OLIGSCHLAGER

Frank Bowers Jr

J Stroche - please review this and discuss with me.
JLH
5/6/82

Rehabilitation of Downtown Kansas City, Missouri Steam Distribution System Years 1985 - 2005

Submitted To: J. L. Hogan
Director, T&D Engineering

Prepared By: J. Gawron
R. B. Friedrich
R. Cocayne
T. M. Theisen
J. R. Bolton

April 23, 1982

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April 23, 1982

TO: J. L. Hogan
FROM: J. Gawron
REF: Kansas City, Missouri Downtown Steam Distribution System

The attached report titled Rehabilitation of Downtown Kansas City Missouri Steam Distribution System Years 1985 - 2005 is submitted for your use in developing the KCP&L Long Range Steam Heat Planning Study being prepared for the Electric Supply Coordinating Committee.

The purpose of this report is to provide reasonable plans of action for the rehabilitation of the downtown steam distribution system that can be used in analyzing and evaluating alternatives as set out in the Statement of Scope for the Long Range Steam Heat Planning Study dated March, 1982. Alternative plans with costs and discussion as to advantages and disadvantages are included. In addition a discussion of alternatives that were considered but not included in the report are included.

I hope this report will serve your purpose and the Electric Supply Coordinating Committee.

J. Gawron

JG/rgl

Attachment

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SCHEDULE 3-2

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Rehabilitation of Downtown Kansas City, Missouri Steam Distribution System Years 1985 - 2005

INTRODUCTION

This report addresses the viable alternatives that Kansas City Power & Light Co. has for the rehabilitation of the downtown steam distribution system for the period of 1985 - 2005. Plans or combination of plans are to be integrated with a study titled KCP&L LONG RANGE STEAM HEATING PLANNING STUDY that is to be prepared by the Electric Supply Coordinating Committee (ESCC).

A report titled A STUDY OF KCP&L STEAM HEAT BUSINESS dated December 19, 1981 was prepared by the Corporate Planning Department. This report addresses the history of the Kansas City Power & Light steam system, physical characteristics and alternatives to continued operation. The reader is referred to this report for specific details of the system.

The Kansas City Power & Light steam distribution system as considered in this report includes all facilities and equipment involved in the distribution of steam to customers in the downtown Kansas City, Missouri area outside of Grand Avenue Station. These facilities include transmission and distribution mains, expansion joints, traps, valves, manholes, pressure reducing stations, customer services and metering. In order to adequately evaluate alternative plans for the rehabilitation of the downtown steam system it is desirable to understand how the steam system presently operates.

As shown in Figure 1, steam at 185# is delivered from Grand Avenue Station to pressure reducing stations located at 604 Baltimore and 1319 Wyandotte through two separate mains which basically loop the present 15# low pressure distribution

system. Along with the transmission mains a stainless steel line supplies pure water to each pressure reducing station to desuperheat 185# steam after it has been reduced to 15#. The 15# distribution system is a grid to which customers are connected as shown on a typical service drawing, Figure 5. The 15# steam sales is approximately 90% of the total steam sales.

The majority of the customers on the system are metered using condensate meters. In 1980 there were approximately 230 condensate meters on the system. In addition there were approximately 10 customers connected to the 185# transmission system who were metered by using flow meters.

The scope of this report is to provide long range plans for the rehabilitation and expansion of the downtown steam system. This report will consider three major topics and plans that may be implemented in the period from 1985 to the year 2005. The three topics for the rehabilitation of the downtown steam distribution system are:

I. Retain Existing 15#, 105# and 185# Systems

II. Expansion of Downtown Steam System

III. Metering

I. RETAIN EXISTING 15#, 105# AND 185# SYSTEMS

Plan 1. Replace 100% of the 15# Distribution System

The downtown steam distribution system consists of 30,340' of 15# mains ranging in size from 4" to 20". There are over 200 service connections to this system. The route and depth of the mains should not be changed because the streets and alleys have telephone, gas, water, electric conduit, sewer and telegraph, already in place. Construction

conflicts would be avoided by placing new steam mains in the same location as the existing mains. The condensate which collects in the mains needs to be trapped out in trap manholes. If the existing trap system which is connected to the sewer system is to be maintained it is necessary to maintain the existing grade of the distribution mains. Most all customer service connections slope back to the distribution main located in the alley or street, and if this were changed, it would be necessary to install traps in the customer's buildings.

We recommend that the existing 105# system not be expanded to connect new customers. At present there are only five customers connected to this system, they are the Continental, Muehlebach, President and Phillips Hotels, and the Kansas City Club. It may be more feasible in the future to convert this system to a 185# pressure. However, new pressure reducing stations would be required by the five customers presently connected to the 105# system. This would allow KCP&L to eliminate the 105# pressure reducing equipment at 1319 Wyandotte.

Under this plan we are proposing to rebuild only the 15# distribution system. This is because there has been little history of 185# transmission line pipe failure. There have been expansion joint failures and pipe failures due to water hammer but these are part of normal maintenance problems.

Some of the construction details that will have to be worked out if the entire 15# distribution system is replaced would be: 1) How would service be maintained during the construction? 2) What would be the schedule of construction? 3) Would it be feasible to do this work only in the summer and spread the work over the entire 20-year period that this study covers? 4) Would it be possible to relocate some of the distribution mains for serving particular customers in an alley or street a half a block away from where they are served now?

As indicated from the above questions a detailed study of each individual customer and section of main would need to be made. It is obvious that under this plan some pipe that has a useful service life left in it would be replaced.

The cost for Plan 1 is based on an estimated cost of $500/foot, which includes material and labor, and in addition, the labor to remove the existing steam main and make connections to the existing customer services.

The 1982 estimated cost is $15,170,000.

Plan 2. Replace 60% of the 15# Distribution System and 25% of the 185# Transmission System

a) According to Mapping Department records, approximately 58% of the existing 15# distribution system was installed prior to 1920. This amounts to 17,691' that would be replaced under this plan and assumes this pipe to have reached the end of its useful service life.

The Construction Department maintains that pipe this age is deteriorated and has been the cause of maintenance problems in the past. In addition, the variators, joints, and bolted fittings are also failing. These variators and flanged pipe joints are located along the entire 15# distribution system and when replacement of a variator or a flanged joint is required it is necessary to replace a full section of pipe on both sides of the fitting, because this old pipe cannot be welded. Therefore, under this plan, it is far more likely that pipe which has reached its expired service life would be replaced. (See Figure 2).

b) This plan also includes replacing 5,901' of 185# transmission line piping installed in and prior to the 1930's. Presently, there has been little history of failure of this pipe, but for the period of 1985 - 2005 it may be reasonable to assume this portion of piping to have reached the end of its useful service life. The cost for Plan 2 is based on an estimated cost of $500/foot including material and labor. (See Figure 3).

The total 1982 estimated cost is $11,796,000

Plan 3. Replace 40% of the 15# Distribution System

This plan is a variation of Plan 2(a), and it provides an alternative to the amount of pipe to be scheduled for replacement. Approximately 40% of the existing 15# distribution system was installed prior to 1910. This amounts to 11,747' that would be replaced under this plan.

The 1982 estimated cost is $5,873,500.

Plan 4. Replace all 15# Distribution System Variators

The original construction of the 15# steam distribution system used variators for what is presently called expansion joints. Presently when a variator fails it is replaced with a new type expansion joint. It is reasonable to assume that in the period of 1985 - 2005 that the existing variators in the ground will have reached the end of their service life. This plan proposes to replace all these variators which are located every 50', and it is estimated there are 221 in service. The cost of this plan is based on $8,750/joint which includes material and labor.

The 1982 estimated cost is $1,933,750

II. EXPANSION OF THE DOWNTOWN STEAM SYSTEM

When one considers the rehabilitation of the downtown steam system, a logical consideration along with rehabilitation is the expansion of the entire system. The following table is a list of alternative plans and their costs that are proposed for your consideration. This expansion assumes an increase in load, and it would only be justified if there is an increase in steam usage.

Plan	Description of Plan	1982 Est. Cost
Plan 1 Fig 101	Complete 185# pipe loop on Holmes Street.	$ 820,000
Plan 2 Fig 102	Third 185# pipe from GAS to 185# system at Admiral & Holmes	$1,600,000
Plan 3 Fig 103	Third 185# pipe and second pure water pipe from GAS to a third pressure reducing station near center east side of 15# grid and complete 185# pipe loop on Holmes St. (Increases 15# system capacity 50%)	$4,600,000

Expansion of the Downtown Steam System Table (Continued)

Plan	Description of Plan	1982 Est. Cost
Plan 4 Fig 104	Third 185# pipe and second pure water pipe from GAS to third and fourth pressure reducing stations near north and south ends on east side of 15# grid and complete pipe loops on Holmes Street and 14th Street. (Increases 15# system capacity 100%)	$7,075,000
Plan 5 Fig 105	New 185# pipe loop from 14th Street to Pershing Road. Note: This assumes third 185# pipe from GAS and Holmes Street pipe loop are existing.	$4,000,000

III. METERING

Plan 1. Install Flow Meters on All 15# System Services

In the future, as steam rates increase and the customer's condensate piping deteriorates to an extent that in order for the Company to ensure that all customers are paying for steam used, it is reasonable to propose the plan of installing "up-front" metering. This type of metering could replace condensate metering, where the customer is metered after he has used the steam. In order to accurately measure steam usage on the 15# system with a meter other than a condensate meter, it is necessary to install pressure temperature type compensation metering.

The 1982 estimated cost is $2,400,000.

The alternative to this type of metering would be a vigorous inspection of the existing meters to ensure that all condensate is being metered on the customer's premises. This would be normal maintenance costs.

SUMMARY OF ABOVE TOPICS

1982 Cost

I. RETAIN EXISTING 15#, 105# AND 185# SYSTEMS

Plan 1.

Replace 100% of the 15# distribution system.

30,340' X $500/ft.----------$15,170,000

Plan 2.

a. Replace 58% of the 15# distribution system.

17,691' X $500/ft.----------$ 8,845,500

b. Replace 25% of the 185# transmission system.

5,901' X $500/ft.----------$ 2,950,500

Total Cost for Plan 2----------$11,796,000

Plan 3.

Replace 40% of the 15# distribution system.

11,747' X $500/ft.----------$ 5,873,500

Plan 4.

Replace all 15# distribution system variators.

221 X 8,750/each----------$ 1,933,750

II. EXPANSION OF DOWNTOWN STEAM SYSTEM

Plan 1. See Figure 101----------$ 820,000

Plan 2. See Figure 102----------$1,600,000

Plan 3. See Figure 103----------$4,660,000

Plan 4. See Figure 104----------$7,075,000

Plan 5. See Figure 105----------$4,000,000

III. METRING

Plan 1.

Install flow meters on all 15# system services.

