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May 11, 1992

Mr. C. Brent Stewart
Executive Secretary
Missouri Public Service Commission
Post Office Box 360
Jefferson City, Missouri 65102

RE: The Kansas Power and Light Company
Case No. GO-91-277

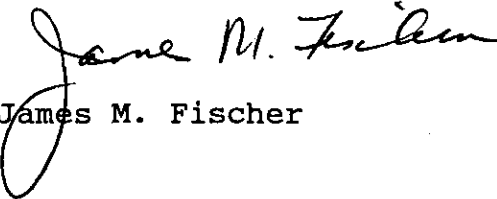
Dear Mr. Stewart:

Enclosed for filing, please find one original and fourteen (14) copies of Response of Gas Service, A Western Resources Company, in the above-referenced matter.

A copy of the foregoing document has been mailed to all parties of record this day.

Thank you for your attention to this matter.

Sincerely,


James M. Fischer

JMF/jr
Enclosures

cc: Office of Public Counsel
William Shansey

FILED
MAY 11 1992
PUBLIC SERVICE COMMISSION

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the matter of the review and)
approval of cast iron main and)
unprotected steel main programs)
for The Kansas Power and Light)
Company)

Case No. GO-91-277

FILED

MAY 11 1992

Response of Gas Service,
a Western Resources Company

A. Introduction

PUBLIC SERVICE COMMISSION

On March 9, 1992, the Staff of the Missouri Public Service Commission (Staff) filed a memorandum with the Commission setting forth its recommendations regarding the Unprotected Steel Main and Cast Iron Main Programs previously submitted by Gas Service, a Western Resources Company (Gas Service or Company).¹ As Staff notes in its memorandum, Gas Service's programs for unprotected steel and cast iron mains were initially submitted by the Company on May 1, 1990, in accordance with 4 CSR 240-40.030(15)(B) of the Commission's safety rules. Following numerous discussions with Staff, the programs were subsequently revised on September 27, 1991, by the filing of new schedules which, in comparison to historical experience, reflected significant increases in the miles of main to be replaced or cathodically protected by Company for the calendar year 1992 and beyond.

By order dated April 8, 1992, the Commission directed Gas Service to file its response to the recommendations set forth in

¹On May 5, 1992, the shareholders of The Kansas Power and Light Company voted to change the Company's name to Western Resources, Inc. Western Resources filed its Unprotected Steel Main and Cast Iron Main Programs under its previous name.

Staff's memorandum. As discussed below, Gas Service believes its existing programs for unprotected steel and cast iron mains not only meet but, in several respects, exceed the requirements imposed by the Commission's safety rules. In addition to incorporating a comprehensive set of procedures and criteria for prioritizing replacements, both programs provide for an expedited rate of replacement and protection in accordance with the Commission's rules. At the same time, they also reflect the need to ensure that the Company's customers will not be burdened by costs that are not truly necessary to provide safe utility service. For these reasons and those presented below, Gas Service accordingly urges the Commission to approve the Company's Unprotected Steel and Cast Iron Main Programs.

B. Explanation of Program

Throughout its March 9, 1992 memorandum, the Staff expressed concern over the lack of a formal explanation describing the various components of the Company's cast iron and unprotected steel main programs. Although the Company filed an explanation of its programs when they were initially submitted and has attempted to keep Staff informed of developments affecting their progress, it welcomes the opportunity to provide a more formal and comprehensive explanation of the programs as they exist today.

1. Prioritization Procedures

The Company recognizes the importance of properly allocating its resources to maximize public safety and insure efficient operations. As part of its program to replace cast iron main and replace or cathodically protect unprotected steel mains, the Company has developed a performance driven, computer-based prioritization system. This system provides the basis for the Company to decide which replacement projects, be they cast iron or bare steel replacements, are completed first. The heart of this system is the Construction Priority Index (CPI) which will be discussed in detail later.

In an effort to provide Staff with a clear understanding of the magnitude and complexity of the Company's overall Main Replacement/Protection Program, Gas Service met with Staff on December 6, 1991. Explanation and documentation was provided to Staff at that time to fully explain how main replacement candidates are identified. The Company also described the application of the CPI once segments of main were identified as needing further evaluation for replacement.

Under the Company's CPI system, a rating form is completed for every section of main identified for replacement. Following the evaluation process, the main section is assigned a project index number which indicates the priority of the specific replacement based upon a comprehensive set of calculated factors. This project index number is then compared to other main segment candidates to determine where resources will be allocated.

1 7

To ensure that the Company is evaluating the appropriate population for replacement, the CPI system was designed to receive input from numerous sources. These sources include the Company's Continuing Surveillance Program (leak surveys, patrols, pipe condition reports, field input and operating activities report), the 5/5/3 leak data system, and Cathodic Protection Program. Data relating to damage prevention and public improvements, as well as information generated as a result of the Company-developed Facility Priority Index (FPI) system, which will be discussed later, are also included. Finally, the Company has identified problematic facilities such as small diameter cast iron main and planned their replacement.

Company procedures have been written to describe in detail the methods used to identify potential main replacement/protection projects and the application of the CPI. These standards are titled respectively Main Replacement/Protection Program and Construction Priority Index (CPI) Procedures and are included in Attachment 1 to this response. These Standards and their application fully satisfy the requirements of CSR 240-40.030(15)(D) & (E). As set forth in the requirements, the Company's program identifies and prioritizes main segments and determines the need to replace or cathodically protect pipelines with consideration given to the high priority replacement areas provided for in the rule.

2. Facility Priority Index

A key prioritization subsystem which has been designed to identify candidates for replacement is the Facility Priority Index (FPI). The FPI process is used to isolate and identify specific segments of piping which are the best candidates for replacement, based upon physical criteria. This system, although only one of several sources for replacement candidates, plays an important role since it is proactive. It is a deterministic, engineering approach to the prediction of pipe failures.

The FPI system was initially designed as a joint effort of Gas Service and ZEI, Inc. As part of the Stone & Webster study, the Oversight Committee authorized the Company to perform an engineering study of the condition of cast iron mains and unprotected bare steel mains and service/yard lines in the gas distribution systems. ZEI also was instructed to propose an effective replacement program which would maintain a safe operating system by helping prioritize facilities on an urgency basis.

ZEI has performed similar analyses at many large gas distribution and transmission companies. ZEI's findings have been presented to various commissions, and is recognized as an expert in this field. ZEI brings knowledge of both theory and practice by virtue of their extensive past associations.

