UTILITY STEAM OPERATIONS

1984 PROGRESS REPORT

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INDUSTRIAL STEAM

CPC Steam Service

The Spring of 1984 saw the efforts of Utility Steam Operations, System Power Operations, Fossil Plant Construction & Engineering, and Commercial Operations, culminate with the first commercial delivery of steam to Corn Products International on April 24, 1984. The contractors, KCPL and Corn Products personnel can be proud of a construction job somewhat unique to this area. The major aspects were the construction of a steam line spanning the Missouri River and the modifications to Grand Avenue Station to serve the load.

The completion of this project, providing the addition of a new high load factor steam customer, was necessary for the Downtown District Steam Heat System to remain an economical energy source for downtown customers.

Late in the Spring of 1984, word spread that CPC was selling its operations. The question of whether the new owner would take steam from KCPL, very much clouded the future viability of the District Heating System. CPC is expected to continue taking steam through 1985, but no decision has been received from the new owner for future years.

Results of Additional CPC Load

The actual operation of the steam service to CPC for nine months in 1984 produced some expected and some unexpected results. The demand has averaged 176,000 lbs./hr., whereas the demand anticipated was 250,000 lbs./hr. As expected, with the addition of the CPC load, the peak load factor has increased from 28% to about 62%. Figure 1 shows the actual load profile experienced in 1984.

Fuel mix at Grand Avenue Station has averaged about 82% coal with improvements in operating procedures continually being made to increase the ratio of coal-to-gas fired at Grand Avenue Station.

Early in the operation of the CPC service, wide swings in load were experienced - up to 80,000 lbs./hr. This caused some operating difficulties at first, but the good working communication between Grand Avenue Station and Corn Products personnel has allowed adjustment of Grand Avenue operations to follow the load more closely.

Since CPC is metered at Grand Avenue Station, there is essentially no loss associated with its distribution. Only the Downtown System contributes to steam losses. Figure 2 shows the effect that the CPC load has had on the total steam loss percentage, which was at 11.18% at year end. This percent should decrease even more in 1985, provided CPC continues to take steam for the entire year.

Metetered steam to CPC totaled 1,062,519 Mlbs. producing a revenue of $6,968,921. Sales to downtown customers totaled 563,574 Mlbs. with a revenue of $5,805,331. Essentially, the effect of the CPC load for nine months of the year increased revenue and tripled steam sold (see Figures 3 & 4).

The system installed to meter steam to CPC cost close to $30,000 and performed exceptionally well. At the sixth month calibration check, the following comment was made by the independent consultant checking the system: "Your pressure and temperature compensated steam flow metering system was found to be very close to calibration over the entire range." This was well within the ±2% range required by the Steam Service Agreement.

Due to the addition of CPC, the cost per unit of "raw product" steam was reduced 30%. This reversed a five year trend, indicated in Figure 5. The ability to fire Grand Avenue Station primarily on low cost coal rather than natural gas, produced the anticipated results of reducing cost per Mlb.

DOWNTOWN DISTRICT HEATING SYSTEM

From an activity standpoint, Downtown Kansas City in 1984 was the place to be. Construction began on four large office buildings, the Vista Hotel opened, and the new Jackson County Jail was completed. The District Heating System was in the middle of all this activity, and plans were made to actively pursue securing new customers for the District Heating System.

New Steam Main Construction

With the start of construction of the new AT&T complex and Commerce Towers, it became necessary to relocate a major north-south 16" steam main out of the construction area. Fossil Plant Construction & Engineering designed and managed the construction of 1,050 feet of new steam main in Main Street. This was the largest construction project undertaken in the District Heating System since the late 1950's, when the high pressure system was completed to the Wall Street and the Wyandotte desuperheating stations.

The total cost for the steam main construction was $411,281 of which AT&T, Commerce Towers and KCPL each paid one-third. The cost per foot of main averaged $391. Most of the construction was done at night in order to minimize traffic problems in Downtown Kansas City. The project was completed on schedule, and within budget, and was in service on July 24, 1984.

The new main replaced piping that was of the early 1900's vintage and will thus reduce steam losses and repair costs in future years. With word that future sale of steam across the Missouri River was uncertain, the decision to no longer connect new customers to the system was implemented.

Department Reorganization

Even though the future was uncertain for growth of the Downtown Steam System, the department actively pursued the work of reducing steam losses in 1984.

With the reorganization effected on February 1, 1984, the positions of one Engineer and two Steam Journeyman Electricians were created and filled with personnel from within the Company who were familiar with the system. It was their main responsibility to upgrade metering systems on customers' premises, upgrade worn out and unreliable equipment in the two desuper-heating plants, provide expertise for training personnel in the operations and maintenance of the system, and increase the reliability of operations.

Up to this time, supervision of the steam crews was the responsibility of one supervisor who, since 1982, along with the enthusiastic efforts of the work group, had reduced system losses from 44.8% down to 26.6% at the end of 1983 (see figure 7). The main focus during those years was to repair leaks, resulting in a total of 42 repaired in 1983. Also during that time, various programs for scheduled maintenance of metering devices and equipment located in manholes and inside customers' premises, was put on the computer using MAPPER. This allowed the implementation of a planned maintenance program.

It became obvious that there was more work than one supervisor could effectively manage. All areas of the system needed attention; therefore, in December 1984 a second supervisor was named. This provided better accountability and effective management of both the operations and maintenance functions of the "steam company".

