule 80)	\$24.36	\$23.45	\$47.81	\$97.83
To install 1 1/2" pipe in conduit (schedule 80)	\$24.91	\$23.43	\$48.34	\$99.63
To install 2" pipe in conduit (schedule 80)	\$25.48	\$23.19	\$48.67	\$104.17
To install 2 1/2" pipe in conduit (schedule 80)	\$28.91	\$23.19	\$52.10	\$112.75
To install 3" pipe in conduit (schedule 80)	\$31.70	\$28.00	\$59.70	\$123.47
To install 4" pipe in conduit (schedule 80)	\$37.58	\$29.17	\$66.75	\$136.46
To install 6" pipe in conduit (schedule 80)	\$49.67	\$37.64	\$87.31	\$178.09
To install 8" pipe in conduit (schedule 80)	\$57.57	\$44.81	\$102.38	\$208.64

Demolition costs for piping in trenches

Means 020-724-2000

0 - 2" Pipe

> 2" - 4" Pipe

> 4" - 8" Pipe

Labor/total costs

\$1.17 Per linear foot

\$1.56 Per linear foot

\$4.69 Per linear foot

Note: Demolition costs do not include the removal of asbestos

Fittings

All fittings will be installed inside of accessible structures with the exception of selected expansion loop locations where 90° elbows will be installed on conduit systems. Pipes in concrete trenches will employ expansion joints. Fitting costs shown below are, thus, for built-up piping systems. Detailed unit costs are developed; results are summarized below.

Valve costs

Valves (Valves in steam and condensate service must be welded and shall be gate valves.

For sizes up to 2-1/2-inches must be rising stem, 3-inches and larger shall be OS&Y)

	Matl	Labor	Total unit cost	
1" gate valve	\$78.82	\$141.64	\$220.46	Ref: Means: 151-980-6105
1 1/4" gate valve	\$138.86	\$208.13	\$346.99	Ref: Means: 151-980-6106
1 1/2" gate valve	\$139.58	\$216.56	\$356.14	Ref: Means: 151-980-6107
2" gate valve	\$182.27	\$282.02	\$464.29	Ref: Means: 151-980-6108
2 1/2" gate valve	\$727.23	\$857.72	\$1,584.95	Ref: Means: 151-980-2040
3" gate valve	\$727.35	\$874.11	\$1,601.46	Ref: Means: 151-980-2050
4" gate valve	\$929.92	\$1,132.46	\$2,062.38	Ref: Means: 151-980-2060
6" gate valve	\$1,448.76	\$1,741.64	\$3,190.39	Ref: Means: 151-980-2070

Tee costs

Ref: Means 151 720 3380				151-720-3830			
Schedule 40 Steam Service				Schedule 80 Condensate Service			
	Matl	Labor	Total unit cost		Matl	Labor	Total unit cost
1" tee	\$28.92	\$78.56	\$107.48		\$33.42	\$90.91	\$124
1 1/4" tee	\$33.06	\$85.57	\$118.63		\$34.46	\$100.72	\$135
1 1/2" tee	\$33.78	\$93.29	\$127.07		\$37.58	\$112.94	\$151
2" tee	\$39.37	\$123.30	\$162.67		\$41.87	\$139.10	\$181
2 1/2" tee	\$47.23	\$141.04	\$188.27		\$52.23	\$165.14	\$217
3" tee	\$49.85	\$290.90	\$340.76		\$58.35	\$188.80	\$247
4" tee	\$65.92	\$220.08	\$286.01		\$84.92	\$251.53	\$336
6" tee	\$105.76	\$310.38	\$416.14		\$128.26	\$357.88	\$486

45 Elbow

Ref: Means 151 720 3230				151-720-3680			
Schedule 40 Steam Service				Schedule 80 Condensate Service			
	Matl	Labor	Total unit cost		Matl	Labor	Total unit cost
1" Elbow	\$20.47	\$61.10	\$81.57		\$22.57	\$74.60	\$97
1 1/4" Elbow	\$21.51	\$66.48	\$87.99		\$23.61	\$79.97	\$104
1 1/2" Elbow	\$21.53	\$70.24	\$91.77		\$23.63	\$86.54	\$110
2" Elbow	\$29.22	\$91.30	\$120.52		\$30.62	\$103.65	\$134
2 1/2" Elbow	\$34.23	\$105.59	\$139.82		\$37.03	\$113.99	\$151
3" Elbow	\$36.10	\$120.75	\$156.86		\$38.95	\$132.00	\$171
4" Elbow	\$49.62	\$156.58	\$206.21		\$52.47	\$180.68	\$233
6" Elbow	\$80.26	\$215.38	\$295.64		\$95.76	\$231.58	\$327

90 Elbow

Ref: Means 151-720-3070				151-720-3540			
Schedule 40 Steam Service				Schedule 80 Condensate Service			
	Matl	Labor	Total unit cost		Matl	Labor	Total unit cost
1" Elbow	\$20.82	\$61.10	\$81.92		\$22.57	\$74.60	\$97.17
1 1/4" Elbow	\$21.86	\$66.48	\$88.34		\$23.61	\$79.97	\$103.58
1 1/2" Elbow	\$21.88	\$70.24	\$92.12		\$23.63	\$86.54	\$110.17

2" Elbow	\$29.57	\$91.30	\$120.87	\$31.32	\$103.65	\$134.97
2 1/2" Elbow	\$35.63	\$105.59	\$141.22	\$38.78	\$113.99	\$152.77
3" Elbow	\$37.50	\$120.75	\$158.26	\$42.45	\$132.00	\$174.46
4" Elbow	\$51.72	\$156.58	\$208.31	\$59.92	\$180.68	\$240.61
6" Elbow	\$90.26	\$215.38	\$305.64	\$110.26	\$231.58	\$341.84

Expansion joint unit cost (2 welded flanges and bellows)

	Matl	Labor	Total unit cost
1" exp. joint	\$188.72	\$78.99	\$267.71
1 1/4" exp. joint	\$192.76	\$86.96	\$279.72
1 1/2" exp. joint	\$193.48	\$92.23	\$285.71
2" exp. joint	\$289.97	\$123.81	\$413.78
2 1/2" exp. joint	\$314.03	\$140.57	\$454.60
3" exp. joint	\$322.25	\$158.77	\$481.03
4" exp. joint	\$366.92	\$208.53	\$575.46
6" exp. joint	\$462.76	\$285.38	\$748.14

Schedule 80 Condensate Service

	Matl	Labor	Total unit cost
Ref: Means 156-225-0120			
Means page 131 weld/neck			
Means 156-235-1200			

Anchor unit cost

Existing anchors are assumed reusable for piping replaced at the same locations. Anchors for new pipes in existing trenches, use the following (based on Means, see detailed estimates):

	Matl	Labor	Total unit cost
1" Anchor unit cost	\$15.28	\$26.98	\$30.57
1-1/4" Anchor unit cost	\$15.90	\$27.02	\$31.23
1-1/2" Anchor unit cost	\$17.43	\$27.22	\$32.96
2" Anchor unit cost	\$17.94	\$27.27	\$33.52
2-1/2" Anchor unit cost	\$18.70	\$27.49	\$34.50
3" Anchor unit cost	\$22.92	\$27.57	\$38.80
4" Anchor unit cost	\$27.18	\$27.91	\$43.40
6" Anchor unit cost	\$31.60	\$28.21	\$48.12

Guide unit cost

	Matl	Labor	Total unit cost	
1" pipe guide	\$51.00	\$9.00	\$60.00	Ref: Means 151-901-1260
1 1/4" pipe guide	\$68.50	\$11.15	\$79.65	Ref: Means 151-901-1280
1 1/2" pipe guide	\$68.50	\$11.15	\$79.65	Ref: Means 151-901-1280
2" pipe guide	\$68.50	\$11.15	\$79.65	Ref: Means 151-901-1280
2 1/2" pipe guide	\$79.00	\$13.00	\$92.00	Ref: Means 151-901-1290
3" pipe guide	\$79.00	\$13.00	\$92.00	Ref: Means 151-901-1290
4" pipe guide	\$140.00	\$14.65	\$154.65	Ref: Means 151-901-1300
6" pipe guide	\$140.00	\$14.65	\$154.65	Ref: Means 151-901-1310

Drip Trap Assembly Cost

Refer to detailed unit cost calculations

	Matl	Labor	Total unit cost	
1" pipe to steam trap	\$1,001	\$168	\$1,072	Includes 2 shut-off valves, steam trap, strainer, check valve and union
1 1/4" pipe to steam trap	\$1,536	\$193	\$1,568	
1 1/2" pipe to steam trap	\$1,942	\$224	\$1,999	
2" pipe to steam trap	\$3,203	\$289	\$3,277	

Pressure regulating valve unit cost

	Matl	Labor	Total unit cost
1-in PRV	\$243	\$12.30	\$255
1 1/4-in PRV	\$305	\$15.60	\$321
1 1/2-in PRV	\$325	\$18.00	\$343
2-in PRV	\$435	\$21.50	\$457
2 1/2-in PRV	\$970	\$35.00	\$1,005
3-in PRV	\$1,100	\$38.50	\$1,139
4-in PRV	\$1,550	\$84.50	\$1,635

Pressure relief valve unit cost

	Matl	Labor	Total unit cost
3/4-in RV	\$54.50	\$8.35	\$62.85
1-in RV	\$79.00	\$9.75	\$88.75
1 1/4-in RV	\$172.00	\$11.70	\$183.70
1 1/2-in RV	\$305.00	\$13.00	\$318.00
2-in RV	\$335.00	\$14.65	\$349.65

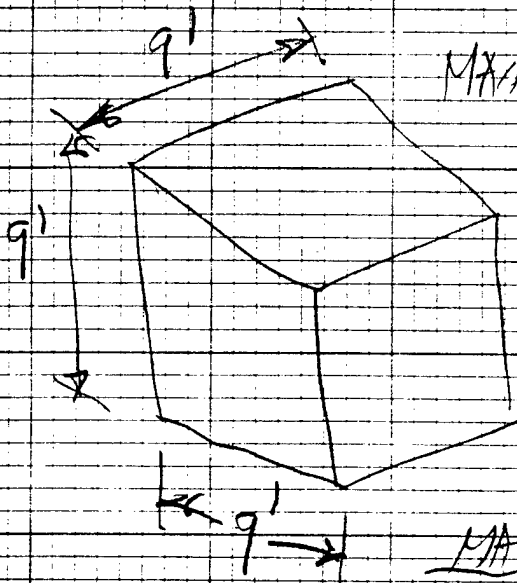
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CONCRETE PIT
UNIT COST ESTIMATE

PROJECT HAWTHORNE
SHEET NO. 1 OF 4 SHEETS



$$\text{MACHINE EXCAVATION} = \frac{10 \times 10 \times 9}{27} = \underline{33 \text{ CY}}$$

$$\text{HAND EXCAVATION} = \frac{1 \times 10 \times 10}{27} = \underline{4 \text{ CY}}$$

$$\text{BACKFILL} = \frac{(\frac{1}{2} \times 9(4) \times 9)}{27} = \underline{16 \text{ CY}}$$

MACHINE

022-238 MEANS EXCAVATION/BACKFILL/COMPACT

	MH	UNIT	LABOR	EQUIP	BARE	BT W/CHP
0200 1 CY BACKHOE	.027	CY	.63	.91	1.54	1.77

240 TRUCK LOADING

15%

022-224 1 CY BACKHOE
-1200 MOBILIZATION

\$ 247
(ONE TIME)

022-246 HAULING, 4 MILES
-0500 ROUND TRIP
12 CY DUMP TRUCK

4.69

MACHINE TOTAL = \$7.66/CY

022-200
250 HAND EX-
-0500 CAVATION

\$82.50/CY

022-200 BACKFILL
0010/0300 (22.50) COMPACTION

\$34.50/CY

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CONCRETE PITS

PROJECT _____
SHEET NO. 2 OF 4 SHEETS

	<u>\$/CY</u>	<u>CY</u>	<u>\$</u>
MACHINE EXCAVATION	7.66	33	253
HAND EXCAVATION	82.50	4	330
1-PERSON - 2 DAY = 28 x .6 x 16)			268
HAND BACKFILL	34.50	6	207
CONCRETE PIT			
(QUOTE FROM JENSEN			\$4600
CONCRETE, SPARKS, NEVADA,			
702-359-6200, DELIVERED,			
SET-IN-PLACE			
SALES TAX			216 ⁰⁰
MOUNT LADDER (6' x 28')			168 ⁰⁰
SEAL 2-24" Ø OPNG (8' x 28')			224 ⁰⁰
TOTAL COST - PIPING NOT INSTALLED			<u>\$6,266</u>

$$MTL = 4600 + 216 = 4816$$

$$LBSR = \quad = 1450$$

JENSEN[®]

FAX (702) 359-1038

FACSIMILE QUOTATION SHEET

NO. 01- 12148

FAX TO NO.

(415) 864 — 3681

2.

Total Number Of Pages
(Including This Sheet)

TO: KELLER AND GANNON

DATE: 6/28/95

ATTN: DON NURISSO

FROM: STEVE GUEVIN

RE: 777 VAULT

Location

Ship To

HAWTHORNE, NV**Job**

600	N/A

Per Your Request

X

No Reply Necessary

X

Confirming Verbal

For Your Use

X

[illegible]

777 VAULT

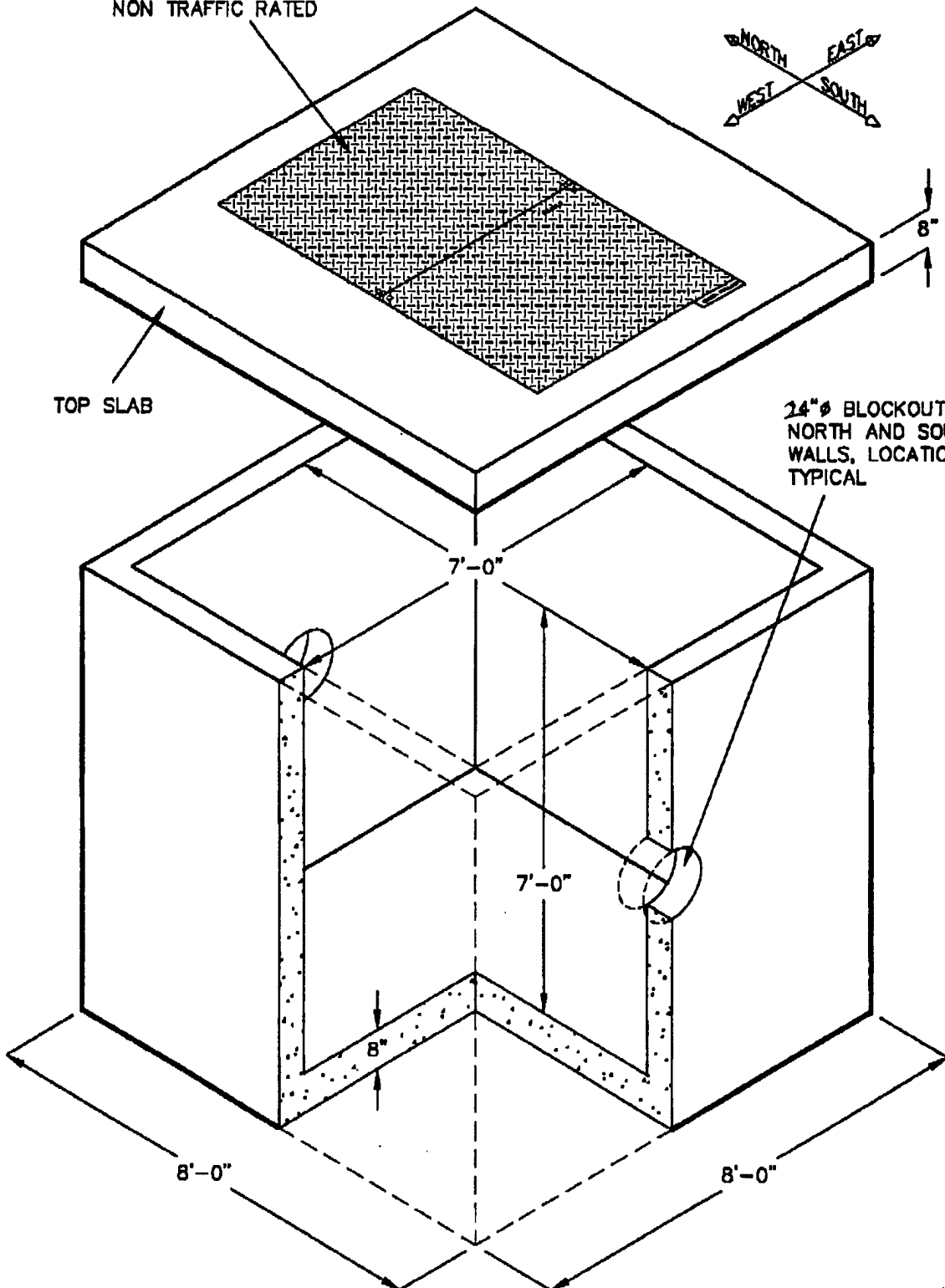
7'-0" WD. x 7'-0" LG. x 7'-0" H.
(INSIDE DIMENSIONS)

4878AT TORSION
SPRING COVER
CAST INTO TOP
SLAB.
NON TRAFFIC RATED



TOP SLAB

24"Ø BLOCKOUT
NORTH AND SOUTH
WALLS, LOCATION
TYPICAL



6/28/95

APPENDIX G

Construction Cost Estimates - Ordnance Area

**EEAP Limited Energy Study of Steam Distribution Systems
Hawthorne Army Ammunition Depot, Nevada**

APPENDIX G

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Ordnance Area Base Case Cost Estimates	G-1
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Ordnance & Industrial Areas Fitting Unit Costs	G-37
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Aboveground Pipe Support Unit Cost Development	G-50
(10 Sheets)	



CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 1 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A1 to MH A11			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	3,384	LF	\$68.84	\$232,951	\$60.52	\$204,790	\$437,741	
6-inch/3-inch	21	LF	\$58.38	\$1,226	\$45.12	\$947	\$2,173	
5-inch/2 1/2-inch	16	LF	\$50.72	\$811	\$39.05	\$625	\$1,436	
4-inch/ 2-inch	26	LF	\$43.27	\$1,125	\$17.94	\$466	\$1,591	
3-inch/1 1/2-inch	16	LF	\$34.93	\$559	\$19.73	\$316	\$874	
2 1/2-inch / 1 1/2-inch	130	LF	\$32.60	\$4,239	\$18.65	\$2,424	\$6,663	
SUPPORTS	106	EA	\$337.01	\$35,723	\$290.00	\$30,740	\$66,463	
STEAM VALVES								
8-inch	8	EA	\$344.50	\$2,756	\$2,282.20	\$18,258	\$21,014	
6-inch	1	EA	\$292.88	\$293	\$1,448.76	\$1,449	\$1,742	
5-inch	2	EA	\$247.71	\$495	\$1,189.34	\$2,379	\$2,874	
4-inch	1	EA	\$202.53	\$203	\$929.92	\$930	\$1,132	
3-inch	2	EA	\$146.75	\$294	\$727.35	\$1,455	\$1,748	
2 1/2-inch	6	EA	\$130.49	\$783	\$727.23	\$4,363	\$5,146	
COND VALVES								
4-inch	8	EA	\$202.53	\$1,620	\$929.92	\$7,439	\$9,060	
3-inch	2	EA	\$146.75	\$294	\$727.35	\$1,455	\$1,748	
2 1/2-inch	3	EA	\$130.49	\$391	\$727.23	\$2,182	\$2,573	
2-inch	2	EA	\$99.75	\$200	\$182.27	\$365	\$564	
1 1/2-inch	40	EA	\$76.98	\$3,079	\$139.58	\$5,583	\$8,662	
STEAM TEES								
8-inch	15	EA	\$371.13	\$5,567	\$162.91	\$2,444	\$8,011	
6-inch	0	EA	\$310.38	\$0	\$105.76	\$0	\$0	
5-inch	0	EA	\$220.08	\$0	\$65.92	\$0	\$0	
4-inch	2	EA	\$215.69	\$431	\$62.14	\$124	\$556	
3-inch	2	EA	\$190.90	\$382	\$49.85	\$100	\$482	
2 1/2-inch	7	EA	\$141.04	\$987	\$47.23	\$331	\$1,318	
2-inch	0	EA	\$123.30	\$0	\$39.37	\$0	\$0	
COND TEES								
4-inch	19	EA	\$251.53	\$4,779	\$84.92	\$1,614	\$6,393	
3-inch	0	EA	\$188.80	\$0	\$58.35	\$0	\$0	
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23	\$0	\$0	
2-inch	4	EA	\$139.10	\$556	\$41.87	\$167	\$724	
1 1/2-inch	5	EA	\$112.94	\$565	\$37.58	\$188	\$753	
45 ELBOWS (COMMON)								
8-inch/4-inch	4	EA	\$441.09	\$1,764	\$164.40	\$658	\$2,422	
6-inch/3-inch	2	EA	\$347.39	\$695	\$119.21	\$238	\$933	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 2 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design completed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A1 to MH A11				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	\$0
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	\$0
90 ELBOW (COMMON)								
8-inch/4-inch	44	EA	\$441.09	\$19,408	\$199.51		\$8,779	\$28,187
6-inch/3-inch	5	EA	\$347.39	\$1,737	\$132.71		\$664	\$2,400
5-inch/3-inch	2	EA	\$276.75	\$553	\$53.05		\$106	\$660
4-inch/2-inch	1	EA	\$260.24	\$260	\$38.80		\$39	\$299
3-inch/2-inch	2	EA	\$207.29	\$415	\$61.14		\$122	\$537
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	\$0
ELBOWS (SINGLE-COND)								
2-inch	1	EA	\$103.65	\$104	\$31.32		\$31	\$135
1 1/2-inch	84	EA	\$86.54	\$7,269	\$23.63		\$1,985	\$9,254
ANCHORS								
8-inch/4-inch	12	EA	\$60.50	\$726	\$61.82		\$742	\$1,468
6-inch/3-inch	1	EA	\$59.62	\$60	\$53.37		\$53	\$113
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	\$0
4-inch/2-inch	1	EA	\$58.87	\$59	\$47.13		\$47	\$106
3-inch/1 1/2-inch	1	EA	\$58.26	\$58	\$42.29		\$42	\$101
2 1/2-inch/1 1/2-inch	1	EA	\$58.10	\$58	\$38.00		\$38	\$96
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
GUIDES								
8-inch/4-inch	13	EA	\$41.15	\$535	\$406.00		\$5,278	\$5,813
6-inch/3-inch	3	EA	\$27.65	\$83	\$219.00		\$657	\$740
5-inch/2 1/2-inch	2	EA	\$27.65	\$55	\$219.00		\$438	\$493
4-inch/2-inch	2	EA	\$25.80	\$52	\$208.50		\$417	\$469
3-inch/1 1/2-inch	3	EA	\$24.15	\$72	\$147.50		\$443	\$515
2 1/2-inch/1 1/2-inch	4	EA	\$24.15	\$97	\$147.50		\$590	\$687
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
Miscellaneous Fittings								
2-inch DRIP NIPPLE	20	EA	\$21.50	\$430	\$33.00		\$660	\$1,090
1 1/2-inch Steam Trap Assembly	16	EA	\$168.12	\$2,690	\$1,000.50		\$16,008	\$18,698
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	\$0
STM GAGE	1	EA	\$7.30	\$7	\$16.50		\$17	\$24
PRESSURE GAGE	1	EA	\$7.30	\$7	\$16.50		\$17	\$24

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 3		of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate			
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design competed)					
Engineer-Architect Keller & Gannon										
Drawing No. MH A1 to MH A11				Estimator DLN		Checked By BIH				
Line Item	Quantity		Labor		Material			Total Cost		
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total			
(BELOW-GRADE PIPING: STM PIPE IN CONDUIT & COND PIPE IN CONDUIT)										
8-inch/4-inch	150	LF	\$93.00	\$13,950	\$80.01		\$12,002	\$25,952		
6-inch/3-inch	0	LF	\$79.77	\$0	\$70.71		\$0	\$0		
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29		\$0	\$0		
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29		\$0	\$0		
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20		\$0	\$0		
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06		\$0	\$0		
TRENCH/BACKFILL										
DIR-LAWN	90	LF	\$7	\$641	\$0.00		\$0	\$641		
CONC-ROAD	60	LF	\$24	\$1,427	\$0.00		\$0	\$1,427		
CONC-SIDEW	0	LF	\$15.17	\$0	\$0.00		\$0	\$0		
RR TRACKS	3	EA	\$750.00	\$2,250	\$0.00		\$0	\$2,250		
STEAM PITS	5	EA	\$1,450	\$7,250	\$4,816		\$24,080	\$31,330		
Subtotal				\$363,021			\$365,281	\$728,302		
Nevada Sales Tax	3.75%						\$13,698	\$13,698		
Subtotal								\$742,000		
Contractor Overhead & Profit	25.0%							\$185,500		
Subtotal								\$927,500		
Estimating Contingency	10.0%							\$92,750		
Total Probable Construction Cost								\$1,020,250		
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$136.29		