$12,000/customer X Approx. 200 customers--$2,400,000

Many ideas and plans were discussed in preparing this study. A few of them are as follows:

1. Increase pressure on the distribution system to compensate for increase in load. This would also be required if extensive sleeving of distribution mains is done in the future. However, if pressures are increased it must be considered that the original equipment, variators and flanges, are rated at only 50 psig. These would have to be replaced. Sleeving of pipe has only a $5/foot labor savings as opposed to replacing with new construction. It must also be considered that with sleeving the insulation is not renewed and whatever caused the attack on the deteriorated pipe may still be present when the main is sleeved.
2. If the 15# distribution system is converted to 185# then all new piping would be required and KCP&L would have to maintain a dual system until the conversion was completed. A high pressure distribution system as such would increase the Company's liability exposure and from a maintenance standpoint is much harder to maintain.
3. Another idea discussed was returning condensate to the pressure reducing stations and to Grand Avenue. This would eliminate the need for 100% makeup at Grand Avenue but the cost could be too prohibitive to install a complete condensate return system in downtown Kansas City.

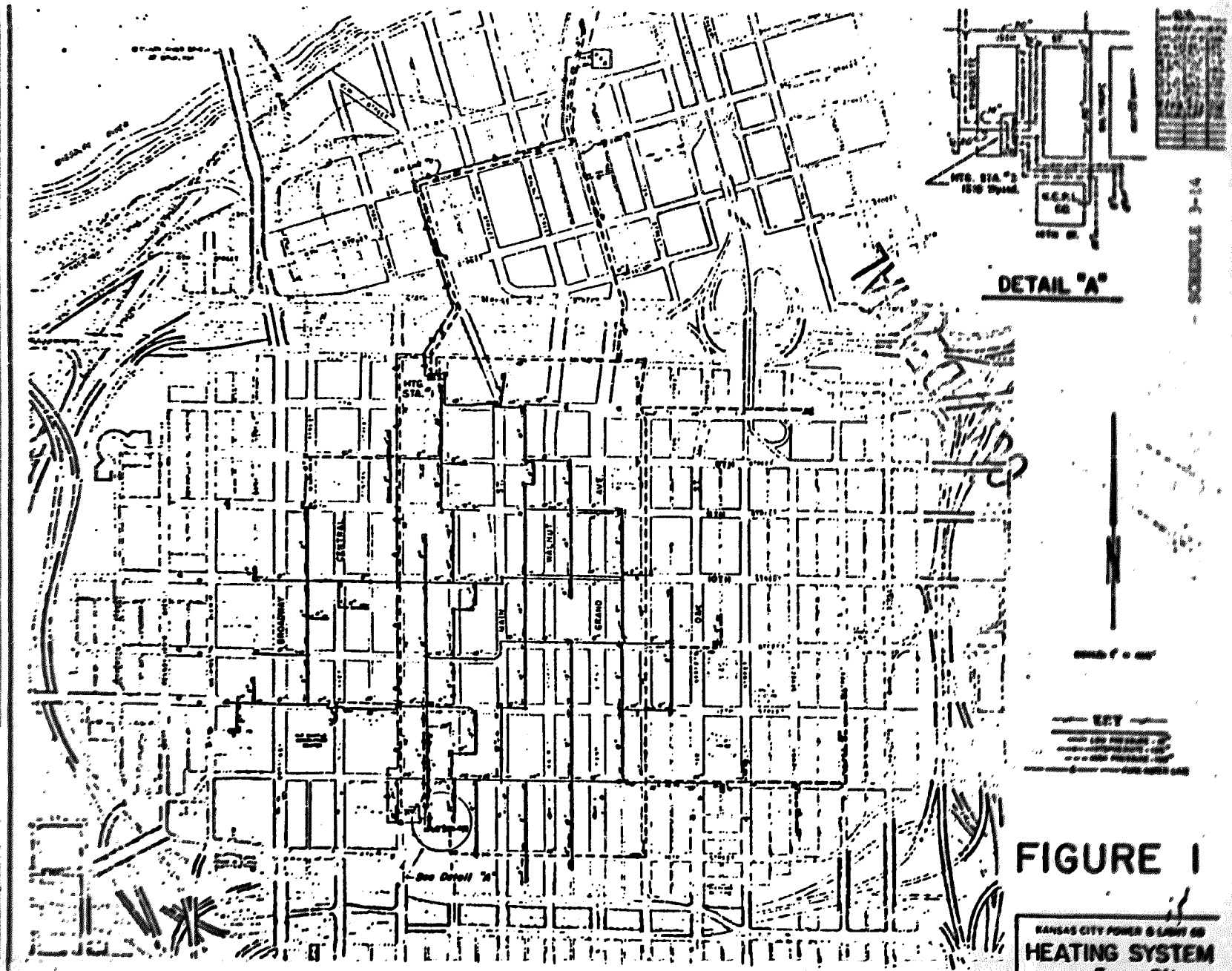
A LEAK IN THE SLEEVED PIPE IS HARD TO FIND

4. This study assumes that the two existing pressure reducing stations will require routine maintenance to maintain their present state of operation but will not require any major rehabilitation before the year 2005. The metering in both stations is to be upgraded and new control air equipment will be installed in both stations.

The stated objective of this report is to provide long range plans for the rehabilitation of the downtown steam system. However, the preparers of this report feel that it is also necessary to propose as a plan the concept of maintaining the existing system as is. By using past experience along with documentation of failure rates, types of failure and failure locations, a preventative maintenance schedule could be arrived at. This preventative maintenance would be in addition to routine maintenance and repair of existing facilities.

A study to determine the most economic balance between capital cost and maintenance cost may need to be undertaken in order to provide a basis for making long range decisions concerning rehabilitation of the downtown steam system.

LIST OF FIGURES AND TABLES


DETAIL "A"
KEY
FIGURE 1
HEATING SYSTEM

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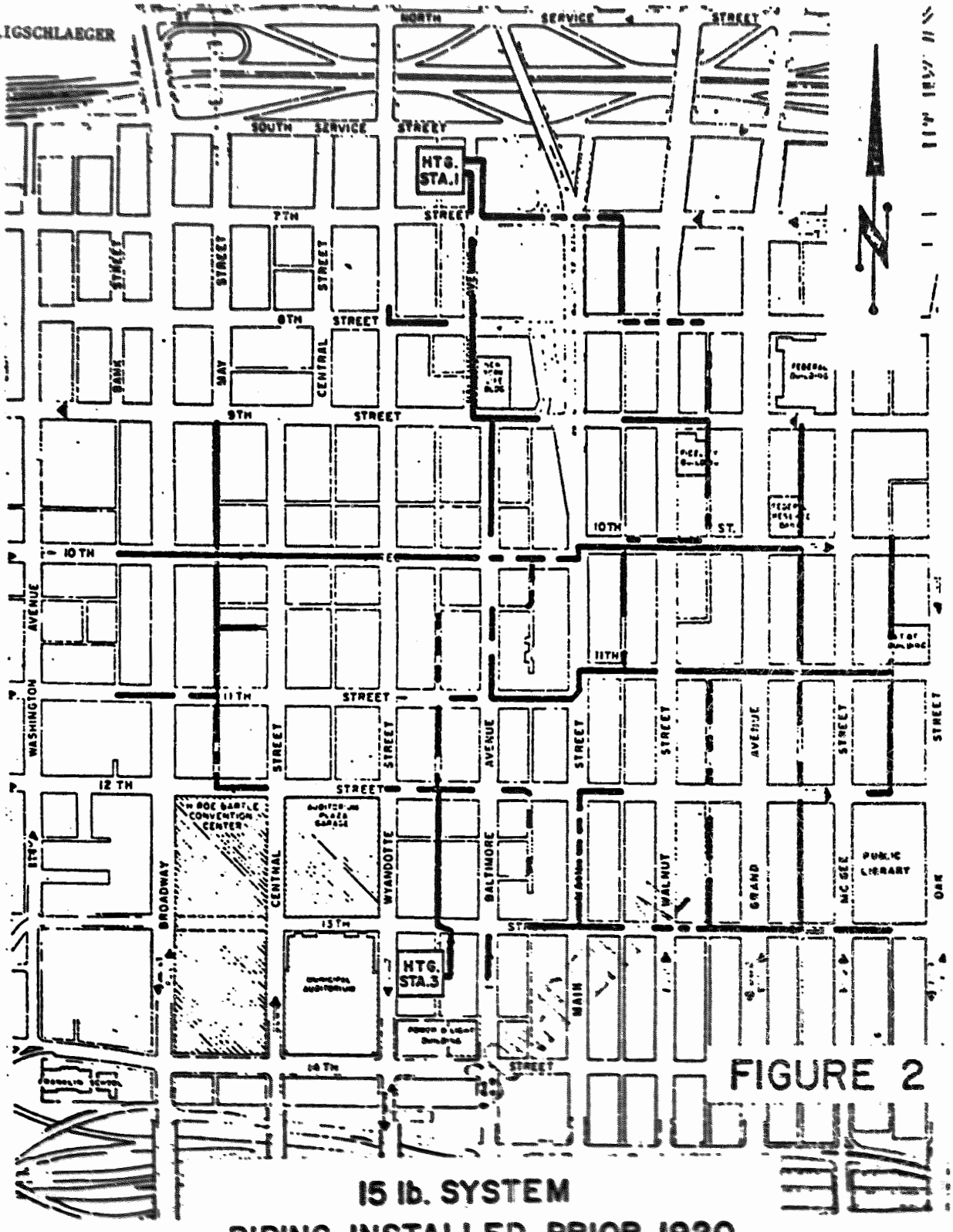

FIGURE 2

15 lb. SYSTEM

PIPING INSTALLED PRIOR 1920

FOOTAGE: 17,691'

