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February 8, 1991

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O'Donnell

Mr. Charles Brent Stewart
Executive Secretary
Missouri Public Service Commission
P.O. Box 360
Jefferson City, Missouri 65102

RE: Case No. GO-91-277 -- In the matter of the Review and
Approval of the Cast Iron Main Program for The Kansas Power
& Light Company.

Dear Mr. Stewart:

Enclosed for filing by the Commission Staff in the
above-captioned case is an original and fourteen (14) copies of
a MOTION TO ESTABLISH DOCKET FOR COMMISSION ACKNOWLEDGEMENT AND
APPROVAL OF PIPELINE REPLACEMENT PROGRAM. Copies have been sent
this date to all parties of record.

Thank you for your attention to this matter.

Sincerely yours,

William M. Shansey

William M. Shansey
Assistant General Counsel

WMS:rsn

Enclosures

cc: Parties of Record

FILED
FEB 8 1991
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 & Light)
Company.)

Case No. *GO-91-277*

MOTION TO ESTABLISH DOCKET FOR COMMISSION ACKNOWLEDGEMENT
AND APPROVAL OF PIPELINE REPLACEMENT PROGRAM

Comes now the Staff of the Missouri Public Service Commission ("Staff") and for its Motion states as follows:

1. Commission Rule 4 CSR 240-40.030(15)(D), adopted by order of this Commission effective December 15, 1989, required the operators of natural gas transportation systems in the State of Missouri having facilities which contain cast iron transmission lines, feeder lines or mains to establish and submit replacement programs to this Commission by May 1, 1990 for Commission review and approval.

2. Commission Rule 4 CSR 240-40.030(15)(E), adopted by order of this Commission effective December 15, 1989, required the operators of natural gas systems in the State of Missouri having facilities which contain unprotected steel transmission lines, feeder lines, and mains to establish and submit replacement/cathodic protection programs to this Commission by May 1, 1990 for Commission review and approval.

3. In compliance with this rule, The Kansas Power & Light Company ("KPL") submitted its programs to this Commission for review and approval. A copy of these programs is attached and hereby incorporated by reference as Staff's Exhibit 1.

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4. On December 27, 1990, after reviewing all programs submitted by operators in the State of Missouri in compliance with these Commission rules, Staff submitted its Motion to Establish Docket for Commission Acknowledgement and Approval of Pipeline Replacement Programs.

5. In paragraph 6.e. of Staff's Motion, Staff stated its intention to seek the establishment of separate dockets for review and acceptance of the submitted programs of certain operators with whom Staff continued to work concerning certain items in their programs.

6. Staff is continuing to work with KPL concerning certain items in its submitted program as evidenced by KPL's subsequent modification to its replacement program submitted on November 27, 1990 and hereby attached and incorporated by reference as Staff's Exhibit 2.

7. Staff therefore moves this Commission to establish a docket to receive KPL's cast iron main and unprotected steel main programs, Staff's ultimate recommendation and the Commission's review and subsequent order concerning approval.

WHEREFORE the Staff of the Public Service Commission respectfully requests this Commission issue its order establishing a docket for the receipt of the cast iron main and unprotected steel main programs of The Kansas Power & Light Company and for receipt of subsequent filings concerning these programs.

Respectfully submitted,

William M. Shansey

William M. Shansey
Assistant General Counsel

Attorney for the Staff of the
Missouri Public Service Commission
P. O. Box 360
Jefferson City, MO 65102
314-751-8702

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing have been mailed or hand-delivered to all parties of record on this 8th day of February, 1991.

William M. Shansey

Hans E. Mertens
Vice President, Engineering
Gas Service Division



2480 Pershing Road
Kansas City, Missouri 64108
Phone (816) 346-5575

November 27, 1990

Mr. Robert R. Leonberger
Interim Assistant Manager
Gas Engineering
Missouri Public Service Commission
P.O. Box 360
Jefferson City, Missouri 65102

RE: Replacement Program

Dear Mr. Leonberger:

Pursuant to your letter of October 23, 1990, the Company offers the following modifications to its replacement program as submitted April 30, 1990.

I. Rule 4 CSR 240-40.030(15)(C) - Unprotected Steel Service Lines/Yard Lines

Company Standards will be revised in accordance with the following:

Company will conduct leak surveys of yard lines located at correctional facilities, military bases and industrial complexes, at customer expense, and providing a location map of each system is obtained by the Company.

Company will conduct leak surveys of residential yard lines associated with transmission line taps.