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 4 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A11 to MH A18				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total		
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	2,225	LF	\$68.84	\$153,167	\$60.52	\$134,650	\$287,817	
6-inch/3-inch	0	LF	\$58.38	\$0	\$45.12	\$0	\$0	
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05	\$0	\$0	
4-inch/ 2-inch	0	LF	\$43.27	\$0	\$17.94	\$0	\$0	
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65	\$0	\$0	
SUPPORTS	72	EA	\$337.01	\$24,265	\$290.00	\$20,880	\$45,145	
STEAM VALVES								
8-inch	6	EA	\$344.50	\$2,067	\$2,282.20	\$13,693	\$15,760	
6-inch	1	EA	\$292.88	\$293	\$1,448.76	\$1,449	\$1,742	
5-inch	0	EA	\$247.71	\$0	\$1,189.34	\$0	\$0	
4-inch	0	EA	\$202.53	\$0	\$929.92	\$0	\$0	
3-inch	1	EA	\$146.75	\$147	\$727.35	\$727	\$874	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
COND VALVES								
4-inch	5	EA	\$202.53	\$1,013	\$929.92	\$4,650	\$5,662	
3-inch	1	EA	\$146.75	\$147	\$727.35	\$727	\$874	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
2-inch	0	EA	\$99.75	\$0	\$182.27	\$0	\$0	
1 1/2-inch	15	EA	\$76.98	\$1,155	\$139.58	\$2,094	\$3,248	
STEAM TEES								
8-inch	9	EA	\$371.13	\$3,340	\$162.91	\$1,466	\$4,806	
6-inch	1	EA	\$310.38	\$310	\$105.76	\$106	\$416	
5-inch	0	EA	\$220.08	\$0	\$65.92	\$0	\$0	
4-inch	0	EA	\$215.69	\$0	\$62.14	\$0	\$0	
3-inch	1	EA	\$190.90	\$191	\$49.85	\$50	\$241	
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23	\$0	\$0	
2-inch	0	EA	\$123.30	\$0	\$39.37	\$0	\$0	
COND TEES								
4-inch	14	EA	\$251.53	\$3,521	\$84.92	\$1,189	\$4,710	
3-inch	0	EA	\$188.80	\$0	\$58.35	\$0	\$0	
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23	\$0	\$0	
2-inch	0	EA	\$139.10	\$0	\$41.87	\$0	\$0	
1 1/2-inch	0	EA	\$112.94	\$0	\$37.58	\$0	\$0	
45 ELBOWS (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$164.40	\$0	\$0	
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21	\$0	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 5 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A11 to MH A18				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total		
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97	\$0	\$0	
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70	\$0	\$0	
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74	\$0	\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86	\$0	\$0	
90 ELBOW (COMMON)								
8-inch/4-inch	28	EA	\$441.09	\$12,351	\$199.51	\$5,586	\$17,937	
6-inch/3-inch	1	EA	\$347.39	\$347	\$132.71	\$133	\$480	
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05	\$0	\$0	
4-inch/2-inch	0	EA	\$260.24	\$0	\$38.80	\$0	\$0	
3-inch/2-inch	1	EA	\$207.29	\$207	\$61.14	\$61	\$268	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26	\$0	\$0	
ELBOWS (SINGLE-COND)								
2-inch	0	EA	\$103.65	\$0	\$31.32	\$0	\$0	
1 1/2-inch	35	EA	\$86.54	\$3,029	\$23.63	\$827	\$3,856	
ANCHORS								
8-inch/4-inch	7	EA	\$60.50	\$424	\$61.82	\$433	\$856	
6-inch/3-inch	0	EA	\$59.62	\$0	\$53.37	\$0	\$0	
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08	\$0	\$0	
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13	\$0	\$0	
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29	\$0	\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00	\$0	\$0	
2-inch/1 1/4-inch	0	EA		\$0		\$0	\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0		\$0	\$0	
GUIDES								
8-inch/4-inch	7	EA	\$41.15	\$288	\$406.00	\$2,842	\$3,130	
6-inch/3-inch	0	EA	\$27.65	\$0	\$219.00	\$0	\$0	
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00	\$0	\$0	
4-inch/2-inch	0	EA	\$25.80	\$0	\$208.50	\$0	\$0	
3-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50	\$0	\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50	\$0	\$0	
2-inch/1 1/4-inch	0	EA		\$0		\$0	\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0		\$0	\$0	
COND GLAND SEALS								
8-inch / 4-inch	0	EA	\$72.38	\$0	\$724.00	\$0	\$0	
8-inch/2 1/2-inch	0	EA	\$41.59	\$0	\$430.00	\$0	\$0	
6-inch / 3-inch	0	EA	\$65.37	\$0	\$647.00	\$0	\$0	
5-inch / 2 1/2-inch	0	EA	\$61.60	\$0	\$582.00	\$0	\$0	
4-inch / 2-inch	0	EA	\$61.60	\$0	\$582.00	\$0	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 6 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A11 to MH A18				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total		
3-inch/2-inch	0	EA	\$61.60	\$0	\$582.00	\$0	\$0	
3-inch/ 1 1/2-inch	0	EA	\$61.60	\$0	\$582.00	\$0	\$0	
2 1/2-inch / 2-inch	0	EA	\$56.20	\$0	\$504.00	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	EA	\$56.20	\$0	\$504.00	\$0	\$0	
2 1/2-inch / 1 1/4-inch	0	EA	\$56.20	\$0	\$504.00	\$0	\$0	
1 1/2-inch/1 1/4-inch	0	EA	\$56.20	\$0	\$504.00	\$0	\$0	
Miscellaneous Fittings								
2-inch DRIP NIPPLE	7	EA	\$21.50	\$151	\$33.00	\$231	\$382	
1 1/2-inch Steam Trap Assembly	7	EA	\$168.12	\$1,177	\$1,000.50	\$7,004	\$8,180	
4-inch 'PRV	0	EA	\$84.50	\$0	\$1,550.00	\$0	\$0	
STM GAGE	0	EA	\$7.30	\$0	\$16.50	\$0	\$0	
PRESSURE GAGE	0	EA	\$7.30	\$0	\$16.50	\$0	\$0	
(BELOW-GRADE PIPING: STM PIPE IN CONDUIT & CONDENSATE PIPE IN CONDUIT)								
8-inch/4-inch	60	LF	\$93.00	\$5,580	\$80.01	\$4,801	\$10,381	
6-inch/3-inch	0	LF	\$79.77	\$0	\$70.71	\$0	\$0	
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29	\$0	\$0	
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29	\$0	\$0	
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06	\$0	\$0	
TRENCH/BACKFILL								
DIR-LAWN	60	LF	\$7.12	\$427	\$0.00	\$0	\$427	
CONC-ROAD	0	LF	\$23.78	\$0	\$0.00	\$0	\$0	
CONC-SIDEW	0	LF	\$15.17	\$0	\$0.00	\$0	\$0	
R/R TRACK	2	EA	\$750.00	\$1,500	\$0.00	\$0	\$1,500	
STEAM PITS	2	EA	\$1,450	\$2,900	\$4,816.00	\$9,632	\$12,532	
Subtotal				\$217,995		\$213,230	\$431,225	
Nevada Sales Tax	3.75%					\$7,996	\$7,996	
Subtotal							\$439,222	
Contractor Overhead & Profit	25.0%						\$109,805	
Subtotal							\$549,027	
Estimating Contingency	10.0%						54,903	
Total Probable Construction Cost							\$603,930	
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings							\$132.15	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 7 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A11 to MH D4				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	0	LF	\$68.84	\$0	\$60.52		\$0	\$0
6-inch/3-inch	763	LF	\$58.38	\$44,541	\$45.12		\$34,424	\$78,964
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05		\$0	\$0
4-inch/ 2-inch		LF	\$43.27	\$0	\$17.94		\$0	\$0
3-inch/1 1/2-inch		LF	\$34.93	\$0	\$19.73		\$0	\$0
2 1/2-inch / 1 1/2-inch		LF	\$32.60	\$0	\$18.65		\$0	\$0
SUPPORTS	42	EA	\$337.01	\$14,154	\$290.00		\$12,180	\$26,334
STEAM VALVES								
8-inch	0	EA	\$344.50	\$0	\$2,282.20		\$0	\$0
6-inch	3	EA	\$292.88	\$879	\$1,448.76		\$4,346	\$5,225
5-inch	0	EA	\$247.71	\$0	\$1,189.34		\$0	\$0
4-inch	0	EA	\$202.53	\$0	\$929.92		\$0	\$0
3-inch	0	EA	\$146.75	\$0	\$727.35		\$0	\$0
2 1/2-inch	1	EA	\$130.49	\$130	\$727.23		\$727	\$858
COND VALVES								
4-inch	0	EA	\$202.53	\$0	\$929.92		\$0	\$0
3-inch	3	EA	\$146.75	\$440	\$727.35		\$2,182	\$2,622
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23		\$0	\$0
2-inch	0	EA	\$99.75	\$0	\$182.27		\$0	\$0
1 1/2-inch	10	EA	\$76.98	\$770	\$139.58		\$1,396	\$2,166
STEAM TEES								
8-inch	0	EA	\$371.13	\$0	\$162.91		\$0	\$0
6-inch	3	EA	\$310.38	\$931	\$105.76		\$317	\$1,248
5-inch	0	EA	\$220.08	\$0	\$65.92		\$0	\$0
4-inch	0	EA	\$215.69	\$0	\$62.14		\$0	\$0
3-inch	0	EA	\$190.90	\$0	\$49.85		\$0	\$0
2 1/2-inch	2	EA	\$141.04	\$282	\$47.23		\$94	\$377
2-inch	0	EA	\$123.30	\$0	\$39.37		\$0	\$0
COND TEES								
4-inch	0	EA	\$251.53	\$0	\$84.92		\$0	\$0
3-inch	6	EA	\$188.80	\$1,133	\$58.35		\$350	\$1,483
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23		\$0	\$0
2-inch	0	EA	\$139.10	\$0	\$41.87		\$0	\$0
1 1/2-inch	1	EA	\$112.94	\$113	\$37.58		\$38	\$151
45 ELBOWS (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$164.40		\$0	\$0
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21		\$0	\$0

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 8 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A11 to MH D4				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	\$0
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	\$0
90 ELBOW (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$199.51		\$0	\$0
6-inch/3-inch	20	EA	\$347.39	\$6,948	\$132.71		\$2,654	\$9,602
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$38.80		\$0	\$0
3-inch/2-inch	0	EA	\$207.29	\$0	\$61.14		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	\$0
ELBOWS (SINGLE-COND)								
2-inch	0	EA	\$103.65	\$0	\$31.32		\$0	\$0
1 1/2-inch	22	EA	\$86.54	\$1,904	\$23.63		\$520	\$2,424
ANCHORS								
8-inch/4-inch	0	EA	\$60.50	\$0	\$61.82		\$0	\$0
6-inch/3-inch	3	EA	\$59.62	\$179	\$53.37		\$160	\$339
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	\$0
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	\$0
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
GUIDES								
8-inch/4-inch	0	EA	\$41.15	\$0	\$406.00		\$0	\$0
6-inch/3-inch	3	EA	\$27.65	\$83	\$219.00		\$657	\$740
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	\$0
4-inch/2-inch	0	EA	\$25.80	\$0	\$208.50		\$0	\$0
3-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
Miscellaneous Fittings								
2-inch DRIP NIPPLE	4	EA	\$21.50	\$86	\$33.00		\$132	\$218
1 1/2-inch Steam Trap Assembly	4	EA	\$168.12	\$672	\$1,000.50		\$4,002	\$4,674
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	\$0
STM GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	\$0
PRESSURE GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	\$0

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 9 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A11 to MH D4				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
BELOW-GRADE PIPING: STM PIPE IN CONDUIT & CONDENSATE PIPE IN CONDUIT								
8-inch/4-inch	0	LF	\$93.00	\$0	\$80.01		\$0	\$0
6-inch/3-inch	500	LF	\$79.77	\$39,885	\$70.71		\$35,355	\$75,240
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29		\$0	\$0
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29		\$0	\$0
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20		\$0	\$0
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06		\$0	\$0
TRENCH/BACKFILL								
DIR-LAWN	500	LF	\$7.12	\$3,560	\$0.00		\$0	\$3,560
CONC-ROAD	30	LF	\$23.78	\$713	\$0.00		\$0	\$713
CONC-SIDEWALK	0	LF	\$15.17	\$0	\$0.00		\$0	\$0
R/R TRACK	4	EA	\$750.00	\$3,000	\$0.00		\$0	\$3,000
STEAM PITS	6	EA	\$1,450	\$8,700	\$4,816.00		\$28,896	\$37,596
Subtotal				\$129,104			\$128,431	\$257,534
Nevada Sales Tax	3.75%						\$4,816	\$4,816
Subtotal								\$262,350
Contractor Overhead & Profit	25.0%							\$65,588
Subtotal								\$327,938
Estimating Contingency	10.0%							32793.81
Total Probable Construction Cost								\$360,732
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$142.81

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 10 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A18 to Bldg 108-20				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	0	LF	\$68.84	\$0	\$60.52	\$0	\$0	
6-inch/3-inch	0	LF	\$58.38	\$0	\$45.12	\$0	\$0	
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05	\$0	\$0	
4-inch/ 2-inch	0	LF	\$43.27	\$0	\$17.94	\$0	\$0	
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73	\$0	\$0	
2 1/2-inch / 1 1/2-inch	30	LF	\$32.60	\$978	\$18.65	\$559	\$1,538	
SUPPORTS	10	EA	\$337.01	\$3,370	\$290.00	\$2,900	\$6,270	
STEAM VALVES								
8-inch	0	EA	\$344.50	\$0	\$2,282.20	\$0	\$0	
6-inch	1	EA	\$292.88	\$293	\$1,448.76	\$1,449	\$1,742	
5-inch	0	EA	\$247.71	\$0	\$1,189.34	\$0	\$0	
4-inch	0	EA	\$202.53	\$0	\$929.92	\$0	\$0	
3-inch	0	EA	\$146.75	\$0	\$727.35	\$0	\$0	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
COND VALVES								
4-inch	0	EA	\$202.53	\$0	\$929.92	\$0	\$0	
3-inch	1	EA	\$146.75	\$147	\$727.35	\$727	\$874	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
2-inch	0	EA	\$99.75	\$0	\$182.27	\$0	\$0	
1 1/2-inch	0	EA	\$76.98	\$0	\$139.58	\$0	\$0	
STEAM TEES								
8-inch	0	EA	\$371.13	\$0	\$162.91	\$0	\$0	
6-inch	0	EA	\$310.38	\$0	\$105.76	\$0	\$0	
5-inch	0	EA	\$220.08	\$0	\$65.92	\$0	\$0	
4-inch	0	EA	\$215.69	\$0	\$62.14	\$0	\$0	
3-inch	0	EA	\$190.90	\$0	\$49.85	\$0	\$0	
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23	\$0	\$0	
2-inch	0	EA	\$123.30	\$0	\$39.37	\$0	\$0	
COND TEES								
4-inch	0	EA	\$251.53	\$0	\$84.92	\$0	\$0	
3-inch	0	EA	\$188.80	\$0	\$58.35	\$0	\$0	
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23	\$0	\$0	
2-inch	0	EA	\$139.10	\$0	\$41.87	\$0	\$0	
1 1/2-inch	0	EA	\$112.94	\$0	\$37.58	\$0	\$0	
45 ELBOWS (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$164.40	\$0	\$0	
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21	\$0	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 11 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design completed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A18 to Bldg 108-20				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	
90 ELBOW (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$199.51		\$0	
6-inch/3-inch	4	EA	\$347.39	\$1,390	\$132.71		\$531	
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	
4-inch/2-inch	0	EA	\$260.24	\$0	\$38.80		\$0	
3-inch/2-inch	0	EA	\$207.29	\$0	\$61.14		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	
ELBOWS (SINGLE-COND)								
2-inch	0	EA	\$103.65	\$0	\$31.32		\$0	
1 1/2-inch	0	EA	\$86.54	\$0	\$23.63		\$0	
ANCHORS								
8-inch/4-inch	0	EA	\$60.50	\$0	\$61.82		\$0	
6-inch/3-inch	0	EA	\$59.62	\$0	\$53.37		\$0	
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00		\$0	
2-inch/1 1/4-inch	0	EA		\$0			\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	
GUIDES								
8-inch/4-inch	0	EA	\$41.15	\$0	\$406.00		\$0	
6-inch/3-inch	1	EA	\$27.65	\$28	\$219.00		\$219	
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	
4-inch/2-inch	0	EA	\$25.80	\$0	\$208.50		\$0	
3-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	
2-inch/1 1/4-inch	0	EA		\$0			\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	
Miscellaneous Fittings								
2-inch DRIP NIPPLE	1	EA	\$21.50	\$22	\$33.00		\$33	
1 1/2-inch Steam Trap Assembly	1	EA	\$168.12	\$168	\$1,000.50		\$1,001	
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	
STM GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	
PRESSURE GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 12		of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)			
Location Hawthorne Army Ammunition Depot, Nevada										
Engineer-Architect Keller & Gannon										
Drawing No. MH A18 to Bldg 108-20				Estimator DLN		Checked By BIH				
Line Item	Quantity		Labor		Material			Total Cost		
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total			
(BELOW-GRADE PIPING: STM PIPE IN CONDUIT & CONDENSATE PIPE IN CONDUIT)										
8-inch/4-inch	0	LF	\$93.00	\$0	\$80.01	\$0	\$0			
6-inch/3-inch	291	LF	\$79.77	\$23,213	\$70.71	\$20,577	\$43,790			
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29	\$0	\$0			
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29	\$0	\$0			
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20	\$0	\$0			
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06	\$0	\$0			
TRENCH/BACKFILL										
DIRT & LAWN	30	LF	\$7.12	\$214	\$0.00	\$0	\$214			
CONCRETE ROAD	0	LF	\$23.78	\$0	\$0.00	\$0	\$0			
CONCRETE SIDEWALK	0	LF	\$15.17	\$0	\$0.00	\$0	\$0			
R/R TRACK	1	EA	\$750.00	\$750	\$0.00	\$0	\$750			
STEAM PITS	1	EA	\$1,450	\$1,450	\$4,816	\$4,816	\$6,266			
Subtotal				\$32,021		\$32,812	\$64,833			
Nevada Sales Tax	3.75%					\$1,230	\$1,230			
Subtotal							\$66,063			
Contractor Overhead & Profit	25.0%						\$16,516			
Subtotal							\$82,579			
Estimating Contingency	10.0%						\$8,258			
Total Probable Construction Cost								\$90,837		
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$141.49		

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 13		of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate			
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)					
Engineer-Architect Keller & Gannon										
Drawing No. MH A5 - Bldg 103-40				Estimator DLN		Checked By BIH				
Line Item	Quantity		Labor		Material			Total Cost		
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total			
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)										
8-inch/4-inch	0	LF	\$68.84	\$0	\$60.52		\$0	\$0		
6-inch/3-inch	0	LF	\$58.38	\$0	\$45.12		\$0	\$0		
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05		\$0	\$0		
4-inch/ 2-inch	0	LF	\$43.27	\$0	\$17.94		\$0	\$0		
3-inch/1 1/2-inch	355	LF	\$34.93	\$12,400	\$19.73		\$7,003	\$19,403		
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65		\$0	\$0		
SUPPORTS	12	EA	\$337.01	\$4,044	\$290.00		\$3,480	\$7,524		
STEAM VALVES										
8-inch	0	EA	\$344.50	\$0	\$2,282.20		\$0	\$0		
6-inch	0	EA	\$292.88	\$0	\$1,448.76		\$0	\$0		
5-inch	0	EA	\$247.71	\$0	\$1,189.34		\$0	\$0		
4-inch	0	EA	\$202.53	\$0	\$929.92		\$0	\$0		
3-inch	1	EA	\$146.75	\$147	\$727.35		\$727	\$874		
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23		\$0	\$0		
COND VALVES										
4-inch	0	EA	\$202.53	\$0	\$929.92		\$0	\$0		
3-inch	0	EA	\$146.75	\$0	\$727.35		\$0	\$0		
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23		\$0	\$0		
2-inch	0	EA	\$99.75	\$0	\$182.27		\$0	\$0		
1 1/2-inch	1	EA	\$76.98	\$77	\$139.58		\$140	\$217		
STEAM TEES										
8-inch	0	EA	\$371.13	\$0	\$162.91		\$0	\$0		
6-inch	0	EA	\$310.38	\$0	\$105.76		\$0	\$0		
5-inch	0	EA	\$220.08	\$0	\$65.92		\$0	\$0		
4-inch	0	EA	\$215.69	\$0	\$62.14		\$0	\$0		
3-inch	2	EA	\$190.90	\$382	\$49.85		\$100	\$482		
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23		\$0	\$0		
2-inch	0	EA	\$123.30	\$0	\$39.37		\$0	\$0		
COND TEES										
4-inch	0	EA	\$251.53	\$0	\$84.92		\$0	\$0		
3-inch	0	EA	\$188.80	\$0	\$58.35		\$0	\$0		
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23		\$0	\$0		
2-inch	0	EA	\$139.10	\$0	\$41.87		\$0	\$0		
1 1/2-inch	0	EA	\$112.94	\$0	\$37.58		\$0	\$0		
45 ELBOWS (COMMON)										
8-inch/4-inch	0	EA	\$441.09	\$0	\$164.40		\$0	\$0		
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21		\$0	\$0		

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 14 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution				Project No. PN-42166		Basis for Estimate Code A (no design competed)		
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A5 - Bldg 103-40				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	\$0
3-inch/2-inch	2	EA	\$207.29	\$415	\$59.74		\$119	\$534
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	\$0
90 ELBOW (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$199.51		\$0	\$0
6-inch/3-inch	0	EA	\$347.39	\$0	\$132.71		\$0	\$0
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$38.80		\$0	\$0
3-inch/1 1/2-inch	4	EA	\$207.29	\$829	\$61.14		\$245	\$1,074
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	\$0
ELBOWS (SINGLE-COND)								
2-inch	0	EA	\$103.65	\$0	\$31.32		\$0	\$0
1 1/2-inch	2	EA	\$86.54	\$173	\$23.63		\$47	\$220
ANCHORS								
8-inch/4-inch	0	EA	\$60.50	\$0	\$61.82		\$0	\$0
6-inch/3-inch	0	EA	\$59.62	\$0	\$53.37		\$0	\$0
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	\$0
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	\$0
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
GUIDES								
8-inch/4-inch	0	EA	\$41.15	\$0	\$406.00		\$0	\$0
6-inch/3-inch	0	EA	\$27.65	\$0	\$219.00		\$0	\$0
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	\$0
4-inch/2-inch	0	EA	\$25.80	\$0	\$208.50		\$0	\$0
3-inch/1 1/2-inch	1	EA	\$24.15	\$24	\$147.50		\$148	\$172
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
Miscellaneous Fittings								
2-inch DRIP NIPPLE	1	EA	\$21.50	\$22	\$33.00		\$33	\$55
1 1/2-inch Steam Trap Assembly	0	EA	\$168.12	\$0	\$1,000.50		\$0	\$0
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	\$0
STM GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	\$0
PRESSURE GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	\$0

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 15 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A5 - Bldg 103-40				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
BELOW-GRADE PIPING: STM PIPE IN CONDUIT & CONDENSATE PIPE IN CONDUIT								
8-inch/4-inch	0	LF	\$93.00	\$0	\$80.01	\$0	\$0	
6-inch/3-inch	0	LF	\$79.77	\$0	\$70.71	\$0	\$0	
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29	\$0	\$0	
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29	\$0	\$0	
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06	\$0	\$0	
TRENCH/BACKFILL								
DIRT & LAWN	0	LF	\$7.12	\$0	\$0.00	\$0	\$0	
CONCRETE ROAD	0	LF	\$23.78	\$0	\$0.00	\$0	\$0	
CONCRETE SIDEWALK	0	LF	\$15.17	\$0	\$0.00	\$0	\$0	
R/R TRACK	0	EA	\$750.00	\$0	\$0.00	\$0	\$0	
STEAM PITS	0	EA	\$1,450	\$0	\$4,816.00	\$0	\$0	
Subtotal				\$18,512		\$12,041	\$30,553	
Nevada Sales Tax	3.75%					\$452	\$452	
Subtotal							\$31,005	
Contractor Overhead & Profit	25.0%						\$7,751	
Subtotal							\$38,756	
Estimating Contingency	10.0%						\$3,876	
Total Probable Construction Cost							\$42,631	
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings							\$60.04	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 16 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH C6-1				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	0	LF	\$68.84	\$0	\$60.52	\$0	\$0	
6-inch/3-inch	0	LF	\$58.38	\$0	\$45.12	\$0	\$0	
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05	\$0	\$0	
4-inch/ 2-inch	1,498	LF	\$43.27	\$64,822	\$17.94	\$26,870	\$91,692	
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65	\$0	\$0	
SUPPORTS	55	EA	\$337.01	\$18,536	\$290.00	\$15,950	\$34,486	
STEAM VALVES								
8-inch	0	EA	\$344.50	\$0	\$2,282.20	\$0	\$0	
6-inch	0	EA	\$292.88	\$0	\$1,448.76	\$0	\$0	
5-inch	0	EA	\$247.71	\$0	\$1,189.34	\$0	\$0	
4-inch	4	EA	\$202.53	\$810	\$929.92	\$3,720	\$4,530	
3-inch	1	EA	\$146.75	\$147	\$727.35	\$727	\$874	
2 1/2-inch	2	EA	\$130.49	\$261	\$727.23	\$1,454	\$1,715	
COND VALVES								
4-inch	0	EA	\$202.53	\$0	\$929.92	\$0	\$0	
3-inch	0	EA	\$146.75	\$0	\$727.35	\$0	\$0	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
2-inch	3	EA	\$99.75	\$299	\$182.27	\$547	\$846	
1 1/2-inch	11	EA	\$76.98	\$847	\$139.58	\$1,535	\$2,382	
STEAM TEES								
8-inch	0	EA	\$371.13	\$0	\$162.91	\$0	\$0	
6-inch	0	EA	\$310.38	\$0	\$105.76	\$0	\$0	
5-inch	0	EA	\$220.08	\$0	\$65.92	\$0	\$0	
4-inch	7	EA	\$215.69	\$1,510	\$62.14	\$435	\$1,945	
3-inch	1	EA	\$190.90	\$191	\$49.85	\$50	\$241	
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23	\$0	\$0	
2-inch	0	EA	\$123.30	\$0	\$39.37	\$0	\$0	
COND TEES								
4-inch	0	EA	\$251.53	\$0	\$84.92	\$0	\$0	
3-inch	0	EA	\$188.80	\$0	\$58.35	\$0	\$0	
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23	\$0	\$0	
2-inch	10	EA	\$139.10	\$1,391	\$41.87	\$419	\$1,810	
1 1/2-inch	1	EA	\$112.94	\$113	\$37.58	\$38	\$151	
45 ELBOWS (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$164.40	\$0	\$0	
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21	\$0	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 17 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design completed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH C6-1				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	\$0
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	\$0
90 ELBOW (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$199.51		\$0	\$0
6-inch/3-inch	0	EA	\$347.39	\$0	\$132.71		\$0	\$0
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	\$0
4-inch/2-inch	20	EA	\$260.24	\$5,205	\$38.80		\$776	\$5,981
3-inch/1 1/2-inch	4	EA	\$207.29	\$829	\$61.14		\$245	\$1,074
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	\$0
ELBOWS (SINGLE-COND)								
2-inch	0	EA	\$103.65	\$0	\$31.32		\$0	\$0
1 1/2-inch	31	EA	\$86.54	\$2,683	\$23.63		\$733	\$3,415
ANCHORS								
8-inch/4-inch	0	EA	\$60.50	\$0			\$0	\$0
6-inch/3-inch	0	EA	\$59.62	\$0	\$61.82		\$0	\$0
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$53.37		\$0	\$0
4-inch/2-inch	6	EA	\$59.46	\$357	\$49.08		\$294	\$651
3-inch/1 1/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	\$0
2-inch/1 1/4-inch	0	EA	\$58.10	\$0	\$38.00		\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
GUIDES								
8-inch/4-inch	0	EA		\$0			\$0	\$0
6-inch/3-inch	0	EA	\$41.15	\$0	\$406.00		\$0	\$0
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	\$0
4-inch/2-inch	6	EA	\$27.65	\$166	\$219.00		\$1,314	\$1,480
3-inch/1 1/2-inch	1	EA	\$25.80	\$26	\$208.50		\$209	\$234
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	\$0
2-inch/1 1/4-inch	1	EA	\$24.15	\$24	\$147.50		\$148	\$172
1 1/2-inch/1 1/4-inch	1	EA		\$0			\$0	\$0
Miscellaneous Fittings								
2-inch DRIP NIPPLE	7	EA		\$0			\$0	\$0
1 1/2-inch Steam Trap Assembly	6	EA	\$168.12	\$1,009	\$1,000.50		\$6,003	\$7,012
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	\$0
STM GAGE	1	EA	\$140.00	\$140	\$2,025.00		\$2,025	\$2,165
PRESSURE GAGE	1	EA	\$7.30	\$7	\$16.50		\$17	\$24