This analysis and the subsequent application work performed by the Company resulted in the FPI system. The primary objectives of the study that led to FPI were:

- Identifying and measuring those factors prevalent in Gas Service service areas that cause underground gas piping to fail;
- Identifying and quantifying the significance of factors impacting the severity of the consequences of piping failure;
- Prescribing prudent rates of replacement or rehabilitation of the principal piping in question; i.e., cast iron mains, unprotected bare steel mains, and unprotected bare steel service/yard lines;
- Directing replacement/rehabilitation efforts and expenditures to those installations and locations likely to produce the greatest benefit/cost ratio, including recognition of the tangible and intangible consequences of pipe failure.

The ZEI study methodology blended theoretical, statistical, and rational models. Through its months-long effort to evaluate the current and future integrity of Gas Service's mains and service/yard lines, ZEI:

- Gathered and analyzed a wealth of data about the Gas Service system and performed regression analysis to identify trends;
- Collected and tested soil samples from throughout the Gas Service service area to determine the aggressiveness of the soil environment and correlated the empirical results with known data bases in developing application programs; and,
- Employed theoretical and rational failure analyses known to influence the weight-loss and pit-depth characteristics of cast iron and bare steel pipe, and created Gas Service-specific indices that can predict long-term performance.

ZEI's work was directed toward developing a deterministic, engineering approach to the prediction of failure, utilizing existing Gas Service management systems and helping construct new systems to gather and analyze the data necessary for successful

Facilities Priority Index application. Effort especially was aimed toward distribution of resources on those projects which would minimize both the probability and consequences of failure.

As part of its study, ZEI developed an unprotected bare steel mains replacement model incorporating Gas Service statistical data and theoretical and rational analyses. The model developed for Gas Service identifies and prioritizes mains for replacement over a period of time based upon specific criteria. Simply stated, **this pro-active program identifies candidates for replacement** according to risk considering several factors, such as age, size, soil type, pressure, etc. When combined with the other data sources and prioritization criteria used by Gas Service to determine which facilities should be replaced, the FPI system ensures that Gas Service will have a state of the art prioritization system that fully complies with the Commission's rules.

2. Schedule of Replacement/Cathodic Protection

As previously noted, in addition to developing the Company procedures discussed herein for main replacements/protection and prioritization, the Company submitted a schedule on September 27, 1991, detailing the Company's revised plans for replacement of cast iron mains and replacement/protection of unprotected bare steel mains. Except for the deletion of data relating to the service line program, this schedule has been replicated in Attachment 2. The schedule set forth in Attachment 2 provides for a specific amount of replacement/protection of the affected facilities for a

period of three years and an estimation of replacements/protection for an additional period of six years. This approach to the establishment of a rate of replacement/protection enables both the Company and the Staff to reevaluate the appropriateness of the Company's program after three years to determine if and where adjustments are needed. The discussion which follows focuses only on the first three years of the program, particularly with respect to how the rates of replacement/protection were determined.

(a) Cast Iron Mains

Under the schedule submitted by Gas Service on September 27, 1991, the Company would replace slightly more than 69 miles of cast iron mains during the period 1992 through 1994. This include 12.8 miles in 1992, 24.3 in 1993 and 32.1 in 1994. The establishment of an initial replacement of 12.8 miles of cast iron main, with a continued increase in the amount of replacements over time was based on four factors:

- Review of historic replacements during the period 1986 - 1990 This base line was used to determine a level of expedited replacement. This historic average level was 4.8 miles. An increase in the first year to a level 267% above this average was determined to be more than a reasonable increase that complies with the rule's requirement that replacements be performed on an expedited basis.
- Construction Logistics The Company evaluated the requirements of organizing construction crews, and assembling the equipment, materials and other items necessary, and determined an increase to 12.8 miles the first year was an ambitious but attainable goal. Following this "gearing-up" year, increased work could be accomplished.

- Coordination of Efforts Completion of the Stoner Model for the various cast iron systems is necessary to assure that the appropriate type of replacement is being made. This sophisticated modeling process includes evaluation of new main size, pressure, location, and alternate feeds or tie-ins to assure both a prudent engineering design and facilitate a systematic replacement program.
- Recommendations in the ZEI report The level selected significantly exceeds the level recommended by ZEI in its report.

(b) Unprotected Steel Mains

The establishment of an initial protection/replacement of 135.5 miles of bare steel main, followed by a similar consistent amount of protection/replacement over time was based on the following considerations:

- Review of historic protection/replacement during the period 1986 - 1990 This base line was used to determine a level of expedited replacement. This historic level averaged 36.6 miles. An increase in the first year to a level 370% above this average was determined to be a more than reasonable increase, especially in light of the added protection that would be applied in conjunction with the service line program. As with its cast iron main replacement schedule, Gas Service believes these increased quantities fully comply with the rule's requirement that such facilities be replaced or cathodically protected on an expedited basis.
- Review of the impact of the Service Line Replacement Program The Company also reviewed those areas where additional efforts focused on main protection would be the most beneficial in achieving main protection in conjunction with the replacement of service lines.

C. Response to Staff Recommendations

1. Prioritization Procedures

In its memorandum, Staff indicates that information relative to the condition of the Company's mains, i.e. FPI, breaks per block, and coupon sampling, may be appropriate tools to prioritize replacements. However, Staff questions whether the same data should also be used to identify facilities that are subject to potential replacement. Instead, Staff appears to be suggesting that such identification should be accomplished through a complete review of all historical Company records relating to pipe condition. As described in its Main Replacement/Protection Program procedures, the Company believes it is most appropriate to use FPI, breaks per block, coupon sampling, as well as leakage reviews (5/5/3 Program), continuing surveillance, damage prevention, and public works projects to identify mains for replacement or cathodic protection.

Contrary to Staff's assertion, prioritization is accomplished by the Company via the Construction Priority Index (CPI) which takes into account the information which caused the main segment to be identified as a candidate, and allows further evaluation of the segment by including additional external factors, i.e., location, surface conditions, potential for public hazard, etc., to determine the urgency of replacement/protection.

In any event, it is not feasible to conduct in an expedited manner a complete evaluation of historical records to identify the main segments with leak or corrosion (and graphitization) history.

The fact that there is a vast quantity of these manually prepared records in numerous locations and formats and spanning many years completed by differing predecessor companies of Gas Service, makes it extremely difficult, if not impossible, to conduct such a review. During the course of the Stone & Webster Safety Study this fact was made known. Indeed the Woodward-Clyde CIMOS modeling effort was set aside in favor of ZEI because of the recognition that adequate documentation was not universally available. An exhaustive review of each and every record in existence would not enhance the identification or prioritization process.²

The Company does, however, include leak and corrosion history records as an integral part of its comprehensive main replacement/protection program, along with other important factors. As described in Company procedures for its Main Replacement/Protection Program, main system data generated from leak surveys, leak repairs, drought surveys, cathodic protection activities, and cast iron analysis are just a few examples which demonstrate that leakage and corrosion information are utilized to identify replacement candidates. While Staff's understanding is correct that not every record throughout history has been reviewed as the basis for the Company's program, these records are routinely analyzed in conjunction with the Construction Priority Index in

²As Staff is aware, the Company implemented automated record keeping systems in 1990 which provide for consistency in establishing and maintaining leak and corrosion history information with regard to these facilities. By year-end, Gas Service will have three years of relevant, accurate data to help drive its models. With each additional year, the Company's data files will improve further.

performing the further evaluation necessary to prioritize identified replacements.