II. Rule 4 CSR 240-40.030(15)(D) - Cast Iron Mains & Rule 4 CSR 240-40.030(15)(E) - Unprotected Steel Mains

The Company has developed a Construction Priority Index (CPI) (See Attached). CPI uses a point system, based on segment evaluation factors to prioritize replacement of Company transmission lines and mains.

Mr. Robert R. Leonberger
Page 2

CPI will be utilized until the Company's Facility Priority Index (FPI) is fully developed and implemented. FPI is a computer program which utilizes statistical projections and considers past construction practices as well as local variations in field conditions. It is the Company's intent to have the FPI system in operation by mid-1991.

To develop FPI, the Company has contracted with ZEI, Inc. to perform an evaluative study of the relevant factors affecting the service life and behavior of the Company's cast iron and unprotected steel mains and customer service lines, and formulate a plan for implementing an optimized replacement program considering safety, reliability of service and available resources. ZEI will develop a rational and a statistical model. In developing the rational model ZEI will utilize engineering principles and theoretical models to analyze the affects of factors such as main size and age, method of placement, soil type, weather effects, loading, etc. The statistical model will consider the Company's past studies, system repair/replace statistics and past leak survey results. The statistical model will support the rational model.

When implemented, FPI will identify projects and CPI will prioritize them.

Company Standards will be modified as follows:

When an unprotected steel main is exposed, it shall be investigated for active corrosion. If active corrosion is found, the segment will be replaced or repaired in accordance with Company Standards, cathodically protected and monitored at the required time intervals. If no active corrosion is found, sacrificial anodes will be installed.

Sincerely,

Harold E. Meston
by James M. Faller

CONSTRUCTION PRIORITY INDEX

PROJECT DESCRIPTION: _____

RA NUMBER: _____
 W.O. NUMBER: _____
 P.D.S. SECTOR: _____
 SEGMENT NUMBER: _____

SEGMENT SIZE: _____
 SEGMENT LENGTH: _____
 PUB. WKS. IMPROVEMENT (Y/N): _____
 CODE REQMT(Y/N): _____

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

FACTORS	SEGMENT EVALUATION POINTS						POINT
MATERIAL	PE PLASTIC	OTHER	STEEL	CAST IRON	PVC		
SIZE (CAST IRON)	OTHER	12"-8"	8"	4"	3"-2"		
SIZE (STEEL)	OTHER	12"-8"	8"	4"	3"-2"		
PRESSURE	2-14#	15-24#	25-60#	UNDER 2#	OVER 60#		
AGE (YEARS)	0-10	11-25	26-45	46-60	OVER 60		
LEAK SURVEY FREQ	3 YRS	ANNUAL	180 DAYS	120 DAYS	90 DAYS		
SOIL RESISTIVITY	OVER 4000	2000-4000	1000-2000	500-1000	0-500		
DEPTH (FEET)	2-4	4-5	UNDER 2	OVER 5	---		
SURFACE CONDITION	DIRT	BRICK	---	ASPHALT	CONCRETE		
METAL CONDITION	GOOD	LIGHT	MODERATE	DEEP PITS	GRAPHITZ		
JOINT TYPE	---	GAS WELD	COMPRESN	SCREW	BEU/MEC JT		
PROXIMITY TO BLDG	---	OVER 100'	51'-100'	16'-50'	1'-15'		
CLASS LOCATION	---	1	2	3	4		
COATING CONDITION	GOOD	---	NONE	DAMAGED	POOR		
						SUBTOTAL	
REPAIRS OR LEAKS PER 500' SECTIONS							
#MAIN LKS RPD, 5YRS	1-2	2-3	4-5	6-7	OVER 7		
#SVC LKS RPD, 5YRS	1-2	2-3	4-5	6-7	OVER 7		
#MAIN LKS ON HAND	1-2	2-3	4-5	6-7	OVER 7		
#SVC LKS ON HAND	1-2	2-3	4-5	6-7	OVER 7		
#BS SVCS ON SEGMENT	0	1-5	6-15	16-30	OVER 30		
						SUBTOTAL	
						TOTAL POINT EVALUATION	

OTHER ITEMS TO BE CONSIDERED:

CORROSION STATUS:

**KPL
GAS
SERVICE**

RECEIVED

MAY 1 1990

**UTILITY DIVISION
P. S. C. MO.**

JAMES W. INGRAM
Vice President,
Gas Safety, Engineering and
Pipeline Operations

April 30, 1990

W R Ellis
Pipeline Safety Program Manager
Missouri Public Serv Commission
Post Office Box 360
Jefferson City, MO 65102

Dear Ron:

Pursuant to Section 15 of the Commission's Pipeline Safety Rules, I have enclosed on behalf of the Kansas Power and Light Company, the original and one copy of the Company's (1) Leak Survey and Replacement Program for Unprotected Steel Service and Yard Lines; (2) Replacement Program for Cast Iron; and (3) Replacement/Cathodic Protection Program for Unprotected Steel Transmission Lines, Feeder Lines, and Mains.