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 18 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH C6-1				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
BELOW-GRADE PIPING: STM PIPE IN CONDUIT & CONDENSATE PIPE IN CONDUIT								
8-inch/4-inch	0	LF		\$0			\$0	\$0
6-inch/3-inch	0	LF	\$93.00	\$0	\$80.01		\$0	\$0
5-inch/2 1/2-inch	0	LF	\$79.77	\$0	\$70.71		\$0	\$0
4-inch/ 2-inch	60	LF	\$65.52	\$3,931	\$56.29		\$3,377	\$7,309
3-inch/1 1/2-inch	117	LF	\$62.09	\$7,265	\$56.29		\$6,586	\$13,850
2 1/2-inch / 1 1/2-inch	0	LF	\$56.91	\$0	\$55.20		\$0	\$0
1 1/2-inch / 1 1/4-inch	72	LF	\$53.93	\$3,883	\$55.06		\$3,964	\$7,847
TRENCH/BACKFILL								
DIRT & LAWN	152	LF	\$7.12	\$1,082	\$0.00		\$0	\$1,082
CONCRETE ROAD	60	LF	\$23.78	\$1,427	\$0.00		\$0	\$1,427
CONCRETE SIDEWALK	0	LF	\$15.17	\$0	\$0.00		\$0	\$0
R/R TRACK	4	EA	\$750.00	\$3,000	\$0.00		\$0	\$3,000
STEAM PITS	6	EA	\$1,450	\$8,700	\$4,816.00		\$28,896	\$37,596
Subtotal				\$128,659			\$106,331	\$234,990
Nevada Sales Tax	3.75%						\$3,987	\$3,987
Subtotal								\$238,977
Contractor Overhead & Profit	25.0%							\$59,744
Subtotal								\$298,721
Estimating Contingency	10.0%							\$29,872
Total Probable Construction Cost								\$328,594
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$94.05

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 19 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH B2			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	321	LF	\$68.84	\$22,097	\$60.52		\$19,426	\$41,523
6-inch/3-inch	0	LF	\$58.38	\$0	\$45.12		\$0	\$0
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05		\$0	\$0
4-inch/ 2-inch	0	LF	\$43.27	\$0	\$17.94		\$0	\$0
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73		\$0	\$0
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65		\$0	\$0
SUPPORTS	12	EA	\$337.01	\$4,044	\$290.00		\$3,480	\$7,524
STEAM VALVES								
8-inch	0	EA	\$344.50	\$0	\$2,282.20		\$0	\$0
6-inch	0	EA	\$292.88	\$0	\$1,448.76		\$0	\$0
5-inch	0	EA	\$247.71	\$0	\$1,189.34		\$0	\$0
4-inch	0	EA	\$202.53	\$0	\$929.92		\$0	\$0
3-inch	3	EA	\$146.75	\$440	\$727.35		\$2,182	\$2,622
2 1/2-inch	1	EA	\$130.49	\$130	\$727.23		\$727	\$858
COND VALVES								
4-inch	1	EA	\$202.53	\$203	\$929.92		\$930	\$1,132
3-inch	0	EA	\$146.75	\$0	\$727.35		\$0	\$0
2 1/2-inch		EA	\$130.49	\$0	\$727.23		\$0	\$0
2-inch	1	EA	\$99.75	\$100	\$182.27		\$182	\$282
1 1/2-inch	3	EA	\$76.98	\$231	\$139.58		\$419	\$650
STEAM TEES								
8-inch	3	EA	\$371.13	\$1,113	\$162.91		\$489	\$1,602
6-inch	0	EA	\$310.38	\$0	\$105.76		\$0	\$0
5-inch	0	EA	\$220.08	\$0	\$65.92		\$0	\$0
4-inch	0	EA	\$215.69	\$0	\$62.14		\$0	\$0
3-inch	0	EA	\$190.90	\$0	\$49.85		\$0	\$0
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23		\$0	\$0
2-inch	0	EA	\$123.30	\$0	\$39.37		\$0	\$0
COND TEES								
4-inch	3	EA	\$251.53	\$755	\$84.92		\$255	\$1,009
3-inch	0	EA	\$188.80	\$0	\$58.35		\$0	\$0
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23		\$0	\$0
2-inch	0	EA	\$139.10	\$0	\$41.87		\$0	\$0
1 1/2-inch	0	EA	\$112.94	\$0	\$37.58		\$0	\$0
45 ELBOWS (COMMON)								
8-inch/4-inch	2	EA	\$441.09	\$882	\$164.40		\$329	\$1,211
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21		\$0	\$0

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 20 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution				Project No. PN-42166		Basis for Estimate Code A (no design competed)		
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH B2			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	\$0
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	\$0
90 ELBOW (COMMON)								
8-inch/4-inch	8	EA	\$441.09	\$3,529	\$199.51		\$1,596	\$5,125
6-inch/3-inch	0	EA	\$347.39	\$0	\$132.71		\$0	\$0
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$38.80		\$0	\$0
3-inch/2-inch	0	EA	\$207.29	\$0	\$61.14		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	\$0
ELBOWS (SINGLE-COND)								
2-inch	3	EA	\$103.65	\$311	\$31.32		\$94	\$405
1 1/2-inch	8	EA	\$86.54	\$692	\$23.63		\$189	\$881
ANCHORS								
8-inch/4-inch	2	EA	\$60.50	\$121	\$61.82		\$124	\$245
6-inch/3-inch	0	EA	\$59.62	\$0	\$53.37		\$0	\$0
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	\$0
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	\$0
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
GUIDES								
8-inch/4-inch	2	EA	\$41.15	\$82	\$406.00		\$812	\$894
6-inch/3-inch	0	EA	\$27.65	\$0	\$219.00		\$0	\$0
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	\$0
4-inch/2-inch	0	EA	\$25.80	\$0	\$208.50		\$0	\$0
3-inch/1 1/2-inch	1	EA	\$24.15	\$24	\$147.50		\$148	\$172
2 1/2-inch/1 1/2-inch	1	EA	\$24.15	\$24	\$147.50		\$148	\$172
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
Miscellaneous Fittings								
2-inch DRIP NIPPLE	1	EA	\$21.50	\$22	\$33.00		\$33	\$55
1 1/2-inch Steam Trap Assembly	1	EA	\$168.12	\$168	\$1,000.50		\$1,001	\$1,169
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	\$0
STM GAGE	1	EA	\$7.30	\$7	\$16.50		\$17	\$24
PRESSURE GAGE	1	EA	\$7.30	\$7	\$16.50		\$17	\$24

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 21 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design completed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH B2				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
BELOW-GRADE PIPING: STM PIPE IN CONDUIT & CONDENSATE PIPE IN CONDUIT								
8-inch/4-inch	120	LF	\$93.00	\$11,160	\$80.01		\$9,601	\$20,761
6-inch/3-inch	0	LF	\$79.77	\$0	\$70.71		\$0	\$0
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29		\$0	\$0
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29		\$0	\$0
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20		\$0	\$0
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06		\$0	\$0
TRENCH/BACKFILL								
DIRT & LAWN	0	LF	\$7.12	\$0	\$0.00		\$0	\$0
CONCRETE ROAD	80	LF	\$23.78	\$1,902	\$0.00		\$0	\$1,902
CONCRETE SIDEWALK	20	LF	\$15.17	\$303	\$0.00		\$0	\$303
R/R TRACK	1	EA	\$750.00	\$750	\$0.00		\$0	\$750
STEAM PITS	1	EA	\$1,450	\$1,450	\$4,816		\$4,816	\$6,266
Subtotal				\$50,549			\$47,012	\$97,561
Nevada Sales Tax	3.75%						\$1,763	\$1,763
Subtotal								\$99,324
Contractor Overhead & Profit	25.0%							\$24,831
Subtotal								\$124,155
Estimating Contingency	10.0%							\$12,416
Total Probable Construction Cost								\$136,571
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$154.84

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 22 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Plant, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH B8 to MH B9-1				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	0	LF	\$68.84	\$0	\$60.52	\$0	\$0	
6-inch/3-inch	0	LF	\$58.38	\$0	\$45.12	\$0	\$0	
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05	\$0	\$0	
4-inch/ 2-inch	250	LF	\$43.27	\$10,818	\$17.94	\$4,484	\$15,302	
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65	\$0	\$0	
SUPPORTS	7	EA	\$337.01	\$2,359	\$290.00	\$2,030	\$4,389	
STEAM VALVES								
8-inch	0	EA	\$344.50	\$0	\$2,282.20	\$0	\$0	
6-inch	0	EA	\$292.88	\$0	\$1,448.76	\$0	\$0	
5-inch	0	EA	\$247.71	\$0	\$1,189.34	\$0	\$0	
4-inch	1	EA	\$202.53	\$203	\$929.92	\$930	\$1,132	
3-inch	0	EA	\$146.75	\$0	\$727.35	\$0	\$0	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
COND VALVES								
4-inch	0	EA	\$202.53	\$0	\$929.92	\$0	\$0	
3-inch	0	EA	\$146.75	\$0	\$727.35	\$0	\$0	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
2-inch	1	EA	\$99.75	\$100	\$182.27	\$182	\$282	
1 1/2-inch	0	EA	\$76.98	\$0	\$139.58	\$0	\$0	
STEAM TEES								
8-inch	0	EA	\$371.13	\$0	\$162.91	\$0	\$0	
6-inch	0	EA	\$310.38	\$0	\$105.76	\$0	\$0	
5-inch	0	EA	\$220.08	\$0	\$65.92	\$0	\$0	
4-inch	0	EA	\$215.69	\$0	\$62.14	\$0	\$0	
3-inch	0	EA	\$190.90	\$0	\$49.85	\$0	\$0	
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23	\$0	\$0	
2-inch	0	EA	\$123.30	\$0	\$39.37	\$0	\$0	
COND TEES								
4-inch	0	EA	\$251.53	\$0	\$84.92	\$0	\$0	
3-inch	0	EA	\$188.80	\$0	\$58.35	\$0	\$0	
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23	\$0	\$0	
2-inch	0	EA	\$139.10	\$0	\$41.87	\$0	\$0	
1 1/2-inch	0	EA	\$112.94	\$0	\$37.58	\$0	\$0	
45 ELBOWS (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$164.40	\$0	\$0	
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21	\$0	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 23 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Plant, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH B8 to MH B9-1				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	\$0
4-inch/2-inch	2	EA	\$260.24	\$520	\$42.70		\$85	\$606
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	\$0
90 ELBOW (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$199.51		\$0	\$0
6-inch/3-inch	0	EA	\$347.39	\$0	\$132.71		\$0	\$0
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	\$0
4-inch/2-inch	4	EA	\$260.24	\$1,041	\$38.80		\$155	\$1,196
3-inch/2-inch	0	EA	\$207.29	\$0	\$61.14		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	\$0
ELBOWS (SINGLE-COND)								
2-inch	2	EA	\$103.65	\$207	\$31.32		\$63	\$270
1 1/2-inch	5	EA	\$86.54	\$433	\$23.63		\$118	\$551
ANCHORS								
8-inch/4-inch	0	EA	\$60.50	\$0	\$61.82		\$0	\$0
6-inch/3-inch	0	EA	\$59.62	\$0	\$53.37		\$0	\$0
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	\$0
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	\$0
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
GUIDES								
8-inch/4-inch	0	EA	\$41.15	\$0	\$406.00		\$0	\$0
6-inch/3-inch	0	EA	\$27.65	\$0	\$219.00		\$0	\$0
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	\$0
4-inch/2-inch	1	EA	\$25.80	\$26	\$208.50		\$209	\$234
3-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
Miscellaneous Fittings								
2-inch DRIP NIPPLE	1	EA	\$21.50	\$22	\$33.00		\$33	\$55
1 1/2-inch Steam Trap Assembly	1	EA	\$168.12	\$168	\$1,000.50		\$1,001	\$1,169
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	\$0
STM GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	\$0
PRESSURE GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	\$0

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 24		of 27		
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)				
Location Hawthorne Army Ammunition Plant, Nevada											
Engineer-Architect Keller & Gannon											
Drawing No. MH B8 to MH B9-1				Estimator DLN		Checked By BIH					
Line Item	Quantity		Labor		Material			Total Cost			
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total				
BELOW-GRADE PIPING: STM PIPE IN CONDUIT & CONDENSATE PIPE IN CONDUIT											
8-inch/4-inch	0	LF	\$93.00	\$0	\$80.01		\$0	\$0			
6-inch/3-inch	0	LF	\$79.77	\$0	\$70.71		\$0	\$0			
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29		\$0	\$0			
4-inch/ 2-inch	30	LF	\$62.09	\$1,863	\$56.29		\$1,689	\$3,551			
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20		\$0	\$0			
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06		\$0	\$0			
TRENCH/BACKFILL											
DIRT & LAWN	0	LF	\$7.12	\$0	\$0.00		\$0	\$0			
CONCRETE ROAD	30	LF	\$23.78	\$713	\$0.00		\$0	\$713			
CONCRETE SIDEWALK	0	LF	\$15.17	\$0	\$0.00		\$0	\$0			
R/R TRACK	0	EA	\$750.00	\$0	\$0.00		\$0	\$0			
STEAM PITS	1	EA	\$1,450	\$1,450	\$4,816.00		\$4,816	\$6,266			
Subtotal				\$19,922			\$15,795	\$35,717			
Nevada Sales Tax	3.75%						\$592	\$592			
Subtotal								\$36,309			
Contractor Overhead & Profit	25.0%							\$9,077			
Subtotal								\$45,387			
Estimating Contingency	10.0%							\$4,539			
Total Probable Construction Cost								\$49,925			
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$89.15			

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 25 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH B2 to MH B8			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	603	LF	\$68.84	\$41,510	\$60.52		\$36,492	\$78,002
8-inch/3-inch	642	LF	\$64.77	\$41,581	\$56.31		\$36,150	\$77,731
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05		\$0	\$0
4-inch/ 2-inch	0	LF	\$43.27	\$0	\$17.94		\$0	\$0
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73		\$0	\$0
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65		\$0	\$0
SUPPORTS	48	EA	\$337.01	\$16,176	\$290.00		\$13,920	\$30,096
STEAM VALVES								
8-inch	2	EA	\$344.50	\$689	\$2,282.20		\$4,564	\$5,253
6-inch	2	EA	\$292.88	\$586	\$1,448.76		\$2,898	\$3,483
5-inch	2	EA	\$247.71	\$495	\$1,189.34		\$2,379	\$2,874
4-inch	0	EA	\$202.53	\$0	\$929.92		\$0	\$0
3-inch	5	EA	\$146.75	\$734	\$727.35		\$3,637	\$4,371
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23		\$0	\$0
COND VALVES								
4-inch	2	EA	\$202.53	\$405	\$929.92		\$1,860	\$2,265
3-inch	2	EA	\$146.75	\$294	\$727.35		\$1,455	\$1,748
2 1/2-inch	2	EA	\$130.49	\$261	\$727.23		\$1,454	\$1,715
2-inch	0	EA	\$99.75	\$0	\$182.27		\$0	\$0
1 1/2-inch	5	EA	\$76.98	\$385	\$139.58		\$698	\$1,083
STEAM TEES								
8-inch	13	EA	\$371.13	\$4,825	\$162.91		\$2,118	\$6,942
6-inch	0	EA	\$310.38	\$0	\$105.76		\$0	\$0
5-inch	0	EA	\$220.08	\$0	\$65.92		\$0	\$0
4-inch	0	EA	\$215.69	\$0	\$62.14		\$0	\$0
3-inch	0	EA	\$190.90	\$0	\$49.85		\$0	\$0
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23		\$0	\$0
2-inch	0	EA	\$123.30	\$0	\$39.37		\$0	\$0
COND TEES								
4-inch	7	EA	\$251.53	\$1,761	\$84.92		\$594	\$2,355
3-inch	6	EA	\$188.80	\$1,133	\$58.35		\$350	\$1,483
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23		\$0	\$0
2-inch	0	EA	\$139.10	\$0	\$41.87		\$0	\$0
1 1/2-inch	0	EA	\$112.94	\$0	\$37.58		\$0	\$0
45 ELBOWS (COMMON)								
8-inch/4-inch	4	EA	\$441.09	\$1,764	\$164.40		\$658	\$2,422
8-inch/3-inch	3	EA	\$392.41	\$1,177	\$150.88		\$453	\$1,630

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 26 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution				Project No. PN-42166		Basis for Estimate Code A (no design competed)		
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH B2 to MH B8			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	\$0
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	\$0
90 ELBOW (COMMON)								
8-inch/4-inch	12	EA	\$441.09	\$5,293	\$199.51		\$2,394	\$7,687
8-inch/3-inch	12	EA	\$392.41	\$4,709	\$182.04		\$2,185	\$6,893
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	\$0
4-inch/2-inch	0	EA	\$260.24	\$0	\$38.80		\$0	\$0
3-inch/2-inch	0	EA	\$207.29	\$0	\$61.14		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	\$0
ELBOWS (SINGLE-COND)								
2-inch	8	EA	\$103.65	\$829	\$31.32		\$251	\$1,080
1 1/2-inch	80	EA	\$86.54	\$6,923	\$23.63		\$1,890	\$8,813
ANCHORS								
8-inch/4-inch	5	EA	\$60.50	\$303	\$61.82		\$309	\$612
6-inch/3-inch	3	EA	\$59.62	\$179	\$53.37		\$160	\$339
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	\$0
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	\$0
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	\$0
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
GUIDES								
8-inch/4-inch	5	EA	\$41.15	\$206	\$406.00		\$2,030	\$2,236
6-inch/3-inch	3	EA	\$27.65	\$83	\$219.00		\$657	\$740
5-inch/2 1/2-inch	4	EA	\$27.65	\$111	\$219.00		\$876	\$987
4-inch/2-inch	2	EA	\$25.80	\$52	\$208.50		\$417	\$469
3-inch/1 1/2-inch	3	EA	\$24.15	\$72	\$147.50		\$443	\$515
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	\$0
2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	\$0
Miscellaneous Fittings								
2-inch DRIP NIPPLE	7	EA	\$21.50	\$151	\$33.00		\$231	\$382
1 1/2-inch Steam Trap Assembly	0	EA	\$168.12	\$0	\$1,000.50		\$0	\$0
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	\$0
STM GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	\$0
PRESSURE GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	\$0

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 27 of 27	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design completed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH B2 to MH B8				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
BELOW-GRADE PIPING: STM PIPE IN CONDUIT & CONDENSATE PIPE IN CONDUIT								
8-inch/4-inch	20	LF	\$93.00	\$1,860	\$80.01	\$1,600	\$3,460	
8-inch/3-inch	60	LF	\$79.77	\$4,786	\$70.71	\$4,243	\$9,029	
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29	\$0	\$0	
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29	\$0	\$0	
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06	\$0	\$0	
TRENCH/BACKFILL								
DIRT & LAWN	0	LF	\$7.12	\$0	\$0.00	\$0	\$0	
CONCRETE ROAD	80	LF	\$23.78	\$1,902	\$0.00	\$0	\$1,902	
CONCRETE SIDEWALK	0	LF	\$15.17	\$0	\$0.00	\$0	\$0	
R/R TRACK	0	EA	\$750.00	\$0	\$0.00	\$0	\$0	
STEAM PITS	4	EA	\$1,450	\$5,800	\$4,816.00	\$19,264	\$25,064	
Subtotal				\$147,033		\$146,628	\$293,661	
Nevada Sales Tax	3.75%					\$5,499	\$5,499	
Subtotal							\$299,160	
Contractor Overhead & Profit	25.0%						\$74,790	
Subtotal							\$373,949	
Estimating Contingency	10.0%						37394.95	
Total Probable Construction Cost				(B2 - B8)			\$411,344	
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings							\$155.22	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 1 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution				Project No. PN-42166		Basis for Estimate Code A (no design competed)		
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A5 to MH A11			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	1,769	LF	\$68.84	\$121,776	\$60.52	\$107,055	\$228,831	
6-inch/3-inch	0	LF	\$58.38	\$0	\$45.12	\$0	\$0	
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05	\$0	\$0	
4-inch/ 2-inch	0	LF	\$43.27	\$0	\$17.94	\$0	\$0	
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65	\$0	\$0	
SUPPORTS	55	EA	\$337.01	\$18,674	\$290.00	\$16,069	\$34,744	
STEAM VALVES								
8-inch	5	EA	\$344.50	\$1,722	\$2,282.20	\$11,411	\$13,134	
6-inch	1	EA	\$292.88	\$293	\$1,448.76	\$1,449	\$1,742	
5-inch	0	EA	\$247.71	\$0	\$1,189.34	\$0	\$0	
4-inch	1	EA	\$202.53	\$203	\$929.92	\$930	\$1,132	
3-inch	1	EA	\$146.75	\$147	\$727.35	\$727	\$874	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
COND VALVES								
4-inch	5	EA	\$202.53	\$1,013	\$929.92	\$4,650	\$5,662	
3-inch	1	EA	\$146.75	\$147	\$727.35	\$727	\$874	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
2-inch	1	EA	\$99.75	\$100	\$182.27	\$182	\$282	
1 1/2-inch	2	EA	\$76.98	\$154	\$139.58	\$279	\$433	
STEAM TEES								
8-inch	10	EA	\$371.13	\$3,711	\$162.91	\$1,629	\$5,340	
6-inch	0	EA	\$310.38	\$0	\$105.76	\$0	\$0	
5-inch	0	EA	\$220.08	\$0	\$65.92	\$0	\$0	
4-inch	0	EA	\$215.69	\$0	\$62.14	\$0	\$0	
3-inch	0	EA	\$190.90	\$0	\$49.85	\$0	\$0	
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23	\$0	\$0	
2-inch	0	EA	\$123.30	\$0	\$39.37	\$0	\$0	
COND TEES								
4-inch	13	EA	\$251.53	\$3,270	\$84.92	\$1,104	\$4,374	
3-inch	0	EA	\$188.80	\$0	\$58.35	\$0	\$0	
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23	\$0	\$0	
2-inch	0	EA	\$139.10	\$0	\$41.87	\$0	\$0	
1 1/2-inch	0	EA	\$112.94	\$0	\$37.58	\$0	\$0	
45 ELBOWS (COMMON)								
8-inch/4-inch	2	EA	\$441.09	\$882	\$164.40	\$329	\$1,211	
6-inch/3-inch	1	EA	\$347.39	\$347	\$119.21	\$119	\$467	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 2 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A5 to MH A11				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	
90 ELBOW (COMMON)								
8-inch/4-inch	24	EA	\$441.09	\$10,586	\$199.51		\$4,788	
6-inch/3-inch	1	EA	\$347.39	\$347	\$132.71		\$133	
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	
4-inch/2-inch	2	EA	\$260.24	\$520	\$38.80		\$78	
3-inch/2-inch	2	EA	\$207.29	\$415	\$61.14		\$122	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	
ELBOWS (SINGLE-COND)								
2-inch	0	EA	\$103.65	\$0	\$31.32		\$0	
1 1/2-inch	42	EA	\$86.54	\$3,635	\$23.63		\$992	
ANCHORS								
8-inch/4-inch	4	EA	\$60.50	\$242	\$61.82		\$247	
6-inch/3-inch	0	EA	\$59.62	\$0	\$53.37		\$0	
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00		\$0	
2-inch/1 1/4-inch	0	EA		\$0			\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	
GUIDES								
8-inch/4-inch	0	EA	\$41.15	\$0	\$406.00		\$0	
6-inch/3-inch	0	EA	\$27.65	\$0	\$219.00		\$0	
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	
4-inch/2-inch	0	EA	\$25.80	\$0	\$208.50		\$0	
3-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	
2-inch/1 1/4-inch	0	EA		\$0			\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	
Miscellaneous Fittings								
2-inch DRIP NIPPLE	7	EA	\$21.50	\$151	\$33.00		\$231	
1 1/2-inch Steam Trap Assembly	7	EA	\$168.12	\$1,177	\$1,000.50		\$7,004	
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	
STM GAGE	1	EA	\$7.30	\$7	\$16.50		\$17	
PRESSURE GAGE	1	EA	\$7.30	\$7	\$16.50		\$17	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 3 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH A5 to MH A11				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(BELOW-GRADE PIPING: STM PIPE IN CONDUIT & COND PIPE IN CONDUIT)								
8-inch/4-inch	90	LF	\$93.00	\$8,370	\$80.01		\$7,201	\$15,571
6-inch/3-inch	0	LF	\$79.77	\$0	\$70.71		\$0	\$0
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29		\$0	\$0
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29		\$0	\$0
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20		\$0	\$0
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06		\$0	\$0
TRENCH/BACKFILL								
DIR-LAWN	40	LF	\$7	\$285	\$0.00		\$0	\$285
CONC-ROAD	50	LF	\$24	\$1,189	\$0.00		\$0	\$1,189
CONC-SIDEWALK	0	LF	\$15.17	\$0	\$0.00		\$0	\$0
RR TRACKS	2	EA	\$750.00	\$1,500	\$0.00		\$0	\$1,500
STEAM PITS	5	EA	\$1,450	\$7,250	\$4,816		\$24,080	\$31,330
Subtotal				\$188,120			\$191,570	\$379,690
Nevada Sales Tax	3.75%						\$7,184	\$7,184
Subtotal								\$386,874
Contractor Overhead & Profit	25.0%							\$96,718
Subtotal								\$483,592
Estimating Contingency	10.0%							\$48,359
Total Probable Construction Cost								\$531,951
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$150.35