Maintenance Activity

Table I indicates some of the maintenance activities performed by the department in 1984 compared to 1983, the most significant item being the number of major leaks repaired: 58 in 1984 as compared to 42 in 1983, a 38% increase. The additional supervision contributed to a portion of this increase in number of steam leaks repaired.

Table I

Utility Steam Operations Maintenance Activity

Maintenance Activities	Total 1984	Total 1983
Steam meters replaced	81	206
Steam meters repaired	104	215
Traps replaced	32	36
Traps repaired	34	46
Expansion joints replaced	36	32
Main valves repaired/replaced/removed	20	40
Service valves repaired/replaced	25	15
Feet of New Pipe Installed, High Press.	405	48
Feet of New Pipe Installed, Low Press.	2,273	1,445
Condensate samples taken	127	135
Services cut off at main	2	2

High Pressure & Low Pressure Steam Leaks Repaired	1984	1983
	58	42

Steam Losses

Figures 6 and 8 show monthly loss comparisons on the Downtown District Heating System for years 1982, 1983 and 1984. The erratic nature of the bar graphs for years 1982 and 1983, as compared to the last nine months of 1984, is explained by inaccurate metering throughout the system in those years, and also catastrophic failures of high pressure expansion joints on the #1 and #2 lines during 1982, 1983 and three months of 1984. Expansion joints were replaced between Grand Avenue Station and the Wall Street desuperheating station in that period. Since March of 1984 there have been no catastrophic failures of high pressure expansion joints.

The efforts begun in 1982 by Utility Steam Operations, including the correction of metering problems on customer premises, installation of new electronic flow meters throughout the system and installation of a new flow meter on the #1 heat line at Grand Avenue Station, have resulted in a loss profile from April of 1984 that is consistent with an expected slope following system load. Actual monthly steam losses on the system are proportional to the system load which follows heating degree days. Some reasons are: as load increases, the traps on the system increase frequency of operation; and as customers heat more space in a building, the percent of unmetered return condensate increases.

The continued success in reducing actual steam losses on the system resulted in a 14.4% decrease from 234,825 Mlbs. in 1983 down to 200,945 Mlbs. in 1984. However, the percentage steam loss shown in Figure 7 for 1984 of 27.4% is not indicative of the significant actual reduction of 14.4% achieved over 1983, because many factors affect this percentage.

For instance, 1984 had a decrease of 4.1% in heating degree days and therefore sales should have decreased about 24,000 Mlbs., assuming customers operated their facilities the same in 1984 as in 1983 and the number of customers remained the same. In addition, the system had a loss of

customers that amounted to about 41,000 Mlbs. in sales, based on actual 1983 usage and adjusted for heating degree days. The combined total of these two reductions should have resulted in a drop of 11.08% in steam sales for 1984.

However, steam sales decreased by only 3.6%. The difference of 7.5% is explained by improved customer metering accomplished in 1984 by the department. The increase in revenue to KCPL, assuming an average cost of $10 per Mlb., amounted to about $438,000. Also, if the "lost" customers had remained on the system, the reported losses for 1984 would most likely have been less than 26% (see Figure 7 and Table II).

Some of the customers leaving the system were FAC, Dixon Inn, the old Telephone Building, Palace Building, Lerner's, Peck Building, Continental Hotel, Harzfeld's, Federal Office Building's use of steam for air conditioning, Kresge's and several smaller ones.

If the present trend of customers leaving the steam system continues without new customers being connected, the yearly loss percentage becomes somewhat meaningless as a barometer indicative of progress being made by the department in cutting system losses. The real future barometer will be the decrease in actual amount of steam unaccounted for in pounds rather than percentage. These figures more accurately reflect savings to KCPL for work being performed by the department.

A tabulated summary of yearly statistics related to the operation of the District Heating System is included in Table II and graphically depicted in Figure 7. CPC usage is not included in 1984 figures.

TABLE II

District Steam Heat Statistics

Total Steam In Mlbs.	1984	1983	1982	1981	1980
To System	734,102	882,919	993,628	931,626	1,064,941
% Change	-16.80%	-11.10%	+6.70%	-12.50%	
Steam Sales	563,574	584,722	652,817	502,779	633,682
% Change	-3.60%	-10.40%	+29.80%	-20.60%	
System Losses	200,946	234,948	343,448	417,200	418,976
% Change	-14.4%	-31.60%	-17.60%	-.42%	
Losses as Percent of Total Steam	27.40%	26.60%	34.60%	44.80%	39.3%
Heating Degree Days	4,798	5,003	4,572	4,190	4,694
% Change	-4.10%	+9.40%	+9.10%	-10.70%	

The combination of the variables, weather, number of customers, metering inaccuracy, occurrence of leaks, rate of leak repair, system load, sales and trap operation make it difficult to conclude what effects a change in each has on the total operation. One thing is clear: unaccounted-for steam has been reduced by about 217,000 Mlbs. yearly over 1980 and 1981 levels. This reduction has been a result of the efforts of a highly motivated work group. The savings to the department in total cost of steam from Grand Avenue Station based on $4.59 per Mlb. amounts to $996,030.

Steam Leak Repairs

As discussed earlier in this report, the number of leaks repaired in 1984 increased from 42 in 1983 to 58 in 1984. The primary reason for this increase can be attributed to the use of fly ash slurry as a substitute for dirt backfill and concrete encasement. This method of backfilling and encasing steam lines was used exclusively in the last five months of 1984 on 40 of the 58 leaks repaired during the year.