Please do not hesitate to contact me if you have questions or comments regarding the enclosed materials.

Sincerely,



James W Ingram

klk
enclosures

REPLACEMENT PROGRAM FOR CAST IRON

Pursuant to Section 15(D) of the Missouri Public Service Commission's (Commission) Pipeline Safety Regulations, the Kansas Power and Light Company (KPL) submits the following program for replacement of cast iron transmission lines, feeder lines, and mains.

I. BACKGROUND

Effective December 15, 1989, the Commission adopted new gas Pipeline Safety Regulations applicable to corporations, municipal gas systems, and public utilities subject to the Commission's jurisdiction. In Section 15(D) of the new regulations, the Commission requires all operators who have cast iron transmission lines, feeder lines, or mains to develop a replacement program to be submitted with an explanation to the Commission by May 1, 1990. Under the regulations, the replacement program is to be prioritized to identify and eliminate pipelines in those areas that present the greatest potential for hazard in an expedited manner. The Commission also identifies a number of areas or conditions that should be considered in prioritizing replacements of cast iron mains.

II. EXPLANATION OF PROGRAM

At the time the Commission initially proposed this requirement, KPL commented that in conjunction with the Missouri and Kansas Commissions, it had requested an outside consulting service to prepare a suggested replacement program for cast iron and bare steel piping. Since the consultant's recommendations were

scheduled to be completed within eighteen (18) months of the letting of a contract, KPL suggested that the submission of a plan for Commission approval should be deferred until the consultant's report was accepted. Id.

In response to these and other comments, the Commission noted that its proposed requirement did not mandate the replacement of cast iron piping, but instead required that operators devise and submit a plan for, if necessary, the eventual replacement of cast iron piping. Missouri Register, Volume 14, Number 23, p. 1598. The Commission also noted some operators already had such plans and that it remained to be seen whether those plans were "effective" under the rule. The Commission also noted that its Staff would evaluate consultant studies presently underway, together with operator programs as submitted, to address this rule as required, in order to achieve better criteria for replacement and/or protection plans. Id.

Pursuant to this clarification, KPL has submitted a revised version of its existing program for the maintenance and replacement of cast iron or ductile mains (See Attachment A) Pending the implementation of a main replacement predictability model, such as CIMOS, or the adoption of a similar system for prioritizing replacements, KPL believes that its existing program for maintaining and replacing cast iron mains represents an effective interim plan and complies with the requirements of the Commission's new rule.

As can be seen from a review of the attached program, KPL's procedures incorporate the various criteria identified by the

Commission in its rule for prioritizing replacements and repairs according to the greatest potential for hazard. Under Section 10.01.1, leak and maintenance history is analyzed to determine geographical areas of concern. Once these areas are identified, repairs or replacements are prioritized based on: (1) reported graphitization problems; (2) leak history; and (3) the location of facilities (with higher priority given to areas of wall-to-wall concrete and more dense population). (See Section 10.01.2.1) In addition, Sections 10.03.4.1, 13.01 and 13.05 require that cast iron mains be supported, replaced, or removed as appropriate in areas of construction activity. Section 10.03.4.2 also requires replacement of cast iron mains subject to undermining as a result of earth movement and areas having underground water problems due to water main or sewer leaks or natural water seepage. Finally, Section 10.03.5.2 requires the replacement of smaller diameter pipes of sizes 6 inches or less whenever there are complete rebuilds of streets.

III. CONCLUSION

Given the degree to which the priority factors identified by the Commission are already incorporated into KPL's existing program, KPL believes that its program is consistent with the Commission's recently adopted rules. The Company accordingly believes it should be approved on an interim basis, pending the implementation of any predictability model or other prioritization technique that may be adopted as a result of the Stone & Webster gas safety audit. Once adopted, such a procedure will enable the Company to develop a more specific schedule for replacing cast iron

mains. Until such time, however, the Company plans to replace at least 20,000 feet of cast iron mains per year.