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 4 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH C3			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	0	LF	\$68.84	\$0	\$60.52	\$0	\$0	
6-inch/3-inch	0	LF	\$58.38	\$0	\$45.12	\$0	\$0	
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05	\$0	\$0	
4-inch/ 2-inch	627	LF	\$43.27	\$27,132	\$17.94	\$11,247	\$38,378	
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65	\$0	\$0	
SUPPORTS	28	EA	\$337.01	\$9,297	\$290.00	\$8,001	\$17,298	
STEAM VALVES								
8-inch	0	EA	\$344.50	\$0	\$2,282.20	\$0	\$0	
6-inch	0	EA	\$292.88	\$0	\$1,448.76	\$0	\$0	
5-inch	0	EA	\$247.71	\$0	\$1,189.34	\$0	\$0	
4-inch	2	EA	\$202.53	\$405	\$929.92	\$1,860	\$2,265	
3-inch	0	EA	\$146.75	\$0	\$727.35	\$0	\$0	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
COND VALVES								
4-inch	0	EA	\$202.53	\$0	\$929.92	\$0	\$0	
3-inch	0	EA	\$146.75	\$0	\$727.35	\$0	\$0	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
2-inch	2	EA	\$99.75	\$200	\$182.27	\$365	\$564	
1 1/2-inch	4	EA	\$76.98	\$308	\$139.58	\$558	\$866	
STEAM TEES								
8-inch	0	EA	\$371.13	\$0	\$162.91	\$0	\$0	
6-inch	0	EA	\$310.38	\$0	\$105.76	\$0	\$0	
5-inch	0	EA	\$220.08	\$0	\$65.92	\$0	\$0	
4-inch	2	EA	\$215.69	\$431	\$62.14	\$124	\$556	
3-inch	0	EA	\$190.90	\$0	\$49.85	\$0	\$0	
2 1/2-inch	0	EA	\$141.04	\$0	\$47.23	\$0	\$0	
2-inch	0	EA	\$123.30	\$0	\$39.37	\$0	\$0	
COND TEES								
4-inch	0	EA	\$251.53	\$0	\$84.92	\$0	\$0	
3-inch	0	EA	\$188.80	\$0	\$58.35	\$0	\$0	
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23	\$0	\$0	
2-inch	4	EA	\$139.10	\$556	\$41.87	\$167	\$724	
1 1/2-inch	0	EA	\$112.94	\$0	\$37.58	\$0	\$0	
45 ELBOWS (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$164.40	\$0	\$0	
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21	\$0	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 5 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH C3			Estimator DLN		Checked By BIH			
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	
90 ELBOW (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$199.51		\$0	
6-inch/3-inch	0	EA	\$347.39	\$0	\$132.71		\$0	
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	
4-inch/2-inch	8	EA	\$260.24	\$2,082	\$38.80		\$310	
3-inch/2-inch	0	EA	\$207.29	\$0	\$61.14		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	
ELBOWS (SINGLE-COND)								
2-inch	0	EA	\$103.65	\$0	\$31.32		\$0	
1 1/2-inch	5	EA	\$86.54	\$433	\$23.63		\$118	
ANCHORS								
8-inch/4-inch	0	EA	\$60.50	\$0			\$0	
6-inch/3-inch	0	EA	\$59.62	\$0	\$61.82		\$0	
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$53.37		\$0	
4-inch/2-inch	2	EA	\$59.46	\$119	\$49.08		\$98	
3-inch/1 1/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	
2-inch/1 1/4-inch	0	EA	\$58.10	\$0	\$38.00		\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	
GUIDES								
8-inch/4-inch	0	EA		\$0			\$0	
6-inch/3-inch	0	EA	\$41.15	\$0	\$406.00		\$0	
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	
4-inch/2-inch	2	EA	\$27.65	\$55	\$219.00		\$438	
3-inch/1 1/2-inch	0	EA	\$25.80	\$0	\$208.50		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	
2-inch/1 1/4-inch	0	EA	\$24.15	\$0	\$147.50		\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	
Miscellaneous Fittings								
2-inch DRIP NIPPLE	2	EA		\$0			\$0	
1 1/2-inch Steam Trap Assembly	2	EA	\$168.12	\$336	\$1,000.50		\$2,001	
4-inch PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	
STM GAGE	1	EA	\$140.00	\$140	\$2,025.00		\$2,025	
PRESSURE GAGE	1	EA	\$7.30	\$7	\$16.50		\$17	
							\$24	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 6 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. Bldg 103-6 to MH C3				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
BELOW-GRADE PIPING: STM PIPE IN CONDUIT & COND PIPE IN CONDUIT								
8-inch/4-inch	0	LF		\$0			\$0	\$0
6-inch/3-inch	0	LF	\$93.00	\$0	\$80.01		\$0	\$0
5-inch/2 1/2-inch	0	LF	\$79.77	\$0	\$70.71		\$0	\$0
4-inch/ 2-inch	70	LF	\$65.52	\$4,586	\$56.29		\$3,940	\$8,527
3-inch/1 1/2-inch	0	LF	\$62.09	\$0	\$56.29		\$0	\$0
2 1/2-inch / 1 1/2-inch	0	LF	\$56.91	\$0	\$55.20		\$0	\$0
1 1/2-inch / 1 1/4-inch	0		\$53.93		\$55.06			
TRENCH/BACKFILL								
DIRT & LAWN	10	LF	\$7.12	\$71	\$0.00		\$0	\$71
CONCRETE ROAD	60	LF	\$23.78	\$1,427	\$0.00		\$0	\$1,427
CONCRETE SIDEWALK	0	LF	\$15.17	\$0	\$0.00		\$0	\$0
R/R TRACK	4	EA	\$750.00	\$3,000	\$0.00		\$0	\$3,000
STEAM PITS	6	EA	\$1,450	\$8,700	\$4,816.00		\$28,896	\$37,596
Subtotal				\$59,286			\$60,165	\$119,451
Nevada Sales Tax	3.75%						\$2,256	\$2,256
Subtotal								\$121,708
Contractor Overhead & Profit	25.0%							\$30,427
Subtotal								\$152,135
Estimating Contingency	10.0%							\$15,213
Total Probable Construction Cost								\$167,348
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$120.05

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 7 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH D2 to MH D4			Estimator DLN		Checked By BIH			
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
(Aboveground piping: built-up steam & condensate lines with insulation & aluminum jackets)								
8-inch/4-inch	0	LF	\$68.84	\$0	\$60.52	\$0	\$0	
6-inch/3-inch	180	LF	\$58.38	\$10,508	\$45.12	\$8,121	\$18,629	
5-inch/2 1/2-inch	0	LF	\$50.72	\$0	\$39.05	\$0	\$0	
4-inch/ 2-inch	0	LF	\$43.27	\$0	\$17.94	\$0	\$0	
3-inch/1 1/2-inch	0	LF	\$34.93	\$0	\$19.73	\$0	\$0	
2 1/2-inch / 1 1/2-inch	0	LF	\$32.60	\$0	\$18.65	\$0	\$0	
SUPPORTS	7	EA	\$337.01	\$2,431	\$290.00	\$2,092	\$4,523	
STEAM VALVES								
8-inch	1	EA	\$344.50	\$344	\$2,282.20	\$2,282	\$2,627	
6-inch	2	EA	\$292.88	\$586	\$1,448.76	\$2,898	\$3,483	
5-inch	0	EA	\$247.71	\$0	\$1,189.34	\$0	\$0	
4-inch	0	EA	\$202.53	\$0	\$929.92	\$0	\$0	
3-inch	0	EA	\$146.75	\$0	\$727.35	\$0	\$0	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
COND VALVES								
4-inch	0	EA	\$202.53	\$0	\$929.92	\$0	\$0	
3-inch	2	EA	\$146.75	\$294	\$727.35	\$1,455	\$1,748	
2 1/2-inch	0	EA	\$130.49	\$0	\$727.23	\$0	\$0	
2-inch	0	EA	\$99.75	\$0	\$182.27	\$0	\$0	
1 1/2-inch	8	EA	\$76.98	\$616	\$139.58	\$1,117	\$1,732	
STEAM TEES								
8-inch	0	EA	\$371.13	\$0	\$162.91	\$0	\$0	
6-inch	3	EA	\$310.38	\$931	\$105.76	\$317	\$1,248	
5-inch	0	EA	\$220.08	\$0	\$65.92	\$0	\$0	
4-inch	0	EA	\$215.69	\$0	\$62.14	\$0	\$0	
3-inch	0	EA	\$190.90	\$0	\$49.85	\$0	\$0	
2 1/2-inch	2	EA	\$141.04	\$282	\$47.23	\$94	\$377	
2-inch	0	EA	\$123.30	\$0	\$39.37	\$0	\$0	
COND TEES								
4-inch	0	EA	\$251.53	\$0	\$84.92	\$0	\$0	
3-inch	4	EA	\$188.80	\$755	\$58.35	\$233	\$989	
2 1/2-inch	0	EA	\$165.14	\$0	\$52.23	\$0	\$0	
2-inch	0	EA	\$139.10	\$0	\$41.87	\$0	\$0	
1 1/2-inch	1	EA	\$112.94	\$113	\$37.58	\$38	\$151	
45 ELBOWS (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$164.40	\$0	\$0	
6-inch/3-inch	0	EA	\$347.39	\$0	\$119.21	\$0	\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 8 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH D2 to MH D4			Estimator DLN		Checked By BIH			
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
5-inch/3-inch	0	EA	\$302.28	\$0	\$101.97		\$0	
4-inch/2-inch	0	EA	\$260.24	\$0	\$42.70		\$0	
3-inch/2-inch	0	EA	\$207.29	\$0	\$59.74		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$57.86		\$0	
90 ELBOW (COMMON)								
8-inch/4-inch	0	EA	\$441.09	\$0	\$199.51		\$0	
6-inch/3-inch	8	EA	\$347.39	\$2,779	\$132.71	\$1,062	\$3,841	
5-inch/3-inch	0	EA	\$276.75	\$0	\$53.05		\$0	
4-inch/2-inch	0	EA	\$260.24	\$0	\$38.80		\$0	
3-inch/2-inch	0	EA	\$207.29	\$0	\$61.14		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$192.13	\$0	\$59.26		\$0	
ELBOWS (SINGLE-COND)								
2-inch	0	EA	\$103.65	\$0	\$31.32		\$0	
1 1/2-inch	17	EA	\$86.54	\$1,471	\$23.63	\$402	\$1,873	
ANCHORS								
8-inch/4-inch	0	EA	\$60.50	\$0	\$61.82		\$0	
6-inch/3-inch	2	EA	\$59.62	\$119	\$53.37	\$107	\$226	
5-inch/2 1/2-inch	0	EA	\$59.46	\$0	\$49.08		\$0	
4-inch/2-inch	0	EA	\$58.87	\$0	\$47.13		\$0	
3-inch/1 1/2-inch	0	EA	\$58.26	\$0	\$42.29		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$58.10	\$0	\$38.00		\$0	
2-inch/1 1/4-inch	0	EA		\$0			\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	
GUIDES								
8-inch/4-inch	0	EA	\$41.15	\$0	\$406.00		\$0	
6-inch/3-inch	3	EA	\$27.65	\$83	\$219.00	\$657	\$740	
5-inch/2 1/2-inch	0	EA	\$27.65	\$0	\$219.00		\$0	
4-inch/2-inch	0	EA	\$25.80	\$0	\$208.50		\$0	
3-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	
2 1/2-inch/1 1/2-inch	0	EA	\$24.15	\$0	\$147.50		\$0	
2-inch/1 1/4-inch	0	EA		\$0			\$0	
1 1/2-inch/1 1/4-inch	0	EA		\$0			\$0	
Miscellaneous Fittings								
2-inch DRIP NIPPLE	3	EA	\$21.50	\$65	\$33.00	\$99	\$164	
1 1/2-inch Steam Trap Assembly	3	EA	\$168.12	\$504	\$1,000.50	\$3,002	\$3,506	
4-inch 'PRV	0	EA	\$84.50	\$0	\$1,550.00		\$0	
STM GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	
PRESSURE GAGE	0	EA	\$7.30	\$0	\$16.50		\$0	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 9 of 9	
Project ECIP Modernize Ordnance Area Steam Distribution					Project No. PN-42166		Basis for Estimate Code A (no design competed)	
Location Hawthorne Army Ammunition Depot, Nevada								
Engineer-Architect Keller & Gannon								
Drawing No. MH D2 to MH D4				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material			Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per	Unit	Total	
BELOW-GRADE PIPING: STM & COND PIPE IN CONDUIT								
8-inch/4-inch	0	LF	\$93.00	\$0	\$80.01		\$0	\$0
6-inch/3-inch	488	LF	\$79.77	\$38,928	\$70.71		\$34,506	\$73,434
5-inch/2 1/2-inch	0	LF	\$65.52	\$0	\$56.29		\$0	\$0
4-inch/ 2-inch	0	LF	\$62.09	\$0	\$56.29		\$0	\$0
3-inch/1 1/2-inch	0	LF	\$56.91	\$0	\$55.20		\$0	\$0
2 1/2-inch / 1 1/2-inch	0	LF	\$53.93	\$0	\$55.06		\$0	\$0
TRENCH/BACKFILL								
DIR-LAWN	458	LF	\$7.12	\$3,261	\$0.00		\$0	\$3,261
CONC-ROAD	30	LF	\$23.78	\$713	\$0.00		\$0	\$713
CONC-SIDEW	0	LF	\$15.17	\$0	\$0.00		\$0	\$0
R/R TRACK	1	EA	\$750.00	\$750	\$0.00		\$0	\$750
STEAM PITS	2	EA	\$1,450	\$2,900	\$4,816.00		\$9,632	\$12,532
Subtotal				\$68,433			\$68,113	\$136,546
Nevada Sales Tax	3.75%						\$2,554	\$2,554
Subtotal								\$139,100
Contractor Overhead & Profit	25.0%							\$34,775
Subtotal								\$173,875
Estimating Contingency	10.0%							17387.52
Total Probable Construction Cost								\$191,263
Average Cost per Linear Foot Including Steam and Condensate Piping & Fittings								\$143.16

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 1 13	
Project ECIP Modernize Steam Distribution Systems				Project No.		Basis for Estimate		
Location Hawthorne Army Ammunition Depot, Nevada						Code A (no design competed)		
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Valves (Valves in steam and condensate service must be welded and shall be gate valves. For sizes up to 2-1/2-inches must be rising stem, 3-inches and larger shall be OS&Y)								
1" Gate Valve (Steam or Condensate Usage)	1	EA	\$31.51	\$31.51	\$65.00	\$65.00	\$97	
Insulation: 1-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$2.99	\$11.96	\$2.85	\$11.40	\$23	
Aluminum Jacket - 10 ga. 1-inch Pipe	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$22	
Unit Cost for 1-inch Valve				\$62.82		\$78.82	\$142	
1 1/4" Gate Valve (Steam or Condensate Usage)	1	EA	\$36.55	\$36.55	\$124	\$124	\$161	
Insulation: 1-1/4-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.08	\$12.32	\$25	
Aluminum Jacket - 10 ga. 1-1/4-inch Pipe	6.05	SF	\$3.36	\$20.32	\$0.42	\$2.54	\$23	
Unit Cost for 1-1/4-inch Valve				\$69		\$139	\$208	
1 1/2" Gate Valve (Steam or Condensate Usage)	1	EA	\$43.29	\$43.29	\$124	\$124	\$167	
Insulation: 1-1/2-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.23	\$12.92	\$25	
Aluminum Jacket - 10 ga. 1-1/2-inch Pipe	6.34	SF	\$3.36	\$21.29	\$0.42	\$2.66	\$24	
Unit Cost for 1-1/2-inch Valve				\$76.98		\$140	\$217	
2" Gate Valve (Steam or Condensate Usage)	1	EA	\$55.70	\$55.70	\$159	\$159	\$215	
Insulation: 2-inch, 2.5-inch Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$4.97	\$19.88	\$37	
Aluminum Jacket - 10 ga. 2-inch pipe	8.06	SF	\$3.36	\$27.09	\$0.42	\$3.39	\$30	
Unit Cost for 2-inch Valve				\$99.75		\$182	\$282	
2 1/2" Gate Valve (Steam or Condensate Usage)	1	EA	\$84.50	\$84.50	\$700	\$700	\$785	
Insulation: 2-1/2-inch, 2.5-in Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$5.90	\$23.60	\$41	
Aluminum Jacket - 10 ga. 2-1/2-inch Pipe	8.64	SF	\$3.36	\$29.03	\$0.42	\$3.63	\$33	
Unit Cost for 2-1/2-inch Valve				\$130		\$727	\$858	
3" Gate Valve (Steam or Condensate Usage)	1	EA	\$94.00	\$94.00	\$700	\$700	\$794	
Insulation: 3-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.48	\$17.92	\$5.75	\$23.00	\$41	
Aluminum Jacket - 10 ga. 3-inch Pipe	10.37	SF	\$3.36	\$34.83	\$0.42	\$4.35	\$39	
Unit Cost for 3-inch Valve				\$147		\$727	\$874	
4" Gate Valve (Steam or Condensate Usage)	1	EA	\$141	\$141	\$895	\$895	\$1,036	
Insulation: 4-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.74	\$18.96	\$7.40	\$29.60	\$49	
Aluminum Jacket - 10 ga. 4-inch Pipe	12.67	SF	\$3.36	\$42.57	\$0.42	\$5.32	\$48	
Unit Cost for 4-inch Valve				\$203		\$930	\$1,132	
5" Gate Valve (Steam or Condensate Usage)	1	EA	\$180	\$180	\$1,148	\$1,148	\$1,328	
Insulation: 5-inch, 3-inch Thick (5 FL/Fitting)	4	LF	\$5.32	\$21.26	\$9.01	\$36.03	\$57	
Aluminum Jacket - 10 ga. 5-inch Pipe	13.82	SF	\$3.36	\$46.45	\$0.42	\$5.81	\$52	
Unit Cost for 5-inch Valve				\$248		\$1,189	\$1,437	
6" Gate Valve (Steam or Condensate Usage)	1	EA	\$219	\$219	\$1,400	\$1,400	\$1,619	
Insulation: 6-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$10.62	\$42.47	\$66	
Aluminum Jacket - 10 ga. 6-inch Pipe	14.97	SF	\$3.36	\$50.32	\$0.42	\$6.29	\$57	
Unit Cost for 6-inch Valve				\$293		\$1,449	\$1,742	
8" Gate Valve (Steam or Condensate Usage)	1	EA	\$263	\$263	\$2,225	\$2,225	\$2,488	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 2 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design competed)			
Engineer-Architect Keller & Gannon					Drawing No.		Estimator	
Ordnance & Industrial Areas Fitting Costs					DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Insulation: 8-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$6.30	\$25.20	\$12.54	\$50.17	\$75	
Aluminum Jacket - 10 ga. 8-inch Pipe	16.76	SF	\$3.36	\$56.30	\$0.42	\$7.04	\$63	
Unit Cost for 8-inch Valve				\$344		\$2,282	\$2,627	
Tees Schedule 40 Steam Service (Tees shall be welded.)								
1" Tee Sch 40 (Steam Usage)	1	EA	\$47.25	\$47.25	\$15.10	\$15.10	\$62	
Insulation: 1-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$2.99	\$11.96	\$2.85	\$11.40	\$23	
Aluminum Jacket - 10 ga. 1-inch Pipe	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$22	
Unit Cost for 1-inch Sch 40 Tee for Steam				\$78.56		\$28.92	\$107	
1 1/4" Tee Sch 40 (Steam Usage)	1	EA	\$52.85	\$52.85	\$18.20	\$18.20	\$71	
Insulation: 1-1/4-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.08	\$12.32	\$25	
Aluminum Jacket - 10 ga. 1-1/4-inch Pipe	6.05	SF	\$3.36	\$20.32	\$0.42	\$2.54	\$23	
Unit Cost for 1-1/4-inch Sch 40 Tee for Steam				\$86		\$33.06	\$119	
1 1/2" Tee Sch 40 (Steam Usage)	1	EA	\$59.60	\$59.60	\$18.20	\$18.20	\$78	
Insulation: 1-1/2-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.23	\$12.92	\$25	
Aluminum Jacket - 10 ga. 1-1/2-inch Pipe	6.34	SF	\$3.36	\$21.29	\$0.42	\$2.66	\$24	
Unit Cost for 1-1/2-inch Sch 40 Tee for Steam				\$93.29		\$33.78	\$127	
2" Tee Sch 40 (Steam Usage)	1	EA	\$79.25	\$79.25	\$16.10	\$16.10	\$95	
Insulation: 2-inch, 2.5-inch Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$4.97	\$19.88	\$37	
Aluminum Jacket - 10 ga. 2-inch pipe	8.06	SF	\$3.36	\$27.09	\$0.42	\$3.39	\$30	
Unit Cost for 2-inch Sch 40 Tee for Steam				\$123		\$39.37	\$163	
2 1/2" Tee Sch 40 (Steam Usage)	1	EA	\$95.05	\$95.05	\$20.00	\$20.00	\$115	
Insulation: 2-1/2-inch, 2.5-in Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$5.90	\$23.60	\$41	
Aluminum Jacket - 10 ga. 2-1/2-inch Pipe	8.64	SF	\$3.36	\$29.03	\$0.42	\$3.63	\$33	
Unit Cost for 2-1/2-inch Sch 40 Tee for Steam				\$141		\$47.23	\$188	
3" Tee Sch 40 (Steam Usage)	1	EA	\$138	\$138	\$22.50	\$22.50	\$161	
Insulation: 3-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.48	\$17.92	\$5.75	\$23.00	\$41	
Aluminum Jacket - 10 ga. 3-inch Pipe	10.37	SF	\$3.36	\$34.83	\$0.42	\$4.35	\$39	
Unit Cost for 3-inch Sch 40 Tee for Steam				\$191		\$49.85	\$241	
4" Tee Sch 40 (Steam Usage)	1	EA	\$159	\$159	\$31.00	\$31.00	\$190	
Insulation: 4-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.61	\$18.44	\$6.58	\$26.30	\$45	
Aluminum Jacket - 10 ga. 4-inch Pipe	11.52	SF	\$3.36	\$38.70	\$0.42	\$4.84	\$44	
Unit Cost for 4-inch Sch 40 Tee for Steam				\$216		\$62.14	\$278	
5" Tee Sch 40 (Steam Usage)	1	EA	\$159	\$159	\$31.00	\$31.00	\$190	
Insulation: 5-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.74	\$18.96	\$7.40	\$29.60	\$49	
Aluminum Jacket - 10 ga. 5-inch Pipe	12.67	SF	\$3.36	\$42.57	\$0.42	\$5.32	\$48	
Unit Cost for 5-inch Sch 40 Tee for Steam				\$220		\$65.92	\$286	
6" Tee Sch 40 (Steam Usage)	1	EA	\$237	\$237	\$57.00	\$57.00	\$294	
Insulation: 6-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$10.62	\$42.47	\$66	
Aluminum Jacket - 10 ga. 6-inch Pipe	14.97	SF	\$3.36	\$50.32	\$0.42	\$6.29	\$57	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 3 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design competed)			
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Unit Cost for 6-inch Sch 40 Tee for Steam				\$310		\$106	\$416	
8" Tee Sch 40 (Steam Usage)	1	EA	\$284	\$284	\$105	\$105	\$389	
Insulation: 8-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$6.30	\$25.20	\$12.54	\$50.17	\$75	
Aluminum Jacket - 10 ga. 8-inch Pipe	18.43	SF	\$3.36	\$61.93	\$0.42	\$7.74	\$70	
Unit Cost for 8-inch Sch 40 Tee for Steam				\$371		\$163	\$534	
Tees Schedule 80 Condensate Service (Tees shall be welded.)								
1" Tee Sch 80 (Condensate Usage)	1	EA	\$59.60	\$59.60	\$19.60	\$19.60	\$79	
Insulation: 1-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$2.99	\$11.96	\$2.85	\$11.40	\$23	
Aluminum Jacket - 10 ga. 1-inch Pipe	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$22	
Unit Cost for 1-inch Sch 80 Tee Condensate				\$90.91		\$33.42	\$124	
1 1/4" Tee Sch 80 (Condensate Usage)	1	EA	\$68.00	\$68.00	\$19.60	\$19.60	\$88	
Insulation: 1-1/4-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.08	\$12.32	\$25	
Aluminum Jacket - 10 ga. 1-1/4-inch Pipe	6.05	SF	\$3.36	\$20.32	\$0.42	\$2.54	\$23	
Unit Cost for 1-1/4-inch Sch 80 Tee Condensate				\$101		\$34.46	\$135	
1 1/2" Tee Sch 80 (Condensate Usage)	1	EA	\$79.25	\$79.25	\$22.00	\$22.00	\$101	
Insulation: 1-1/2-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.23	\$12.92	\$25	
Aluminum Jacket - 10 ga. 1-1/2-inch Pipe	6.34	SF	\$3.36	\$21.29	\$0.42	\$2.66	\$24	
Unit Cost for 1-1/2-inch Sch 80 Tee Condensate				\$113		\$37.58	\$151	
2" Tee Sch 80 (Condensate Usage)	1	EA	\$95.05	\$95.05	\$18.60	\$18.60	\$114	
Insulation: 2-inch, 2.5-inch Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$4.97	\$19.88	\$37	
Aluminum Jacket - 10 ga. 2-inch pipe	8.06	SF	\$3.36	\$27.09	\$0.42	\$3.39	\$30	
Unit Cost for 2-inch Sch 80 Tee Condensate				\$139		\$41.87	\$181	
2 1/2" Tee Sch 80 (Condensate Usage)	1	EA	\$119	\$119	\$25.00	\$25.00	\$144	
Insulation: 2-1/2-inch, 2.5-in Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$5.90	\$23.60	\$41	
Aluminum Jacket - 10 ga. 2-1/2-inch Pipe	8.64	SF	\$3.36	\$29.03	\$0.42	\$3.63	\$33	
Unit Cost for 2-1/2-inch Sch 80 Tee Condensate				\$165		\$52.23	\$217	
3" Tee Sch 80 (Condensate Usage)	1	EA	\$136	\$136	\$31.00	\$31.00	\$167	
Insulation: 3-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.48	\$17.92	\$5.75	\$23.00	\$41	
Aluminum Jacket - 10 ga. 3-inch Pipe	10.37	SF	\$3.36	\$34.83	\$0.42	\$4.35	\$39	
Unit Cost for 3-inch Sch 80 Tee Condensate				\$189		\$58.35	\$247	
4" Tee Sch 80 (Condensate Usage)	1	EA	\$190	\$190	\$50.00	\$50.00	\$240	
Insulation: 4-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.74	\$18.96	\$7.40	\$29.60	\$49	
Aluminum Jacket - 10 ga. 4-inch Pipe	12.67	SF	\$3.36	\$42.57	\$0.42	\$5.32	\$48	
Unit Cost for 4-inch Sch 80 Tee Condensate				\$252		\$84.92	\$336	
6" Tee Sch 80 (Condensate Usage)	1	EA	\$284	\$284	\$79.50	\$79.50	\$364	
Insulation: 6-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$10.62	\$42.47	\$66	
Aluminum Jacket - 10 ga. 6-inch Pipe	14.97	SF	\$3.36	\$50.32	\$0.42	\$6.29	\$57	
Unit Cost for 6-inch Sch 80 Tee Condensate				\$358		\$128	\$486	