The use of fly ash slurry saves the department a minimum of five man-days per leak repair. The expected number of leaks to be repaired in 1985 is approximately 70 which indicates a significant increase in the department's efficiency and productivity. The department is continuing to work with local suppliers on improving mix designs to reduce the cost of the product. In 1984 the Steam Superintendent participated in presentations and demonstrations to contractors, representatives of local municipalities, consulting engineers and representatives of local utilities on the use and benefits of fly ash slurry. This type of work will help decrease the disposal cost of this waste product to the Company.

New leaks averaged about four per month during the year. There were 4 major leaks at the beginning of 1985 compared to 15 at the start of 1984. This shows headway is being made on leaks in the downtown area.

During 1984 steam leaks that affected KCPL's own electrical system in the downtown area were classified as an emergency situation. T&D took field measurements of manhole temperatures and prepared a list of locations requiring immediate attention by Utility Steam Operations. Engineering prepared contingency plans in the event of cable failure on sections of the downtown network. Utility Steam Operations made the repair of these leaks a top priority in the last half of 1984.

DESUPERHEATING STATIONS

During 1984 extensive work was done in the two desuperheating plants. After years of neglect, the operating reliability, safety, and basic functioning ability of the plants were questionable at best.

Wyandotte Station

Wyandotte Station, located in the basement of the 1319 Wyandotte garage, has undergone almost a complete upgrading of control equipment. The major items replaced include: a pressure reducing valve, three desuperheating water control valves, four auto/manual valve controllers, pressure and temperature control and indicating devices, a 21-point alarm panel capable of receiving telemetered alarm signals from Wall Street Station, and block valves. The installation of this equipment required an almost complete rewiring of the station and replacement of control air tubing.

In 1983 a safety concern was raised relating to the deteriorated condition of asbestos insulation in the station and resulted in complete repair and extensive reinsulating and wrapping of piping. This work was essentially completed in 1984 and is now in the final stages of painting and functional labeling.

Obsolete equipment, no longer required for service to intermediate pressure (105 Psi.) customers was removed, providing new work space in the plant. Along with the equipment renovation, the entire station was painted, new lighting installed, and new ceiling and floor tiles were installed in the control room.

Wall Street Station

In August 1984 a 12" water main ruptured at 7th and Baltimore and caused the flooding of Wall Street Station. No major items of desuperheating equipment were damaged. However, repairs were made to damaged insulation and lighting fixtures. Also the walls and ceiling were painted. In addition to the work required because of water damage, two pressure reducing valves were sent out for repair and reinstalled prior to the heating season. The emergency shutdown system was put in working condition with the installation of dead weight shut down valves. A major underground desuperheating water leak was repaired outside the station with the installation of approximately 150 ft. of new stainless steel line.

Department Metering

Temperature and pressure recording equipment and steam flow meters were put in full service and telemetry equipment made fully operational at mid-year. The information gathered from these meters is used daily to determine the condition of the system and as a check against Grand Avenue reported steam send out to the District Heating System.

Reliability

The results of all this work and upgrading of equipment has produced a very reliable operation of the desuperheating plants. During 1984 there were no unplanned customer outages due to equipment malfunction. Also the necessity to bring a maintenance man in on overtime to check alarms and problems of low pressure throughout the system, has all but been eliminated.

Complaints of "wet steam" from customers common before 1984, have not occurred this heating season. This has resulted from the installation of new water control valves and controls which allow the plants to maintain a set temperature for steam send out. Prior to this work, the desuperheaters were essentially dumping water into the 15 lb. distribution system. By the time the steam reached customers on the ends of the system, the steam quality was poor.

Figure 10 graphically shows this decrease in desuperheating water consumption. The reduced amount of water has contributed to lowering the percentage of steam losses. Prior to March of 1984 the reliability of water usage data is questionable due to the high use of city water for desuperheating while repairs were made to the pure water line. In March of 1984 the installation of new water meters at Grand Avenue Station and in the desuperheating plants has corrected this problem. Further decreases in 1985 should be apparent due to installation of new valves in Wall Street for desuperheating water control.

METERING

Although significant, it is difficult to measure exactly what effect improved metering has had on loss reduction throughout the system. All presently available steam metering devices have been reviewed, and we are now using several different types, to match the metering requirements.

Condensate Meters

In 1983 an extensive regular replacement of condensate meters on customer premises was instituted with a total of 206 meters replaced. This program carried on into 1984 with monthly computer printouts of meters scheduled for a two year changeout cycle issued to maintenance personnel for completion during the month. This resulted in 81 changed in 1984. Maintenance programs such as this ensure reliable customer metering and lessen billing complaints. Also, work load is more evenly spread throughout the year.

Prior to 1984 the customers' meters were read twice monthly. In June 1984 the mid-month meter reading was eliminated, allowing the meter reader inspector a time when he can perform the equally important function of inspection without the time constraint of completing meter readings.

The focus of these inspections is intentional divergence, locating condensate that may not be metered and checking for leaks in the steam service that may cause damage to the property. A form is completed on each location visited so there is a record of inspections performed. It is also an opportunity to establish good rapport with the customer.

Regular condensate sample testing at customer locations continued through 1984. The value of these tests is that it gives a positive date from which to make billing adjustments in the event city water enters the customer's condensate return system.