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PREPARED BY: Standards and Codes		
APPROVED: <i>J. W. Ingram</i>		

Maintenance and Replacement of Cast Iron or Ductile Mains

8.00 PURPOSE

8.01 The purpose of this program is to outline policy parameters and establish policy guidelines relative to the operation, maintenance and replacement of cast iron piping systems. The physical aspects of accomplishing a specific work effort shall be in accordance with previously-established construction, maintenance and operating procedures as stated in various manuals.

9.00 SCOPE

9.01 The program covers existing cast iron mains and gas service lines connected to them. It covers the analysis of leaks reported and classified, establishment of areas of leakage, replacement of certain gas service lines, cast iron main analysis relative to maintenance history criteria for repair/replacement, and use of contractors for certain types of work.

10.00 PARAMETERS AND GUIDELINES

10.01 Analysis of System

.1 Areas of leakage will be established based on analysis of leaks on hand and known maintenance history performed on facilities.

- Analyze leaks on hand
- Analyze maintenance records
- Analyze propriety of leak classification

.1 Based on the above, establish geographical areas of concern. Areas of concern would be geographical areas indicated to have a rather concentrated number of leaks on hand. These areas would be ranked, based on indicated severity and leak exposure.

.2 After establishment, each area must be further analyzed to determine:



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.1 Magnitude of repair required

- Service lines to replace
- Joints to seal
- Main to replace because of break history or reported graphitization problems
- Number of #3 leaks on hand
- Location of facilities - higher priority must be given in areas of wall-to-wall concrete and more dense population

.2 Field work may be required to make this determination.

.3 Areas of concern will be prioritized within the Division and Company-wide.

10.02 Service Lines

- .1 Any time a service connection is exposed, any non-compliance with current standards of construction shall be corrected. This will normally require total replacement.

10.03 Mains - analysis will be handled as outlined below and repair/ replace criteria will be followed as indicated:

.1 Bell Joints

- .1 Preventative joint sealing will not be accomplished.
- .2 Bell joints will be sealed when exposed for any reason.
- .3 Bell joints will be sealed in area where gas from them is entering sewers or other ducts.



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.4 Leaking bell joints may be sealed in the areas indicated in 10.01 as the area is overhauled.

.2 Graphitization

.1 Every cast iron main exposure shall include an inspection to determine extent of graphitization.

.2 If such is indicated:

Supervisory consultation shall be had to determine course of action. The need will exist to:

- Examine available past records
- Possibly expose more main for inspection
- Determine need to replace

.3 Breaks

.1 A record of cast iron breaks, excluding third party damage, shall be established and maintained.

.2 Every cast iron main break reported and repaired shall be recorded and analyzed for:

- Past break history in the block (one block length) OR
- Break history in an intersection (street)

.3 In-block mains shall be scheduled for replacement in the area of breakage when records indicate three or more breaks (include current break) have occurred within the previous five years.

.4 Intersection mains shall be scheduled for replacement when records indicate two or more breaks (include current break) have occurred within the previous five years.



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.4 Mains in Areas of Construction

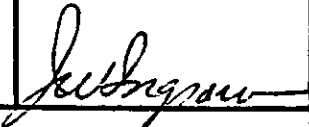
- .1 As outlined in the Operation, Maintenance and Inspection Manual, Section A, Part 1, pages 24D through 24F, cast iron shall be supported, replaced or removed from service as required in areas of construction activity.
- .2 Also considered in this Section are areas of earth movement and areas having underground water problems due to water main or sewer leaks or natural water seepage. Mains subjected to such undermining, etc. shall be scheduled for replacement in the area of concern, upon such determination.

.5 Street Overhaul

- .1 "Resurfacing Only" projects will normally require the repair of leaks detected within the bounds of the resurface project, which it is anticipated would require repair within two years.
- .2 Complete rebuild of streets will require replacement in sizes 6" and under. If over 6" in size and not in the way of construction, the main should be rehabilitated by necessary joint sealing and service renewal.
- .3 In both 10.03.5.1 and 10.03.5.2 above, replacement may be required if records indicate breakage or graphitization problems as previously outlined.



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PREPARED BY: Standards and Codes		
APPROVED: 		

10.04 Contracting

- .1 Contractor labor should be considered to cut concrete, expose gas piping, seal joints, refill and repair the excavation.
- .2 Contractor labor should be considered to replace gas mains and service lines connected to them, when such is required.