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Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design competed)			
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
45° ELs Schedule 40 Steam Service (45° ELs shall be welded.)								
1" 45° EL Sch 40 (Steam Usage)	1	EA	\$29.79	\$29.79	\$6.65	\$6.65	\$36	
Insulation: 1-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$2.99	\$11.96	\$2.85	\$11.40	\$23	
Aluminum Jacket - 10 ga. 1-inch Pipe	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$22	
Unit Cost for 1-inch Sch 40 45° EL for Steam				\$61.10		\$20.47	\$82	
1 1/4" 45° EL Sch 40 (Steam Usage)	1	EA	\$33.76	\$33.76	\$6.65	\$6.65	\$40	
Insulation: 1-1/4-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.08	\$12.32	\$25	
Aluminum Jacket - 10 ga. 1-1/4-inch Pipe	6.05	SF	\$3.36	\$20.32	\$0.42	\$2.54	\$23	
Unit Cost for 1-1/4-inch Sch 40 45° EL for Steam				\$66.48		\$21.51	\$88	
1 1/2" 45° EL Sch 40 (Steam Usage)	1	EA	\$36.55	\$36.55	\$5.95	\$5.95	\$43	
Insulation: 1-1/2-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.23	\$12.92	\$25	
Aluminum Jacket - 10 ga. 1-1/2-inch Pipe	6.34	SF	\$3.36	\$21.29	\$0.42	\$2.66	\$24	
Unit Cost for 1-1/2-inch Sch 40 45° EL for Steam				\$70.24		\$21.53	\$92	
2" 45° EL Sch 40 (Steam Usage)	1	EA	\$47.25	\$47.25	\$5.95	\$5.95	\$53	
Insulation: 2-inch, 2.5-inch Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$4.97	\$19.88	\$37	
Aluminum Jacket - 10 ga. 2-inch pipe	8.06	SF	\$3.36	\$27.09	\$0.42	\$3.39	\$30	
Unit Cost for 2-inch Sch 40 45° EL for Steam				\$91.30		\$29.22	\$121	
2 1/2" 45° EL Sch 40 (Steam Usage)	1	EA	\$59.60	\$59.60	\$7.00	\$7.00	\$67	
Insulation: 2-1/2-inch, 2.5-in Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$5.90	\$23.60	\$41	
Aluminum Jacket - 10 ga. 2-1/2-inch Pipe	8.64	SF	\$3.36	\$29.03	\$0.42	\$3.63	\$33	
Unit Cost for 2-1/2-inch Sch 40 45° EL for Steam				\$106		\$34.23	\$140	
3" 45° EL Sch 40 (Steam Usage)	1	EA	\$68.00	\$68.00	\$8.75	\$8.75	\$77	
Insulation: 3-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.48	\$17.92	\$5.75	\$23.00	\$41	
Aluminum Jacket - 10 ga. 3-inch Pipe	10.37	SF	\$3.36	\$34.83	\$0.42	\$4.35	\$39	
Unit Cost for 3-inch Sch 40 45° EL for Steam				\$121		\$36.10	\$157	
4" 45° EL Sch 40 (Steam Usage)	1	EA	\$95.05	\$95.05	\$14.70	\$14.70	\$110	
Insulation: 4-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.74	\$18.96	\$7.40	\$29.60	\$49	
Aluminum Jacket - 10 ga. 4-inch Pipe	12.67	SF	\$3.36	\$42.57	\$0.42	\$5.32	\$48	
Unit Cost for 4-inch Sch 40 45° EL for Steam				\$157		\$49.62	\$206	
5" 45° EL Sch 40 (Steam Usage)	1	EA	\$118	\$118	\$23	\$23.10	\$141	
Insulation: 5-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$9.01	\$36.03	\$60	
Aluminum Jacket - 10 ga. 5-inch Pipe	13.82	SF	\$3.36	\$46.45	\$0.42	\$5.81	\$52	
Unit Cost for 5-inch Sch 40 45° EL for Steam				\$188		\$64.94	\$253	
6" 45° EL Sch 40 (Steam Usage)	1	EA	\$142	\$142	\$31.50	\$31.50	\$173	
Insulation: 6-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$10.62	\$42.47	\$66	
Aluminum Jacket - 10 ga. 6-inch Pipe	14.97	SF	\$3.36	\$50.32	\$0.42	\$6.29	\$57	
Unit Cost for 6-inch Sch 40 45° EL for Steam				\$215		\$80.26	\$296	
8" 45° EL Sch 40 (Steam Usage)	1	EA	\$177	\$177	\$54.50	\$54.50	\$232	
Insulation: 8-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$6.30	\$25.20	\$12.54	\$50.17	\$75	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 5 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada					Code A (no design completed)			
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs					Estimator DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Aluminum Jacket - 10 ga. 8-inch Pipe	17.28	SF	\$3.36	\$58.06	\$0.42	\$7.26	\$65	
Unit Cost for 8-inch Sch 40 45° EL for Steam				\$260		\$112	\$372	
45° ELs Schedule 80 Condensate Service (45° ELs shall be welded.)								
1" 45° EL Sch 80 (Condensate Usage)	1	EA	\$43.29	\$43.29	\$8.75	\$8.75	\$52	
Insulation: 1-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$2.99	\$11.96	\$2.85	\$11.40	\$23	
Aluminum Jacket - 10 ga. 1-inch Pipe	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$22	
Unit Cost for 1-inch Sch 80 45° EL Condensate				\$74.60		\$22.57	\$97	
1 1/4" 45° EL Sch 80 (Condensate Usage)	1	EA	\$47.25	\$47.25	\$8.75	\$8.75	\$56	
Insulation: 1-1/4-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.08	\$12.32	\$25	
Aluminum Jacket - 10 ga. 1-1/4-inch Pipe	6.05	SF	\$3.36	\$20.32	\$0.42	\$2.54	\$23	
Unit Cost for 1-1/4-inch Sch 80 45° EL Condensate				\$79.97		\$23.61	\$104	
1 1/2" 45° EL Sch 80 (Condensate Usage)	1	EA	\$52.85	\$52.85	\$8.05	\$8.05	\$61	
Insulation: 1-1/2-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.23	\$12.92	\$25	
Aluminum Jacket - 10 ga. 1-1/2-inch Pipe	6.34	SF	\$3.36	\$21.29	\$0.42	\$2.66	\$24	
Unit Cost for 1-1/2-inch Sch 80 45° EL Condensate				\$86.54		\$23.63	\$110	
2" 45° EL Sch 80 (Condensate Usage)	1	EA	\$59.60	\$59.60	\$7.35	\$7.35	\$67	
Insulation: 2-inch, 2.5-inch Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$4.97	\$19.88	\$37	
Aluminum Jacket - 10 ga. 2-inch pipe	8.06	SF	\$3.36	\$27.09	\$0.42	\$3.39	\$30	
Unit Cost for 2-inch Sch 80 45° EL Condensate				\$104		\$30.62	\$134	
2 1/2" 45° EL Sch 80 (Condensate Usage)	1	EA	\$68.00	\$68.00	\$9.80	\$9.80	\$78	
Insulation: 2-1/2-inch, 2.5-in Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$5.90	\$23.60	\$41	
Aluminum Jacket - 10 ga. 2-1/2-inch Pipe	8.64	SF	\$3.36	\$29.03	\$0.42	\$3.63	\$33	
Unit Cost for 2-1/2-inch Sch 80 45° EL Condensate				\$114		\$37.03	\$151	
3" 45° EL Sch 80 (Condensate Usage)	1	EA	\$79.25	\$79.25	\$11.60	\$11.60	\$91	
Insulation: 3-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.48	\$17.92	\$5.75	\$23.00	\$41	
Aluminum Jacket - 10 ga. 3-inch Pipe	10.37	SF	\$3.36	\$34.83	\$0.42	\$4.35	\$39	
Unit Cost for 3-inch Sch 80 45° EL Condensate				\$132		\$38.95	\$171	
4" 45° EL Sch 80 (Condensate Usage)	1	EA	\$119	\$119	\$17.55	\$17.55	\$137	
Insulation: 4-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.74	\$18.96	\$7.40	\$29.60	\$49	
Aluminum Jacket - 10 ga. 4-inch Pipe	12.67	SF	\$3.36	\$42.57	\$0.42	\$5.32	\$48	
Unit Cost for 4-inch Sch 80 45° EL Condensate				\$181		\$52.47	\$233	
6" 45° EL Sch 80 (Condensate Usage)	1	EA	\$158	\$158	\$47.00	\$47.00	\$205	
Insulation: 6-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$10.62	\$42.47	\$66	
Aluminum Jacket - 10 ga. 6-inch Pipe	14.97	SF	\$3.36	\$50.32	\$0.42	\$6.29	\$57	
Unit Cost for 6-inch Sch 80 45° EL Condensate				\$232		\$95.76	\$327	
90° ELs Schedule 40 Steam Service (90° ELs shall be welded.)								
1" 90° EL Sch 40 (Steam Usage)	1	EA	\$29.79	\$29.79	\$7.00	\$7.00	\$37	
Insulation: 1-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$2.99	\$11.96	\$2.85	\$11.40	\$23	
Aluminum Jacket - 10 ga. 1-inch Pipe	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$22	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet of 6 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada							Code A (no design competed)	
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs				Estimator DLN		Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Unit Cost for 1-inch Sch 40 90° EL for Steam				\$61.10		\$20.82	\$82	
1 1/4" 90° EL Sch 40 (Steam Usage)	1	EA	\$33.76	\$33.76	\$7.00	\$7.00	\$41	
Insulation: 1-1/4-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.08	\$12.32	\$25	
Aluminum Jacket - 10 ga. 1-1/4-inch Pipe	6.05	SF	\$3.36	\$20.32	\$0.42	\$2.54	\$23	
Unit Cost for 1-1/4-inch Sch 40 90° EL for Steam				\$66.48		\$21.86	\$88	
1 1/2" 90° EL Sch 40 (Steam Usage)	1	EA	\$36.55	\$36.55	\$6.30	\$6.30	\$43	
Insulation: 1-1/2-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.23	\$12.92	\$25	
Aluminum Jacket - 10 ga. 1-1/2-inch Pipe	6.34	SF	\$3.36	\$21.29	\$0.42	\$2.66	\$24	
Unit Cost for 1-1/2-inch Sch 40 90° EL for Steam				\$70.24		\$21.88	\$92	
2" 90° EL Sch 40 (Steam Usage)	1	EA	\$47.25	\$47.25	\$6.30	\$6.30	\$54	
Insulation: 2-inch, 2.5-inch Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$4.97	\$19.88	\$37	
Aluminum Jacket - 10 ga. 2-inch pipe	8.06	SF	\$3.36	\$27.09	\$0.42	\$3.39	\$30	
Unit Cost for 2-inch Sch 40 90° EL for Steam				\$91.30		\$29.57	\$121	
2 1/2" 90° EL Sch 40 (Steam Usage)	1	EA	\$59.60	\$59.60	\$8.40	\$8.40	\$68	
Insulation: 2-1/2-inch, 2.5-in Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$5.90	\$23.60	\$41	
Aluminum Jacket - 10 ga. 2-1/2-inch Pipe	8.64	SF	\$3.36	\$29.03	\$0.42	\$3.63	\$33	
Unit Cost for 2-1/2-inch Sch 40 90° EL for Steam				\$106		\$35.63	\$141	
3" 90° EL Sch 40 (Steam Usage)	1	EA	\$68.00	\$68.00	\$10.15	\$10.15	\$78	
Insulation: 3-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.48	\$17.92	\$5.75	\$23.00	\$41	
Aluminum Jacket - 10 ga. 3-inch Pipe	10.37	SF	\$3.36	\$34.83	\$0.42	\$4.35	\$39	
Unit Cost for 3-inch Sch 40 90° EL for Steam				\$121		\$37.50	\$158	
4" 90° EL Sch 40 (Steam Usage)	1	EA	\$95.05	\$95.05	\$16.80	\$16.80	\$112	
Insulation: 4-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.74	\$18.96	\$7.40	\$29.60	\$49	
Aluminum Jacket - 10 ga. 4-inch Pipe	12.67	SF	\$3.36	\$42.57	\$0.42	\$5.32	\$48	
Unit Cost for 4-inch Sch 40 90° EL for Steam				\$157		\$51.72	\$208	
5" 90° EL Sch 40 (Steam Usage)	1	EA	\$95.05	\$95.05	\$16.80	\$16.80	\$112	
Insulation: 5-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$5.32	\$21.26	\$9.01	\$36.03	\$57	
Aluminum Jacket - 10 ga. 5-inch Pipe	13.82	SF	\$3.36	\$46.45	\$0.42	\$5.81	\$52	
Unit Cost for 5-inch Sch 40 90° EL for Steam				\$163		\$58.64	\$221	
6" 90° EL Sch 40 (Steam Usage)	1	EA	\$142	\$142	\$41.50	\$41.50	\$183	
Insulation: 6-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$10.62	\$42.47	\$66	
Aluminum Jacket - 10 ga. 6-inch Pipe	14.97	SF	\$3.36	\$50.32	\$0.42	\$6.29	\$57	
Unit Cost for 6-inch Sch 40 90° EL for Steam				\$215		\$90.26	\$306	
8" 90° EL Sch 40 (Steam Usage)	1	EA	\$177	\$177	\$77.00	\$77.00	\$254	
Insulation: 8-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$6.30	\$25.20	\$13.83	\$55.33	\$81	
Aluminum Jacket - 10 ga. 8-inch Pipe	17.28	SF	\$3.36	\$58.06	\$0.42	\$7.26	\$65	
Unit Cost for 8-inch Sch 40 90° EL for Steam				\$260		\$140	\$400	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 7 of 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada							Code A (no design competed)	
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs			Estimator DLN			Checked By BIH		
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
90° ELs Schedule 80 Condensate Service (90° ELs shall be welded.)								
1" 90° EL Sch 80 (Condensate Usage)	1	EA	\$43.29	\$43.29	\$8.75	\$8.75	\$52	
Insulation: 1-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$2.99	\$11.96	\$2.85	\$11.40	\$23	
Aluminum Jacket - 10 ga. 1-inch Pipe	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$22	
Unit Cost for 1-inch Sch 80 90° EL Condensate				\$74.60		\$22.57	\$97	
1 1/4" 90° EL Sch 80 (Condensate Usage)	1	EA	\$47.25	\$47.25	\$8.75	\$8.75	\$56	
Insulation: 1-1/4-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.08	\$12.32	\$25	
Aluminum Jacket - 10 ga. 1-1/4-inch Pipe	6.05	SF	\$3.36	\$20.32	\$0.42	\$2.54	\$23	
Unit Cost for 1-1/4-inch Sch 80 90° EL Condensate				\$79.97		\$23.61	\$104	
1 1/2" 90° EL Sch 80 (Condensate Usage)	1	EA	\$52.85	\$52.85	\$8.05	\$8.05	\$61	
Insulation: 1-1/2-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.23	\$12.92	\$25	
Aluminum Jacket - 10 ga. 1-1/2-inch Pipe	6.34	SF	\$3.36	\$21.29	\$0.42	\$2.66	\$24	
Unit Cost for 1-1/2-inch Sch 80 90° EL Condensate				\$86.54		\$23.63	\$110	
2" 90° EL Sch 80 (Condensate Usage)	1	EA	\$59.60	\$59.60	\$8.05	\$8.05	\$68	
Insulation: 2-inch, 2.5-inch Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$4.97	\$19.88	\$37	
Aluminum Jacket - 10 ga. 2-inch pipe	8.06	SF	\$3.36	\$27.09	\$0.42	\$3.39	\$30	
Unit Cost for 2-inch Sch 80 90° EL Condensate				\$104		\$31.32	\$135	
2 1/2" 90° EL Sch 80 (Condensate Usage)	1	EA	\$68.00	\$68.00	\$11.55	\$11.55	\$80	
Insulation: 2-1/2-inch, 2.5-in Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$5.90	\$23.60	\$41	
Aluminum Jacket - 10 ga. 2-1/2-inch Pipe	8.64	SF	\$3.36	\$29.03	\$0.42	\$3.63	\$33	
Unit Cost for 2-1/2-inch Sch 80 90° EL Condensate				\$114		\$38.78	\$153	
3" 90° EL Sch 80 (Condensate Usage)	1	EA	\$79.25	\$79.25	\$15.10	\$15.10	\$94	
Insulation: 3-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.48	\$17.92	\$5.75	\$23.00	\$41	
Aluminum Jacket - 10 ga. 3-inch Pipe	10.37	SF	\$3.36	\$34.83	\$0.42	\$4.35	\$39	
Unit Cost for 3-inch Sch 80 90° EL Condensate				\$132		\$42.45	\$174	
4" 90° EL Sch 80 (Condensate Usage)	1	EA	\$119	\$119	\$25.00	\$25.00	\$144	
Insulation: 4-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.74	\$18.96	\$7.40	\$29.60	\$49	
Aluminum Jacket - 10 ga. 4-inch Pipe	12.67	SF	\$3.36	\$42.57	\$0.42	\$5.32	\$48	
Unit Cost for 4-inch Sch 80 90° EL Condensate				\$181		\$59.92	\$241	
6" 90° EL Sch 80 (Condensate Usage)	1	EA	\$158	\$158	\$61.50	\$61.50	\$219	
Insulation: 6-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$10.62	\$42.47	\$66	
Aluminum Jacket - 10 ga. 6-inch Pipe	14.97	SF	\$3.36	\$50.32	\$0.42	\$6.29	\$57	
Unit Cost for 6-inch Sch 80 90° EL Condensate				\$232		\$110	\$342	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 8 of 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada							Code A (no design competed)	
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs					Estimator DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Expansion Joints (Bellows type assumed to replace existing)								
1" Expan Joint (Steam or Condensate Usage)	1	EA	\$18.00	\$18.00	\$142	\$142	\$160	
Welding Neck Flange 150 lb	2	EA	\$14.84	\$29.68	\$16.45	\$32.90	\$63	
Insulation: 1-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$2.99	\$11.96	\$2.85	\$11.40	\$23	
Aluminum Jacket - 10 ga. 1-inch Pipe	5.76	SF	\$3.36	\$19.35	\$0.42	\$2.42	\$22	
Unit Cost for 1-inch Expan Joint				\$78.99		\$189	\$268	
1 1/4" Expan Joint (Steam or Condensate Usage)	1	EA	\$21.50	\$21.50	\$145	\$145	\$167	
Welding Neck Flange 150 lb	2	EA	\$16.37	\$32.74	\$16.45	\$32.90	\$66	
Insulation: 1-1/4-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.08	\$12.32	\$25	
Aluminum Jacket - 10 ga. 1-1/4-inch Pipe	6.05	SF	\$3.36	\$20.32	\$0.42	\$2.54	\$23	
Unit Cost for 1-1/4-inch Expan Joint				\$86.96		\$193	\$280	
1 1/2" Expan Joint (Steam or Condensate Usage)	1	EA	\$22.00	\$22.00	\$145	\$145	\$167	
Welding Neck Flange 150 lb	2	EA	\$18.27	\$36.54	\$16.45	\$32.90	\$69	
Insulation: 1-1/2-inch, 2-inch Thick (4 FL/Fitting)	4	LF	\$3.10	\$12.40	\$3.23	\$12.92	\$25	
Aluminum Jacket - 10 ga. 1-1/2-inch Pipe	6.34	SF	\$3.36	\$21.29	\$0.42	\$2.66	\$24	
Unit Cost for 1-1/2-inch Expan Joint				\$92.23		\$193	\$286	
2" Expan Joint (Steam or Condensate Usage)	1	EA	\$32.50	\$32.50	\$231	\$231	\$264	
Welding Neck Flange 150 lb	2	EA	\$23.63	\$47.26	\$17.85	\$35.70	\$83	
Insulation: 2-inch, 2.5-inch Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$4.97	\$19.88	\$37	
Aluminum Jacket - 10 ga. 2-inch pipe	8.06	SF	\$3.36	\$27.09	\$0.42	\$3.39	\$30	
Unit Cost for 2-inch Expan Joint				\$124		\$290	\$414	
2 1/2" Expan Joint (Steam or Condensate Usage)	1	EA	\$35.00	\$35.00	\$249	\$249	\$284	
Welding Neck Flange 150 lb	2	EA	\$29.79	\$59.58	\$18.90	\$37.80	\$97	
Insulation: 2-1/2-inch, 2.5-in Thick (4 FL/Fitting)	4	LF	\$4.24	\$16.96	\$5.90	\$23.60	\$41	
Aluminum Jacket - 10 ga. 2-1/2-inch Pipe	8.64	SF	\$3.36	\$29.03	\$0.42	\$3.63	\$33	
Unit Cost for 2-1/2-inch Expan Joint				\$141		\$314	\$455	
3" Expan Joint (Steam or Condensate Usage)	1	EA	\$38.50	\$38.50	\$255	\$255	\$294	
Welding Neck Flange 150 lb	2	EA	\$33.76	\$67.52	\$19.95	\$39.90	\$107	
Insulation: 3-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.48	\$17.92	\$5.75	\$23.00	\$41	
Aluminum Jacket - 10 ga. 3-inch Pipe	10.37	SF	\$3.36	\$34.83	\$0.42	\$4.35	\$39	
Unit Cost for 3-inch Expan Joint				\$159		\$322	\$481	
4" Expan Joint (Steam or Condensate Usage)	1	EA	\$53	\$52.50	\$284	\$284	\$337	
Welding Neck Flange 150 lb	2	EA	\$47.25	\$94.50	\$24.00	\$48.00	\$143	
Insulation: 4-inch, 3-inch Thick (4 FL/Fitting)	4	LF	\$4.74	\$18.96	\$7.40	\$29.60	\$49	
Aluminum Jacket - 10 ga. 4-inch Pipe	12.67	SF	\$3.36	\$42.57	\$0.42	\$5.32	\$48	
Unit Cost for 4-inch Expan Joint				\$209		\$367	\$575	
6" Expan Joint (Steam or Condensate Usage)	1	EA	\$70.00	\$70.00	\$340	\$340	\$410	
Welding Neck Flange 150 lb	2	EA	\$70.75	\$142	\$37.00	\$74.00	\$216	
Insulation: 6-inch, 3.5-inch Thick (4 FL/Fitting)	4	LF	\$5.89	\$23.57	\$10.62	\$42.47	\$66	
Aluminum Jacket - 10 ga. 6-inch Pipe	14.97	SF	\$3.36	\$50.32	\$0.42	\$6.29	\$57	
Unit Cost for 6-inch Expan Joint				\$285		\$463	\$748	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 9 of 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada							Code A (no design competed)	
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs					Estimator DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Pipe Anchors - In Trench Replacement pipes use existing anchors, new pipes in existing trench, use:								
Covering Protection Saddle 1-inch Pipe Size	1	EA	\$3.45	\$3.45	\$7.30	\$7.30	\$11	
Insulation Shield 1-inch Pipe Size	1	EA	\$2.29	\$2.29	\$3.70	\$3.70	\$6	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 1-inch Pipe Size	1	EA	\$1.54	\$1.54	\$0.60	\$0.60	\$2	
Unit Cost for 1-inch Pipe Anchor				\$26.98		\$15.28	\$31	
Covering Protection Saddle 1-1/4-inch Pipe Size	1	EA	\$3.45	\$3.45	\$7.30	\$7.30	\$11	
Insulation Shield 1-1/4-inch Pipe Size	1	EA	\$2.29	\$2.29	\$4.24	\$4.24	\$7	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 1-1/4-inch Pipe Size	2	EA	\$1.58	\$3.16	\$0.68	\$1.36	\$2	
Unit Cost for 1-1/4-inch Pipe Anchor				\$28.60		\$16.58	\$31	
Covering Protection Saddle 1-1/2-inch Pipe Size	1	EA	\$3.55	\$3.55	\$7.75	\$7.75	\$11	
Insulation Shield 1-1/2-inch Pipe Size	1	EA	\$2.33	\$2.33	\$5.30	\$5.30	\$8	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 1-1/2-inch Pipe Size	2	EA	\$1.64	\$3.28	\$0.70	\$1.40	\$2	
Unit Cost for 1-1/2-inch Pipe Anchor				\$28.86		\$18.13	\$33	
Covering Protection Saddle 2-inch Pipe Size	1	EA	\$3.55	\$3.55	\$7.75	\$7.75	\$11	
Insulation Shield 2-inch Pipe Size	1	EA	\$2.33	\$2.33	\$5.80	\$5.80	\$8	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 2-inch Pipe Size	2	EA	\$1.69	\$3.38	\$0.71	\$1.42	\$2	
Unit Cost for 2-inch Pipe Anchor				\$28.96		\$18.65	\$34	
Covering Protection Saddle 2-1/2-inch Pipe Size	1	EA	\$3.66	\$3.66	\$7.75	\$7.75	\$11	
Insulation Shield 2-1/2-inch Pipe Size	1	EA	\$2.38	\$2.38	\$6.10	\$6.10	\$8	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 2-1/2-inch Pipe Size	2	EA	\$1.75	\$3.50	\$1.17	\$2.34	\$3	
Unit Cost for 2-1/2-inch Pipe Anchor				\$29.24		\$19.87	\$35	
Covering Protection Saddle 3-inch Pipe Size	1	EA	\$3.66	\$3.66	\$11.40	\$11.40	\$15	
Insulation Shield 3-inch Pipe Size	1	EA	\$2.38	\$2.38	\$6.60	\$6.60	\$9	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 3-inch Pipe Size	2	EA	\$1.83	\$3.66	\$1.24	\$2.48	\$3	
Unit Cost for 3-inch Pipe Anchor				\$29.40		\$24.16	\$39	
Covering Protection Saddle 4-inch Pipe Size	1	EA	\$3.78	\$3.78	\$12.20	\$12.20	\$16	
Insulation Shield 4-inch Pipe Size	1	EA	\$2.43	\$2.43	\$10.00	\$10.00	\$12	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 4-inch Pipe Size	2	EA	\$2.00	\$4.00	\$1.30	\$2.60	\$3	
Unit Cost for 4-inch Pipe Anchor				\$29.91		\$28.48	\$43	
Covering Protection Saddle 5-inch Pipe Size	1	EA	\$3.91	\$3.91	\$12.20	\$12.20	\$16	
Insulation Shield 5-inch Pipe Size	1	EA	\$2.49	\$2.49	\$10.45	\$10.45	\$13	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 5-inch Pipe Size	2	EA	\$2.06	\$4.12	\$1.44	\$2.88	\$4	
Unit Cost for 5-inch Pipe Anchor				\$30.22		\$29.21	\$44	
Covering Protection Saddle 6-inch Pipe Size	1	EA	\$3.91	\$3.91	\$14.50	\$14.50	\$18	
Insulation Shield 6-inch Pipe Size	1	EA	\$2.49	\$2.49	\$10.95	\$10.95	\$13	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 6-inch Pipe Size	2	EA	\$2.11	\$4.22	\$2.47	\$4.94	\$5	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 10 of 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada							Code A (no design competed)	
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs					Estimator DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Unit Cost for 6-inch Pipe Anchor				\$30.22		\$29.21	\$44	
Covering Protection Saddle 8-inch Pipe Size	1	EA	\$4.04	\$4.04	\$12.20	\$12.20	\$16	
Insulation Shield 8-inch Pipe Size	1	EA	\$2.55	\$2.55	\$11.80	\$11.80	\$14	
Self Drilling Anchor Bolt 1/2-inch	2	EA	\$9.85	\$19.70	\$1.84	\$3.68	\$12	
U-Bolt 8-inch Pipe Size	2	EA	\$2.15	\$4.30	\$2.83	\$5.66	\$5	
Unit Cost for 8-inch Pipe Anchor				\$30.59		\$33.34	\$47	
Pipe Guide - In Trench Replacement pipes use existing guides, new pipes in existing trench, use:								
Pipe Guide Sized for Insulation 1-inch Pipe	1	EA	\$9.00	\$9.00	\$51.00	\$51.00	\$60	
Pipe Guide Sized for Insulation 1-1/4-inch Pipe	1	EA	\$11.15	\$11.15	\$68.50	\$68.50	\$80	
Pipe Guide Sized for Insulation 1-1/2-inch Pipe	1	EA	\$11.15	\$11.15	\$68.50	\$68.50	\$80	
Pipe Guide Sized for Insulation 2-inch Pipe	1	EA	\$11.15	\$11.15	\$68.50	\$68.50	\$80	
Pipe Guide Sized for Insulation 2-1/2-inch Pipe	1	EA	\$13.00	\$13.00	\$79.00	\$79.00	\$92	
Pipe Guide Sized for Insulation 3-inch Pipe	1	EA	\$13.00	\$13.00	\$79.00	\$79.00	\$92	
Pipe Guide Sized for Insulation 4-inch Pipe	1	EA	\$14.65	\$14.65	\$140	\$140	\$155	
Pipe Guide Sized for Insulation 5-inch Pipe	1	EA	\$14.65	\$14.65	\$140	\$140	\$155	
Pipe Guide Sized for Insulation 6-inch Pipe	1	EA	\$14.65	\$14.65	\$140	\$140	\$155	
Pipe Guide Sized for Insulation 8-inch Pipe	1	EA	\$26.50	\$26.50	\$266	\$266	\$293	
Drip Trap Assembly								
Steam Trap 1-inch Steel Socket Welded	1	EA	\$39.39	\$39.39	\$755	\$755	\$794	
1" Gate Valve Welded	2	EA	\$31.51	\$63.02	\$65.00	\$130	\$97	
Strainer Y Type Iron Body 1-inch Pipe Screwed	1	EA	\$14.65	\$14.65	\$12.60	\$12.60	\$27	
Check Valve Forged Threaded 1-inch Pipe	1	EA	\$31.51	\$31.51	\$97.00	\$97.00	\$129	
Union Malleable Iron 150 lb 1-inch Pipe Threaded	1	EA	\$19.55	\$19.55	\$5.90	\$5.90	\$25	
Unit Cost for 1-inch Drip Trap Assembly				\$168		\$1,001	\$1,072	
Steam Trap 1-1/4-inch Steel Socket Welded	1	EA	\$47.25	\$47.25	\$1,075	\$1,075	\$1,122	
1 1/4" Gate Valve Welded	2	EA	\$36.55	\$73.10	\$124	\$248	\$161	
Strainer Y Type Iron Body 1-1/4-inch Pipe Screwed	1	EA	\$15.60	\$15.60	\$17.40	\$17.40	\$33	
Check Valve Forged Threaded 1-1/4-inch Pipe	1	EA	\$36.55	\$36.55	\$188	\$188	\$225	
Union Malleable Iron 150 lb 1-1/4-inch Pipe Threaded	1	EA	\$20.00	\$20.00	\$7.85	\$7.85	\$28	
Unit Cost for 1-1/4-inch Drip Trap Assembly				\$193		\$1,536	\$1,568	
Steam Trap 1-1/2-inch Steel Socket Welded	1	EA	\$52.85	\$52.85	\$1,475	\$1,475	\$1,528	
1 1/2" Gate Valve Welded	2	EA	\$43.29	\$86.58	\$124	\$248	\$167	
Strainer Y Type Iron Body 1-1/2-inch Pipe Screwed	1	EA	\$19.50	\$19.50	\$21.00	\$21.00	\$41	
Check Valve Forged Threaded 1-1/2-inch Pipe	1	EA	\$43.29	\$43.29	\$188	\$188	\$231	
Union Malleable Iron 150 lb 1-1/2-inch Pipe Threaded	1	EA	\$22.00	\$22.00	\$9.60	\$9.60	\$32	
Unit Cost for 1-1/2-inch Drip Trap Assembly				\$224		\$1,942	\$1,999	
Steam Trap 2-inch Steel Socket Welded	1	EA	\$67.50	\$67.50	\$2,575	\$2,575	\$2,643	
2" Gate Valve Welded	2	EA	\$55.70	\$111	\$159	\$318	\$215	
Strainer Y Type Iron Body 2-inch Pipe Screwed	1	EA	\$29.50	\$29.50	\$32.50	\$32.50	\$62	
Check Valve Forged Threaded 2-inch Pipe	1	EA	\$55.70	\$55.70	\$265	\$265	\$321	
Union Malleable Iron 150 lb 2-inch Pipe Threaded	1	EA	\$25.00	\$25.00	\$12.15	\$12	\$37	
Unit Cost for 2-inch Drip Trap Assembly				\$289		\$3,203	\$3,277	