SCHEDULE 3-15

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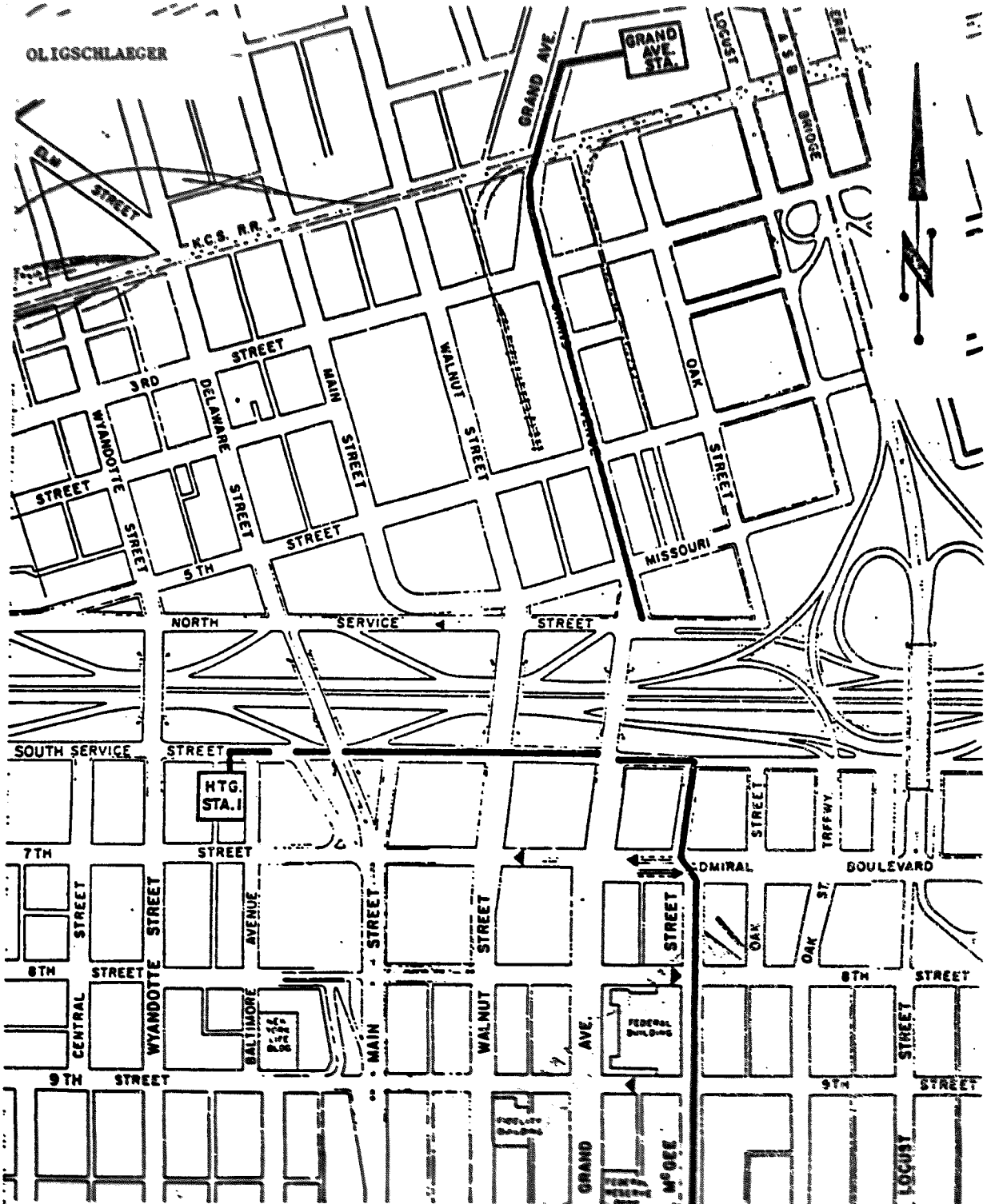

185 lb. SYSTEM
PIPING INSTALLED PRIOR TO 1930'S
FOOTAGE: 5901'

FIGURE 3

SCHEDULE 3-16

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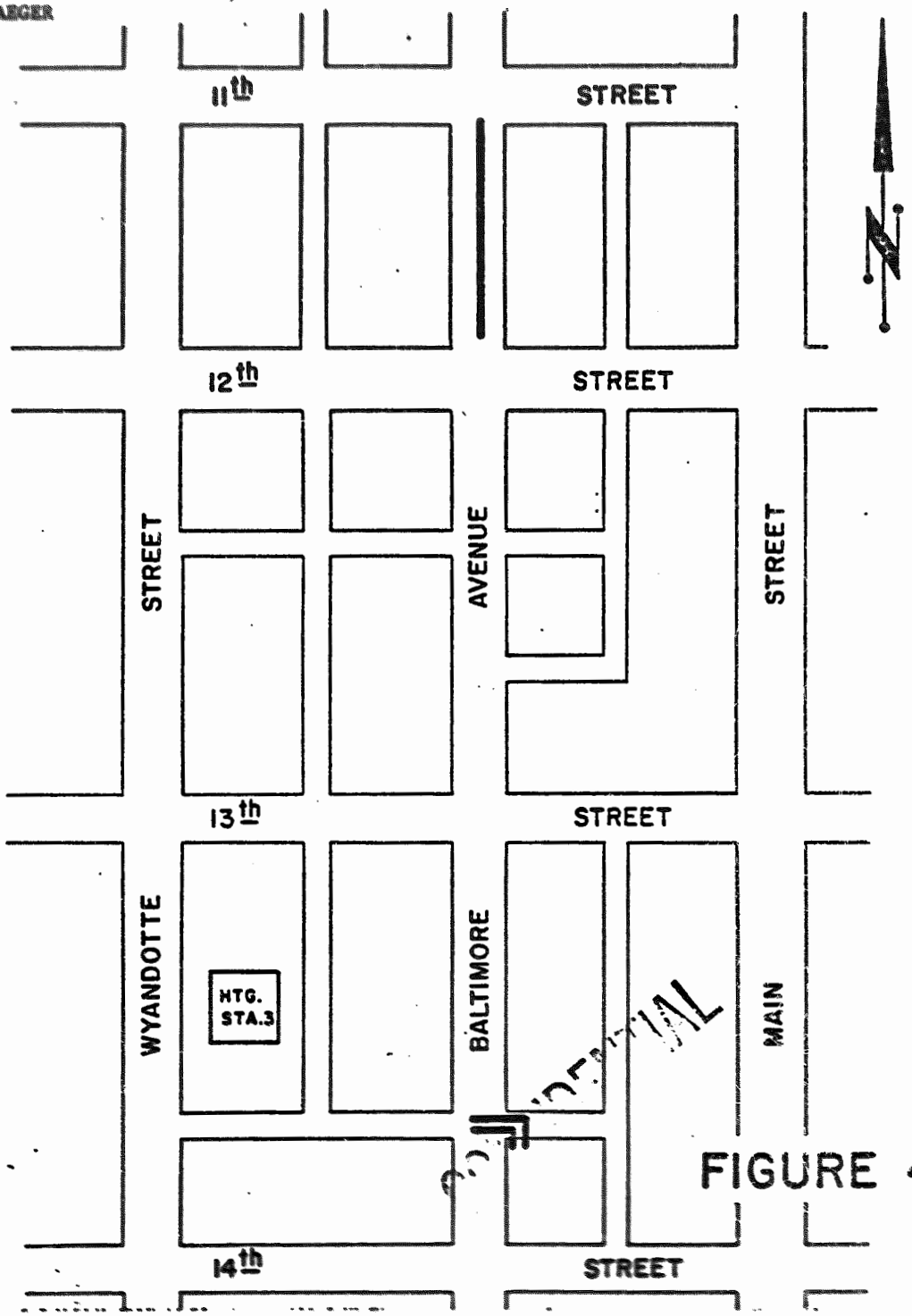

FIGURE 4

105 lb. SYSTEM

PIPING INSTALLED PRIOR TO 1930'S

FOOTAGE: 343'

SCHEDULE 3-17

KEPL FORM NO. 07-11 10/79

ANALYSIS FORM

Steam System Summaries Per Record Plates

DATE: 4-7-82

Total Length of Pipe Per Decade Per Pressure

Length of Pipe Per Decades

	1900	1910	1920	1930	1940	1950	1960	1970	1980			Total Pipe Per Pressure		
15#	11,747'	5,944'	2,807'	2,523'	123'	4,165'	1,482'	663'	886'			30,340'		
105#	0	0	108'	235'	0	1,310'	0	0	0			1,653'		
185#	0	0	3,110'	2,791'	0	11,005'	4,809'	779'	60'			22,554'		
Sys Pressure Per Ft.														
TOTALS	11,747'	5,944'	6,025'	5,549'	123'	16,480'	6,291'	1,442'	946'			54,547'		

Grand Total of System 54,547'

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[redacted] SHEET 1 OF 1

KCPL FORM NO. 83-11 14/791

ANALYSIS FORM

STEAM MAIN PROJECT - VARIATOR & EXPANSION JOINT COUNT OF 15 lb. PRESSURE SYSTEM PER RECORD PLATES

DATE: APRIL 21, 1982

VARIATORS			EXPANSION JOINTS		TOTAL VARIATORS	TOTAL EXP. JOINTS						
SINGLE	DOUBLE											
82	139		116		221	116						

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SCHEMATIC Y-19

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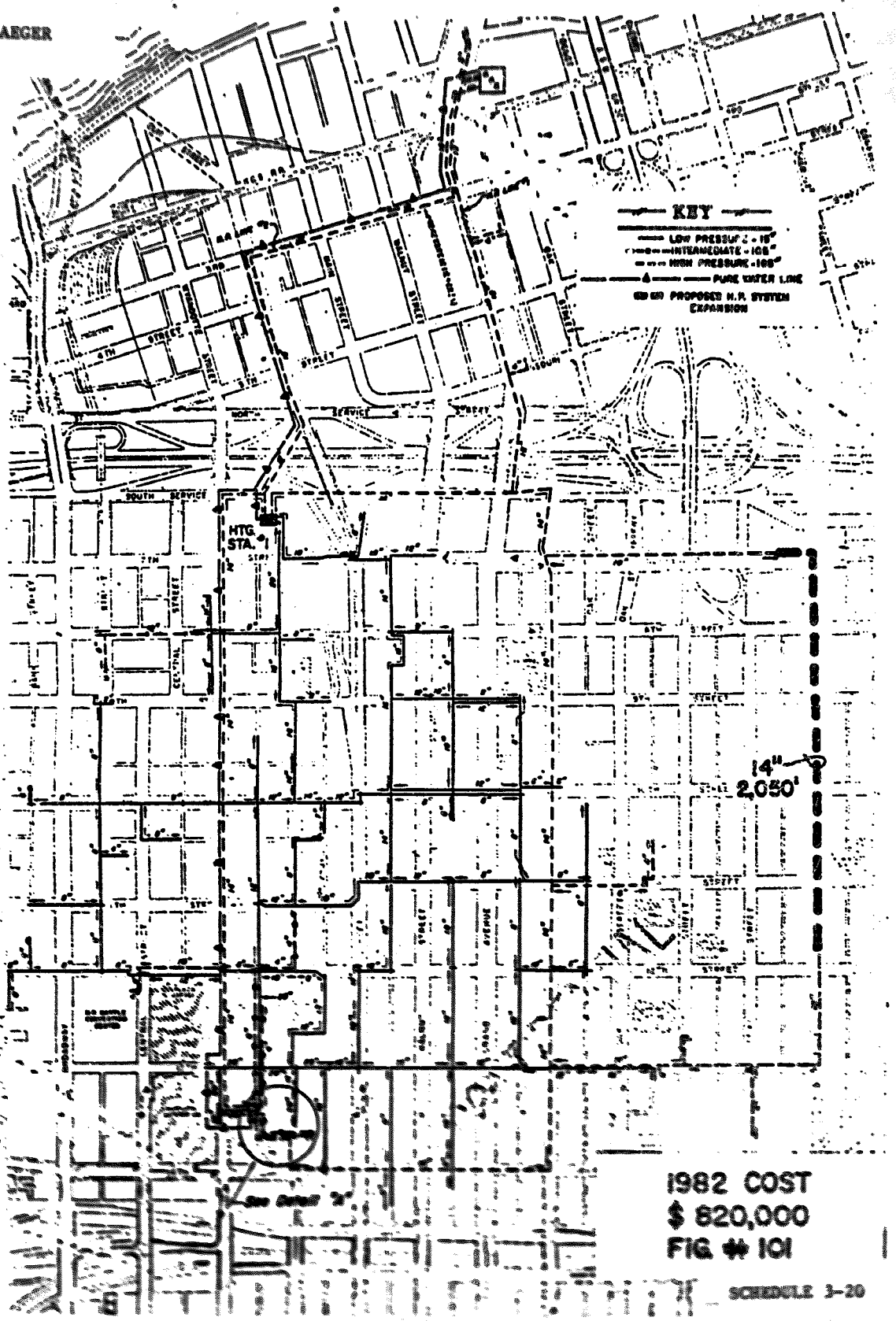