2. Program Schedule (Cast Iron Mains)

As part of its September 27, 1991 filing, the Company submitted a forecast of cast iron main replacements. The forecast depicts a transition from historic replacement levels of approximately five miles per year to a level of 32.1 miles during 1994. This orderly progression from a lower historic level to an expedited future level allows the Company to manage a process that will require a significantly higher level of planning, resources, and contracting. The Company believes the establishment of up-front levels of training and supervision afforded by this schedule will benefit both Company and customer for the duration of this multi-year program while not compromising safety.

The following tables compare the Company's cast iron replacement plan with the plan filed by Staff for 1992-1994. Both plans have been modified for two adjustments to make the plans comparable.

The first adjustment removes both the Company's and Staff's replacements related to Public Works projects. These replacements are generally a result of street moves or facility relocation. The Company agrees that cast iron associated with Public Works projects should be replaced when these projects occur. However, we believe, when comparing the two programs, an item such as a public works project which is generally uncontrollable by either the Company or

Staff should be removed. It is not appropriate to evaluate either program when both contain an item that could vary dramatically because of an unforeseen action of a city or county.

The second adjustment removes Staff's estimate of replacements due to past excavations. The Company previously reviewed the data available on past excavations to determine the replacements which were required. We have found no information that indicates Staff's level of future replacements is a reasonable forecast. The Company believes its current practice of replacing mains in the proximity of current construction projects while continuing its surveillance for soil subsidence related to prior excavations is appropriate.

Company Cast Iron Main Replacements
(Miles)

	1992	1993	1994
Total Replacements	12.8	24.3	32.1
Less Public Works	---	(1.5)	(3.0)
Less Prior Excavations	---	---	---
Comparable Replacements	12.8	22.8	29.1

Staff Cast Iron Main Replacements
(Miles)

	1992	1993	1994
Total Replacements	24	36	41
Less Public Works	(3)	(3)	(3)
Less Prior Excavations	(6)	(6)	(3)
Comparable Replacements	18	27	35

As the charts indicate, both Staff and the Company are in agreement that the level of replacements should be increased from the historic level of approximately five miles per year. However, the Company believes the inclusion of a level of replacements associated with prior excavations which have already been addressed is inappropriate. Likewise, the Company believes its plan for an orderly progression from five miles per year to an expedited level more effectively achieves its goals for safety and efficiency in a prudent manner.

3. Program Schedule (Unprotected Steel)

The Company also filed a forecast of bare steel main replacement and protection on September 27, 1991. Under this plan,

the level of bare steel pipe either replaced or cathodically protected increases dramatically over historic levels.

The following tables compare the Company's bare steel replacement plan with the plan filed by Staff for 1992-1994. Both plans have been modified to exclude replacements related to Public Works projects. The Company agrees bare steel pipe associated with Public Works projects should be replaced or protected. However, as in the previous discussion of cast iron, the Company believes it is not appropriate to include an item which is generally outside the Company's control in the evaluation of the Company's or Staff's program.

Company Bare Steel Main Replacement
(Miles)

	1992	1993	1994
Total Replacements	9.3	10.6	10.6
Less Public Works	(1.0)	(1.0)	(1.0)
Comparable Replacements	8.3	9.6	9.6

Staff Bare Steel Main Replacements
(Miles)

	1992	1993	1994
Total Replacements	11	11	11
Less Public Works	(4)	(4)	(4)
Comparable Replacements	7	7	7

As demonstrated by these charts, the Company is actually proposing to replace more miles than Staff has suggested. Staff has also indicated that six of the seven miles replaced in their plan each year should be areas of past corrosion. Historically, the Company has addressed these areas of corrosion as they are discovered. The Company does not have information which indicates that there is a level of past corrosion which requires replacement of six miles of main per year. Instead, through the use of FPI and CPI the Company has focused on high priority areas of known corrosion or areas where corrosion is likely to occur.

Staff's recommended level of cathodic protection also varies significantly from the Company's. This is due in part to the fact that the Company has included 302 miles of cathodic protection associated with the service line replacement program for 1992-1994. The Company also included 52 miles of cathodic protection for this period under the category protection - independent. This protection is generally applied in situations where an excavation

has already been made for another reason or the Company has the opportunity to cathodically protect an entire town. As explained below, application of cathodic protection in these cases is both prudent and efficient.

The remaining differences between the Company and Staff on the level of cathodic protection relate to pipe under pavement and close to concentrations of the public (P&P). These differences are not in the number of miles protected but in the timing of the protection. Both Staff and the Company have proposed to apply cathodic protection to approximately 30 miles of this main during the forecast period. The chart below illustrates the two programs.

Cathodic Protection P&P
(Miles)

	1992	1993	1994	Total
Company Plan	2.2	11.8	16.1	30.1
Staff Plan	10.0	10.0	10.0	30.0

The Company has put in place a balanced plan for bare steel removal and bare steel cathodic protection. The plan calls for levels of bare steel replacement that exceed Staff's comparable proposal in all of 1992-1994. Although not included in Staff's proposal, the Company has also proposed an accelerated level of cathodic protection associated with its service line replacement program and other routine excavations. This program has historically proven to

be very cost efficient. Finally the Company has proposed to cathodically protect all pipe in areas of pavement and close to concentrations of the public over the same three year period as Staff, the only difference being that the Company's level of cathodic protection is lower in the first year than Staff's. When viewed in its totality, the Company believes its program best permits the operation of a safe, efficient, and reliable system.

4. Shift from Cathodic Protection to Cast Iron Main Replacement

Staff suggests that the Company should increase the amount of cast iron replacement while reducing the efforts towards protecting additional sections of unprotected bare steel main. These two proposals are not interchangeable. There is a small incremental cost increase associated with protecting the bare steel main in combination with the service line replacements. Diverting these funds would not allow any significant increase in the cast iron main replacement, as is believed by Staff. Furthermore, the shift would delay preserving the Company's bare steel pipe and thereby shorten its useful life.