CONSTRUCTION COST ESTIMATE					Date Prepared July 1995		Sheet 11 of 13	
Project ECIP Modernize Steam Distribution Systems					Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada							Code A (no design competed)	
Engineer-Architect Keller & Gannon								
Drawing No. Ordnance & Industrial Areas Fitting Costs					Estimator DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost	
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total		
Steam Pressure Regulator Valves								
1-inch Pressure Regulator Valve	1	EA	\$12.30	\$12.30	\$243	\$243	\$255	
1 1/4-inch Pressure Regulator Valve	1	EA	\$15.60	\$15.60	\$305	\$305	\$321	
1 1/2-inch Pressure Regulator Valve	1	EA	\$18.00	\$18.00	\$325	\$325	\$343	
2-inch Pressure Regulator Valve	1	EA	\$21.50	\$21.50	\$435	\$435	\$457	
2 1/2-inch Pressure Regulator Valve	1	EA	\$35.00	\$35.00	\$970	\$970	\$1,005	
3-inch Pressure Regulator Valve	1	EA	\$38.50	\$38.50	\$1,100	\$1,100	\$1,139	
4-inch Pressure Regulator Valve	1	EA	\$84.50	\$84.50	\$1,550	\$1,550	\$1,635	
Steam Pressure Relief Valves								
3/4-inch Pressure Relief Valve	1	EA	\$8.35	\$8.35	\$54.50	\$54.50	\$63	
1-inch Pressure Relief Valve	1	EA	\$9.75	\$9.75	\$79.00	\$79.00	\$89	
1 1/4-inch Pressure Relief Valve	1	EA	\$11.70	\$11.70	\$172	\$172	\$184	
1 1/2-inch Pressure Relief Valve	1	EA	\$13.00	\$13.00	\$305	\$305	\$318	
2-inch Pressure Relief Valve	1	EA	\$14.65	\$14.65	\$335	\$335	\$350	
90° Elbows in Conduits								
90° Elbow in 16-inch Conduit: 8 -inch Dia Sch 40	1	EA	-	-	\$384	\$384	\$384	
Install Elbow- 8 -inch Dia Sch 40	1	EA	\$236	\$236			\$236	
Install Elbow- 16-inch Conduit	1	EA	\$64.28	\$64			\$64	
90° EI - 8-inch Steam Pipe in Conduit				\$300		\$384	\$684	
90° Elbow in 14-inch Conduit: 6 -inch Dia Sch 40	1	EA	-	-	\$305	\$305	\$305	
Install Elbow- 6 -inch Dia Sch 40	1	EA	\$177	\$177			\$177	
Install Elbow- 14-inch Conduit	1	EA	\$58.88	\$59			\$59	
90° EI - 6-inch Steam Pipe in Conduit				\$236		\$305	\$541	
90° Elbow in 12-3/4-inch Conduit: 5 -inch Dia Sch 40	1	EA	-	-	\$272	\$272	\$272	
Install Elbow- 5 -inch Dia Sch 40	1	EA	\$169	\$169			\$169	
Install Elbow- 12-3/4-inch Conduit	1	EA	\$54.54	\$55			\$55	
90° EI - 5-inch Steam Pipe in Conduit				\$223		\$272	\$495	
90° Elbow in 12-3/4-inch Conduit: 4 -inch Dia Sch 40	1	EA	-	-	\$244	\$244	\$244	
Install Elbow- 4 -inch Dia Sch 40	1	EA	\$158	\$158			\$158	
Install Elbow- 12-3/4-inch Conduit	1	EA	\$54.54	\$55			\$55	
90° EI - 4-inch Steam Pipe in Conduit				\$212		\$244	\$456	
90° Elbow in 10-3/4-inch Conduit: 3 -inch Dia Sch 4	1	EA	-	-	\$206	\$206	\$206	
Install Elbow- 3 -inch Sch 40	1	EA	\$135	\$135			\$135	
Install Elbow- 10-3/4-inch Conduit	1	EA	\$50.75	\$51			\$51	
90° EI - 3-inch Steam Pipe in Conduit				\$186		\$206	\$392	
90° Elbow in 10-3/4-inch Conduit: 2-1/2 -inch Sch 40	1	EA	-	-	\$196	\$196	\$196	
Install Elbow- 2-1/2 -inch Sch 40	1	EA	\$118	\$118			\$118	
Install Elbow- 10-3/4-inch Conduit	1	EA	\$50.75	\$51			\$51	
90° EI - 2-1/2-inch Steam Pipe in Conduit				\$169		\$196	\$365	
90° Elbow in 6-5/8-inch Conduit: 2 -inch Dia Sch 40	1	EA	-	-	\$150	\$150	\$150	
Install Elbow- 6 2 -inch Dia Sch 40	1	EA	\$78.75	\$79			\$79	
Install Elbow- 6-5/8-inch Conduit	1	EA	\$47.00	\$47			\$47	
90° EI - 2-inch Steam Pipe in Conduit				\$126		\$150	\$276	

CONSTRUCTION COST ESTIMATE				Date Prepared July 1995		Sheet 12 of 13	
Project ECIP Modernize Steam Distribution Systems				Project No.		Basis for Estimate	
Location Hawthorne Army Ammunition Depot, Nevada						Code A (no design competed)	
Engineer-Architect Keller & Gannon							
Drawing No. Ordnance & Industrial Areas Fitting Costs				Estimator DLN		Checked By BIH	
Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total	
90° Elbow in 6-5/8-inch Conduit:1-1/2 -inch Sch 40	1	EA	-	-	\$150	\$150	\$150
Install Elbow- :1-1/2 -inch Sch 40	1	EA	\$52.85	\$53			\$53
Install Elbow- 6-5/8-inch Conduit	1	EA	\$47.00	\$47			\$47
90° EI -1-1/2-inch Steam Pipe in Conduit				\$100		\$150	\$250
90° Elbow in 6-5/8-inch Conduit:1-inch Dia Sch 40	1	EA	-	-	\$150	\$150	\$150
Install Elbow-1-inch Dia Sch 40	1	EA	\$36.55	\$37			\$37
Install Elbow- 6-5/8-inch Conduit	1	EA	\$47.00	\$47			\$47
90° EI - 1-inch Steam Pipe in Conduit				\$84		\$150	\$234
90° Elbow in 12-3/4-inch Conduit:4 -inch Dia Sch 80	1	EA	-	-	\$244	\$244	\$244
Install Elbow- 4 -inch Dia Sch 80	1	EA	\$158	\$158			\$158
Install Elbow- 12-3/4-inch Conduit	1	EA	\$54.54	\$55			\$55
90° EI - 4-inch Condensate Pipe in Conduit				\$212		\$244	\$456
90° Elbow in 10-3/4-inch Conduit: 3 -inch Dia Sch 8	1	EA	-	-	\$206	\$206	\$206
Install Elbow-3 -inch Sch 80	1	EA	\$135	\$135			\$135
Install Elbow- 10-3/4-inch Conduit	1	EA	\$50.75	\$51			\$51
90° EI - 3-inch Condensate Pipe in Conduit				\$186		\$206	\$392
90° Elbow in 10-3/4-inch Conduit:2-1/2 -inch Sch 80	1	EA	-	-	\$206	\$206	\$206
Install Elbow- 2-1/2 -inch Sch 80	1	EA	\$118	\$118			\$118
Install Elbow- 10-3/4-inch Conduit	1	EA	\$50.75	\$51			\$51
90° EI - 2-1/2-inch Condensate Pipe in Conduit				\$169		\$206	\$375
90° Elbow in 6-5/8-inch Conduit: 2 -inch Dia Sch 80	1	EA	-	-	\$196	\$196	\$196
Install Elbow- 6 2 -inch Dia Sch 80	1	EA	\$78.75	\$79			\$79
Install Elbow- 6-5/8-inch Conduit	1	EA	\$47.00	\$47			\$47
90° EI - 2-inch Condensate Pipe in Conduit				\$126		\$196	\$322
90° Elbow in 6-5/8-inch Conduit:1-1/2 -inch Sch 80	1	EA	-	-	\$150	\$150	\$150
Install Elbow- :1-1/2 -inch Sch 80	1	EA	\$52.85	\$53			\$53
Install Elbow- 6-5/8-inch Conduit	1	EA	\$47.00	\$47			\$47
90° EI -1-1/2-inch Condensate Pipe in Conduit				\$100		\$150	\$250
90° Elbow in 6-5/8-inch Conduit:1-inch Dia Sch 80	1	EA	-	-	\$150	\$150	\$150
Install Elbow-1-inch Dia Sch 80	1	EA	\$36.55	\$37			\$37
Install Elbow- 6-5/8-inch Conduit	1	EA	\$47.00	\$47			\$47
90° EI - 1-inch Condensate Pipe in Conduit				\$84		\$150	\$234
Piping thru Building Basements (Piping through building basements remains in adequate condition. Allowances below are for one connection at each end.)							
Steam Pipe 8-inch Dia Sch 40	1	EA	\$177	\$177	\$50	\$50	\$227
Steam Pipe 6-inch Dia Sch 40	1	EA	\$142	\$142	\$40	\$40	\$182
Steam Pipe 5-inch Dia Sch 40	1	EA	\$95.05	\$95	\$30	\$30	\$125
Steam Pipe 4-inch Dia Sch 40	1	EA	\$95.05	\$95	\$25	\$25	\$120
Steam Pipe 3-inch Dia Sch 40	1	EA	\$68.00	\$68	\$22	\$22	\$90
Steam Pipe 2-1/2-inch Dia Sch 40	1	EA	\$59.60	\$60	\$18	\$18	\$78
Steam Pipe 2-inch Dia Sch 40	1	EA	\$47.25	\$47	\$15	\$15	\$62
Steam Pipe 1-1/2-inch Dia Sch 40	1	EA	\$36.55	\$37	\$12	\$12	\$49
Steam Pipe 1-inch Dia Sch 40	1	EA	\$29.79	\$30	\$10	\$10	\$40

CONSTRUCTION COST ESTIMATE				Date Prepared July 1995		Sheet 13		of 13	
Project ECIP Modernize Steam Distribution Systems				Project No.		Basis for Estimate			
Location Hawthorne Army Ammunition Depot, Nevada						Code A (no design competed)			
Engineer-Architect Keller & Gannon									
Drawing No. Ordnance & Industrial Areas Fitting Costs				Estimator DLN		Checked By BIH			
Line Item	Quantity		Labor		Material		Total Cost		
	No. Units	Unit Meas	Per Unit	Total	Per Unit	Total			
Core Drill and Anchor Pipes in Existing Manholes									
Core Drill for 6-5/8-inch Conduit Casing 8-inch Dia	1	EA	\$26	\$26	\$11	\$11	\$36		
Conduit Casing Anchor 6-5/8-inch Conduit	1	EA	\$89	\$89	\$226	\$226	\$315		
Core Drill & Anchor for 1 to 2-inch Pipe in Conduit				\$114		\$237	\$351		
Core Drill for 10-3/4-inch Conduit Casing 12-inch Dia	1	EA	\$33	\$33	\$17	\$17	\$50		
Conduit Casing Anchor 10-3/4-inch Conduit	1	EA	\$101	\$101	\$310	\$310	\$411		
Core Drill & Anchor for 2-1/2 & 3-inch Pipe in Conduit				\$134		\$327	\$461		

COMPUTATION SHEET

KELLER & GANNON
Engineers & Architects
Quality Services Since 1941

COMPUTED BY

DLN

CHECKED BY

ABOVE-GRADE

DATE

6/29

19

PIPE SUPPORTS

REV.

19

PROJECT

HAWTHORNE

SHEET NO.

1 OF 10

SHEETS

PIPE
SUPPORTS
COVER
SHEET

COMPUTED BY _____
 CHECKED BY _____
 DATE _____ 19____
 REV. _____ 19____

ABOVE-GROUND
PIPE SUPPORTS

 PROJECT HANTHORNE
 SHEET NO. 2 OF 10 SHEETS

PROBLEM: WHAT IS DESIGN & INSTALLATION
 COSTS FOR PIPE SUPPORTS FOR
 ABOVE-GROUND PIPING

GIVEN: 8" SCH. 40 w/ 3" INSULATION, 150#
 STEAM BLACK-WELDED STEEL PIPE w/
 10 GAGE CASING & 4" SCH 80
 BLACK STEEL PIPE w/ 2" INSULATION
 & 10 GA. CASING,

PIPE SUPPORT SPACING

- 4" ϕ w/ 2" ϕ INSULATION REQUIRES
 CLOSEST SPACING SUPPORT

- WEIGHT PER LINEAL FOOT

ITEM	lb/FL
o 10" ϕ CONDUIT	15.2
o WIND LOAD 60 MPH	2.2
o SUPPORTS	2.3
o 4" SCH 80 PIPE	14.98
o WATER	4.98
o INSULATION	8.0

47.67 — say 50#/ft

25 SPACING

COMPUTATION SHEET

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CHECKED BY _____
DATE _____ 19____
REV. _____ 19____

PROJECT _____
SHEET NO. 3 OF 10 SHEETS

- 8" ϕ SCH 40 PIPE, 1 1/3" INSULATION
WEIGHT PER LINEAL FOOT

ITEM	WT. #/ft
1/8" ϕ CONDUIT	25.73
60 MPH WIND LOAD	3.53
SUPPORTS	6.50
8" SCH 40 PIPE	28.55
WATER	21.60
INSULATION	11.0

$$\Sigma = \underline{96.91 \text{ #/ft}}$$

SUPPORT EVERY 34'

$\Rightarrow$ CONCLUSION:

USE ONE SUPPORT EACH 25' SPACING

TOTAL WEIGHT PER 25' SPACING

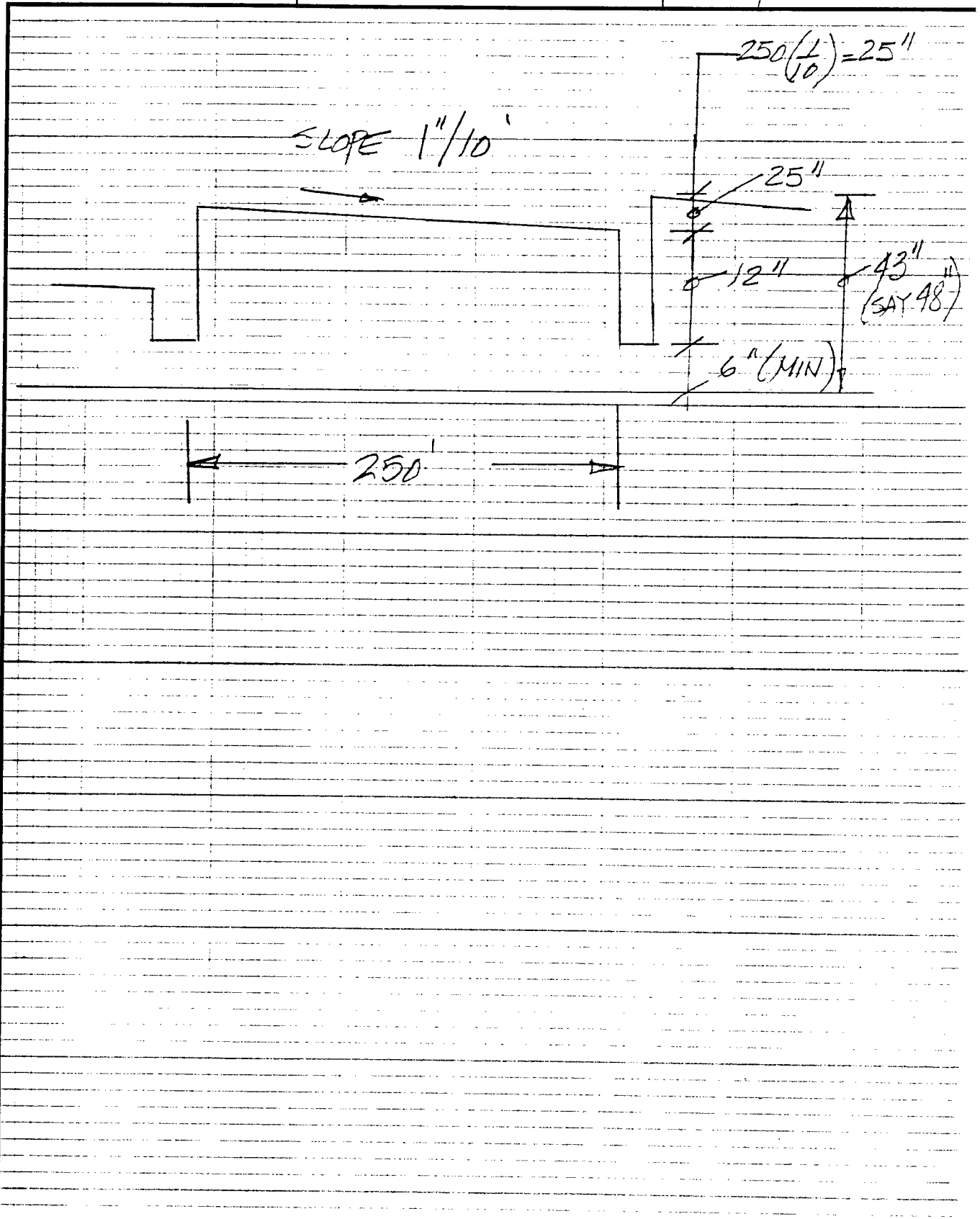
$$= 25 (96.91 + 47.67) = \underline{3,615 \text{ #}}$$