Flow Meters

The conversion of all flow meters to the electronic type was completed in 1984 in the desuperheating plants and on customer premises. Also, all flow charts were converted to seven day clocks. This saves a minimum of two man days per week since flow charts are now changed weekly rather than daily.

Monthly and seasonal inspection of these new instruments was begun. This preventive type maintenance ensures reliable metering, lessens billing complaints and considerably reduces losses, since flow type meters are usually found on the larger customers.

Turbine Meters

The installation of new turbine meters at selected locations throughout the system has had mixed success. The department is experiencing a learning process regarding the type and configuration of equipment needed to achieve good results. On entering the program, this type of meter was viewed as a solution to account for unmetered condensate loss within a customer's premises on the low pressure (15 lb.) system. After initial installation

and collection of data, some of the installations required additional piping modifications and different sized turbines in order to accurately meter steam flow at the service entrance. This work was completed at the beginning of the 84-85 heating season.

Figure 13 shows graphically the results of six installations comparing turbine meter readings to condensate meter readings for the period of November 1, 1984 through January 21, 1985. Four of the installations show positive percentage increases in amount of steam measured compared to the condensate metered results. The increase totals 1,759 Mlbs. At approximately $10/Mlb. this calculates into $17,590 of increased revenue, as well as a reduction in reported losses.

The installation labeled "BOT - 5.7%" (Board of Trade) experienced a mechanical failure during the graphed time period. Since January 1, 1985 however, the metered data is a positive percentage. The installation labeled "KCS - 13%" (Kansas City Southern) has throughout its installation been recording readings lower on the turbine than the condensate meter. Piping modifications have been made and different size rotors installed to achieve better results. However, due to space limitations on the customer's premises and the configuration of piping entering the building, a suitable velocity profile within the pipe to accurately measure steam flow has not been achieved. This meter is scheduled for removal from this installation and will be installed at another location early in 1985.

The turbine meter is not the complete answer to customer metering problems but when used within the correct physical parameters it can improve the accuracy of steam metering and thus increase revenue to the department. 1985 results for these installations will give us more data upon which to base future decisions about metering.

System Metering

Figure 11 shows the monthly maximum and minimum steam input to the District Heating System through the year of 1984. It is included as a part of this report to address the problem of orifice meters calibrated for the high flow conditions experienced in the winter heating season also used to measure steam flow in the summer months.

In 1984 the maximum steam flow from Grand Avenue to the District Heating System was 333,000 lbs./hr. and the minimum was 15,000 lbs./hr. The same orifice meter cannot accurately measure steam flows over that large a difference between maximum and minimum flow. An orifice meter could be off plus or minus 10% or more, if used to measure the flow conditions throughout the year that are presently being experienced.

The CPC meter has the capability to measure 300,000 lbs./hr. down to 50,000 lbs./hr. and it incorporates the latest electronic equipment and a calibrated flow tube. As the future of the district heating system becomes more defined, this area of desuperheating plant metering and send out metering at Grand Avenue Station to the District Heating System will be addressed.

OPERATING EXPENSES

Figure 12 shows the operating expenses for 1984, and Table III indicates expenses since 1980.

TABLE III

UTILITY STEAM OPERATIONS FINANCIAL STATISTICS

	1984	1983	1982	1981	1980
Distribution Operations	$ 165,544	$ 127,163	$ 122,132	$ 109,175	$ 89,168
Distribution Maintenance	980,590	996,789	651,140	266,684	289,481
Administrative & General	900,063	887,928	857,153	675,851	585,435
Depreciation, Taxes, & Accounting	1,723,678	231,817	453,855	(117,508)	(105,626)
Purchased Steam	8,252,652	5,799,985	4,463,822	3,555,289	3,356,088
Total Expenses	$12,022,527	$8,043,682	$6,548,102	$4,489,491	$4,214,546

( ) Denotes negative figure

The depreciation and taxes were 14.3% of total expenses in 1984, compared to 2.9% of total expenses in 1983. This increase is predominately due to the increase of taxes on revenue from the CRC steam sales.

Distribution operation and maintenance costs for 1984 increased 2.0% from 1983, a portion of which was due to increased manpower for the department. Operation and maintenance expenses have stabilized and are expected to remain at the present level for the immediate future.

Purchased steam cost was the largest increase, 42%, which was due to the CPC steam sales. Total expenses for the department increased by $3,978,845 or 49%, for 1984 over the 1983 amount.

SAFETY

Utility Steam Operations had no lost time accidents in 1984. Considering not only the type of work but also the unusual environment that the work group is exposed to such as traffic, adverse weather conditions, and often working through the night, this record demonstrates the high safety consciousness of the group.

CUSTOMER RELATIONS

Throughout 1984 there was a real emphasis placed on responding effectively to customer inquiries, complaints and any problems that were being experienced on the system. Department personnel and the Commercial Operations engineer assigned to coordinate steam accounts assisted customers in a professional and responsive manner. Some procedures in place that contributed to making the customer feel good about KCPL and his steam service were: the minimum of 24 hour notice of planned outages; the immediate notification of any emergencies affecting service; responding as soon as possible to customer damage complaints; the monthly review of steam bills in order to spot problems; and arranging outages so that customers were inconvenienced as little as possible.