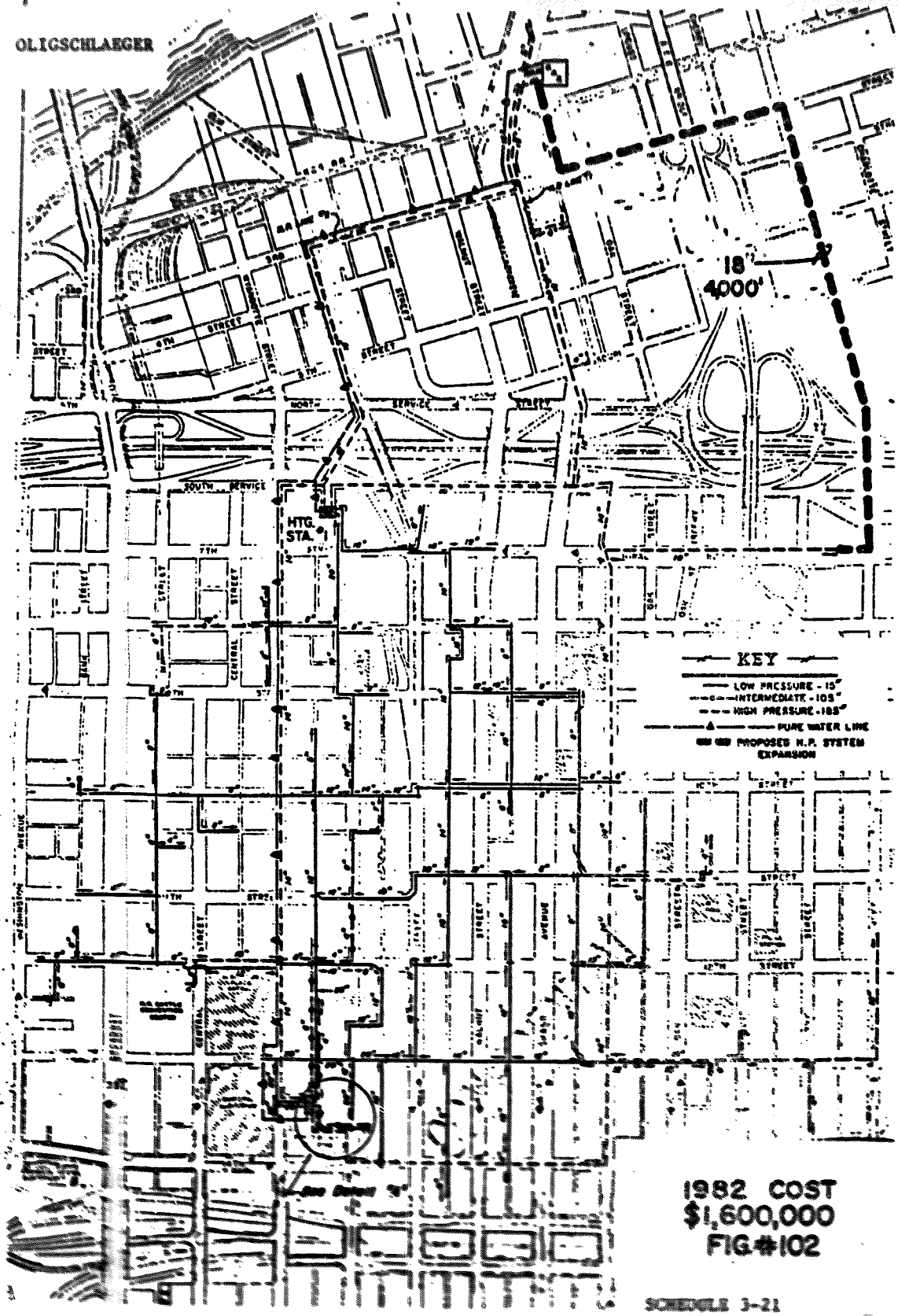

1982 COST
$1,600,000
FIG.#102

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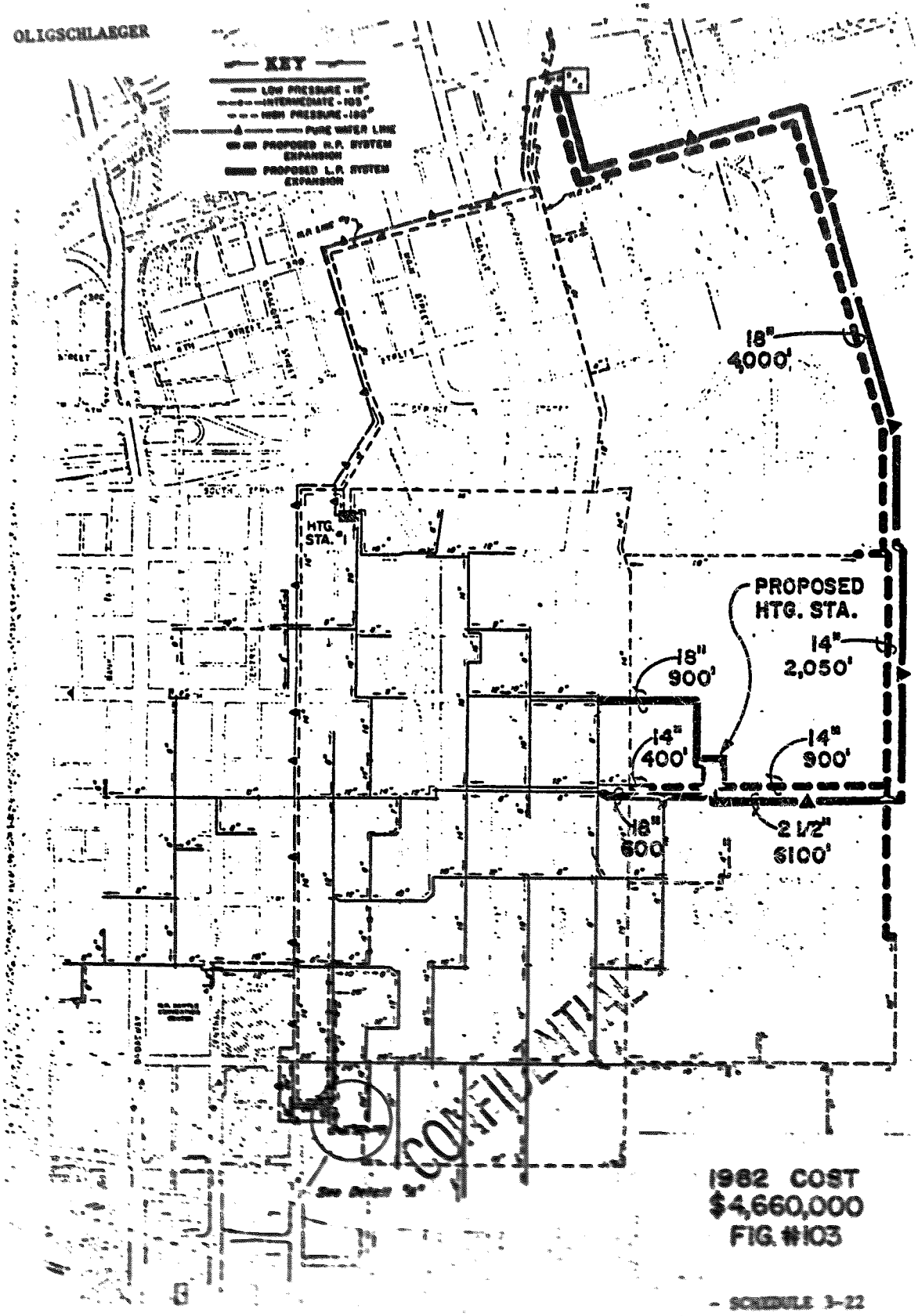