The Company recognizes that not all unprotected bare steel mains, which will be placed under cathodic protection, are located in high priority areas as described in the Missouri requirements. The Company's plan to protect additional bare steel mains, beyond those which are identified as being high priority, is both prudent and efficient. As service/yard lines are replaced, or when other construction, operations or maintenance work provides opportunities

to efficiently apply cathodic protection to unprotected steel mains, it makes good business sense to apply cathodic protection at that time, extend the life of those facilities, and maintain the continuity of safe, reliable service. Therefore, it is neither practical nor wise to "switch" investment from the cathodic protection program to the cast iron program.

Finally, in developing its replacement/protection program, the Company did not shift emphasis from cast iron replacements to cathodic protection of unprotected bare steel mains. The Company believes in making performance-based decisions. Those facilities requiring attention, receive it. Using broad-based assumptions that result in artificial quotas is not appropriate.

D. Conclusion

For the reasons discussed herein, the Company believes that its Unprotected Steel Main and Cast Iron Main Programs fully comply with and, in many respects, exceed the requirements of the Commission's safety rules.

The Company also urges the Commission to recognize that the Stone & Webster Gas Safety Audit, which in part directly addresses bare steel main replacement/protection and cast iron replacement, was completed in early May, 1992. Gas Service currently is evaluating the findings, conclusions and recommendations made by Stone & Webster, but believes its proposed plan is well within the recommendations made by Stone & Webster. The Company suggests its proposals, as submitted, serve as the approved foundation for its

cast iron and bare steel programs. Furthermore, the Company will continue to work with Staff to analyze the Stone & Webster recommendations and discuss any impact Staff believes the recommendations will have on future main replacements.

Respectfully Submitted,

GAS SERVICE,
A WESTERN RESOURCES COMPANY

By: Michael C. Pendergast
Michael C. Pendergast *as GM*
Assistant General Attorney,
Regulation
P.O. Box 889, 818 Kansas Avenue
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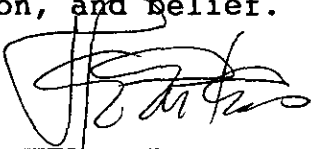
CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing **Response of Gas Service, a Western Resources Company** was deposited in the United States mail, first class postage prepaid, this 11th day of May, 1992, to all parties of record.

James M. Fischer
James M. Fischer

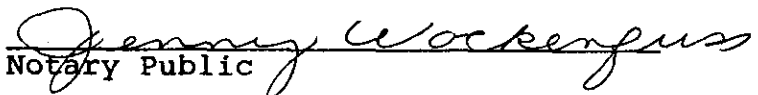
STATE OF MISSOURI)
) ss:
COUNTY OF JACKSON)

Hans E. Mertens, being duly sworn upon his oath, deposes and says that he is Vice President, Engineering, of The Kansas Power and Light Company herein; that he has read and is familiar with the foregoing Response; and that the statements therein are true to the best of his knowledge, information, and belief.



Hans E. Mertens

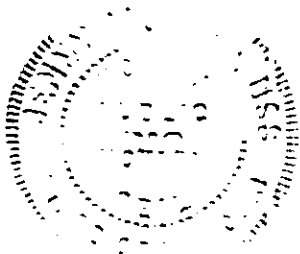
SUBSCRIBED AND SWORN to before me this 7th day of May, 1992.



Notary Public

My Appointment Expires:

JENNY WOCKENFUSS
Notary Public - State of Missouri
Commissioned in Jackson County
My Commission Expires May 23, 1995





ATTACHMENT 1
GAS ENGINEERING
STANDARDS



SUBJECT Main Replacement/Protection Program - Distribution				DATE EFFECTIVE Final Draft	SECTION/PAGE Sec. 3140.7, Pg. 1
SUPERSEDES Original Issue	PAGE	SECTION	DATED	PREPARED BY D.P. Spears	APPROVED

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GAS ENGINEERING STANDARDS



SUBJECT Main Replacement/Protection Program - Distribution				DATE EFFECTIVE Final Draft	SECTION/PAGE Sec. 3140.7, Pg. 2
SUPERSEDES Original Issue	PAGE	SECTION	DATED	PREPARED BY D.P. Spears	APPROVED

1.0 Scope

- 1.1 This Standard describes the procedures which specify the criteria to be used for determining gas main replacements and/or cathodic protection and the prioritization of the replacement/cathodic protection projects.
- 1.2 This Standards meets the requirements of Parts 192.459, 483, 487, 489 of the Federal Pipeline Safety Regulations, Missouri - 4 CSR 240-40.030 9(F)(R)(S)(T)(U), 15(C), 15(D), 15(E), 13(Z), Kansas - K.A.R. 82-11-4(s), (i), (KK), and Oklahoma - Part 192.459, 483, 487, 489 of their respective Pipeline Safety Regulations.

2.0 Application

- 2.1 This Standard applies to those Company personnel and departments responsible for the administration of the Company's Main Replacement/Cathodic Protection Programs.

3.0 General

- 3.1 The main replacement program shall be prioritized to identify main segments in those areas that present the greatest potential for hazard in an expedited manner. High priority replacement areas may include, but not be limited to:
 - 3.1.1 High-pressure cast iron and unprotected steel mains located beneath pavement which is continuous to building walls.
 - 3.1.2 High-pressure cast iron and unprotected steel mains located near concentrations of the general public such as Class 4 locations, business districts and schools.
 - 3.1.3 Small diameter cast iron mains (4" and less).
 - 3.1.4 Areas where extensive excavation, blasting or construction activities have occurred in close proximity to cast iron and unprotected steel mains.
 - 3.1.5 Sections of cast iron and unprotected steel main(s) that lie in areas of planned future development, such as city, county or state highway construction/relocation, and urban renewal projects.
 - 3.1.6 Sections of cast iron and unprotected steel main(s) that exhibit a history of leakage or graphitization/corrosion.
 - 3.1.7 Sections of unprotected steel mains subject to stray current.



GAS ENGINEERING STANDARDS



SUBJECT Main Replacement/Protection Program - Distribution				DATE EFFECTIVE Final Draft	SECTION/PAGE Sec. 3140.7, Pg. 3
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4.0 Procedure

4.1 Main replacement candidates will be selected after evaluating of data gathered from the following nine areas:

4.1.1 **Facility Priority Index (FPI)** - Identification and categorization of the physical main data into segments, approximately one block in length in the same Premise Data System (PDS) Sector, based on the following characteristics:

- Pipe size
- Pipe age
- Soil Corrositivity
- Material
- Pressure

4.1.2 **Cathodic Protection Program** - An evaluation program based on pipeline location, and used in conjunction with other replacement programs such as Service Line Replacement Program (SLRP) and Construction Priority Index (CPI), to determine the need to either protect or replace identified gas mains.