CONCLUSION

As the saying goes 1984 "was a good year." The "Steam Company" had sales of $12,774,252 and total heat operating expenses of $12,022,527 which resulted in net income of $833,461 as compared to a loss of $786,227 in 1983. But even more important, steam losses continued to be reduced from 343,448 Mlbs. in 1982, 234,947 Mlbs. in 1983, down to 200,946 Mlbs. in 1984.

Utility Steam Operations, System Power Operations, Commercial Operations and others throughout the Company can take credit for this achievement which is the result of each individual taking pride in his work.

FUTURE

1985 and the years beyond will be filled with changes for the department and the District Heating System. The uncertainty of having a large industrial customer after 1985 makes it difficult to forecast future developments. However, this department will continue with the efforts begun in 1982 to improve the efficiency of its operation and maintenance activities.

A loss reduc .. program which includes the installation of electric boilers at selected customer locations throughout downtown is presently being implemented. The experience gained in 1985 will provide valuable input for future company decisions affecting the Downtown District Heating System.

Since the early 1900's, the existence of a central station heating system in Downtown Kansas City has played a major role in the city's economic and social development. Any future decisions that affect this system will need to consider the varied political, social and economic impacts that will result to the Company and community. Utility Steam Operations is preparing to meet these future challenges and opportunities with a work force that is committed to doing the best job possible for the Company and community.

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REPORT ON PHASING OUT THE ELECTRIC GENERATION AT GRAND AVENUE PLANT

EXECUTIVE SUMMARY

On August 11, 1983 a task force of SPO and T&D personnel was formed to address the unique engineering, operating and planning aspects associated with phasing Grand Avenue Station out of electric service. The task force was formed to develop a plan in response to the Missouri Public Service Commission Order, dated July 8, 1983, that required that KCPL should at its next rate filing, submit its schedule for phase-out of Grand Avenue electric generation.

Grand Avenue Station electric generation presently serves as needed peaking capacity and it provides back-up to the critical network loads of the downtown Kansas City business district. A substitute for both functions must be in place before phase-out can be implemented.

The phase-out of electric generation will result in a 100% allocation of Grand Avenue to steam heat rates. Another objective of the study was to quantify possible operations and maintenance savings associated with electric generation phase-out that would lessen the impact on steam rates.

The task force reached the following conclusions:

1. Transmission and distribution improvements can be implemented to transfer network support from Grand Avenue generation;

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and Avenue capacity will not be necessary to system operations after Wolf Creek;

3. The impact on steam heat rates of re-allocation will be offset by a combination of reduced O&M expense due to electric generation deactivation and reduced fuel expense due to lower fuel costs and improved fuel mix; and,
4. Projected labor and material savings at Grand Avenue Station will be $1.4 million annually.
5. The retirement of Grand Avenue Station generation results in a 100% allocation of Grand Avenue Station costs to the steam customers.
6. The combined effects of items 4 and 5 result in an increased steam revenue requirement of $2,868,000.
7. The improved fuel mix due to Corn Products steam load and the new one year coal contract for Grand Avenue Station result in estimated fuel cost reductions to steam customers of $3.7 million. This reduction in cost is independent of removing electric generation at Grand Avenue Station.

The task force recommends the following action:

1. Install one 40 MVA 161/13 kV transformer at Grand Avenue West prior to June, 1985;
2. Retire electric generation at Grand Avenue when Wolf Creek goes into commercial operation;
3. Effective May 1, 1984, transfer operation and maintenance of Northeast Substation and Grand Avenue West to T&D Operations;

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4. Transfer operation and maintenance of substation equipment and distribution circuit breakers at Grand Avenue effective upon retirement of Grand Avenue generation; and,

5. Continue to operate and maintain Northeast combustion turbines and their associated 13 kV generator breakers with personnel assigned to Grand Avenue Station.

INTRODUCTION

The scope of the Long-Range System Operating Study approved by the System Expansion Alternatives Committee (SEAC) on May 20, 1983 included several items of mutual concern to System Power Operations and Transmission and Distribution Operations. One key area of concern was the future role of Grand Avenue Station electric generation.

The subsequent Missouri Public Service Commission Order, dated July 8, 1983, required that the Company should, at its next rate filing, submit its schedule for phasing the Grand Avenue Station out of electric service and phasing the allocation of Grand Avenue Station to 100% steam service. In order to accelerate the review of Grand Avenue Station and to adequately address the unique operating, engineering, and planning aspects of the problem, a task force was formed on August 11, 1983. The task force consisted of:

Senior Director Engineering
Director System Planning
Director Power Supply Services
Director Technical Support
Director T&D Operations

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The task force was charged with responsibility for preparing the necessary plan along with estimated costs that would comply with the Commission Order. Personnel from the rate department and the Manager of Utility Steam Operations participated in the task force meetings.

GRAND AVENUE STATION

Grand Avenue Station is now the oldest active generating station in the KCPL system. The station began providing steam service in 1929 and through the years was modernized until by 1950 it assumed essentially the equipment configuration that exists today.

Three dual-fueled (coal or natural gas) boilers with total steaming capability of about 900,000 pounds per hour provide the bulk of steam requirements. In addition, an oil and natural gas fueled package boiler with a 200,000 pound per hour capability is available to supplement the steam supply. Present annual steam sales are approximately 700,000 Mlbs. The addition of the industrial process steam load of Corn Products Corporation in early 1984 will increase the annual steam sales to about 2.8 million Mlbs.

