May 25, 1976

Chief, Technical Division
Chief, Regulations Division

George L. Mocharko

American Society of Mechanical Engineers' (ASME)
Request to Revise Section 192.465

ASME has requested that the Office of Pipeline Safety Operations (OPSO) revise 49 CFR Section 192.465 by including the following as an alternate method for monitoring cathodically protected facilities:

> "Where electrical test methods for evaluating and monitoring are impractical or are ineffectual in applying the criteria for cathodic protection in Appendix D of this Sub-Part; annual leakage surveys, and, corrosion and leak history studies, may be used to verify and monitor the effectiveness of cathodic protection and other corrosion control procedures."

Review:

> Corrosion accounts for the largest number of repaired leaks each year. The minimum Federal safety regulations contained in Subpart I wee promulgated and became effective as of August 1, 1971, to provide the highest degree of protection for the public from leak incidents attributed or caused by corrosion. In that corrosion is the largest single problem which is controllable, within the operators capacity, from a technical feasibility and economic practicability standpoint; it would be an anomaly to revise Section 192.465 as stated by ASME. If safe operations is the goal as set by OPSO, corrosive control measures must be instituted before leaks occur. Monitoring is the only means by which the operator can prevent a hazard which can become detrimental to public safety.

Technical Summary:

> 1. Cathodic protection is an electrical method of preventing corrosion on metallic structures (such as pipelines in electrolytes) and involves electro-chemistry. Therefore, it is illogical to monitor or verify whether or not cathodic protection has been installed to prevent corrosion or is at adequate levels to control corrosion with annual leakage surveys, and corrosion and leak history studies.
>
> 2. There has been no systematic attempt to develop direct results or corrolation [sic] between gas leakage or leaks to cathodic protection or severity of corrosion, hence, electrical surveys, measurements, and tests are the only acceptable technology for

monitoring or verification. It appears operators would like to just conduct post mortem leak surveys rather than any preventative surveys. This is supported by the contract studies OPSO had initiated, such as Technical report No. OPS-TR-71-001, "Ferrous Pipeline Corrosion Processes, Detection and Mitigation," and Contract DOT-OS-40190, "Study on Current Practices, Technologies Problems, and Recommendations Relating to Overall Safety of Gas Pipeline Distribution Systems," and NTSB accident reports. The TR-71-001 report stated, "At this time the best indicator of pipeline corrosion appears to be close monitoring and interpreting of pipe potentials. Since it is current leaving the buried structure that causes corrosion, the optimum measurement would be the determination of current leaving the structure." The DOT-40190 study stated, "Corrosion accounts for the largest number of repaired leaks each year. Improvements are needed in the overall understanding of the corrosion process and methods for better determination of active corrosion and assessment of applied cathodic protection. The methods now used by gas utilities to determine the physical condition and integrity of their pipelines are largely based on detecting and locating leaks. This procedure is essentially after the fact and largely precludes preventative maintenance. Efforts should be promoted to develop methods for identifying and locating deteriorating conditions before failure occurs and leakage ensues."

Conclusions:

1. The ASME has not provided adequate supportive information to justify the statement that electrical surveys are ineffectual and impractical for determining the adequacy of cathodic protection in distribution system. In fact, they have only summarized the variables that knowledgeable corrosion control persons have worked with for many years. They have also strengthened the position that OPSO has taken in the requirements of Section 192.453. "Each operator shall establish procedures to implement the requirements of this Subpart. These procedures, including those for the design, installation, operation and maintenance of cathodic protection, must be carried out by, or under the direction of, a person qualified by experience and training in pipeline corrosion control methods."

2. The proposed ASME revision is not technically sound and would have the effect of shielding imprudent operators for liability to the public as well as penalize the prudent operators who have met the monitoring requirements of Section 192.465. However, OPSO should consider some sort of relief for the distribution or transmission operators with regard to conducting electrical surveys. OPSO should take a serious look at the time requirements of all surveys in the Federal standards to determine priority of performance to enhance safety.