10.05 Accounting

- .1 The replacement of mains and service lines is a capital expenditure whether by Company or contracted labor.
- .2 It is recommended that individual work order numbers be assigned to capture the cost of "work done" in each geographical area, as outlined in Part I. A separate blanket-type work order will be required.

.1 Joint sealing

.2 Mains sleeved or repaired

.3 Service lines repaired

.4 Service lines renewed

- .3 A set of the above work orders must be kept for each:

.1 Company force work

.2 Contractor force work

This will allow cost data to be collected separately for any Company forces or contractor forces doing the work described.

- .4 As labor and material costs are applied to each work order, it will also be necessary to make notations relative to units such as:

.1 Number of joints sealed



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- .2 Number of sleeves installed
- .3 Number of service lines repaired
- .4 Number of service lines renewed

10.06 Cost Analysis

- .1 Analysis will be made by Division, relative to:
 - .1 Cost of contractor usage on a yearly basis
 - .2 Determining the reduction in the leak backlog

11.00 METHODS OF REPAIR

11.01 Repair by Clamping and Sleeving

- .1 C.I. or ductile unlike steel will require repair or replacement when damaged since it would rarely be considered damaged unless it had been cracked or broken. Dents cannot, of course, occur in C.I., and other mechanical damage such as gouges or grooves are because of the structure of the metal not likely to be extensive or stress producing. In other words with the exception of corrosive action which is negligible when compared with steel and with the exception of joint and service connection leakage, repairs on C.I. will for the most part consist of repairs of fractures or breaks. Permanent repair of these fractures or breaks should normally consist of installation of mechanical split sleeves.
- .2 Repairs with full encirclement type clamps would not in many instances be considered standard as a permanent repair since clamps provide little reinforcement to the main and would be apt to fail if a deviation of the pipe occurred at the weakened or broken portion being repaired. Where reinforcement is not considered necessary as on repair of limited corrosion or as on damage which has not be caused by in-line stress



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and where the main is solidly bedded, full encirclement clamps could be considered as a permanent repair.

- .3 Split repair sleeves on cast iron must, when available, be of insulating style and clamps must be of stainless steel, full circle type. See Company Corrosion Control standards for proper cathodic installation of clamps and sleeves on C.I. main.

11.02 Bell and Spigot Joints

- .1 Repairs or maintenance must be performed on bell joints when any of the four following situations occur:
 - .1 All cast iron bell and spigot joints repaired because of caulking leaks must be repaired with mechanical leak clamps.
 - .2 All caulked cast iron bell and spigot joints that are subject to pressures of 25 psig or more, must be sealed with mechanical leak clamps.
 - .3 All caulked cast iron bell and spigot joints that are subject to pressures less than 25 psig and which are exposed for any reason must be sealed with mechanical leak clamps.
 - .4 Where bells are split or broken they should, if possible, be removed and properly replaced with a section of steel pipe. If this is not feasible, bell joint encasement sleeves may be used.
- .2 Bell joint clamps or bell joint encasement sleeves must be methodically installed as shown in the Company Corrosion manual.



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	21-24E	Pt. A Sec. 1	4/18/86	Standards and Codes	<i>J. Ingram</i>

11.03 Other Type Joints

- .1 Mechanical and compression coupled or any other type joints on C.I. which are leaking or have excessively deteriorated must be dealt with on an individual basis. Repair problems caused by these type joints might in some instances be extensive enough to justify replacement of the C.I. main. In other instances proper and economically feasible repairs may be possible. Again, good judgment is necessary based on experience and available facts.

12.00 TESTING

- 12.01 All repairs made on C.I. or ductile mains where leakage was occurring must be leak tested. Where more than one length of steel pipe was installed as a replacement, that portion replaced must be tested as required under "Testing" in the standards for installation of new steel mains. Replacement with plastic shall require testing as required under applicable Company standards for plastic. Tie-ins or other repairs where air testing is not feasible may be leak tested at the existing operating pressure of the main.

13.00 PROTECTING CAST IRON MAINS

- 13.01 During the excavation of a cast iron main by Company forces or in the event knowledge is had that other parties are excavating around cast iron mains, which excavation process results in disturbance of earth supporting the cast iron, proper action must be taken to assure that the piping is not subjected to possible damaging forces. On-site observation should analyze:
 - .1 The amount (length) of pipe having earth support disturbed.
 - .2 The possibility of earth movement such as caused by ditch walls caving, etc., which could cause pipe to be abnormally loaded or moved.