In the 1970's electric generating capability at Grand Avenue Station was as high as 108 MW. Over the past several years turbine generators have been retired or put on inactive reserve status so that current accredited capability is 70 MW consisting of units #7, a 1930 vintage unit, and #9, installed in 1948.

Although the number of megawatts of Grand Avenue Station electric capacity is relatively minor compared to total system capacity, the importance of that 70 MW is not minor. The downtown area is served electrically through a low voltage underground network system. In the event of multiple system contingencies that would interrupt electric service to the downtown network, Grand Avenue Station presently provides the electrical backup for the Kansas City downtown business district.

Reconstructed with new coal-burning facilities in the late 1940s, Grand Avenue Station remains an essentially non-automated power plant typical of that period. Operating expenses of this basically labor intensive station are further increased due to the station's age which requires that a great deal of maintenance be performed to keep equipment operating properly.

Present authorized 1984 manpower for Grand Avenue Station is 138 people to operate and maintain equipment for steam and electric production. Station personnel also operate and maintain substations at Grand Avenue Station, Grand Avenue West, and Northeast and the eight combustion turbines located at Northeast Station.

A phase-out of electric generation will impact the cost of steam. The magnitude of the impact will largely depend on the amount of operations and maintenance savings that can be achieved with electric retirement.

The electric generation at Grand Avenue Station serves two very important functions:

1. It provides 70 MW of peaking capacity; and,
2. It provides electric service back-up to the critical network loads of the downtown Kansas City business district.

an alternative to each function must be found to permit the phase-out of Grand Avenue Station electric generation.

CAPACITY NEEDS

The station's value as a capacity resource was recently demonstrated during the summer of 1983. The 70 MW of peaking capacity was often operating during the summer heat storms displacing higher cost oil-fired generation. Without the 70 MW of Grand Avenue Station capacity, KCPL reserves would have fallen some 68 MW below the MOKAN Pool required minimum reserve. This would have required Reserve Equalization payments to MOKAN of some $2.7 million for contract year 1983.

Projected load and capability for the 1980's is as follows:

	Load + Reserves	Capability
1984	2693	2655
1985	2717	3056
1986	2772	3056
1987	2826	3056
1988	2876	3056
1989	2924	3056
1990	2968	3116

The present plan calls for deactivation of Grand Avenue Station generator #7 (30 MW) in 1985 with #9 deactivated in 1990. Based on the project peak load plus reserves for 1984, the 70 MW at Grand Avenue Station is necessary to meet KCPL's capacity responsibility.

[illegible] is projected for commercial operation in Spring, 1985, at which time Grand Avenue Station generator #7 is deactivated. The reserve levels that exist because of Wolf Creek allow KCPL to look at the feasibility of deactivating older, less efficient generating units, such as Grand Avenue Station and Hawthorn Units 1 - 4. From a capacity standpoint, total phase-out of Grand Avenue Station generation can be accelerated to coincide with commercial operation of Wolf Creek.

NETWORK SUPPORT

In order to accelerate the phase-out of Grand Avenue Station generation, an alternative must be found to the second important function of that generation, network support.

The downtown network system was established in 1946 and at present has 13 cables from #3 bus at Grand Avenue serving network load. Circuits 1541 thru 1545 have two cables each, except for Circuit 1544 which has only one cable. The network load served from these circuits total 46.2 MVA and is referred to as the East Side, West Side, and 14th Street networks. In addition, Circuits 1531 thru 1534 each have one cable that serves 17.4 MVA of load and serves the area referred to as the spot network. Factors to be considered in serving a network are:

1. Each network must be served from a common bus in order to prevent circulating current flowing through the network.
2. Provision must be made to continue serving the network if a bus fault occurs which required circuits to be connected to a reserve bus.

.. sources to the network need to be designed to handle a second contingency failure since distribution circuits from other substations cannot be used.

4. Loss of the network requires that it be reestablished as a unit from a high capacity system. A rule of thumb is that 18 MVA of short circuit capability is required to energize one MVA of network load.

In addition to the network load served from Grand Avenue, there are 7 circuits carrying 36.1 MVA served from #6 bus, 8 circuits from #7 bus carrying 38.8 MVA, and 8 circuits from Grand Avenue West busses 1 and 2 carrying 44.7 MVA. A summary of the total load at Grand Avenue is as follows:

Grand Ave. West Substation	#1 bus	23.3 MVA	4 circuits
Grand Ave. West Substation	#2 bus	21.4 MVA	4 circuits
Grand Avenue Station	#6 bus	36.1 MVA	7 circuits
Grand Avenue Station	#7 bus	38.8 MVA	8 circuits
Grand Avenue Station	#3 bus E.side, W.side, 14th St.network	46.2 MVA	5 circuits (9 cables)
Grand Avenue Station	#3 bus Spot network	17.4 MVA	4 circuits
	Total Load	183.2 MVA	

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and transformer capacity at Navy Substation, Grand Avenue, and Grand Avenue West Substation is as follows: Capacity available from the 115 kV source for Navy transformers is 60 MVA due to the 13 kV distribution load on the tertiary winding of #78 transformer at Northeast Substation. This reduces the capacity available from the two Navy transformers to 60 MVA even though rated at 40 MVA each for a total of 80 MVA.