4.1.3 **Leakage Review** - Evaluation of main leakage based on the Company's program driven by the Leakage Data System (LDS) system, whereby segments of 500' of main, having five leaks, within a 3 year period are identified. When this criteria is met, the segment is identified as a candidate for replacement/protection.

4.1.4 **Cast Iron Breakage** - Replacement of cast iron systems that have experienced three (3) breaks within a block, generally 500' or where two (2) breaks have occurred within an intersection.

4.1.5 **Continuing Surveillance Program (Sec. 3501)** - The collection, monitoring, tracking and analysis of the following data to evaluate main segments for replacement:

- Leak Surveys
- Patrols
- Monthly Operating Activities Report
- Field Input



GAS ENGINEERING STANDARDS



SUBJECT Main Replacement/Protection Program - Distribution				DATE EFFECTIVE Final Draft	SECTION/PAGE Sec. 3140.7, Pg. 4
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- Industry Bench-Marking
- Drought Surveys

4.1.6 **Cast Iron Coupon Sampling** - Evaluation of graphitization to determine main replacement. In **Kansas**, further evaluation by laboratory analysis to determine the percent of graphitization as follows:

Diameter	Percent Graphitization
2 Inch	25%
3 and 4 Inch	60%
6 and 8 Inch	75%
10 Inch and Greater	90%

4.1.7 **Public Improvement Programs** - Candidates identified and categorized in conjunction with street improvement projects.

4.1.8 **Damage Prevention Program** - Candidates identified by third party damage and by cast iron protection requirements.

4.1.9 **Replacement of Above Ground Mains (Kansas Only)** - Replacements based on Kansas Pipeline Safety Regulations requiring above ground piping to be placed underground by December 31, 1995, with the following exceptions:

- Regulator station piping;
- Bridge crossings;
- Aerial crossings or spans;
- Short segments of piping for valves intentionally brought aboveground, including but not limited to, risers, piping at compressor, processing or treating facilities, block gate settings, sectionalizing valves and district regulator sites;
- Distribution mains specifically designed to be aboveground and have the approval of the landowner to provide service to commercial customers from the aboveground main and associated service line(s); or
- Pipelines in Class 1 locations.



GAS ENGINEERING STANDARDS



SUBJECT Main Replacement/Protection Program - Distribution				DATE EFFECTIVE Final Draft	SECTION/PAGE Sec. 3140.7, Pg. 5
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- 4.2 When the evaluation(s) of the above areas are complete the segments of main(s) identified for replacement/protection will be prioritized in accordance with the Company's CPI Standard 3140.2.

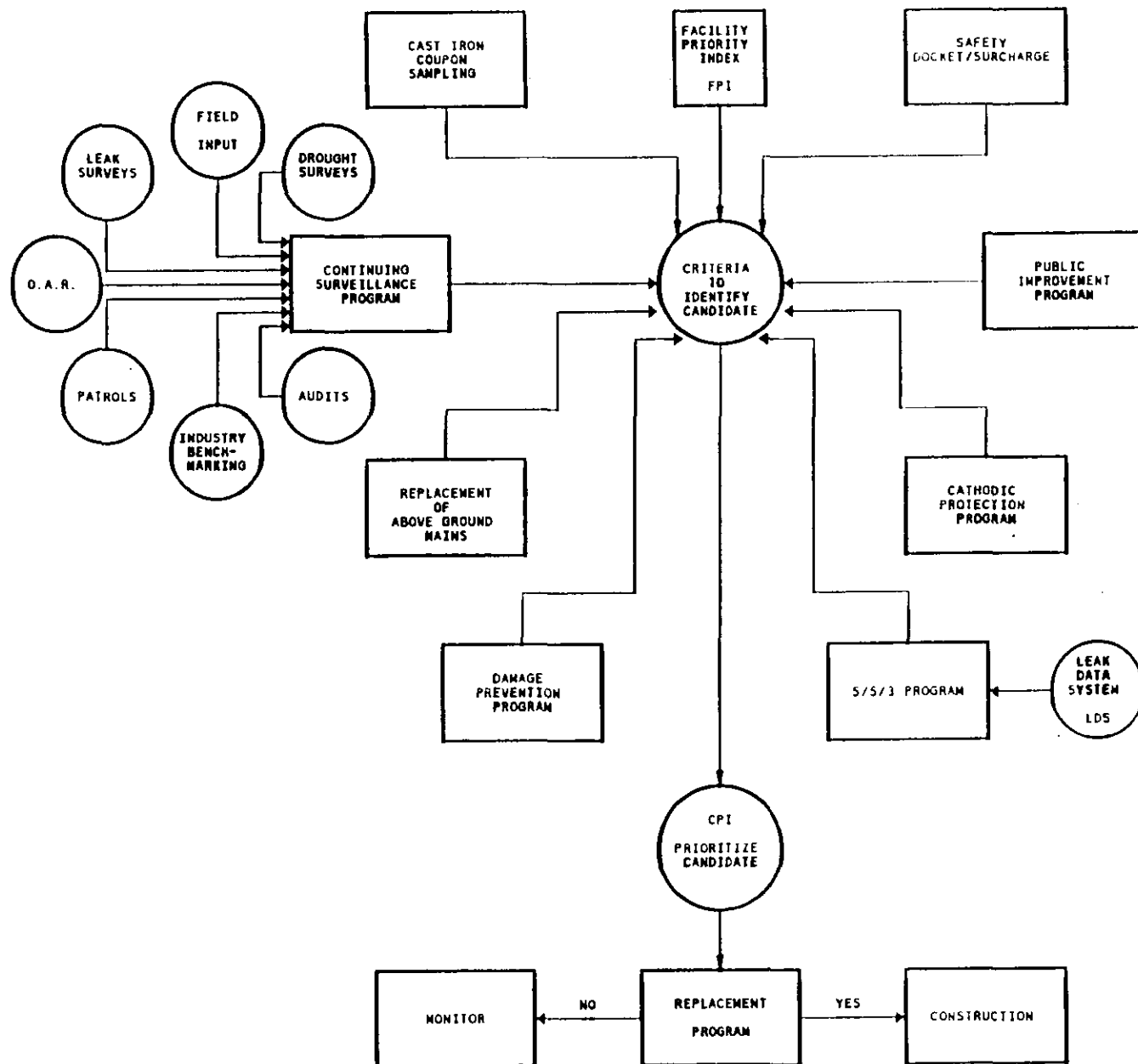
5.0 Monitoring/Reporting

- 5.1 Segments identified for replacement/protection will tracked. A status report will be generated once each quarter by Gas Engineering.