COMPUTATION SHEET

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Engineers & Architects
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COMPUTED BY _____
CHECKED BY _____
DATE _____ 19____
REV. _____ 19____

PROJECT _____
SHEET NO. 4 OF 10 SHEETS

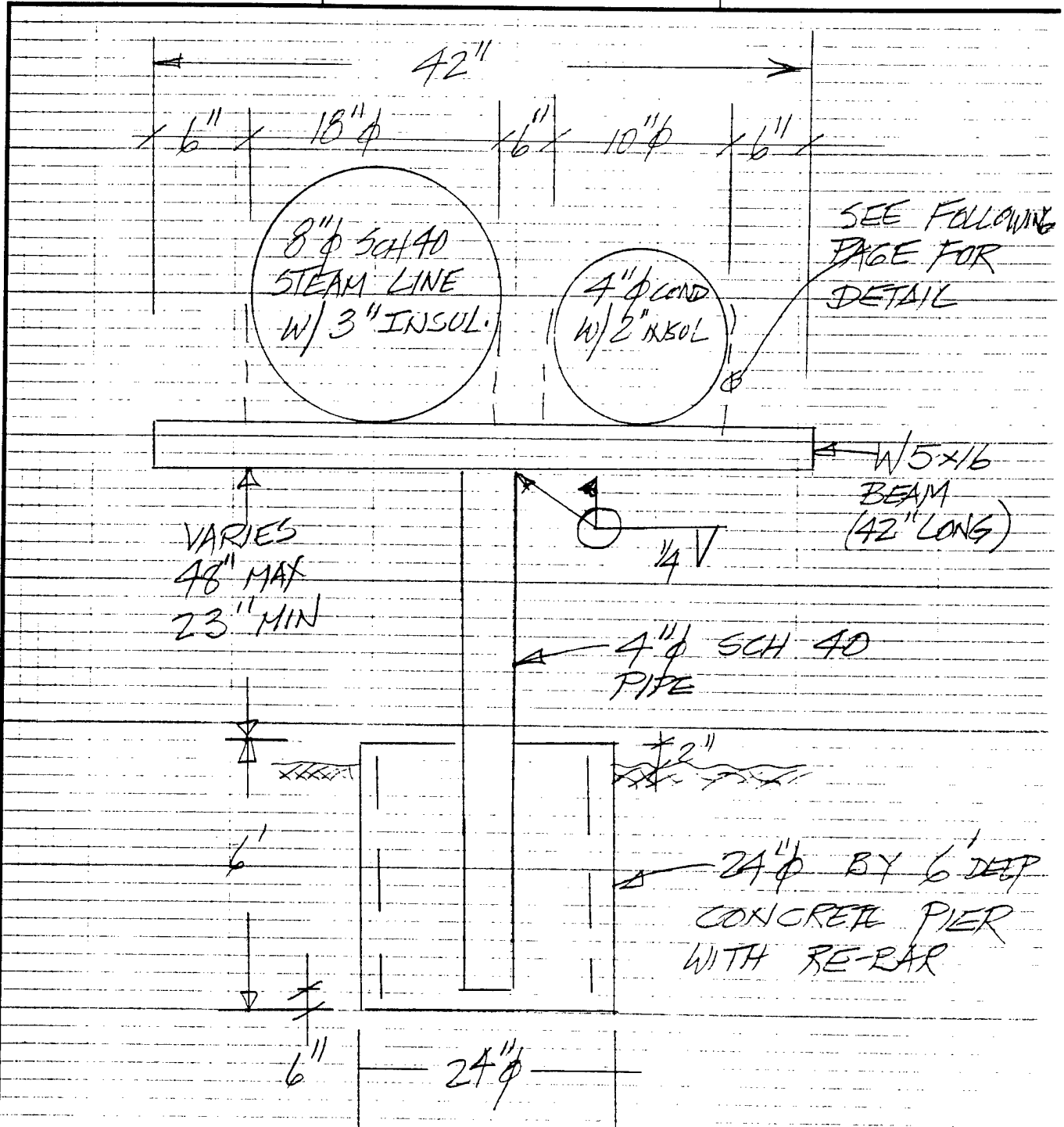


COMPUTATION SHEET

KELLER & GANNON
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CHECKED BY _____
DATE _____ 19____
REV. _____ 19____

PROJECT _____
SHEET NO. 5 OF 10 SHEETS



6.110

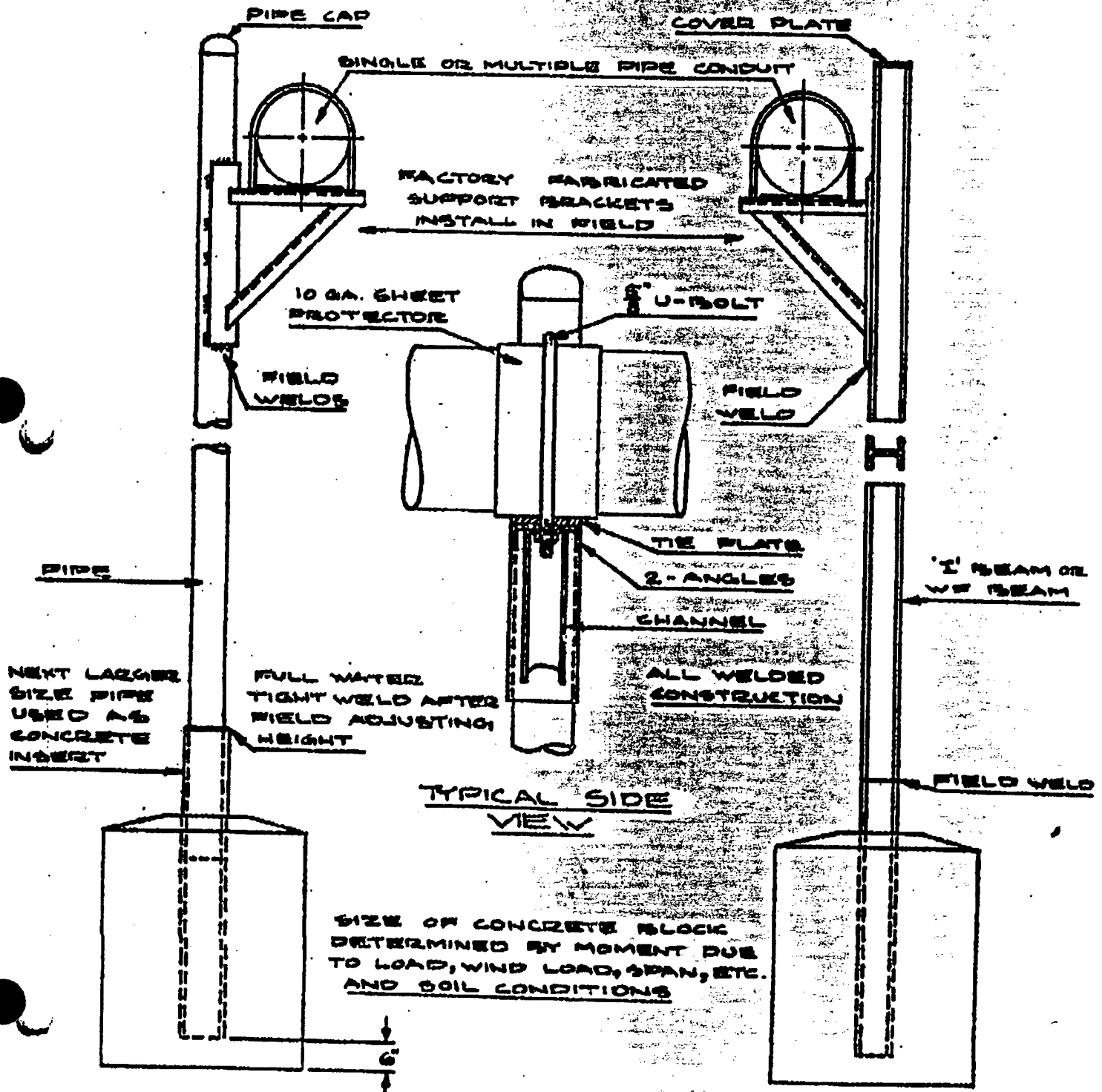
**RIC-WIL, INCORPORATED**

Brecksville, Ohio 44141

A SUBSIDIARY OF AMVIL INDUSTRIES, INC.

ABOVEGROUND

3:04.03

Sketches -
Typical

COMPUTATION SHEET

KELLER & GANNON
Engineers & Architects
Quality Services Since 1941

COMPUTED BY _____
CHECKED BY _____
DATE _____ 19____
REV. _____ 19____

A/G PIPE SUPPORT
COST ESTIMATE

PROJECT _____
SHEET NO. 7 OF 10 SHEETS

ITEM	MEANS #	UNITS	QUANTITY	MTL \$	LABOR \$
EXCAVATE 2' ϕ X 6' HOLE	023-800 804-0280	LF	$\left\{ \begin{array}{l} \$30.50 \text{ 6 LF @ } 1.7 \\ \text{LF} \end{array} \right\}$	NCL	183-
POUR 140 #/ft ³ CONC W/ REBAR	CAISSON	CY	0.70		
GALV. STEEL SCH 40 PIPE, 4" ϕ	151-700 701-1400	FEET	10	(A) 92-	(B) 124-
W5X16 BEAM	051-200 250-020	FEET	3 1/2	(E) 45-	(F) 10-
WELD PIPE TO BEAM	050-575 -1400	LF	1.31	(G) 50-	
TIE PIPES TO BEAM GALV CLAMP	151-900			(C) 103-	(D) 12-
CUT PIPE	EA		1		\$8-
				\$290	\$337

$$(A) = \left(\frac{\$12.00}{\text{LF}} \times .77 \right) (10) \text{ LF} = \$92$$

$$(B) = .444 \frac{\text{MH}}{\text{LF}} \times 10 \text{ LF} \times \frac{\$28}{\text{MH}} = \$124$$

$$(C) = (42 + 29) (1.45) = \$103$$

$$(D) = [0.235 + .167] \times \frac{\$28}{\text{MH}} = 12-$$

$$(E) = 12.70 \times 3 \frac{1}{2} = \$45$$

$$(F) = .093 \times 3 \frac{1}{2} \times 28 = \$10-$$

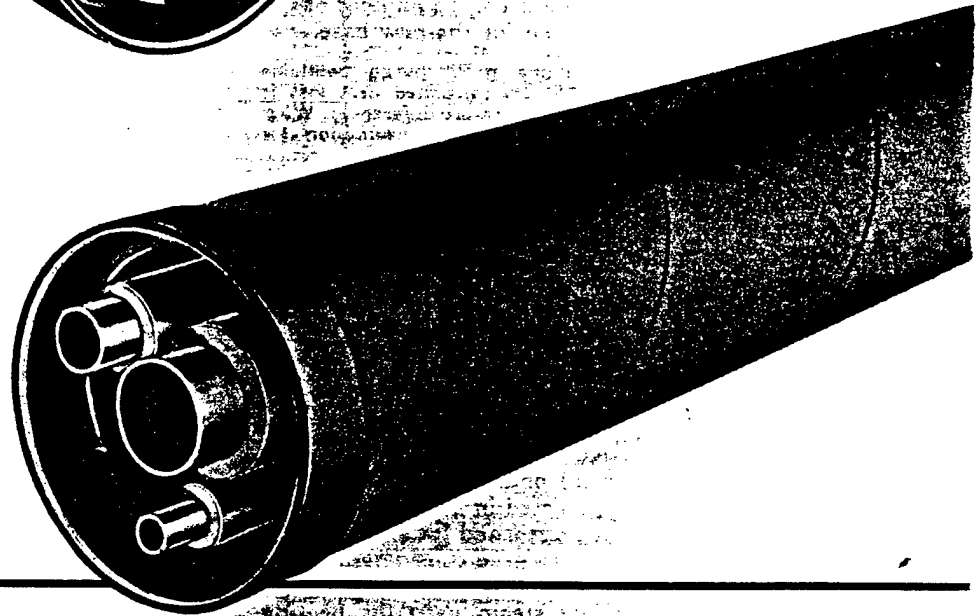
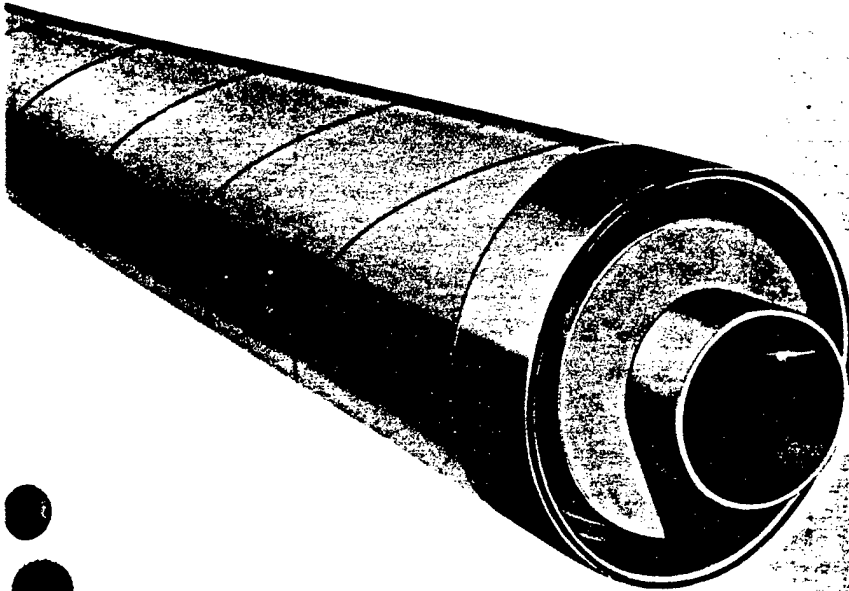
$$(G) = \$50 / \text{WELD}$$

\$627

PER SUPPORT

ENGINEERING

DATA



**RICWIL PIPING
SYSTEMS**

INTERGY

INTERGY INC.

P.O. Box 418051 • Brecksville, Ohio 44141-8051

(216) 526-1600 Fax: (216) 526-3158

INTERGY LTD.

P.O. Box 174 • St. Thomas, Ontario N5P 3T7

REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT NORTH AMERICA

Properties of Steel Pipe

9.10

The table presented below is reprinted through the courtesy of Tube Turns, Inc., of Louisville, Ky.

Pipe schedule numbers and weights shown are considered regular commercial grades of standard and extra heavy steel pipe. Unless otherwise specified by customer, all piping shipped with RICWIL® Insulated Pipe Units will be of the weight shown for the class designated.

Piping designers will find the data presented in the table particularly useful in connection with problems involving the supporting and anchoring of piping systems. It also provides valuable information for calculating heat losses and figuring insulation requirements.

Nominal Pipe Size	Schedule No.	Outside Diam.	In-side Diam.	Wall Thick-ness	Weight per Foot	Wt. of Water per Ft. Pipe	Sq. Ft. Outside Surface per Ft.	Sq. Ft. Inside Surface per Ft.	Trans-verse Area Sq. In.	Area of Metal Sq. In.	Mo-ment of Inertia	Section Modu-lus 1/Y	Radius Gyra-tion Squared	Radius Gyra-tion	Strength Factor Q 1000 Ft. Lbs.
1	40	1.315	1.049	.133	1.678	.3740	.344	.2740	.8640	.4939	.08734	.1328	.1769	.4205	.2989
	80	1.315	.957	.179	2.171	.3112	.344	.2520	.7190	.6388	.10560	.1606	.1653	.4066	.3614
1¼	40	1.660	1.380	.140	2.272	.6471	.434	.3620	1.495	.6685	.1947	.2346	.2913	.5397	.5278
	80	1.660	1.278	.191	2.996	.5553	.434	.3356	1.283	.8815	.2418	.2913	.2743	.5237	.6555
1½	40	1.900	1.610	.145	2.717	.8820	.497	.4213	2.036	.800	.3099	.3262	.3876	.6226	.7340
	80	1.900	1.500	.200	3.631	.7648	.497	.3927	1.767	1.068	.3912	.4118	.3663	.6052	.9265
2	40	2.375	2.067	.154	3.652	1.452	.622	.5401	3.355	1.075	.6657	.5606	.6196	.7871	1.261
	80	2.375	1.939	.218	5.022	1.279	.622	.5074	2.953	1.477	.8679	.7309	.5875	.7665	1.644
2½	40	2.875	2.469	.203	5.79	2.072	.753	.6462	4.788	1.704	1.530	1.064	.8976	.9474	2.394
	80	2.875	2.323	.276	7.66	1.834	.753	.6095	4.238	2.254	1.924	1.339	.8539	.9241	3.012
3	40	3.500	3.068	.216	7.57	3.20	.916	.802	7.393	2.228	3.017	1.724	1.354	1.164	3.879
	80	3.500	2.900	.300	10.25	2.86	.916	.761	6.605	3.016	3.892	2.225	1.291	1.136	5.007
3½	40	4.000	3.548	.226	9.11	4.28	1.047	.929	9.89	2.68	4.788	2.394	1.787	1.337	5.386
	80	4.000	3.364	.318	12.51	3.85	1.047	.880	8.89	3.68	6.280	3.140	1.707	1.307	7.065
4	40	4.500	4.026	.237	10.29	5.51	1.178	1.055	12.73	3.17	7.23	3.214	2.279	1.510	7.23
	80	4.500	3.826	.337	14.98	4.98	1.178	1.002	11.50	4.41	9.61	4.271	2.181	1.477	9.61
5	40	5.563	5.047	.258	14.62	8.66	1.456	1.321	20.01	4.30	15.16	5.451	3.526	1.878	12.26
	80	5.563	4.813	.375	20.78	7.87	1.456	1.260	18.19	6.11	20.67	7.431	3.382	1.839	16.72
6	40	6.625	6.065	.280	18.97	12.51	1.735	1.587	28.99	5.58	28.14	8.50	5.04	2.24	19.12
	80	6.625	5.761	.432	28.57	11.29	1.735	1.510	26.07	8.40	40.49	12.22	4.82	2.19	27.50
8	40	8.625	7.981	.322	28.55	21.6	2.26	2.090	50.0	8.40	72.5	16.81	8.63	2.94	37.8
	80	8.625	7.625	.500	43.39	19.8	2.26	2.006	45.6	12.76	105.7	24.51	8.28	2.88	55.2
10	40	10.750	10.020	.365	40.48	34.1	2.81	2.62	78.9	11.91	160.7	29.90	13.50	3.67	67.3
	80	10.750	9.750	.500	54.74	32.3	2.81	2.55	74.7	16.10	212.0	39.43	13.16	3.63	88.7
12	40	12.750	11.938	.406	53.6	48.5	3.34	3.13	111.9	15.74	300.3	47.1	19.07	4.37	106.0
	80	12.750	11.750	.500	65.4	46.9	3.34	3.08	108.4	19.24	361.5	56.7	18.79	4.33	127.6
14 O.D.	—	14.000	13.250	.375	55	59.7	3.67	3.47	137.9	16.05	372.8	53.2	23.22	4.82	119.8
	80	14.000	13.000	.500	72	57.4	3.67	3.40	132.7	21.21	483.8	69.1	22.81	4.78	155.5
16 O.D.	—	16.000	15.250	.375	63	79.1	4.20	4.00	182.6	18.41	562.1	70.3	30.54	5.53	158.1
	80	16.000	15.000	.500	83	76.5	4.20	3.93	176.7	24.35	731.9	91.5	30.06	5.48	205.9
18 O.D.	—	18.000	17.250	.375	71	101.2	4.71	4.51	233.7	20.76	806.6	89.6	38.85	6.23	201.7
	80	18.000	17.000	.500	93	98.2	4.71	4.45	227.0	27.49	1053.0	117.0	38.31	6.19	263.3
20 O.D.	—	20.000	19.250	.375	79	126.0	5.24	5.04	291.1	23.12	1113	111.3	48.16	6.94	250.5
	80	20.000	19.000	.500	105	122.8	5.24	4.97	283.5	30.63	1457	145.7	47.56	6.90	327.9
24 O.D.	—	24.000	23.250	.375	95	183.8	6.28	6.09	424.6	27.83	1942	161.9	69.79	8.35	364.0
	80	24.000	23.000	.500	125	181.0	6.28	6.02	416.0	36.90	2550	213.0	69.00	8.31	480.0

SUPPORT SPACING FOR ABOVE GROUND CONDUIT SYSTEMS

MAXIMUM SPAN IN FEET BETWEEN SUPPORTS

(CONTINUOUS BEAM)

CONDUIT SIZE (GAGE)

TOTAL WGT. LBS./FT.	6"	8"	10 3/4"	12"	12 3/4"	14"	16"	18"	20"	22"	22"	24"	24"	25"	25"	26"	26"	26"
	(10ga)	(10ga)	(10ga)	(10ga)	(10ga)	(10ga)	(10ga)	(10ga)	(10ga)	(8ga)	(8ga)	(10ga)	(10ga)	(8ga)	(8ga)	(10ga)	(8ga)	(8ga)
450																		
425																		
400																		
375																		
350																		
325																		
300																		
275																		
250																		
225																		
200																		
175																		
150																		
125																		
110																		
100																		
90																		
80																		
70																		
60																		
50																		
40																		
30																		
25																		
20																		
15																		
10																		

LBS./FT.

BASIC DATA

Conduit Wgt.	9.29	12.15	15.19	16.98	18.08	19.84	22.71	25.73	28.61	31.49	36.30	45.20	34.37	41.70	49.35	35.81	43.56	51.42	37.25	45.31	53.49
Ice Load	4.35	5.57	6.87	7.63	8.09	8.86	10.08	11.30	12.52	13.74	13.74	13.74	14.97	14.97	14.97	15.58	15.58	15.58	16.19	16.19	16.19
Wind Load	1.34	1.73	2.16	2.41	2.55	2.81	3.20	3.58	3.98	4.37	3.67	3.15	4.77	4.01	3.43	4.97	4.16	3.57	5.16	4.33	3.72
Supports	1.60	1.80	2.30	2.80	3.20	3.80	5.10	6.50	8.10	9.90	9.90	8.90	12.00	12.00	12.00	12.80	12.80	12.80	13.80	13.80	13.80

ADD WEIGHT OF ALL PIPES, INSULATION PLUS WEIGHT OF WATER IN PIPE LBS./FT.

DESIGN CONDITIONS:

1. FULL WELDED CONNECTORS - 120° CONTACT SADDLES AT SUPPORTS
2. WIND LOAD 60 MPH
3. ICE LOAD 1/2" THICK TOTAL CIRCUMFERENCE
4. MAXIMUM DEFLECTION .1"
5. MAXIMUM COMBINED CONDUIT STRESSES - 18,000 PSI

10.10

APPENDIX H

Fuel Usage and Make-Up Water Records

APPENDIX H

Table of Contents

Industrial Area Building 13 Boiler Plant Log

- Graph of Make-Up Water and Fuel Oil H-1
- Make-Up Water and Fuel Oil Tabular Data H-2
January 1994 Through April 1995 (6 Sheets)

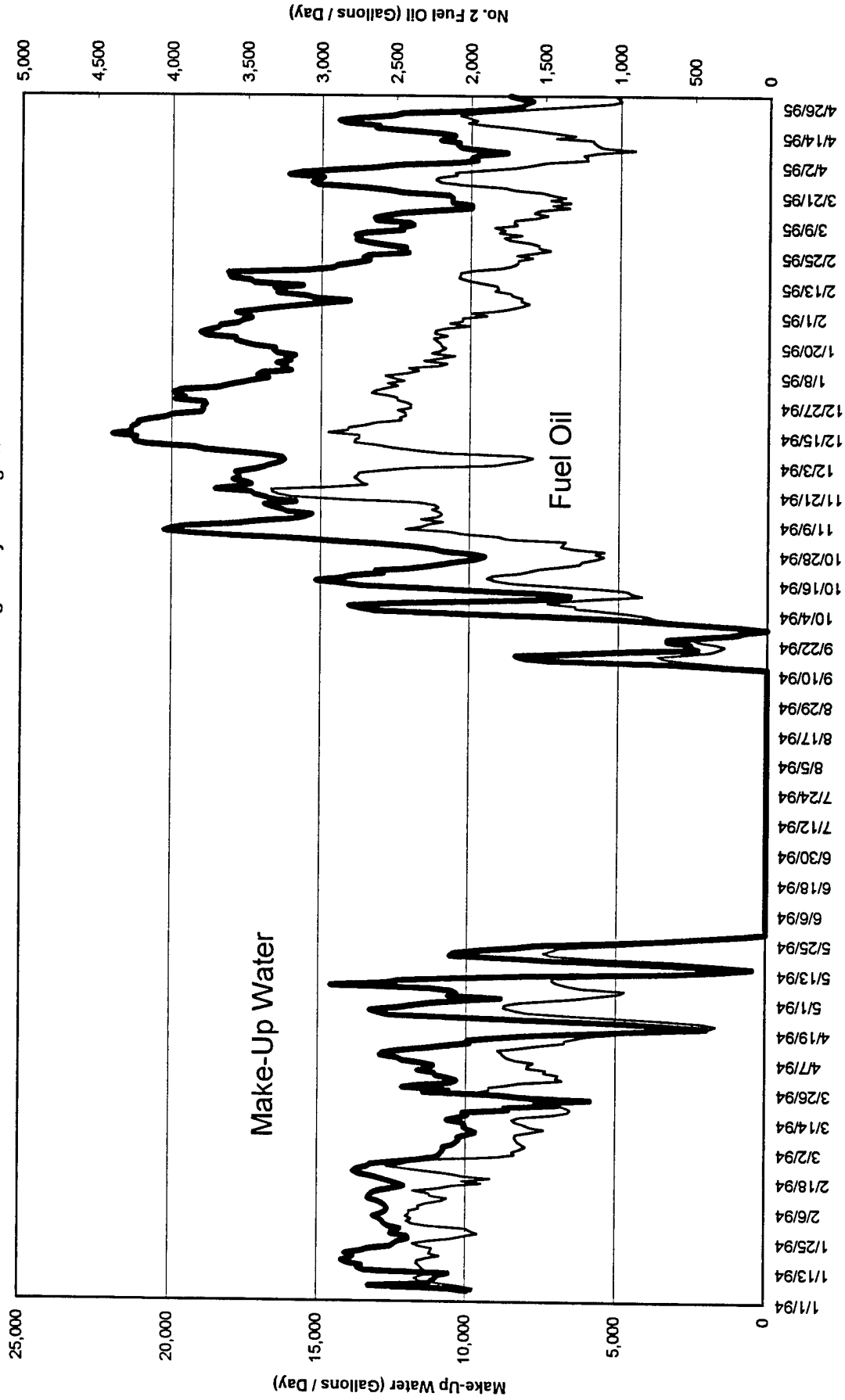
Ordnance Area Building 103-6 Boiler Plant Log

- Graph of Make-Up Water and Fuel Oil H-8
- Make-Up Water and Fuel Oil Tabular Data H-9
January 1994 Through April 1995 (3 Sheets)

Boiler Operating Hour Logs H-12

Hawthorne Army Ammunition Plant Industrial Area Building 13 Boiler Plant Log

Note: Data Plots are Smoothed Using 5-Day Averages.