3. Surveys--One area of particular concern to the operators involves the monitoring of "hot spot" cathodic protection in active corrosion areas. More Information is needed to determine whether or not using a statistical sampling - probability approach as a method

of monitoring or some other type of risk analysis be used to monitor the effectiveness of cathodic protection.

\signed\

George L. Mocharko

February 27, 1976

Mr. Cesar DeLeon
Acting Director
Office of Pipeline Safety Operations
Department of Transportation
Washington, D.C. 20590

Dear Mr. DeLeon:

The American Society of Mechanical Engineers Gas Piping Standards Committee has been reviewing the requirements of Sub-Part I, "Requirements for Corrosion Control," Part 192, Title 49, of the Code of Federal Regulations. As a result, we would like to offer the following comments and request a new paragraph to 192.465, External Corrosion Control: monitoring, to provide for an alternate method of monitoring.

Messrs. Elder and Dean discussed this particular proposal with you early last fall, and indicated that they would like to meet with you and your staff to discuss it in some detail. However, the Office workload didn't seem to lend itself to an extended meeting on this subject, what with the offshore regulations, Alyeska, the Technical Safety Committee meeting, etc. We heard recently that 192.465 might be added to your March 30-31 Committee meeting agenda if time permits. Therefore, it seemed prudent to formally submit the proposal to you in advance of the March Committee meeting.

The ASME Committee was established by ASME to provide technical and professional guidelines with respect to certain portions of 49 CFR Part 192, Transportation of Natural and Other Gas by Pipeline, Minimum Federal Safety Standards, to assist gas transmission and distribution system operators in their efforts of compliance. In addition, the Committee has a responsibility to comment on proposed amendments or other matters which affect Part 192.

The ASME Committee consists of 40 members, each having technical expertise in one or more of the following areas: gas distribution, transmission, gathering, design, research, construction, and testing. It is a broad based, balanced Committee drawing its membership from the gas transmission and distribution industry, government regulatory agencies, material and equipment suppliers, contractors, and independent consultants and research agencies.

We offer the following comments and request a revision providing for alternate methods of monitoring in 192.465, External Corrosion Control: monitoring.

Compliance with the requirement that "each pipeline that is under cathodic protection must be tested at least once each calendar year, but at intervals not exceeding 15 months to determine whether the cathodic protection meets the requirements of 192.463 by means of electrical survey" is both impractical and ineffectual in: (1) areas congested with numerous buried metallic structures, (2) in business and commercial areas where roadway and sidewalk paving exists between buildings on each side of the streets, and (3) in areas where stray current effects are predominant. Other criteria or methods for evaluating and monitoring of cathodic protection are necessary in such areas since the usual electrical tests are impractical to accomplish and/or are ineffectual since meaningful and reliable interpretation of these electrical tests are nullified by conditions in the environment that are foreign to the structure being evaluated.

We respectfully request 192.465 be revised by including the following as an alternate method for monitoring cathodically protected facilities:

> "Where electrical test methods for evaluating and monitoring are impractical or are ineffectual in applying the criteria for cathodic protection in Appendix D of this Sub-Part; annual leakage surveys, and, corrosion and leak history studies, may be used to verify and monitor the effectiveness of cathodic protection and other corrosion control procedures."

This recommended alternate will not be detrimental to present safety regulations. It will enhance, and is consistent with gas pipeline safety. The proposed rule change is not a less stringent substitute for the present requirement of monitoring, but rather provides a monitoring alternative were no other is practical or effectual. It is proposed because the present requirement stipulates methods for monitoring of cathodic protection that are impractical and ineffectual and therefore not safety or cost beneficial in the conditions discussed. The proposed alterative affords a means of confirming the effectiveness of applied cathodic protection by a more positive method.

Discussion

The following is offered as information to explain the practical and technical problems inherent in congested and paved areas, and to point out other equally important conditions in support of our contention that a rule change is necessary.