1982 COST
$4,660,000
FIG. #103

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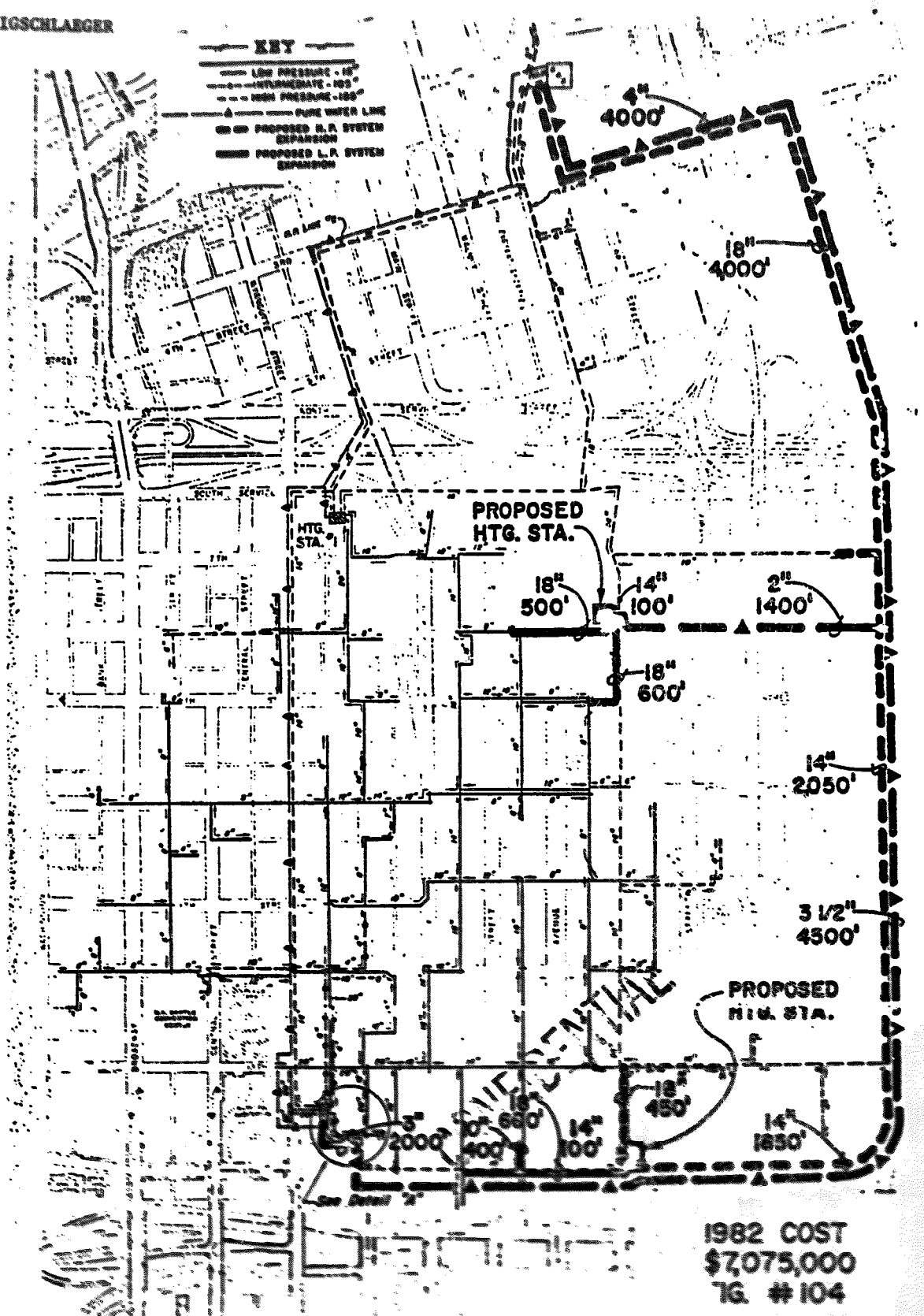
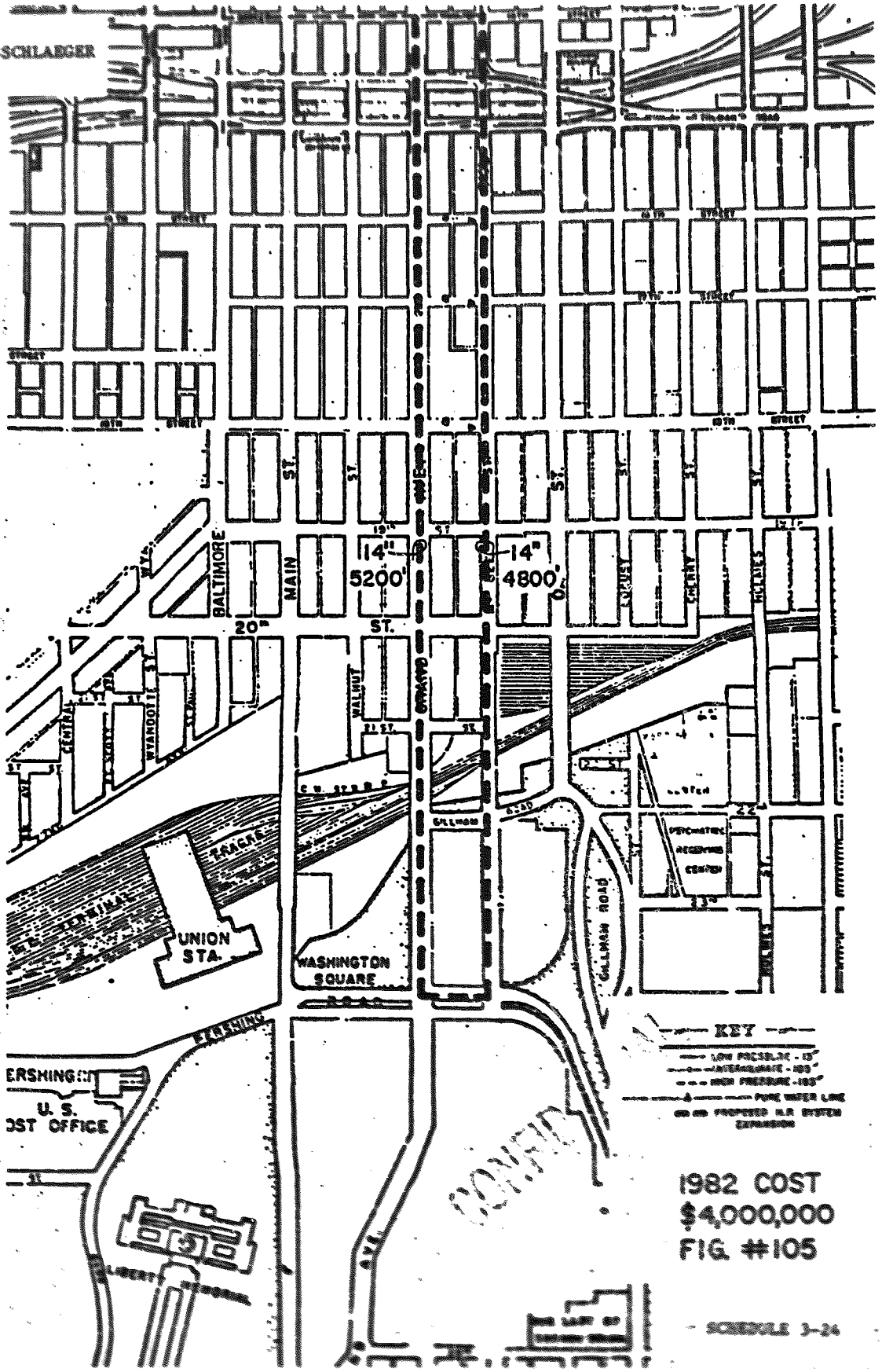


OLIVER SCHLARGER



Some of the significant achievements which have been accomplished in the operations area include a scheduled maintenance program for all Company steam facilities, a monthly inspection of customer locations, an organized approach to steam distribution line repair, and efficient meter reading and condensate sampling programs. Formal recordkeeping, reporting, and work scheduling procedures have been put into effect for all Steam Department operations also.

Enhanced meter maintenance, installation of reliable flowmeters, and a qualified technician recently transferred to steam work have all contributed to the development of a much more reliable and accurate metering program. A daily monitoring and reporting of steam and condensate transferred from Grand Avenue into the system began early in the year. These procedures will be refined as needed. The installation of new flow meters in the two desuperheating stations will provide a means to sectionalize the steam flow on the distribution system, and better analyze our loss situation.

The method of reporting steam usage, billing adjustments and "unaccounted for" steam has been completely revised on page 40 of the Monthly Financial Operating Report. The new format provides an accurate means of accounting for all the steam used each month.

All of the above efforts, together with many newly implemented ancillary procedures, have succeeded in providing a definite increase in the profitability of the steam business. The improvement in operating income and the reduction in steam lost is depicted in the table below.

One area of major concern continues to be the large amount of steam lost. Twenty-five major leaks were repaired the last seven months of 1982. The impact of these repairs was not nearly as great as originally anticipated. Therefore, a main priority of 1983 will be a concentrated effort to repair the 10 to 15 major leaks we now know of, and to continue to identify causes and locations of new leaks. After many years without a comprehensive maintenance program, we are facing much time and expense in order to get the system up to acceptable standards.

It should be noted that the revenue figures below indicate a trend, and are not biased because of rate increase just this last year. There have been rate increases even during the years of increasing losses - 10.97% in 1977; 10.5% in 1980; 23.74% in 1981; and 24.9% in 1982.

	1979	1980	1981	1982
Steam Revenue	$3,948,747	$3,620,443	$3,848,478	$6,301,126.55
Net Income	$ (281,875)	$ (554,442)	$ (595,366)	$ (178,701.00)
Mlb Sold	764,440 Mlb	633,682 Mlb	502,799 Mlb	652,862 Mlb
% Losses	35.7%	39.34%	44.78%	34.63%

The functional priorities for the steam business in 1983 are to get the steam service connected and operating properly to Corn Products; reduce losses to 20%; and to produce a positive net operating income for the year. In order to accomplish this we will have to continue training our personnel in all facets of the operation, strengthen their moral and team spirit even more, and provide the means for them to assist us in developing the steam business into a high quality operation.

M. C. Mandacina

MCM:sk

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SCHEDULE 4-3

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CPC Steam Service

In 1982 the Long-Range Steam Heat Planning Study concluded that the addition of a new high load factor steam customer would be necessary for the Downtown District Steam Heat System to remain competitive with natural gas. Such a customer was acquired by the execution of a steam service agreement with CPC International in November, 1982. The schedule committed Kansas City Power & Light to be ready to provide steam to the Corn Products facility in North Kansas City by November, 1983.

Through the combined efforts of System Power Operations and T & D Engineering, the plans were developed and work begun to prepare Grand Avenue Station for the new steam service. Extensive additions and modifications were completed on schedule, and the station was ready to provide steam to Corn Products by November 1, 1983.

Due to various contractural problems regarding steam pipe attachment to the ASB bridge, and then further construction delays by a severely cold winter, Corn Products was not able to complete its steam line in 1983. The mile long pipeline which crosses over the Missouri river, and about 10 sets of railroad tracks, should be completed and fully operational by April 1, 1984.

It is projected that the 24 hours per day Corn Products steam demand will increase the overall steam load factor from 28% to about 60%. Figure 1 projects the anticipated load profile. The fuel mix at Grand Avenue should increase to at least 80% coal, thus reducing the overall per unit cost of steam. This obvious benefit will allow steam to continue to be an economic and

reliable source of heat to the downtown business community.

Steam Losses Reduced

After successfully reducing steam losses in 1982 from 44.8% to 34.6%, we approached 1983 very realistically. Since much improvement had been made in accounting for steam on the monthly Operating and Financial Report, over 20 major leaks repaired on the underground steam lines and metering problems in many customer locations corrected, we established a goal to reduce losses to 30% in 1983.

Aided by infrared photography, we have identified over 25 places in streets and alleys where the higher surface temperature indicated a potential steam leak somewhere below the pavement. These locations were scheduled for repair in order of severity. This long-range schedule proved to be even longer due to interruptions caused by catastrophic failures of expansion joints and other old equipment requiring immediate repair on an emergency basis. This occurred almost monthly throughout the year with the culmination of a high pressure expansion joint failure on Christmas Day, followed four days later with a similar failure two blocks away. The year ended with 15 known leaks still needing repair.

Of the approximately 12 miles of buried steam pipe in the downtown system, 80% was installed prior to 1960. During the last year, steam crews replaced 1,493 feet of pipe and 36 expansion joints. Altogether, a total of 42 separate areas where there had been leaks were repaired. The exact amount of steam lost at each location proved to be very difficult to quantify. In a number of areas on the 15 lb. system, the excavated pipe had five or more holes which had rusted clear through and had obviously been leaking for some time. This condition is very prevalent on the older

parts of the low pressure system. The "old garden hose" effect became very apparent also. As a section of old leaky pipe was replaced we found that leaks intensified in the remaining adjacent sections. The present repair procedure, therefore, is to replace larger sections of pipe in order to eliminate as many small sections of old pipe between new pipe as possible.

Although somewhat related to the total steam demand, we are not able to accurately quantify a projected amount of steam lost for the entire system. As depicted in Figure 2, an increase or decrease of total steam does not necessarily represent a corresponding increase or decrease in losses. The obvious failures are relatively easy to measure, such as the catastrophic failures of high pressure expansion joints that cause the street to erupt and a geyser of steam to fill the air. More difficult to measure are the slow, low-pressure leaks that can exist for years without detection.

However, the intensified repair efforts have resulted in very real improvements. Figure 3 shows this progress by comparing the losses on a monthly basis since January, 1981. The December, 1983 representation is somewhat inaccurate due to a situation with month-end meter readings that did not sufficiently account for all the steam actually used by customers during one of the coldest Decembers in Kansas City history. Since the difference was about 25,000 Mlbs, we adjusted the total losses for 1983 to 234,826 Mlbs as compared to 343,448 Mlbs in 1982. This is a 32% reduction in lost steam, ending the year with 26.6% system losses!