6.0 Records and Forms

- 6.1 A Construction Priority Index (CPI) Form will be generated and maintained with each work order for each identified segment which is a candidate for replacement. As work orders are developed for these segments, the CPI Form will be filed with the work order.

KPL GAS SERVICE MAIN REPLACEMENT PROGRAM





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1.0 Scope

- 1.1 This Standard describes the procedures for completing a Construction Priority Index (CPI) for each section of main being evaluated for replacement. The CPI shall be used to prioritize mains which are being considered for replacement.

2.0 Application

- 2.1 This Standard applies to those Company personnel and departments responsible for evaluating and prioritizing mains for replacement.

3.0 General

- 3.1 When a section of main is to be evaluated for replacement, a Construction Priority Index Form 318-9 (cast iron), Form 318-10 (other) shall be completed and used as a basis for prioritizing the work, relative to other main replacements within the system. The CPI - Grand Total will be used as a system-wide evaluation control point to assure consistency in resource allocation and piping replacement.
- 3.2 A CPI Form shall accompany all proposed main replacement projects. At locations where the mains have been segmented, a separate CPI Form shall be completed for each segment. In locations where the main has not been segmented, a separate CPI Form will be generated when there is a change in size, type of main, or age of main. When the factors in Section A of the CPI Form, have multiple conditions, the predominant factors relative to the project shall be used.
- 3.3 Main replacement candidates that are identified by the Facility Priority Index (FPI) will have some physical data information pre-printed on the CPI form. These forms will then be sent to the appropriate local Operating Area for completion.

4.0 Construction Priority Index Information

- 4.1 There are two Construction Priority Index Forms. Form 318-9 shall be used for cast iron mains, and Form 318-10 shall be used for all other mains, i.e., steel, plastic, etc.
- 4.2 **General Information:** The following is a listing, by subject, of the general information necessary to complete either of the CPI forms. Enter an "X" in the box to the left of the relevant information and enter the associated segment evaluation points (a value of one through ten), found at the top of each column, in the far right column labeled "POINTS".
- 4.2.1 **Project Location/Description** - Enter the closest intersection including north/south and east/west streets in the vicinity of the area to be considered for replacement.



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4.2.2 **CPI Initiated** - Enter an "X" in the appropriate box which best describes why the segment was nominated for main replacement. The segment considered for main replacement can be nominated by any one of the following: FPI, Leak Survey, pipe condition reports, cathodic protection, angle of repose, 5/5/3 replacement program, continuing surveillance, public improvement, safety docket, damage, or other. If the box for **OTHER** is marked, enter the other condition in the "Other Items To Be Considered" area.

- If the main replacement is for a public works improvement project, enter an "X" in **Public Imp** and do not fill out rest of the CPI form.

4.2.3 **Date** - Enter the date that the CPI Form is completed.

4.2.4 **Prepared by** - Enter the name of individual who completed the CPI Form.

4.2.5 **RA/Town Number** - Enter the responsibility area and corresponding town number as listed in the General Accounting Manual (Section GA-2.2).

4.2.6 **Work Order Number** - Enter the work order and year that the main was originally installed to provide information for the associated main retirement.

4.2.7 **Premise Data System Sector** - Enter the sector number corresponding to the location of the main. This can be obtained through a cross-reference of the address/premise number for a service in the main replacement area, an area sector map, or from an FPI candidate list.

4.2.8 **Segment Size** - Enter the diameter (in inches) of the main to be replaced.

4.2.9 **Segment Length** - Enter the length of the main (in feet) to be replaced.

4.2.10 **Code Requirement** - Enter "YES" if the main replacement is necessary for code compliance and enter the specific code requirement in the "Other Items to be Considered" area.

4.2.11 **FPI Segment Number** - Enter the segment number that has been assigned to this segment as part of the Facilities Priority Index Study. This is currently only available in Kansas City, Mo.; Kansas City, Ks.; Topeka; Emporia; Wichita; Joplin.

4.3 **Section A:** The following is a listing of information necessary to complete Section A of the Construction Priority Index (CPI). There are two items (Graphitization and Joint Seal Method) included on the **Cast Iron Only** CPI Form and three items (Pit Depth, Coating Condition, and Cathodic Protection Status) included on the **Steel and All Other Materials** CPI Form which are specific to each individual form.



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- 4.3.1 **Material** - Enter the type of main material. The CPI Form for Cast Iron is preprinted with the appropriate information.
- 4.3.2 **Size** - Enter the diameter of main (in inches) to be replaced.
- 4.3.3 **Pressure** - Enter the maximum operating pressure.
- 4.3.4 **Age** - Enter the age of the pipe segment from the work order completion records. This can also be obtained through a review of the FPI information.
- 4.3.5 **Soil Type or Soil Resistivity** - Enter the soil type from a review of the FPI information in any of the six pilot local Operating Areas, Kansas City, MO; Kansas City, KS; Topeka; Emporia; Wichita; Joplin. All other locations shall use soil resistivity in main replacements made in the same general area. Two possible sources are the Gas Service Order and Record (Form 312-2) and the Soil Resistivity Form (320-16) from Corrosion Section. This measurement shall be in ohms-cm.
- 4.3.6 **Depth of Main** - Enter the depth of main measured (in feet) from the top of main to the top of the grade surface (pavement, dirt, etc). This can be obtained from Gas Service Order and Record (Form 312-2), or Work Reports (Form 318-5).
- 4.3.7 **Surface Condition** - Enter the type of surface material that is directly over main. Also enter the conditions on the form that represent the predominant surface conditions between the main and the buildings.
- 4.3.8 **Proximity to Building** - Enter the distance (in feet) between the main and the nearest building.
- 4.3.9 **Proximity to Other Facilities** - Enter the distance (in feet) from the main to other water lines, sewer, electric, drainage ditches, etc. This distance can be measured over, to the side, or under our main. If more than one utility is in the immediate area, enter the distance on the form to the closest utility.
- 4.3.10 **Leak Survey Frequency** - Enter the frequency of leak surveys. This information can be obtained from the FPI information list or from leak survey records in the local Operating Area.



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4.3.11 The following items are specific to steel piping and shall be included on the **Steel and All Other Material** (Form 318-10):

- **Pit Depth** - Enter the depth of the deepest pit as a percentage of total wall thickness, measured when the main was previously exposed as indicated on a Work Report (Form 318-5) or obtain this information from Service Card Records (Form 312-2);
- **Coating Condition** - Enter the coating condition [(good, damaged, poor or bare (if main is not coated))] using the most current Work Report, (Form 318-5) or from Service Cards (Form 312-2).