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- .3 Type of equipment working close to or around the pipe which could cause severe vibration or impact problems.
 - .4 The indicated magnitude of total construction activity which could affect the pipe. What are the parameters of the overall project.
 - .5 How the excavation will be backfilled and provisions for considering proper backfill material and compaction.
- 13.02 Any excavation and backfill involving cast iron pipe must be accomplished so the end result will avoid having the pipe.
- .1 Resting on any unyielding structure.
 - .2 Supporting another structure.
 - .3 Supported by improper backfill.
 - .4 Subjected to excavation backfill settlement.
- 13.03 Any of the above may subject the cast iron pipe to beam action and thus a possible break.
- 13.04 Although the above discussion indicates vertical type deflection, it should be mentioned also that equally important are possible movements horizontally which also can cause the pipe to act as a beam. Earth shifts also occur in this manner and cannot be discounted in the evaluation.
- 13.05 Based on the above, consideration must be given to the replacement of cast iron pipe with steel in areas of extensive excavation or in areas where known earth slides are occurring or where knowledge is obtained that such is likely. In like manner, the undermining of cast iron pipe in areas of water main breaks or sewer leaks may require replacement action. It may be necessary to take a section of cast iron pipe out of service in areas of construction activity so as to eliminate the possibility of a break resulting in gas escaping and then replacing the cast iron with steel at a later date after the construction has been completed.



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13.06 Action must be taken so far as removing pipe from service and subsequent replacement when the length of pipe having earth support removed approaches:

- .1 One-third the joint length for 8" and under.
- .2 Two-thirds the joint length for over 8".

13.07 If any question arises as to the care being taken by the excavator, or if obtaining proper backfill and resulting support is questionable. The above lengths should be modified downward if pipe condition warrants or if bell and spigot joints are in or close to the excavation.

REPLACEMENT/CATHODIC PROTECTION PROGRAM

Unprotected Steel Transmission Lines

Feeder Lines and Mains

Pursuant to Section 15(E) of the Missouri Public Service Commission's Pipeline Safety Regulations, The Kansas Power and Light Company (KPL) submits the following program for replacement and/or cathodic protection of unprotected steel transmission lines, feeder lines, and mains.

I. BACKGROUND

Effective December 15, 1989, the Commission adopted new Gas Pipeline Safety Regulations applicable to corporations, municipal gas systems, and public utilities subject to the Commission's jurisdiction. In Section 15(E) of the new regulations, the Commission requires all operators who have unprotected steel transmission lines, feeder lines, or mains to develop a replacement/cathodic protection program to be submitted with an explanation to the Commission by May 1, 1990. Under the regulations, the program is to be prioritized to identify and cathodically protect or replace pipelines in those areas that present the greatest potential for hazard. The Commission went on to identify a number of areas and conditions that should be considered in determining the priority for replacing or cathodically protecting such lines.

II. EXPLANATION OF PROGRAM

At the time the Commission initially proposed its rule regarding the replacement or protection of unprotected steel mains,

KPL commented that in conjunction with the Missouri and Kansas Commissions, it had requested an outside consulting service (Stone & Webster) to prepare a recommended replacement program for cast iron and bare steel piping. Since the consultant's recommendations were scheduled to be completed within 18 months of the letting of the contract, KPL suggested that the submission of a plan for Commission approval be deferred until the consultant's report was accepted. Id.

In response to these and other comments, the Commission indicated (through reference to similar comments made by the Commission on cast iron replacements) that its proposed rule did not require the replacement of such piping, but instead required the development of a plan for replacing or cathodically protecting such piping. The Commission also noted that its Staff would evaluate consultant studies presently underway, together with operator programs, as submitted, to address this rule as required, in order to achieve better criteria for replacement and for protection plans. Id.

Pursuant to this clarification, KPL has submitted a revised version of its existing program for the maintenance and replacement of steel mains. (See Attachment A) Pending implementation of a main replacement predictability model such as CIMOS, or the adoption of a similar system for prioritizing replacements, KPL believes that its existing program for replacing and cathodically protecting bare steel mains represents an effective interim plan, and complies with the requirements of the Commission's new rule. Under KPL's revised maintenance and replacement program for steel

mains, an analysis of previous leak history and anticipated leaks, as well as various economic considerations, is conducted to determine whether steel mains should be repaired and cathodically protected or replaced. (See pages 3-3C, Attachment A). Among other factors, specific pressure, corrosion, and age factors are also considered in determining whether repair or replacement is most appropriate. (See pages 2-3) In addition, all unprotected steel mains are cathodically protected whenever such mains are exposed. Pursuant to the Commission's rule, KPL has also added to its program the specific priority criteria which the Commission has identified in its rule for use in determining the greatest potential for hazard.