Hawthorne Steam Plant Building 13 Boiler Log
(Gallons No. 2 Diesel Fuel Oil / Gallons Make-up Water)

Date	January 1994	February 1994	March 1994	April 1994	May 1994	June 1994	July 1994	August 1994	September 1994
1	10,500 2,350	13,100 2,314	11,400 1,717	11,800 1,663	10,100 1,274	- -	- -	- -	- -
2	12,500 2,079	13,100 2,460	11,700 1,708	10,800 1,488	8,100 900	- -	- -	- -	- -
3	11,500 1,834	12,800 2,205	9,400 1,655	11,100 1,542	7,400 999	- -	- -	- -	- -
4	12,600 1,578	12,900 2,375	10,400 1,226	11,900 1,479	17,600 915	- -	- -	- -	- -
5	13,900 1,952	12,300 2,531	9,200 1,787	10,500 1,774	8,500 815	- -	- -	- -	- -
6	13,600 2,285	12,300 2,316	10,900 1,853	11,200 1,646	10,900 1,078	- -	- -	- -	- -
7	14,600 2,589	12,900 2,132	11,200 1,771	12,900 1,303	12,000 2,358	- -	- -	- -	- -
8	14,100 2,484	13,100 2,238	9,600 1,709	14,400 2,168	23,900 1,481	- -	- -	- -	- -
9	12,200 2,223	13,400 2,125	9,000 1,204	12,600 1,742	8,300 1,235	- -	- -	- -	- -
10	13,100 2,120	13,200 2,026	7,700 1,306	13,400 1,893	6,400 979	- -	- -	- -	- -
11	13,500 2,055	13,800 2,028	11,900 1,381	10,700 1,709	1,100 1,031	- -	- -	- -	- -
12	12,600 2,285	12,700 2,700	12,100 2,248	10,000 1,412	- -	- -	- -	- -	- -
13	15,400 2,658	12,700 2,285	9,400 1,893	10,000 1,427	- -	- -	- -	- -	8,500 888
14	13,400 2,336	12,400 2,658	9,500 1,488	9,100 1,119	- -	- -	- -	- -	8,800 900
15	12,600 2,206	10,900 1,174	10,200 1,415	9,600 1,064	1,100 -	- -	- -	- -	18,900 924

Hawthorne Steam Plant Building 13 Boiler Log
(Gallons No. 2 Diesel Fuel Oil / Gallons Make-up Water)

Date	January 1994	February 1994	March 1994	April 1994	May 1994	June 1994	July 1994	August 1994	September 1994
16	13,800	11,700	10,000	11,100	10,900	-	-	-	4,500
	2,159	1,687	1,151	1,665	791	-	-	-	745
17	13,600	13,900	10,600	5,400	10,100	-	-	-	1,400
	2,228	1,673	1,171	991	1,268	-	-	-	233
18	13,900	14,100	10,200	4,500	13,000	-	-	-	-
	2,344	2,950	1,365	943	1,192	-	-	-	-
19	13,000	13,800	1,800	-	7,800	-	-	-	-
	1,925	1,696	1,390	-	2,477	-	-	-	-
20	13,900	12,600	10,900	-	11,000	-	-	-	5,700
	2,551	2,125	1,585	-	1,410	-	-	-	690
21	13,300	13,800	1,050	-	10,300	-	-	-	5,900
	2,120	2,183	1,395	-	1,074	-	-	-	506
22	12,200	14,600	14,400	11,800	6,100	-	-	-	1,300
	2,172	2,295	1,822	722	977	-	-	-	491
23	10,100	13,500	1,100	12,000	6,900	-	-	-	3,900
	2,784	3,696	1,572	1,372	924	-	-	-	581
24	12,500	12,100	13,200	13,000	4,200	-	-	-	0
	2,120	2,353	1,605	1,223	788	-	-	-	201
25	13,200	12,100	15,000	12,800	-	-	-	-	0
	2,028	1,615	2,046	1,582	-	-	-	-	174
26	11,600	9,700	13,500	13,500	-	-	-	-	0
	1,353	1,910	2,546	1,707	-	-	-	-	0
27	12,400	10,400	10,100	13,600	-	-	-	-	0
	1,788	1,433	1,445	2,097	-	-	-	-	163
28	12,800	10,800	8,900	13,300	-	-	-	-	0
	2,291	1,671	1,573	1,807	-	-	-	-	162
29	12,300	-	10,900	8,700	-	-	-	-	4,700
	2,361	-	1,052	1,552	-	-	-	-	760
30	11,900	-	9,200	9,900	-	-	-	-	6,800
	2,184	-	1,555	1,559	-	-	-	-	872
31	13,600	-	12,500	-	-	-	-	-	-
	2,647	-	1,145	-	-	-	-	-	-

Hawthorne Steam Plant Building 13 Boiler Log (Gallons No. 2 Diesel Fuel Oil / Gallons Make-up Water)

Date	October 1994	November 1994	December 1994
1	7,500	15,200	15,900
	922	1,327	2,147
2	6,100	19,000	17,200
	979	1,233	1,753
3	12,400	20,900	15,600
	462	2,675	0
4	19,710	21,200	16,800
	1,360	2,429	2,161
5	20,000	20,200	15,700
	1,729	2,524	2,094
6	10,100	19,900	16,200
	1,899	1,807	1,867
7	7,900	17,900	20,000
	986	2,683	2,115
8	5,200	18,300	20,600
	1,388	2,179	2,712
9	5,100	13,200	22,000
	840	2,172	3,044
10	6,160	16,600	17,600
	597	2,037	2,880
11	8,600	14,100	23,800
	385	2,528	2,359
12	12,200	15,500	22,100
	1,362	2,150	2,879
13	16,100	17,100	20,800
	1,541	2,025	2,693
14	14,400	17,400	21,500
	1,762	2,247	2,903
15	16,900	17,500	21,500
	2,122	2,295	2,899

Hawthorne Steam Plant Building 13 Boiler Log

(Gallons No. 2 Diesel Fuel Oil / Gallons Make-up Water)

Date	October 1994	November 1994	December 1994
16	11,600 1,748	15,800 2,299	20,800 3,365
17	16,700 1,942	16,700 2,344	22,100 2,249
18	12,000 1,804	11,800 2,607	20,600 2,639
19	12,500 1,557	21,600 4,785	20,600 2,322
20	11,600 1,226	18,700 3,946	21,500 2,576
21	12,900 1,370	17,500 2,748	18,900 2,497
22	11,300 1,673	17,100 2,564	19,300 2,314
23	8,700 1,043	17,700 2,629	19,600 2,433
24	9,900 979	18,400 2,796	15,700 2,341
25	9,100 1,145	16,000 2,697	21,200 2,836
26	9,800 913	18,400 2,966	19,100 2,068
27	9,900 1,395	19,200 2,660	18,700 2,290
28	11,000 1,325	16,700 2,758	19,800 2,571
29	14,600 689	18,600 2,680	20,600 2,670
30	10,800 2,137	16,400 2,656	19,600 2,836
31	13,300 1,363	- -	20,600 2,341

Hawthorne Steam Plant Building 13 Boiler Log (Gallons No. 2 Diesel Fuel Oil / Gallons Make-up Water)

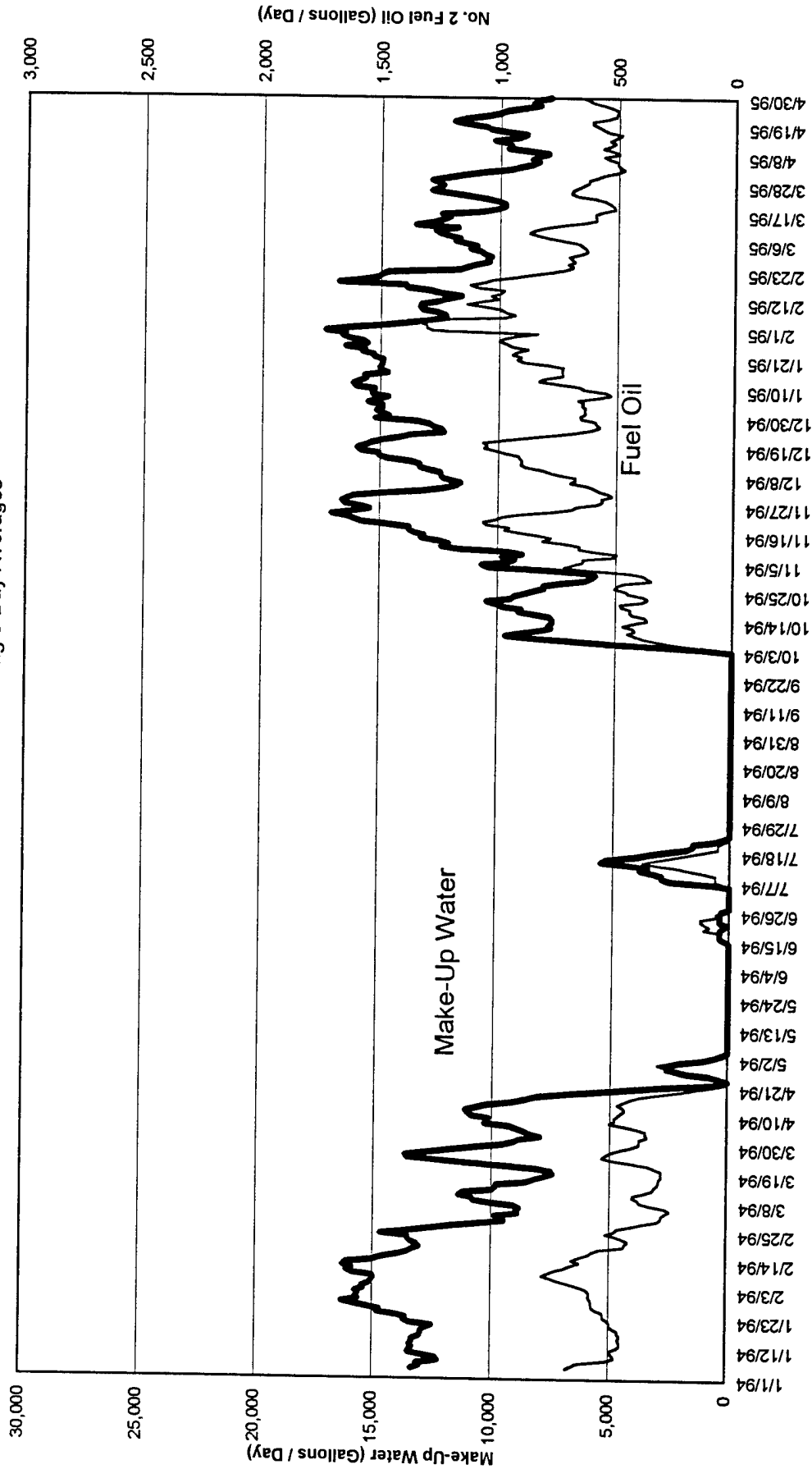
Date	January 1995	February 1995	March 1995	April 1995
1	19,100 2,886	18,700 1,514	15,500 1,430	9,000 1,215
2	18,700 2,426	20,200 1,880	15,000 2,140	11,900 1,382
3	14,300 2,344	14,100 1,652	11,900 1,707	8,800 1,192
4	18,100 2,416	14,600 1,476	13,500 1,540	10,000 984
5	18,400 2,694	12,100 1,774	13,400 1,473	10,200 1,330
6	17,100 2,319	14,400 1,229	13,500 2,168	7,800 1,338
7	16,000 2,800	15,100 2,170	9,000 1,944	7,100 865
8	16,100 2,605	20,100 1,603	12,400 2,056	13,200 0
9	17,500 1,688	15,900 1,810	11,300 788	13,300 2,068
10	13,400 2,301	16,900 1,834	14,000 1,592	10,800 1,507
11	18,500 2,656	14,200 1,744	19,200 2,128	7,600 1,442
12	15,400 1,758	15,800 2,059	9,200 1,241	10,100 920
13	17,700 2,347	15,400 1,674	10,200 1,670	11,400 1,201
14	15,200 2,477	24,000 2,295	8,700 1,241	12,800 1,445
15	14,200 1,794	17,500 2,299	8,200 1,431	13,300 2,170

Hawthorne Steam Plant Building 13 Boiler Log
(Gallons No. 2 Diesel Fuel Oil / Gallons Make-up Water)

Date	January 1995	February 1995	March 1995	April 1995
16	16,900	17,500	13,600	13,400
	2,131	2,045	1,107	2,073
17	18,400	16,100	9,100	15,100
	2,528	2,016	1,798	1,616
18	18,400	15,500	13,400	10,900
	2,079	1,671	1,086	2,098
19	14,900	11,200	8,700	18,200
	2,270	1,901	1,902	2,131
20	17,600	12,900	8,200	14,500
	1,942	1,317	928	1,861
21	18,700	16,600	14,300	10,000
	2,172	1,655	1,549	2,344
22	19,800	13,200	16,700	9,500
	2,660	1,870	2,120	1,919
23	18,400	13,100	16,100	9,300
	2,177	1,660	2,032	1,540
24	19,900	12,200	12,900	6,300
	1,814	1,424	2,251	993
25	18,400	12,100	15,800	8,700
	2,361	1,824	2,291	860
26	17,400	9,800	15,100	7,500
	2,143	1,086	2,304	956
27	18,100	14,000	15,500	9,000
	2,349	1,333	2,293	931
28	18,200	12,700	15,400	8,200
	1,361	2,042	1,950	1,244
29	16,900	-	18,700	8,400
	2,460	-	1,616	1,095
30	17,700	-	13,600	10,400
	1,928	-	2,368	947
31	15,800	-	9,200	-
	2,165	-	1,314	-

Hawthorne Army Ammunition Plant Ordnance Area Building 103-6 Boiler Plant Log

Note: Data Plots Smoothed Using 5-Day Averages



Hawthorne Steam Plant Building 103-6 Boiler Log

(Gallons No. 2 Diesel Fuel Oil / Gallons Make-Up Water)

Day of Month	January 1994		February 1994		March 1994		April 1994	
	Water	Fuel	Water	Fuel	Water	Fuel	Water	Fuel
1	5,190	1,346	6,100	1,643	3,630	836	3,120	734
2	6,120	1,305	5,720	1,622	2,050	1,059	3,420	867
3	11,690	1,808	5,790	1,536	2,350	912	2,770	575
4	6,880	1,174	6,200	1,570	2,680	1,007	4,580	1,109
5	4,100	1,042	7,870	1,355	2,560	636	3,410	1,042
6	4,180	1,172	8,160	1,492	2,530	869	5,080	887
7	4,800	1,370	7,840	1,585	3,230	992	6,170	1,041
8	5,660	1,361	7,260	1,491	5,410	1,050	5,790	1,082
9	5,030	1,216	8,050	1,588	4,820	1,527	3,560	1,062
10	4,380	1,351	6,670	1,776	3,060	963	3,460	1,008
11	4,770	1,437	6,860	1,609	3,620	888	4,480	1,248
12	4,790	1,349	5,760	1,473	2,940	1,255	5,420	1,117
13	4,120	1,312	5,860	1,688	3,050	978	4,930	1,129
14	4,490	1,259	6,120	1,518	3,110	919	3,990	853
15	4,520	1,305	8,350	1,230	2,700	881	4,630	775
16	5,060	1,440	5,120	1,390	2,980	875	3,210	715
17	4,310	1,194	4,000	1,143	2,680	613	3,800	787
18	4,690	1,289	5,120	1,492	3,050	799	2,970	919
19	4,450	1,244	4,680	1,424	2,550	718	0	216
20	5,640	1,236	3,100	1,083	2,920	709	0	0
21	5,730	1,293	4,760	1,441	2,770	916	0	0
22	4,270	1,655	3,330	1,272	4,020	952	0	0
23	5,230	1,407	6,270	1,552	4,560	1,485	0	0
24	5,350	1,209	6,120	1,424	6,100	1,457	0	0
25	5,630	1,474	5,230	1,643	6,710	1,382	0	173
26	5,970	1,661	3,020	888	5,200	1,518	2,520	217
27	5,700	1,607	2,750	835	3,340	980	7,620	511
28	5,970	1,660	3,250	1,120	3,470	988	3,120	240
29	5,500	1,485			4,390	1,021	0	167
30	5,570	1,736			4,170	883	1,630	134
31	6,200	1,326			3,560	926		

Hawthorne Steam Plant Building 103-6 Boiler Log

(Gallons No. 2 Diesel Fuel Oil / Gallons Make-Up Water)

Day of Month	May 1994		June 1994		July 1994		October 1994		November 1994	
	Water	Fuel	Water	Fuel	Water	Fuel	Water	Fuel	Water	Fuel
1	20	0	0	0	0	0	0	0	5,030	799
2	0	0	0	0	0	0	0	0	7,410	1,017
3	0	0	0	0	0	0	0	0	11,510	1,265
4	0	0	0	0	0	0	4,080	510	6,480	1,473
5	0	0	0	0	0	0	4,050	970	3,580	779
6	0	0	0	0	630	0	4,440	1,143	2,990	252
7	0	0	0	0	540	380	3,680	824	7,430	867
8	0	0	0	0	1,760	891	2,820	824	5,070	1,539
9	0	0	0	0	0	174	5,940	1,064	5,620	1,044
10	0	0	0	0	0	0	5,430	640	8,270	1,120
11	0	0	0	0	3,060	216	2,940	767	6,570	1,311
12	0	0	0	0	3,960	639	4,030	574	7,170	1,186
13	0	0	0	0	4,380	721	4,970	881	8,100	1,383
14	0	0	0	0	4,290	611	3,820	982	10,410	1,267
15	0	0	0	0	2,910	564	2,390	638	6,480	1,480
16	0	0	1,260	74	0	105	3,460	823	9,600	1,250
17	0	0	860	123	0	0	6,780	906	10,810	1,402
18	0	0	0	0	1,140	445	5,530	1,203	11,250	1,477
19	0	0	0	0	1,270	203	3,620	925	9,460	1,271
20	0	0	3,330	0	0	140	4,220	1,042	11,360	1,916
21	0	0	0	0	0	0	3,860	934	10,280	1,823
22	0	0	1,860	33	0	0	1,930	1,118	8,180	1,554
23	0	0	910	170	0	0	4,470	704	9,810	1,631
24	0	0	0	0	0	0	4,720	856	5,580	1,588
25	0	0	0	0	0	0	7,210	818	4,690	1,501
26	0	0	0	0	0	0	4,560	752	6,360	1,434
27	0	0	0	0	0	0	4,220	886	6,970	1,770
28	0	0	0	0	0	0	4,060	723	5,300	1,946
29	0	0	0	0	0	0	3,220	499	4,560	1,649
30	0	0	0	0	0	0	1,270	293	4,990	1,372
31	0	0			0	0	5,610	617		

Hawthorne Steam Plant Building 103-6 Boiler Log

(Gallons No. 2 Diesel Fuel Oil / Gallons Make-Up Water)

Day of Month	December 1994		January 1995		February 1995		March 1995		April 1995	
	Water	Fuel	Water	Fuel	Water	Fuel	Water	Fuel	Water	Fuel
1	4,070	1,307	5,260	1,585	29,231	1,639	5,990	957	4,610	814
2	7,770	1,091	6,450	1,547	11,970	1,246	5,650	1,188	3,360	765
3	7,320	1,176	6,120	1,442	8,990	1,218	7,200	1,063	4,150	788
4	5,540	1,230	7,490	1,618	9,350	1,130	7,350	1,281	7,660	1,068
5	6,680	1,100	6,850	1,563	9,860	1,266	6,370	998	5,360	885
6	7,520	1,207	6,330	1,421	8,810	1,260	6,850	1,168	4,490	685
7	6,660	1,311	2,390	1,293	9,700	1,269	8,560	1,429	5,280	905
8	7,280	1,336	3,280	1,769	11,020	1,378	10,340	968	5,320	651
9	9,010	1,263	8,660	1,626	10,280	1,451	9,720	1,523	4,400	858
10	8,710	1,117	11,270	1,504	13,260	1,317	8,230	1,188	6,430	1,288
11	9,250	1,462	7,540	1,830	12,580	1,230	5,890	1,259	6,810	1,131
12	10,030	1,487	6,800	1,350	6,810	939	6,160	954	3,830	849
13	8,320	1,329	7,300	1,636	7,440	1,195	6,780	1,849	4,120	712
14	8,690	1,450	7,590	1,478	11,750	1,134	5,190	1,193	5,600	1,142
15	9,260	1,627	7,350	1,540	11,180	1,739	5,570	960	5,100	770
16	9,510	1,632	7,480	1,346	11,880	1,469	6,090	1,100	5,640	973
17	12,750	1,489	7,040	1,504	12,420	1,420	6,190	1,131	6,760	1,265
18	10,220	1,706	6,960	1,640	9,010	1,217	5,270	993	5,300	1,079
19	11,290	1,525	10,850	1,438	8,880	1,055	2,540	885	6,580	1,230
20	8,560	1,448	12,510	1,528	9,460	1,204	5,880	782	6,350	1,148
21	10,420	1,496	8,970	1,337	7,410	1,172	6,870	1,118	5,630	1,256
22	7,980	1,255	6,140	1,685	8,640	1,341	7,140	1,284	3,570	1,062
23	5,540	1,350	8,890	1,659	4,920	1,087	7,350	1,251	3,540	636
24	5,980	1,308	9,930	1,673	5,440	1,047	6,630	1,259	6,270	934
25	3,810	742	10,220	1,477	8,080	1,039	6,970	1,160	6,030	998
26	7,040	1,547	12,100	1,749	8,540	990	6,570	1,485	6,840	883
27	6,270	1,442	7,310	1,215	7,120	1,064	6,040	1,126	5,380	716
28	6,240	1,430	10,480	1,750	5,570	1,128	6,120	1,162	5,790	791
29	6,370	1,574	9,070	1,957			5,720	1,361	7,250	840
30	6,710	1,602	7,680	1,640			6,820	1,310	7,340	708
31	7,170	1,265	7,390	1,675			4,830	1,133		

Hawthorne Army Ammunition Plant - Boiler Operating Hour Log

Boiler Building 13 - Industrial Area

Boiler Number / Hours per Month				
Month/Year	No. 1	No. 2	No. 3	Total
Jan-94	403.0	375.0	407.0	1185.0
Feb-94	374.5	334.0	375.5	1084.0
Mar-94	254.0	273.0	257.0	784.0
Apr-94	223.0	0	270.5	493.5
May-94	0	0	245.0	245.0
Jun-94	0	0	0	0
Jul-94	0	0	0	0
Aug-94	0	0	0	0
Sep-94	0	0	0	0
Oct-94	6.0	237.0	229.0	472.0
Nov-94	317.0	322.5	312.0	951.5
Dec-94	523.5	81.0	524.0	1128.5
Jan-95	330.0	308.5	326.5	965.0
Feb-95	222.0	238.0	256.5	716.5
Mar-95	253.0	210.0	234.0	697.0
Apr-95	194.0	196.5	172.0	562.5
Total	3100.0	2575.5	3609.0	9284.5

3,546.5

2,941.0 -17.07% for April
from 1994 to 1995

Boiler Building 103-6 - Ordinance Area

Boiler Number / Hours per Month				
Month/Year	No. 24	No. 25	No. 26	Total
Jan-94	381.0	361.0	0	742.0
Feb-94	339.0	230.0	0	569.0
Mar-94	302.5	397.5	0	700.0
Apr-94	228.5	233.5	0	462.0
May-94	0	0	0	0
Jun-94	0	0	0	0
Jul-94	0	0	170.0	170.0
Aug-94	0	0	0	0
Sep-94	0	0	0	0
Oct-94	212.0	334.0	0	546.0
Nov-94	291.0	416.0	0	707.0
Dec-94	352.0	371.0	0	723.0
Jan-95	223.0	145.0	381.0	749.0
Feb-95	187.0	218.0	253.0	658.0
Mar-95	396.0	0	169.0	565.0
Apr-95	356.0	0	359.0	715.0
Total	3268.0	2706.0	1332.0	7306.0

2,473.0

2,687.0 +8.65% for April
from 1994 to 1995