Location	Transformer Rating	Capacity Available to System	Date Installed
Navy	2 - 40 MVA	60 MVA	1943
Grand Avenue	2 - 80 MVA	160 MVA	1965
Grand Avenue West	1 - 50 MVA	50 MVA	1970
Total	290 MVA	270 MVA	

In order to provide for a second contingency, the source must be designed to lose 2 - 80 MVA transformers or 160 MVA which would leave capacity of 110 MVA to serve 183 MVA load. The past practice has been to bring on generation during peak load periods or if a transformer fails. 70 MW of generation is available from #7 and #9 generators.

The load conditions stated above will be reduced in 1984 due to load transfer from Grand Avenue to the new North Kansas City Substation. The North Kansas City Substation is being built to replace the capacity of existing cables on the old ASB Bridge. The removal of the roadway from the bridge eliminates maintenance access to the cables. 7 circuits with 35 MVA load will be transferred from Grand Avenue to the new North Kansas City Substation. Plans are also underway to transfer an additional 15 MVA of load from Grand Avenue to Crosstown Substation to serve load south of the Crosstown Substation.

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... of 50 MVA load from Grand Avenue will reduce the remaining load to 133.2 MVA which is above the firm capacity of 110 MVA if the two largest transformers are out of service. It is recommended that additional transformer capacity be installed to serve this load.

1. The two Navy transformers rated 40 MVA each were installed in 1942 and are nearing the end of their service life. They are rated 115kV, and there are no spare transformers available on our system to replace these transformers. In addition, the 115 kV source to these transformers is from a 115 kV gas filled cable served from a 161 kV to 115 kV auto transformer at Northeast Substation. The failure of either the 115 kV cable or autotransformer will prevent serving load through the Navy transformers. Because of its age and the nature of its 115 kV source, Navy cannot be considered as reliable support for the future.

2. Several new projects are now being constructed or are in the planning stage in the downtown Kansas City area. The Vista International Hotel is under construction and will be completed in 1984. Excavations for Executive Hills at 11th and Wyandotte, United Missouri Bank at 11th and Walnut, and Commerce Bank at 10th and Main have been started. Construction of the AT&T Building in Block 93 between 11th and 12th Streets, Main to Walnut has recently been announced and will start soon. This new construction will add additional load to the downtown area that needs to be served from Crosstown and Grand Avenue. The load added to Grand Avenue will be on primary radial feeders and will not be added to the network system.

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NEW FACILITIES AND COSTS

Additional transformer capability can be provided by installing a 40 MVA 161/13 kV transformer in the space available at Grand Avenue West Substation. This capacity would replace the same capacity previously provided by #9 generator and provide firming for both network and other distribution circuits under contingency conditions. The estimated cost of this transformer and cable is $750,000 and can be completed prior to the summer of 1985 if plans to proceed are approved by April, 1984.

GRAND AVENUE STATION

OPERATIONS AND MAINTENANCE

Grand Avenue Station O&M expense is presently allocated between steam heat and electric operations. If the electric generating equipment is retired, the entire station O&M expense must be recovered through the steam rates.

As part of this study, the Plant Manager reviewed, in detail, the Grand Avenue Station manpower requirements to determine possible O&M savings that can be achieved if electric generation is retired. In addition, equivalent manpower to operate and maintain the three substations (Grand Avenue, Grand Avenue West and Northeast) was identified along with the equivalent manpower necessary for combustion turbine maintenance. Identification of manpower for these functions was necessary to evaluate the possibility of transferring substation maintenance to Transmission & Distribution Operations and combustion turbine maintenance to Hawthorn Station.

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The present authorized manpower level for Grand Avenue Station is 138 people of which 117 are represented by the bargaining unit. It is estimated that the equivalent of two electricians are used for substation operations and maintenance and an equivalent of four people are necessary for combustion turbines.

Apopendix A, pages 1 and 2, are job listings showing those positions that could be deleted if electric generation were eliminated and substations were transferred to T&D. Pages 3, 4 and 5 of appendix A show the corresponding effect on operating schedules. As shown in Appendix A, supervision would be reduced from 21 authorized positions to 17. Bargaining unit personnel are reduced by 38 people from the 117 presently authorized.

It is important to note the assumptions listed in Appendix A. The manpower reductions depend on increased flexibility in assignment and duties of the remaining personnel. Some capital expenditures will be necessary to motorize the soot blowers and relocate #6 boiler control panel. Furthermore, some portion of the labor "savings" may be offset by increased contractor expense and increased support from Central Maintenance.

Total station manpower is reduced from 138 authorized to 96 people. This assumes no electric generation at Grand Avenue Station, transfer of substation operations and maintenance to T&D, and combustion turbines continue to be Grand Avenue Station responsibility. In order to determine the impact on steam heat rates, the manpower level should be considered at 92 people. This is a reduction by the equivalent of 4 people that are charged to combustion turbine electrical operations and maintenance.

The experience of Grand Avenue personnel in maintaining the combustion turbines has produced an excellent record of availability for combustion turbine operation. It would not be prudent to tamper with success. The Task Force concludes that combustion turbine responsibility remain at Grand Avenue Station.

The substations at Grand Avenue, Grand Avenue West, and Northeast are similar to other distribution substations on the system. Operation and maintenance of distribution substations is one of the primary functions of the Transmission Operations Department. If substations are transferred to Transmission Operations the reduction of two electricians at Grand Avenue Station could be offset by increased T&D manpower, however, the T&D shift workers who perform substation operations and maintenance could perform switching and inspections on a dispatched assignment while also being available for other substation assignments in the metropolitan area. The task force concludes that responsibility for the three substations be transferred to Transmission Operations.