The major problems concern the difficulty inherent in evaluating and monitoring pipeline installations in congested business districts to determine whether they are cathodically protected to a level required by the criteria for cathodic protection of 192.463 and Appendix D. Distribution operators have great difficulties in applying any of the five criteria listed in Appendix D for pipe in congested areas since each criterion requires the use of a reference electrode contacting the electrolyte and valid interpretation of such voltage measurements requires the consideration of IR drops other than those across the pipe/electrolyte boundary. In congested areas the presence of pavement from building wall to building wall prevents the reference electrode from being placed in intimate contact with the underlying soil and introduces conditions that nullify valid interpretations of the pipe-to-soil voltage measurements. Additionally, these surface type electrical tests are affected adversely by the earth potential gradients around other metallic structures located in the vicinity of the gas pipeline. In highly congested area where numerous foreign structures are corroding, the effect of current and voltage gradients from these sources defy accurate interpretation.

The following are conditions that frequently render pipe-to-soil tests impractical and nullify valid and meaningful interpretation. Monitoring of cathodic protection by the usual pipe-to-soil voltage measurements under these conditions is impractical and ineffectual and does not establish a valid basis for evaluating or monitoring the effectiveness of cathodic protection for the subject structure.

1. Such test readings are affected by potential gradients and shielding conditions created by other metal structures that may be electrically coupled through low earth resistance to the pipeline being tested. Other metal structures typically found include water lines; telephone, electric power, and traffic control cables and conduits; steam lines; pipe type cable; street light cables, conduits, and light standards; electric ground rods; sewage lines; and miscellaneous manholes, drain pipes, etc. Additionally, junk metal, such as pipe and rails from abandoned facilities, are sometimes present. Other metal structures also include reinforcing rod or wire mesh that may exist in the paving between the reference electrode and the pipeline being tested.

2. Where pipelines are beneath paving, the reference electrode often cannot be placed in intimate electrical contact with the soil. Where the surface is not an effective electrolytic media, it will not permit the ion migration necessary to make a valid test (in addition to the indeterminate shielding and gradient effects previously discussed). In business areas, pavement is usually existing from building wall to building wall and precludes the use of pipe-to-soil profile surveys. Further complications exist since the pavement is frequently underlaid by ballast of stone, sand, and gravel; and layers of old roadways consisting of cobblestone, brick, asphalt, macadam, etc. There are conditions where the paving is not reinforced that test readings can sometimes be obtained on concrete surfaces by thoroughly wetting the surface and applying correction factors to such readings. The presence of asphalt either above or below the concrete will prevent valid readings. Additionally, there may not be an effective close earth path between the pipe and pavement surface due to the existence of voids under the pavement caused by earth settlement, or the existence of other underlying high resistivity material such as road ballast, cobblestone, brick, gravel, and stone.

3. Dynamic stray currents further complicate and in some cases, make it impractical to effectively evaluate and monitor cathodic protection in congested urban areas in accordance with the required criteria stipulated in Appendix D. Such strays are common in large metropolitan areas where electric powered surface and subway

rail transit systems are in operation. In such areas the control of stray currents to mitigate their corrosive effects is the main corrosion control consideration. Where stray current effects are predominant the pipe-to-soil potential measurements are constantly fluctuating and frequently override the effects of sacrificial anode methods of cathodic protection. This may also necessitate the installation of interference type control bonds across insulators in the pipeline therefore reducing the effectiveness of attempts to isolate newly installed sections of cathodically protected coated pipe from unprotected bare pipe, for example. In areas where fluctuating stray currents are the dominant problem, compliance with 192.473(a) dealing with control of stray currents, and proposed alternate method recommended herein should therefore take priority, and compliance with the present 192.465(a) dealing with monitoring for cathodic protection should not apply.

4. Pipelines or segments of pipelines employing compression type couplings can introduce erroneous pipe-to-soil readings. Compression type couplings (including those having armored gaskets) have a varying longitudinal resistance caused by movement of the pipe within the coupling. This may result in test readings not being indicative of actual conditions.