The following table shows how 1983 compared to previous years. Due to the complexity of accounting for losses, several factors must be considered. These include the total system load and number of customers. Thus, losses espressed as a percentage of total steam input to the system from Grand Avenue

provide another guage to establish real improvement. The number of customers, temperature, and total sales are interrelated with system losses.

IN MLBS	1978	1979	1980	1981	1982	1983
Total Steam To System	1,253,227	1,208,735	1,064,941	931,626	993,628	882,919
Steam Sales	863,919	764,400	633,682	502,779	652,817	*618,053
System Losses	379,462	431,541	418,976	417,200	343,448	*234,825
Losses as % of Total Steam	30.3%	35.7%	39.3%	44.8%	34.6%	*26.6%

*Includes correction for December, 1983.

In addition to the December meter reading problem, indicated steam sales decreased due to two major factors. The new construction in the Central Business District affected three complete square block areas, as well as other isolated spots. This caused a loss of about 30 steam customers, most of whom will not return as steam users. Coupled with the Federal Office Building changing the majority of its air conditioning from steam drive to electric, the total sales for 1983 were about ½% below 1982. Figure 4 provides a graphic representation of all of these elements on an annual basis since 1978.

Improved Metering

The basis of accounting for steam losses begins with the amount of steam supplied to the system. The old meters on the two steam heat lines at Grand Avenue Station had created some concern in the past. Through a coordinated effort during the year we were able to ascertain the basis of an approach to more accurate accountability for steam supplied to the downtown system. Although the new metering system is not yet completely [illegible] we anticipate

more reliable supply data in 1984.

Flow meters installed at the two pressure reduction stations during the year provided a new means to correlate the steam from Grand Avenue with customer usage. We concluded that a portion of the previously "unaccounted for" steam had been due to unreliable supply metering. A major portion was obviously due to the multitude of leaks, mainly on the low pressure system. Also, 12 to 15% "lost" steam is not unusual due to radiation losses, cooling of steam due to water leaks near the steam pipes, and typical steam trap operation. "Lost" steam and condensate in customer facilities is the final contributor to total system losses.

As an approach to the metering problem at customer locations, a new program tested in 1983 has proved to be very cost effective. Due to various factors including the age, internal remodeling, and maintenance conditions of many older buildings using steam, it was obvious that all of the condensate was not getting to the steam condensate meters. The past history of differential pressure flow meters, which measure steam entering a building as opposed to condensate meters that measure steam as condensate after it has gone through the heating cycle, had been somewhat less than reliable in a number of locations. Also, these flow meters will not accurately function on the 15 lb. low pressure system.

To solve this problem, we initiated the test of a new front-end metering system comprised of an insertion turbine flow meter and an on-line microprocessor. Previous research of these systems, enforced by inspections of existing installations with over five years operating experience, indicated this state-of-the-art metering would provide more accurate and reliable steam measurement on both high and low pressure customer services. An on-line test of six of these turbine meter systems simultaneously with existing

condensate metering at actual customer locations has proven the future viability of their continued use. They are especially adaptable to new locations and have been installed in the new Jackson County Jail and Vista International Hotel.

Varying amounts of piping modifications are often required at existing locations to provide the necessary orientation for accurate flow measurement. In all of the test locations where we have established proper flow conditions, the turbine meter system has recorded more steam entering the building than the exit condensate measured by the existing condensate meters. Based on other steam utilities' experience with similar old buildings, we anticipated a minimum average gain of 10% with the new meters. The following table shows the steam for December, 1983 and January, 1984 as measured at four locations by the different meters.

	Turbine Flow Meters	Existing Condensate Meters	Difference Mlbs	Difference Percent
Dec.	7,604	6,875	729	+10.6%
Jan.	8,041	7,123	918	+12.9%
Total	15,645	13,998	1,647	+11.8%

In addition to the improved accountability for steam, these savings represent a potential increase in annual revenue of over $120,000. Due to the volatile nature of steam measurement, we will continue to make refinements in our installation procedures but will certainly continue the program for "front-end" steam measurement using the insertion turbine flow meter system.

The program for on-site inspections was continued at customer locations throughout the year in an attempt to locate lost or diverted condensate. A number of diversions were found, two of which resulted in awards for the meter readers.

As an additional effort to isolate steam losses, we initiated a plan to divide the whole steam system into quadrants by using main valves and take individual meter readings at the customers' meters in that quadrant. The sum of these readings was then compared to the amount of measured steam entering that quadrant. The idea was to isolate the "high loss" areas and customers. The operating complexity of this test may limit its use in 1984, but the potential results make it worth the attempt.

Operating Expenses

As the programs to reduce losses and increase the operating reliability of the pressure reducing stations were implemented, we obviously anticipated an increase in annual expenditures. The following table shows how the costs correlated with the efforts to revitalize the steam operation beginning in mid 1982. The most dramatic change, however, is the cost of our "raw product" steam from Grand Avenue Station.

	1978	1979	1980	1981	1982	1983
Distribution Operations	$ 64,023	$ 74,503	$ 89,168	$ 109,175	$ 122,132	$ 127,163
Distribution Maintenance	236,127	252,891	289,481	266,684	651,140	996,789
Administrative & General	477,247	493,311	585,435	675,851	857,153	887,928
Depreciation, Taxes, & Accounting	496,441	320,003	(105,626)	(117,508)	453,855	231,817
Purchased Steam	2,697,831	3,127,249	3,356,088	3,555,289	4,463,822	5,799,985
Total Expenses	$3,971,669	$4,267,957	$4,214,546	$4,489,491	$6,548,102	$8,048,682

As previously mentioned, steam sales were down about ½% in 1983 with a revenue of $7,257,454. The cost of steam from Grand Avenue to Utility Steam Operations increased $1,336,163 or some 30%. However, the total amount of actual steam supplied decreased by 11,071 Mlbs or about 11%. In other words, our raw product cost increased from $4.49/Mlb in 1982 to $6.57/Mlb in 1983. Figure 5 depicts the trend since 1978 in the cost of steam to the Steam Department and the total amount of steam transferred with the resulting cost/Mlb listed with each year. However, in anticipation of a lower cost fuel supply at Grand, coupled with the better fuel mix due to the Corn Product's load, we hope to see a reduction in the escalation of the steam cost to Utility Steam Operations in 1984.

The preceding table also vividly depicts a considerable escalation in distribution maintenance expenses. As mentioned, this corresponds with the beginning of our intense efforts in mid 1982 to reduce system losses. Using the average maintenance cost of 1980 and 1981 as a base, the total increase in maintenance costs in 1982 and 1983 amounted to $1,091,763. Using the same year's steam losses as a base, the total amount of losses reduced in 1982 and 1983 is 233,340 Mlbs. At an average of $11.00/Mlb to the customer, this reduction of losses potentially represents a savings of $2,566,740 for an investment of $1,091,763. The obvious benefit, other than the immediate payback, is the savings to be incurred over many future years by these maintenance efforts now.

As the various programs to increase the operating efficiency of the steam system continue, we anticipate several more years of cost effective investment in distribution operations and maintenance above "normal". At the same time, however, we will continue to review areas where costs can be reduced, especially in "administrative and general" catagories. Figure 6 provides a graphic

representation of the distribution of 1983 expenses for Utility Steam Operations.

Future Development

Since the basis for acquiring the Corn Products steam load was to maintain steam as a competitive heat source to downtown customers, the achievements of 1983 will enable us to proceed with a marketing effort of sorts in 1984. A presentation is being developed for civic, business, and industry organizations. The narration, accompanied by slides, will describe the history of the KCPL steam system, present revitalized efforts, and benefits of the new CPC steam load for the downtown business community. This program will be adapted to a formal paper to be presented this May at the International District Heating Association annual technical conference in New Hampshire.

The goal of this marketing effort is to retain as many present steam customers as possible and maximize steam sales on the existing network within existing production limitations. Typically, once a customer has installed a steam service, especially in a new building, the chances of economically converting to gas are very slim and the potential increases for future electric heat applications.

The overall efforts to revitalize the steam operation has created the opportunity for another significant achievement. Although difficult to measure, the increase in morale and esprit de corps of the Steam Department is obvious. For many years a "forgotten" segment of the Company, this group has now been unified and each person openly takes pride in being a member of the "Steam Team". Together with Grand Avenue Station, their efforts will soon represent over a $20 million annual revenue for KCPL.

The recent consolidation of operations has conceptually outlined the

framework of a total business organisation in the future. The continued development of the steam operation has been possible due to the new attention and the cooperation at all levels of KCPL making Utility Steam Operations a viable facet of the Company business.