It should be noted that under these procedures and the Company's electrical survey program, KPL has replaced or cathodically protected 99 miles of its unprotected steel mains in Missouri over the past four years alone. This compares to the approximately 881 miles of unprotected steel mains remaining on KPL's system in Missouri.

III. CONCLUSION

Given the program's incorporation of the Commission's priority criteria, and the progress made by KPL in replacing or cathodically protecting its bare steel mains under its existing procedures, KPL believes the attached program is consistent with the Commission's newly-adopted rule. The Company accordingly requests that it be approved on an interim basis, pending the implementation of any predictability model or other prioritization technique that may be adopted as a result of the Stone & Webster gas safety audit. Once

adopted, such a procedure will enable Company to incorporate additional priority criteria into its program, including corrosive soil conditions, age of facilities, and a more comprehensive consideration of leakage patterns.



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STEEL PIPELINES

UNPROTECTED BARE STEEL TRANSMISSION LINES, FEEDER LINES AND MAINS

Special consideration will be given to determine when these facilities should be cathodically protected or replaced. In addition to the other criteria discussed in this section, emphasis must be placed on those areas that present the greatest potential for hazard. These high priority areas should include, but not be limited to:

1. High-pressure unprotected steel pipelines located beneath pavement which is continuous to buildings walls;
2. High-pressure unprotected steel pipelines near concentrations of the general public such as Class 4 locations, business districts, and schools;
3. Areas where extensive excavation, blasting, or construction activities have occurred in close proximity to unprotected steel pipelines;
4. Sections of unprotected steel pipeline that lie in areas of planned future development projects, such as city, county, or state highway construction/relocations, urban renewal, etc.;
5. Sections of unprotected steel pipeline that exhibit a history of leakage or corrosion; and
6. Sections of unprotected steel pipeline subject to stray current.

MAINTENANCE OF STEEL MAINS (General)

The necessity for repair or replacement of steel mains may be brought about by any of the following factors:

- (1) Electrolytic corrosion causing pipe deterioration
- (2) Split pipe seams.
- (3) Circumferential cracks or separation of welds due to stress.



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- (4) Tears, holes, or dents caused by machinery or other external forces.
- (5) Thread leaks.
- (6) Joint leaks other than threads.

Of the above, corrosion is the primary cause of the failure of steel mains. Since we have hundreds of miles of steel mains which were in the past installed without protection for corrosion, we are now faced with various problems of maintenance repairs or in many instances replacement of these mains. Other factors which are mentioned and which would require repair of the main, although less frequent in occurrence would often require a different type of repair than would corrosion. Our concern here will be to provide guides in determining whether main should be repaired or replaced, and if repaired by what methods and materials.

Repair or Replacement of Steel Mains?

Where bare piping or where coated piping bared by reason of coating damage is exposed because of leakage or for any other reason it shall be examined for external corrosion and repaired or replaced as required by the following. Nominal walls mentioned in the following are walls currently being used. Heavier wall pipe need only have as much wall left as currently used pipe.

- (1) If pressure in piping is 100 psig or less and:
 - (a) Piping is so generally corroded over an extensive area that the remaining wall thickness is less than 50% of the nominal wall, the piping must be replaced.
 - (b) Piping is corroded in a small area or has isolated pits whose diameter is 3 times the nominal wall thickness or less at the pipe surface and whose depth leaves a wall thickness at the bottom of the pit of at least 30% of the nominal wall need not be repaired. If pits are larger and deeper, pipe shall be repaired or replaced.



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(2) If pressure is greater than 100 psig but produces a stress less than 20% of specified minimum yield and:

(a) Piping is so generally corroded over an extensive area that the remaining wall thickness is less than 60% of the nominal wall, the piping must be replaced.

(b) Piping is corroded in a small area or has isolated pits whose diameter is 3 times the nominal wall thickness or less at the pipe surface and whose depth leaves a wall thickness at the bottom of the pit of at least 60% of the nominal wall need not be repaired. If pits are larger and deeper, pipe shall be repaired or replaced.