5. The presence of galvanic anodes (or impressed current anodes) will further limit the points at which valid pipe-to-soil potential readings may be taken. Readings taken with a reference electrode placed directly over such anodes ar not indicative of the actual pipe-to-soil potential.

Section 192.457(b)(3) and the preamble to Sub-Part I recognizes that electrical surveys are not always practical and provides for alternatives in such cases. Furthermore, 192.463(a) recognizes that the criteria contained in Appendix D may not always be applicable. The most effective evidence of the successful application of cathodic protection or other corrosion control measures is the absence of pitting or general corrosion as evidenced by routine visual examinations made when any portion of the buried pipeline is exposed. Non-conventional methods (that is, other than surface type pipe-to-soil potential measurements) may be possible at certain key points for the purpose of evaluating or monitoring the effectiveness of cathodic protection. However, these too have limited applicability and are discussed in the following. Methods A, C, and D are possible only at a limited number of points, and the installation costs and maintenance costs would further limit their applicability.

A. The installation of permanent access enclosures through the pavement will allow the insertion of the reference electrode for contact in soil adjacent to the protected structure:

1. Roadwork and paving repairs will damage or cover such enclosures. Maintenance would be difficult due to the usual construction activity and repairing in these areas.

2. Their use limits the type and number of tests possible.

3. The depths to which these enclosures might have to be installed limits accurate or practical placement of the reference electrode.

4. Underground facility congestion can totally prohibit their use.

B. An alternate buried metallic structure such as a water piping system may be used as a reference as provided for in (c) of Appendix D.

1. This is a practical alternate in those areas where the potential stability of the water piping can be established. Stray currents such as those present in areas of DC operated transportation systems or other DC equipment will nullify this stability. Similarity, the electrical continuity and extensiveness of the reference structure will affect the stability of such reference structures.

2. The presence of mixed metals such as copper, lead, cast iron, and steel used in the reference structure will nullify valid interpretation of data.

3. Access to the reference system is not always available.

C. Permanent reference cells (such as zinc reference) may be installed closely adjacent to the pipe:

1. As in A. above, roadwork and paving repairs can damage or cover the access boxes.

2. The type tests possible are limited.

3. Other buried facilities can cause practical and accurate placement of these electrodes to be impossible.

4. Permanent reference cells presently available will require extensive testing to assure their reliability, stability, and reference voltage equivalent.

D. The installation of test coupons buried closely adjacent to the pipe may be effective in evaluating the cathodic protection provided at certain points on the pipe.

1. This requires the capability for removal and examination of the coupon. This requirement limits the applicability of this method.

2. Access to the coupon is subject to roadwork and paving repairs.

3. There are limited areas where these coupons can be installed to reflect actual conditions on the pipe and remain isolated from foreign structures.

4. There is considerable question as to whether the conditions reflected by these coupons actually indicate any corrosion on the protected structure. For example, if the coupon evidenced corrosion in an area where the main was well coated any analogy would be questionable.

Safety Aspects

The alternative proposed for these difficult areas is intended to recognize the ineffectiveness and impractical application of the normal test procedures under the conditions described. It is not detrimental to safety requirements and continues to provide for stray current control and cathodic protection of such facilities based on sound engineering design and the detection of corrosion and prevention of the existence of any hazardous condition through the utilization of gas detection surveys and the study of reports of visual observations of the pipe condition. This proposed change to the existing regulations provides a monitoring alternative where no other is practical or valid.

The impracticality of electrical surveys under certain conditions has previously been recognized by the Office of Pipeline Safety in the preamble to Sub-Part I in referring to Section 192.457(b) "... since determination of areas of corrosion by electrical survey is often impractical in the case of distribution lines (such as those under paved city streets and sidewalks)."

Very truly yours,

\signed\

Manuel Gutierrez, Secretary
ASME Gas Piping Standards Committee