MCM:sj

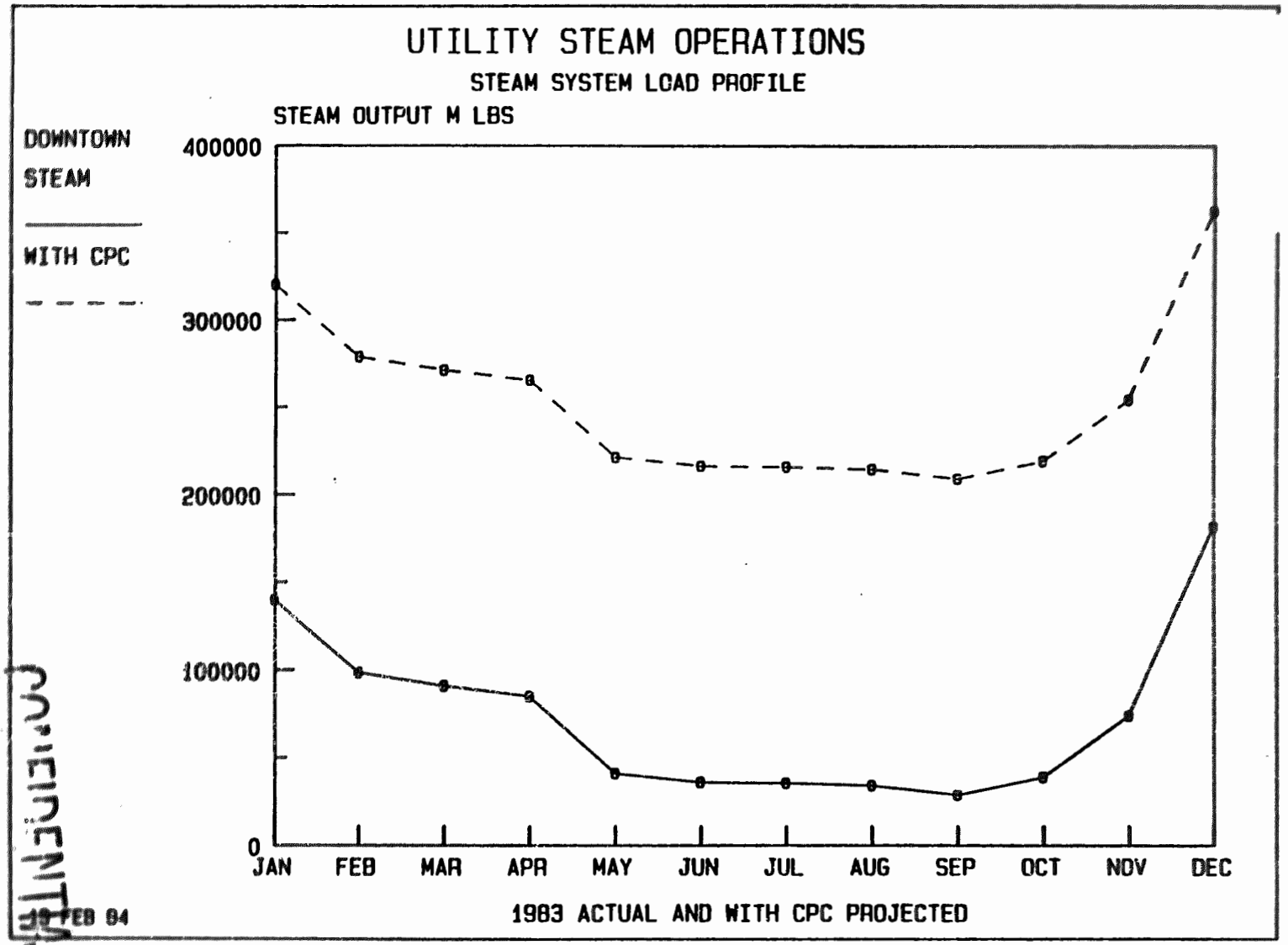

UTILITY STEAM OPERATIONS
STEAM SYSTEM LOAD PROFILE
STEAM OUTPUT M LBS
DOWNTOWN
STEAM
WITH CPC
400000
300000
200000
100000
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
1983 ACTUAL AND WITH CPC PROJECTED
OLIGSCHLAEGER
CONFIDENTIAL
FEB 84

Figure 1

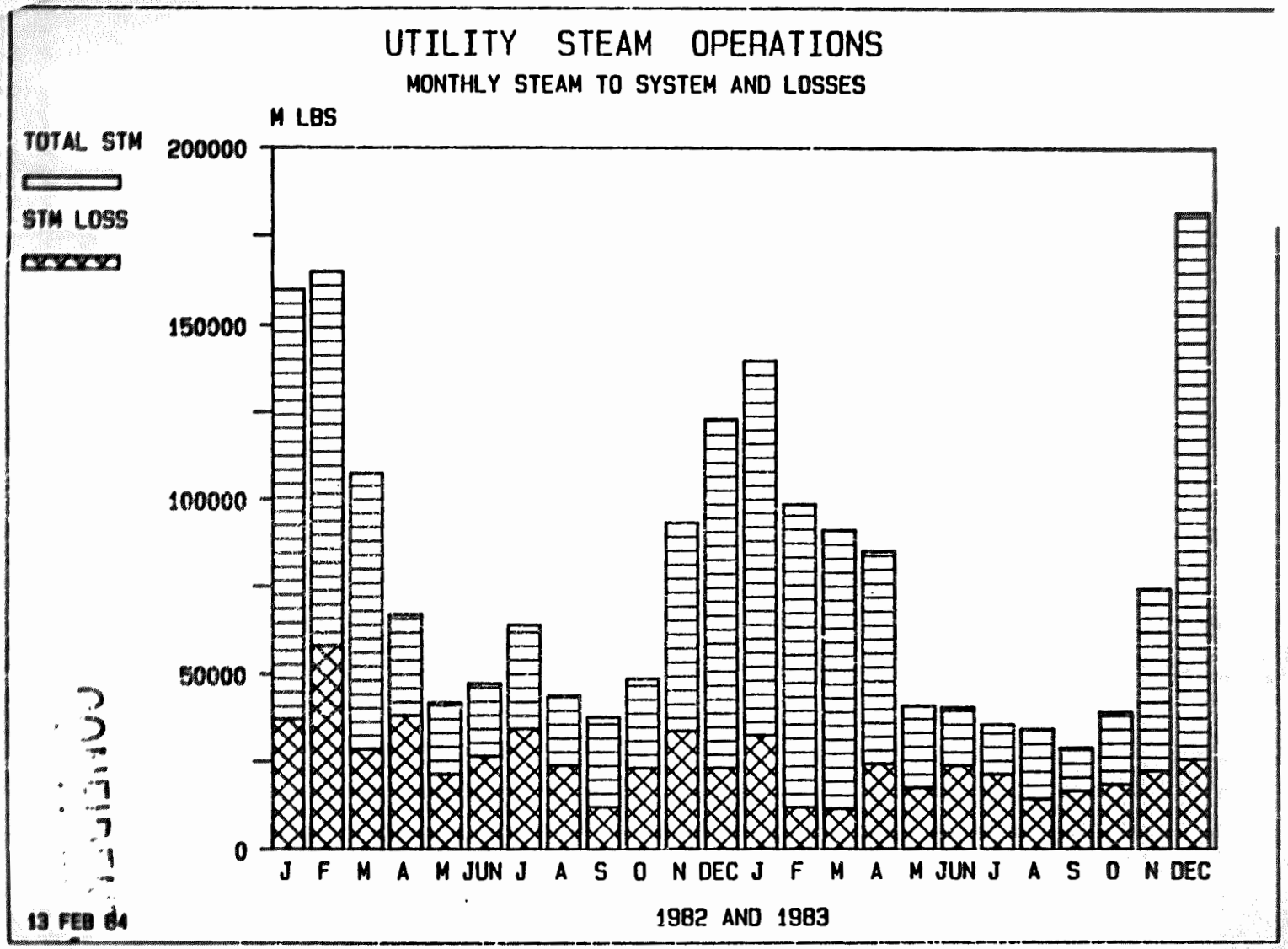


Figure 2

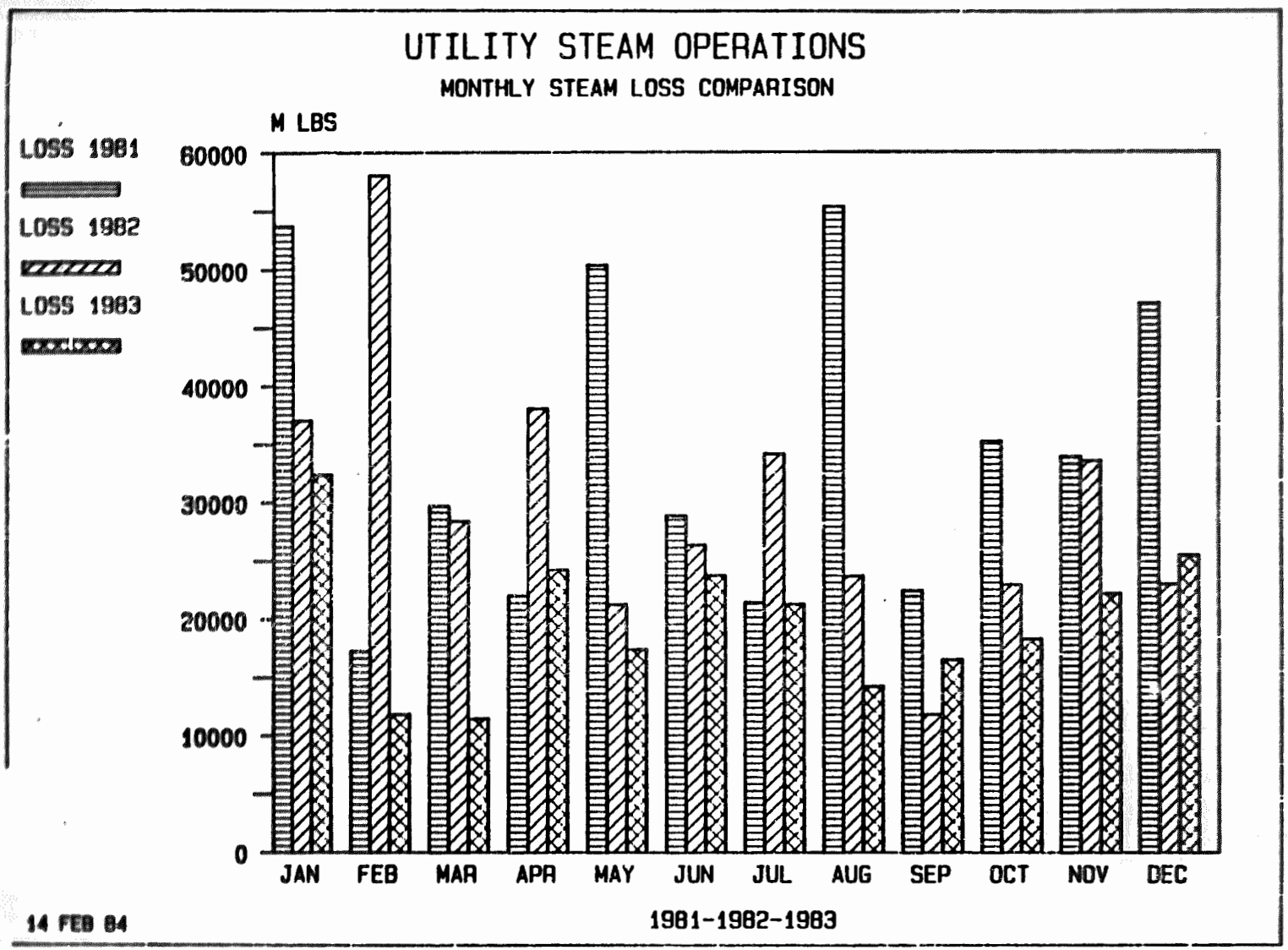

UTILITY STEAM OPERATIONS
MONTHLY STEAM LOSS COMPARISON
M LBS
LOSS 1981
LOSS 1982
LOSS 1983
60000
50000
40000
30000
20000
10000
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
14 FEB 84
1981-1982-1983