(3) If pressure in piping produces a stress of 20% or more of specified minimum yield and:

(a) Pipe is so generally corroded that remaining wall thickness over an extensive area is reduced to the point whereby the remaining thickness is 75% or less of original wall, pipe shall be replaced.

(b) Pipe is corroded in a small area or has isolated pits whose diameter is measured at the pipe surface is less than the wall of the pipe and whose depth leaves a wall thickness at the bottom of the pit of 75% or more of the nominal wall thickness of the pipe, the pipe need not be repaired. If pits are larger and remaining wall of the pipe is less than 75% of nominal pipe wall, pipe shall be repaired or replaced.

Whenever piping replacements are made with steel pipe, coated pipe shall be used and installed according to Company Standards and cathodic protection applied. Whenever bare steel piping is exposed, for any reason, it shall be coated and have hot spot cathodic protection applied if it is unprotected.

It is realized that the preceding guides will require visual examination and usually be applicable to repair or replacement due to corrosion. The pipe adjoining this portion may also require maintenance. It must therefore be standard procedure to investigate the condition of the main adjoining the exposed portion. The extent of this investigation would usually depend on the severity of the



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corrosion exposed. Where limited corrosion or isolated pits exist and where a large area of the exposed pipe appears in good condition, bar hole tests into the side of excavation over the main shall be sufficient, providing no additional leakage is indicated. When heavy corrosion has occurred over an extensive area of the exposed portion, additional investigation is required. It is therefore necessary to utilize good judgment based on experience and on facts which are available and which can be obtained.

The following information should be obtained to assist in determining the extent of investigation and the repair or replacement necessary, if any, adjacent to the corroded portion.

1. Determine if past records indicate light or excessive maintenance on the main in this immediate area.
2. Determine if bar hole tests over the main indicate leakage in the area of exposed corrosion or if they indicate that the main seems to be in a sound condition.
3. Determine if it is practical to expose the main for visual examination at other close locations.
4. Determine the age of the main and if it is has been painted or coated. If it has been coated, determine the general condition of the coating where it is exposed. On old painted or coated main, bar hole tests may indicate leakage over extensive lengths. Unlike old bare main which usually suffers a more even corrosion, the corrosion might be intermittent at high spots with the main actually being basically sound and repairable.
5. Consider the operating pressure and the importance of the main to the distribution system.
6. Take appropriate corrosion readings. Proper analysis can give information without costly additional excavating.



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Based on experience and a summary of the facts which are available, it will then be necessary to decide if the main is to be repaired or replaced. THE INTENT SHOULD ALWAYS BE TO REPAIR AND CATHODICALLY PROTECT MAINS WHERE THEY ARE BASICALLY SOUND AND WHERE THEIR SERVICEABLE LIFE CAN FEASIBLY BE EXTENDED, AND TO REPLACE THEM WHERE THEY ARE BEYOND PRACTICAL REPAIR. It should be kept in mind that a large portion of the effort expended in continuous maintenance of excessively corroded mains is wasted effort. Where this excessive and continuing maintenance is occurring and where condition of the main so indicates the main must be replaced.

Formula to determine cost relationship - replacement versus repair:

$$\frac{N}{10n(LC) + IR + 10f (FR)} = \begin{matrix} \text{If less than 2, replace.} \\ \text{If greater than 2, repair.} \end{matrix}$$

Where:

- N - is the cost to replace with a new facility.
- LC* - is the recheck cost of each existing leak to re-evaluate severity status.
- n - is the number of leaks which have to be rechecked each year.
- IR* - is the cost of repairs required immediately or in the very near future to assure safety.
- f - is the number of leaks on the facility which have to be repaired each year. This number of leaks would include those in leak inventory at time of analysis required to be repaired on some time schedule (such as #3's in 5 years). It would also reflect the number of corrosion leaks the analysis of historical leakage indicates would likely develop. This number should reflect the best estimate of leaks required to be repaired each year.
- FR* - is the cost of repair of each leak expected to develop or which existed at time of analysis, as outlined in (f) above.

The above formula is based on replacement when the total projected cost of maintaining existing facility for next 10 years exceeds one-half** the total cost of replacement and resulting monitoring.

*Each Division should develop costs to serve as a guideline which should be kept current through periodic review.



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**Future evaluation of this program may require this amount to be changed at a later date.

When it is determined that main is to be replaced rather than repaired that portion being replaced must be installed to Company Standards as set forth in "Standard Procedures for Installation of New Steel Mains" or as set forth by Removal of Mains by Insertion of Plastic Pipe.