4.3.12 The following items are specific to cast iron piping and shall be included on the **Cast Iron Only** (Form 318-9):

- **Graphitization** - Enter the amount of graphitization which is determined analysis by visual inspection or laboratory analysis. Additional field work may be required to make this determination.
- **Joint Seal Method** - Enter an "X" in the appropriate boxes if the joints have been sealed and enter the method used (avon seal or bell joint clamps).

4.3.13 Total the points determined from items 4.3.1 through 4.3.12 and enter as Subtotal A.

4.4 **Other Items to be Considered:** In the area labeled "Other Items to Be Considered", the following shall be addressed:

4.4.1 Enter the code requirement when applicable;

4.4.2 Enter any other concerns that should be considered for main replacement which have not been included on the CPI Form.

4.5 **Cathodic Protection Status** - On the **Steel and All Other Materials** (Form 318-10), enter the cathodic protection information if applicable. Include the year protected and method of protection. This information can be obtained from a review of Rectifier Inspection Location Reports (Form 317-5), Corrosion Maps, Service Cards (Form 312-2), or Work Reports (Form 318-5). If the main is unprotected, enter an "X" in the "None" field.

4.6 **Services** - Enter the total number of services and also the total number of unprotected bare steel services on the segment. This information can be obtained from service card inspections or from the Premise Data System (PDS).



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4.7 **Section B (reverse side):** The following is a listing of information necessary to complete Section B of the Construction Priority Index (CPI) which takes into account the number of repaired leaks over the past five years and the number of active main leaks.

4.7.1 Number of Main Leaks Repaired in the last five years.

- On the **Cast Iron Only** CPI Form, enter the total number of breaks which have occurred during the past five years on this segment of pipe. This information can be obtained from the Work Reports (Form 318-5) or from local sector main breakage maps over this period. Enter the total footage of the main segment being considered for the replacement. Divide the number of breaks by the total footage of the main segment and then multiply this number by 4000 (Round all numbers to the next highest whole number). Enter that number in the space provided. Do not include a break used in this calculation as a leak in the next two (2) sections.
- Enter the total number of Class 1 and Class 2 leaks which have been repaired during the past five years on this segment of pipe. This information can be obtained from the Leak Data System (LDS), Work Reports (Form 318-5), or from Leak Classification Orders (Form 316-4) over this period. Enter the total footage of the main segment being considered for replacement. Divide the number of leaks by the total footage of the main segment and then multiply this number by 3000 (Round all numbers to the next highest whole number). Enter that number in the space provided.
- Enter the total number of Class 3 and Class 4 (where applicable) leaks which have been repaired during the past five years on this segment of pipe. This information can be obtained from the Leak Data System (LDS), Work Reports (Form 318-5), or from Leak Classification Orders (Form 316-4) over this period. Enter the total footage of the main segment being considered for the replacement. Divide the number of leaks by the total footage of the main segment and then multiply this number by 2000 (Round all numbers to the next highest whole number). Enter that number in the space provided.

4.7.2 Number of Outstanding Main Leaks

- Enter the total number of Class 2 leaks which are currently on hand. This information can be obtained from Leak Data System (LDS). Enter the total footage of the main segment being considered for the replacement. Divide the number of leaks by the total footage of the main segment and then multiply this number by 4000 (Round all numbers to the next highest whole number). Enter that number in the space provided.



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- Enter the total number of Class 3 and Class 4 (where applicable) leaks that are currently on hand. This information can be obtained from the Leak Data System (LDS). Enter the total footage of the main segment being considered for the replacement. Divide the number of leaks by the *total footage of the main segment* and then multiply this number by 3000 (Round all numbers to the next highest whole number). Enter that number in the space provided.

4.7.3 Total the points determined from items 4.7.1 and 4.7.2 and enter as Subtotal B on both the sides of the form.

4.8 Enter the Grand Total by adding Subtotal A and Subtotal B and enter this in the box marked **Grand Total** on the front of this form. Use this figure to evaluate and prioritize replacement activities as set forth in 3.0 - General.



CONSTRUCTION PRIORITY INDEX (CAST IRON) ONLY

PROJECT DESCRIPTION: _____

CPI INITIATED:	FPI	LEAK SURVEY	PIPE COND	ANG OF REP	5/5/3	CONT SURV	PUBLIC IMP	SAFETY DOC	DAMAGE	OTHER
----------------	-----	-------------	-----------	------------	-------	-----------	------------	------------	--------	-------

DATE: _____
PREPARED BY: _____
RA/TOWN: _____
W.O. NUMBER: _____
P.D.S. SECTOR: _____

****ATTACH MAP OR SKETCH AND L.D.S. REPORT SUPPORTING LEAK DATA.****

SEGMENT SIZE: _____
SEGMENT LENGTH: _____
CODE REQUIREMENT (Y/N): _____
FPI SEGMENT NUMBER: _____

SECTION A

FACTORS		SEGMENT EVALUATION POINTS														POINTS
		0	1	2	3	4	5	6	7	8	9	10				
MATERIAL		---	---	---	---	---	---	X	CAST IRON	---	---	---	---	6		
SIZE		---	---	8" & LARGER	---	6"	---	---	---	4"	---	2"-3"				
PRESSURE		---	1#-14#	---	---	15#-24#	---	---	25#-59#	---	OVER 60#	UNDER 1#				
AGE (YEARS)		---	---	---	---	26-45	---	46-60	OVER 60	---	---	---				
SOIL TYPE		---	---	#21	---	#20	---	#11	#41	#34	---	---				
OR																
SOIL RESISTIVITY (OHMS)		OVER 6001	---	5001-6000	---	3001-5000	---	---	2001-3000	501-2000	0-500	---				
DEPTH OF MAIN (FEET)		---	---	4-5	---	2-4	---	---	OVER 5	---	UNDER 2	---				
SURFACE CONDITION																
1) OVER MAIN		DIRT/GRASS	---	GRAVEL	---	---	BRICK	---	ASPHALT	CONCRETE	---	---				
2) MAIN TO BLDG.		---	---	DIRT/GRASS	---	---	---	---	DRIVEWAY	---	PAVED AREA	---				
PROXIMITY TO BLDG.		OVER 100'	---	---	51'-100'	---	---	26'-50'	---	11'-25'	1'-10'	---				
PROXIMITY TO OTHER UTILITIES		OVER 6'	---	---	---	---	5'-6'	---	2'-4'	---	UNDER 2'	---				
LEAK SURVEY FREQ.		---	---	---	---	ANNUAL	---	180 DAYS	120 DAYS	---	90 DAYS	---				
GRAPHITIZATION (CI)																
SIZE	2"	0-9%	---	---	---	---	10-14%	---	15-19%	---	---	OVER 20%				
	3"-4"	UNDER 20%	21-30%	---	---	31-40%	---	41-49%	50-54%	---	---	OVER 55%				
	6"-8"	UNDER 30%	---	---	31-49%	---	40-49%	---	50-69%	---	---	OVER 70%				
	10"	UNDER 30%	31-39%	---	40-49%	---	50-69%	---	70-84%	---	---	OVER 85%				
JOINT SEAL METHOD		---	---	AVON SEAL	---	---	NONE	---	---	BJ CLAMP	---	---				