In addition to labor savings, some material and "other" expenditures will be reduced if electric generation is retired. The reduction in other than labor expense associated with no generation at Grand Avenue Station is estimated at approximately $150,000 per year.

Increased operations and maintenance expense due to the increased coal burn projected for Grand Avenue Station is estimated at $451,000 for 1984. With the addition of the CPC load, annual coal burn will approach 200,000 tons

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requiring increased O&M for mills, fuel and ash handling, precipitators and flyash disposal. Grand Avenue Station, with 35 year old equipment, will be called upon to burn a quantity of coal greater than any amount since 1975. Experience over the next year will be an indication of the accuracy of the labor and materials estimates contained in this report.

STEAM RATE IMPACT OF ELECTRIC GENERATION RETIREMENT

A forecasted cost of service study was performed for steam service from Grand Avenue Station with no electric allocation, i.e., only CPC and downtown steam customers were served. It was found that a revenue increase of about $2,868,000 from steam customers would be required to cover the fixed costs no longer allocated to electric operations at Grand Avenue Station. For this study the following main assumptions were made:

1. A 92 man work force at Grand Avenue Station.
2. A 13 man work force for steam distributions operations.
3. Energy costs based on:
   (a) Boiler efficiency for steam transferred equals 70%
   (b) Coal @ $1.20 per MMBtu; 80% mix
   (c) Gas @ $3.75 per MMBtu; 20% mix
   (d) Water @ 20c per Mlb.
4. Forecast sales and losses of:

	Mlbs.	Losses
Downtown steam heat	625,824	25%
CPC	2,167,360	0

5. All electric plant and electric O&M costs were reduced to zero.

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other rate case matters, such as allocation of overhead and rate of return calculated per ER 83-49.

7. The revenue requirement increase was allocated between CPC and Downtown Steam Heat by a demand allocator.

Since rate case allocations have historically allocated about 70% of Grand Avenue Plant and non-fuel expenses to the electric operations, one might expect the rate increase resulting from removal of electric operations to be much more dramatic. Fortunately, the addition of a large new steam customer, CPC, in 1984 will significantly improve the boiler efficiencies and fuel mix to moderate, for all steam customers, the rate impact of the retirement of electric operations.

The table below summarizes the total revenue requirement with and without an Electric Allocation for the downtown steam customers. In addition, the table compares the CPC revenue requirement without an electric allocation to the revenue requirement that was expected during contract negotiations.

TABLE XX

RATE IMPACT OF RETIRING ELECTRIC GENERATION

	Revenue Requirements with Electric Allocation		Forecasted Revenue Requirements without Electric Allocation		Percentage Increase (Decrease) (%)	
	Total $	$/Mlb	Total $	$/Mlb		
Downtown Steam Heat	$5,450,927	8.71	$6,715,092	10.73	23.2	
Corn Products	4,139,657	1.91	5,743,504	2.65	38.7	
Total	$9,590,584		$12,458,596		29.9	$2,868,012 Increase

Fuel Adjustments and Energy Charges - Not Related to Retiring Electric Generation

	Present Fuel Cost or Energy Charge		Forecasted Fuel Charge with improved fuel mix and new coal contract		Percentage Increase (Decrease) (%)	
	Total $	$/Mlb	Total $	$/Mlb		
Downtown Steam Heat	$2,121,543	3.39	650,857	1.04	(69.3)	
Corn Products	8,951,197	4.13	$6,762,163	3.12	(24.5)	
Total	$11,072,740		$7,413,020		(33.0)	$3,659,720 Decrease

Combination of Electric Generation Retirement Increase and Improved Fuel Mix and New Coal Contract Decrease

	Present Combination		Forecasted Combination		Percentage Increase (Decrease) (%)
	Total $	$/Mlb	Total $	$/Mlb	
Steam Heat	$7,572,470	12.10	$ 7,365,949	11.77	(2.7)
			$12,505.667	5.77	(4.5)

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CONCLUSIONS AND RECOMMENDATIONS

1. Install one 40 MVA 161/13 kV transformer at Grand Avenue West prior to June, 1985 at an estimated cost of $750,000. Projects already underway to transfer Grand Avenue load to Crosstown Substation and the new North Kansas City Substation will also be completed by this date. This load reduction and the addition of one 40 MVA transformer at Grand Avenue West will provide the capacity required for distribution circuits and network load. It will also supply capacity to the new downtown projects and an initial step toward replacing the 40 year old Navy transformers.

2. Retire electrical generation at Grand Avenue when Wolf Creek is in commercial operation and operate Grand Avenue Station to supply steam customers. The estimated annual savings on manpower and materials is $1.4 million.

3. Transfer operation and maintenance of Northeast Substation and Grand Avenue West Substation to T&D Operations effective May 1, 1984. The combustion turbines and their associated 13 kV generator breakers at Northeast would be the responsibility of System Power Operations; other equipment at these locations would become the responsibility of T&D Operations.

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r operation and maintenance of substation equipment and distribution circuit breakers at Grand Avenue Station effective upon deactivation of Grand Avenue generation.

5. Continue to maintain the combustion turbines at Northeast with personnel assigned to Grand Avenue Plant.