Figure 3

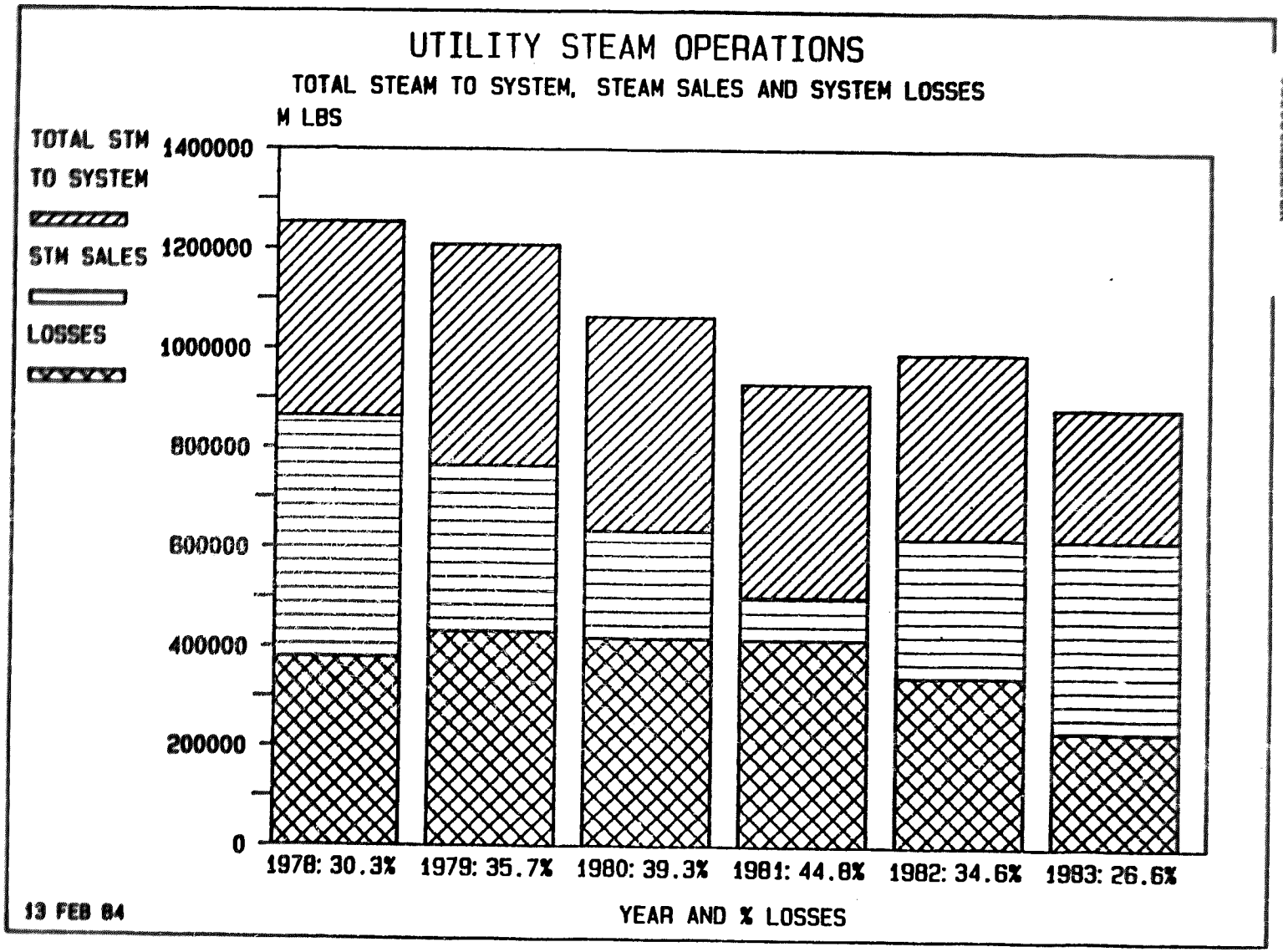

UTILITY STEAM OPERATIONS
TOTAL STEAM TO SYSTEM, STEAM SALES AND SYSTEM LOSSES
M LBS
TOTAL STM TO SYSTEM
STM SALES
LOSSES
1400000
1200000
1000000
800000
600000
400000
200000
0
1978: 30.3%
1979: 35.7%
1980: 39.3%
1981: 44.8%
1982: 34.6%
1983: 26.6%
13 FEB 84
YEAR AND % LOSSES

Figure 4

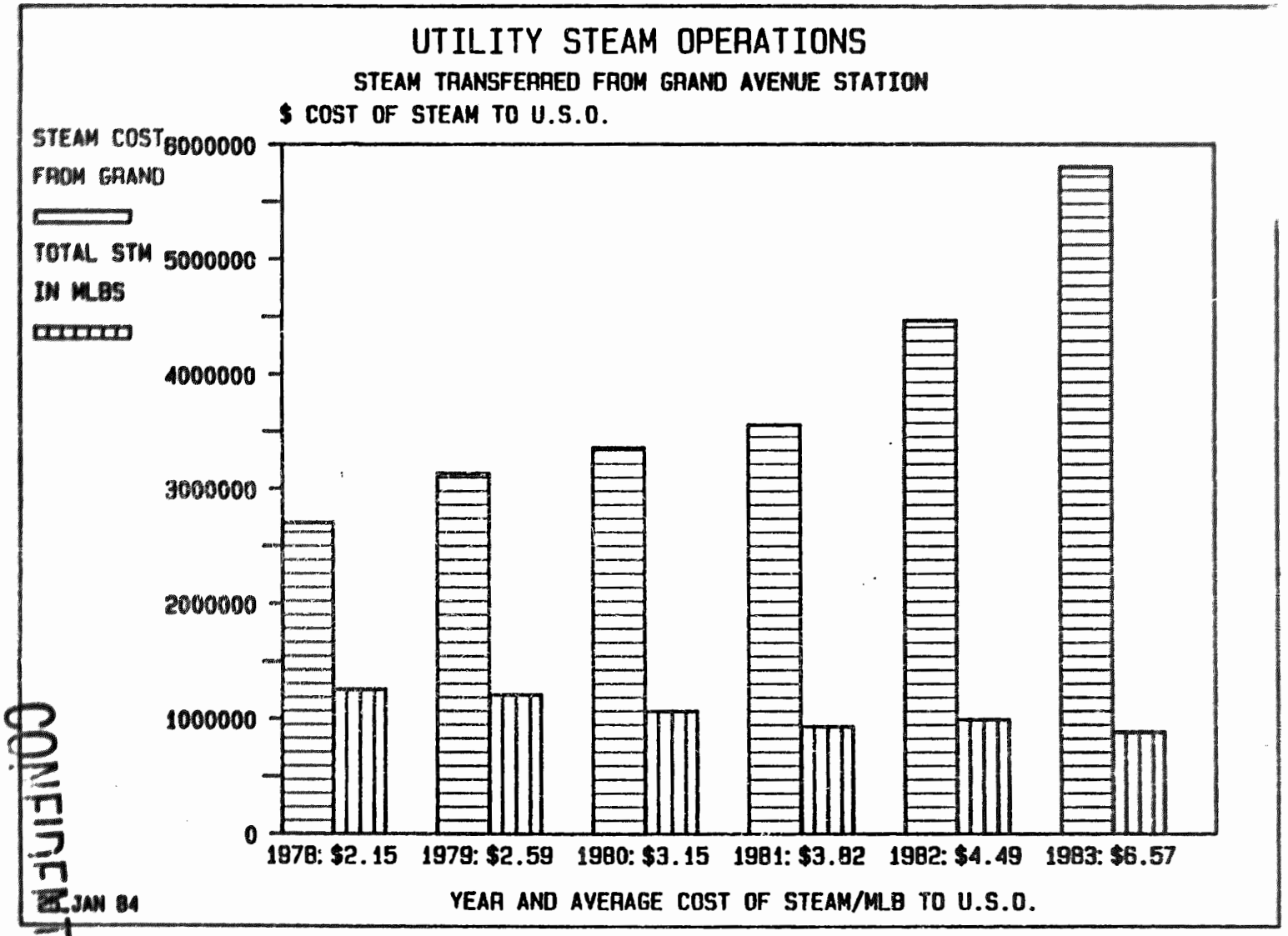
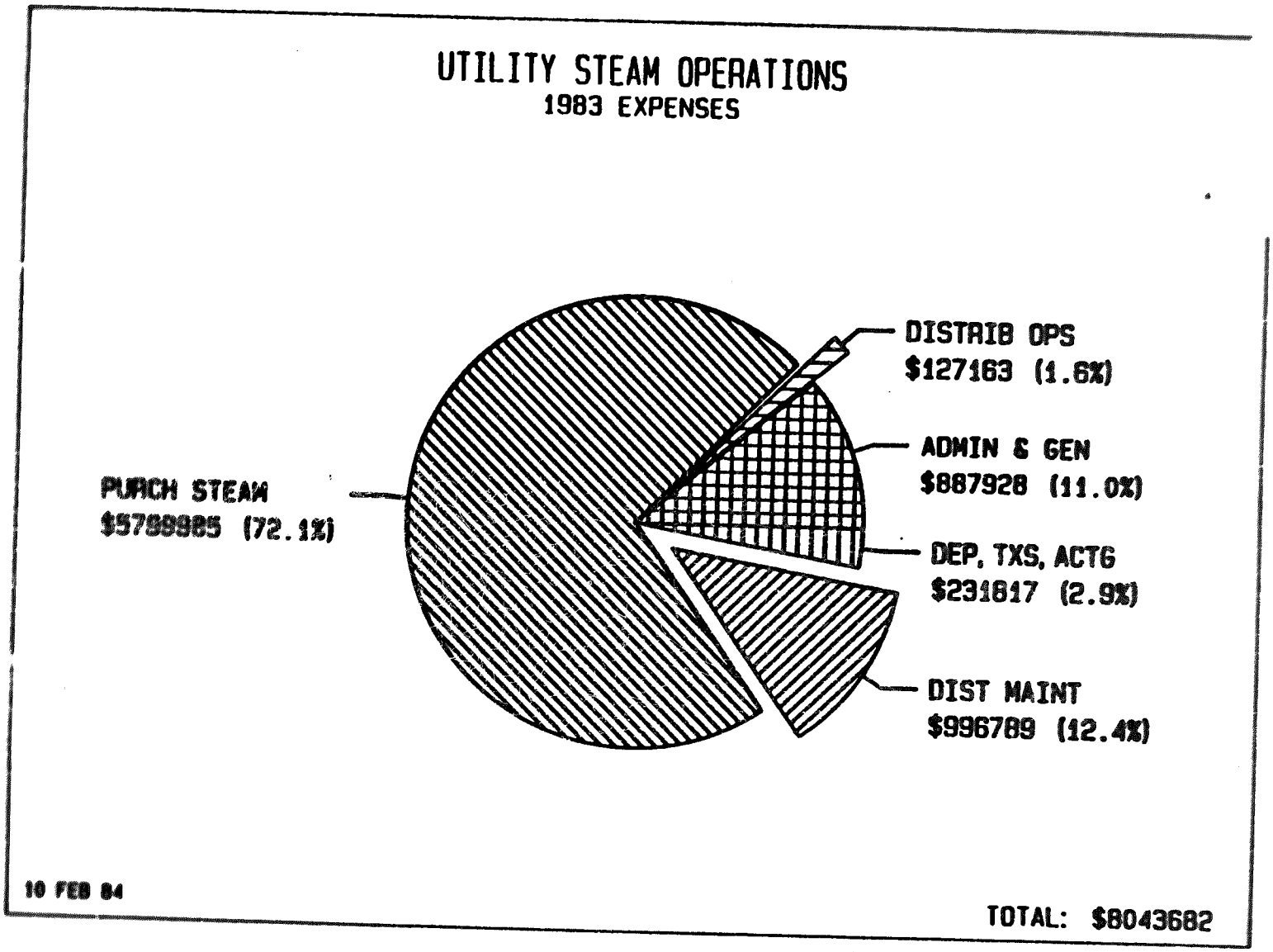


Figure 5


UTILITY STEAM OPERATIONS
1983 EXPENSES
DISTRIB OPS
$127163 (1.6%)
ADMIN & GEN
$887928 (11.0%)
DEP, TXS, ACTG
$231817 (2.9%)
DIST MAINT
$996789 (12.4%)
PURCH STEAM
$5789985 (72.1%)
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TOTAL: $8043682

Figure 6