OTHER ITEMS TO BE CONSIDERED: _____

SUBTOTAL A

SUBTOTAL B

GRAND TOTAL

SERVICES: Number of Services (House & Yard Lines) on Segment _____
Number of Bare Steel Services on Segment _____

Continued on Other Side

CONSTRUCTION PRIORITY INDEX (STEEL AND ALL OTHER MATERIALS)

PROJECT DESCRIPTION: _____

CPI INITIATED:	FPI	LEAK SURVEY	PIPE COND	CATH PROT	5/5/3	CONT SURV	PUBLIC IMP	SAFETY DOC	DAMAGE	OTHER
----------------	-----	-------------	-----------	-----------	-------	-----------	------------	------------	--------	-------

DATE: _____

PREPARED BY: _____

RA/TOWN: _____

W.O. NUMBER: _____

P.D.S. SECTOR: _____

ATTACH MAP OR SKETCH AND L.D.S. REPORT SUPPORTING LEAK DATA.

SEGMENT SIZE: _____

SEGMENT LENGTH: _____

CODE REQUIREMENT (Y/N): _____

FPI SEGMENT NUMBER: _____

SECTION A

FACTORS	SEGMENT EVALUATION POINTS													POINTS
	0	1	2	3	4	5	6	7	8	9	10			
MATERIAL	---	---	PE PLASTIC	PROT. ST.	OTHER	PVC	UNPROT. ST.	---	---	---	---	---		
SIZE	---	---	8" & LARGER	---	6"	---	4"	3'-2"	---	---	---	---		
PRESSURE	---	---	---	1#-14#	---	15#-24#	25#-59#	---	---	OVER 60#	UNDER 1#	---		
AGE (YEARS)	---	0-10	11-25	---	26-45	---	46-60	OVER 60	---	---	---	---		
SOIL TYPE	---	---	#11	---	#21	---	#20	#34	#41	---	---	---		
OR														
SOIL RESISTIVITY (OHMS)	OVER 6001	---	5001-6000	---	3001-5000	---	---	2001-3000	501-2000	0-500	---	---		
DEPTH OF MAIN (FEET)	---	---	4-5	---	2-4	---	UNDER 2	OVER 5	---	---	---	---		
SURFACE CONDITION														
1) OVER MAIN	DIRT/GRASS	---	GRAVEL	---	---	BRICK	---	ASPHALT	CONCRETE	---	---	---		
2) MAIN TO BLDG.	---	---	DIRT/GRASS	---	---	---	---	DRIVEWAY	---	PAVED AREA	---	---		
PROXIMITY TO BLDG.	OVER 100'	---	---	51-100'	---	---	26'-50'	---	11'-25'	1'-10'	---	---		
PROXIMITY TO OTHER UTILITIES	---	OVER 6'	5'-6'	2'-4'	---	---	UNDER 2'	---	---	---	---	---		
LEAK SURVEY FREQ.	---	3 YRS	---	---	ANNUAL	---	180 DAYS	120 DAYS	---	90 DAYS	---	---		
PIT DEPTH	UNDER 30%	---	---	31-40%	---	41-50%	---	51-60%	---	OVER 61%	---	---		
COATING CONDITION	GOOD	---	---	BARE	---	---	DAMAGED	---	---	POOR	---	---		

OTHER ITEMS TO BE CONSIDERED: _____

SUBTOTAL A

SUBTOTAL B

GRAND TOTAL

CATHODIC PROTECTION STATUS:

YEAR PROTECTED _____

Rectifier _____ Anode _____ None _____

SERVICES: Number of Services (House & Yard Lines) on Segment _____

Number of Bare Steel Services on Segment _____

Continued on Other Side

MISSOURI SAFETY DOCKET
(CAST IRON AND BARE STEEL MAINS)

		1992	1993	1994	1995	1996	1997	1998	1999	2000
CAST IRON MAIN - MILES										
4 INCH AND SMALLER - P & P *	SEC 15-D-1-A,B,C	9.4	8.6	5.4	0.0	0.0	0.0	0.0	0.0	0.0
OVER 4 INCH - P & P *	SEC 15-D-1-A,B	0.0	0.0	3.7	11.0	19.0	32.0	7.3	0.0	0.0
4 INCH AND SMALLER & OTHER	SEC 15-D-1-C	2.1	12.4	18.0	32.1	40.0	40.0	72.7	80.0	68.9
PUBLIC WORKS PROJECTS	SEC 15-D-1-D,E,F	0.0	1.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0
FPI	SEC 15-D-1-G	0.3	0.8	1.0	** 1.0	** 1.0	** 1.0	** 1.0	** 1.0	** 1.0
SYSTEM IMPROVEMENT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL CAST IRON MILES		12.8	24.3	32.1	48.1	64.0	77.0	85.0	85.0	73.9
BARE STEEL MAIN - MILES										
ALL SIZES - PROTECT - P & P *	SEC 15-E-1,2	2.2	11.8	16.1	0.0	0.0	0.0	0.0	0.0	0.0
ALL SIZES - REPLACE - P & P *	SEC 15-E-1,2	0.0	1.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0
PROTECTION - WITH SLRP		102.0	100.0	100.0	90.0	75.0	44.5	0.0	0.0	0.0
PROTECTION - INDEPENDENT		22.0	15.0	15.0	15.0	16.0	24.0	0.0	0.0	0.0
PUBLIC WORKS PROJECTS	SEC 15-E-3,4	1.0	1.0	1.0	4.0	4.0	4.0	0.0	0.0	0.0
FPI	SEC 15-E-5	7.3	7.3	7.3	** 7.2	** 7.2	** 7.2	0.0	0.0	0.0
SYSTEM IMPROVEMENTS		1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0
TOTAL BARE STEEL MILES		135.5	137.4	141.7	117.2	103.2	80.7	0.0	0.0	0.0
TOTAL MILES		148.3	161.7	173.8	165.3	167.2	157.7	85.0	85.0	73.9

* IN AREAS OF CONTINUOUS PAVEMENT AND NEAR CONCENTRATIONS OF THE GENERAL PUBLIC

** FPI REPLACEMENT MILES WILL VARY AS SEGMENTS OF MAIN ARE IDENTIFIED FOR REPLACEMENT