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PROCEEDINGS
PIPELINE TRANSPORTATION SAFETY R&D WORKING GROUP MEETING

June 30 - July 1, 1980

JULY 30, 1980
INTERIM REPORT

Prepared for:
U.S. DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
Transportation Programs Bureau
Office of Systems Engineering
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16. Abstract

A Pipeline Transportation Safety R&D Working Group Meeting took place at the DOT Transportation Systems Center on June 30 - July 1, 1980. The objective of this meeting was to reach concensus on future pipeline transportation safety issues and possible solutions requiring specific and timely R&D. The meeting was attended by representatives from industry, associations, research institutes, universities and government agencies associated with pipeline transportation safety.

The meeting resulted in the identification of future concerns in the areas of: pipeline system analysis methodology, pipeline inspection and maintenance, and pipeline design and construction. The conclusions of the workshop will be a source for formulating the Pipeline Transportation Safety R&D Plan of the DOT Transportation Programs Bureau.

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Pipeline Safety, Transportation Safety, Hazardous Materials, Corrosion, Leak Detection, Fracture Mechanics

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PREFACE

These proceedings contain the edited reports of the Pipeline Transportation Safety R&D Working Group Meeting held at the Department of Transportation (DOT), Transportation Systems Center (TSC), June 30-July 1, 1980. This meeting was attended by representatives from industry, associations, research institutes, universities, and government agencies (listed in Appendix B) associated with pipeline transportation and safety.

The purpose of the meeting was to reach concensus on future safety-related issues in pipeline transportation and to identify possible solutions requiring specific and timely R&D.

As a result of this meeting several areas of R&D were identified for further Federal consideration.

CONTENTS

1. INTRODUCTION

At present, a large number of companies utilize in excess of a quarter of a million miles of gathering and transmission pipeline systems for the transport of energy products, particularly petroleum, natural gas and some coal. To these systems should be added the distribution pipeline networks for the delivery of natural gas. During the next few years, transmission pipelines will be constructed using both established and new engineering practices to accommodate existing and new energy products.

The Pipeline Transportation Safety R&D Working Group Meeting which took place at TSC during June 30 - July 1, 1980 will assist in identifying those future safety issues within the DOT responsibilities.

It is in the interest of the Federal Government and the pipeline industry to be prepared to meet any future safety issues which may come about as a consequence of these new or innovative practices or new energy products interaction with the pipeline materials.

A. To supply knowledge in order to support DOT's regulatory and policy making responsibilities. Sound regulatory and other policies can only be formulated on the basis of factual information of which R&D is one mechanism for obtaining desired data and knowledge. Additional R&D may be appropriate if there is sufficient doubt as to the objectivity of available information.

B. To supply specialized equipment and knowledge to support DOT's responsibilities. The DOT may develop its own equipment to support missions in which the private sector is not stimulated to provide unilateral support due to possible developmental risk or potential market limitations.

C. To supply the innovations and knowledge needed in cases in which market mechanisms are not effective in stimulating the needed investment from the private sector.

Size is a larger inhibitor for R&D support in the private sector than in the public. Therefore, risks which may be considered too high for individual companies may be acceptable on a Federal level since consequences of success or failure are different.

The implementation of the results of research and development activities are, by their nature, long term. In evaluating a proposed R&D investment and applying selection criteria, the probable (and possible) future operational environment should be considered rather than the present constraints.

These general areas were suggested by DOT for deliberations by the working groups.

Secretary - R. Heidersbach
Transportation Systems Center

Working Group III -- Design and Construction

Chairperson - R.J. Eiber
Section Manager
Battelle-Columbus Laboratories

Secretary - O. Orringer
Transportation Systems Center

The two-day sessions started with a general meeting of all the attendees, followed by individual meetings of each working group for the duration of June 30 and most of July 1. Chairpersons presented the findings of the respective working groups to all the attendees at a general session concluding the workshop. After each presentation, questions and comments were entertained.

4.2 AGENDA

Each working group secretary had a prepared set of questions to start and stimulate the discussion. Discussions in all three groups were kept informal and concentrated in areas related to future safety issues and research requirements.

B. Are methods available to lower the number of accidents caused by anchor drag?

4. Remote Sensing

   A. What benefits could arise from satellite monitoring of large transmission pipelines over present methods?

   B. What are the advantage/disadvantages of infrared monitoring of pipelines when compared with present visual techniques?

5. Unconventional Gases & Fuels

   A. What are future hazardous materials which will be transported by pipelines?

   B. Will these new materials increase/change modes of pipeline failures?

6. Technology Forecasting

   A. What new pipeline transportation technology should be investigated to insure safe operation of future pipeline systems?

   B. What other relevant areas of pipeline transportation need additional research and development support?

5.3 MEETING REPORT

The group met and elected R.E. Moore, Vice President and Chief Engineer for the Texas Eastern Transmission Corporation (Houston, Texas) as the chairman. The secretaries were S.J. Gozzo and R.K. Sharp, both of TSC. The group included representatives from industry, associations, universities and government agencies. A list of attendees is included in Appendix B.

Broad topics for discussion suggested in the final agenda overlapped specific technical information covered by groups in Inspection and Maintenance (Group II), and Design and Construction (Group III).

representation. At present, the post-accident price of repairing pipe systems is included in estimating damage costs. Industry suggests that this is an issue of internal finance, not related to public safety. A second problem with current statistical analysis is the use of ton miles of product transported as a normalization factor. This method is not a reliable standard since densities of various transported substances vary widely. Industry suggests that total pipeline mileage would be a preferable normalization factor.

2. Outside Forces

A discussion arose during which agreement was generally expressed that the greatest cause of transmission pipeline failures were caused by contractors and other individuals striking the lines with construction equipment; therefore, the industry could not be responsible for the actions of others. The pipeline industry could only be held responsible for its own actions.

A. Diffuse Forces

The multi-variable nature of diffuse forces makes pipeline system reaction unpredictable. Additional research through computer modeling of geological systems could provide useful information about subsidence and pipeline response to mudslides. The magnitude of forces inherent in earthquakes makes it infeasible to design or construct a fully protected pipeline system.

B. Concentrated Forces

A high percentage of pipeline accidents result from third-party damage, particularly pipe rupture through construction accidents. Pipe-locating techniques help to eliminate a portion of these construction accidents. Pre-dig scanning equipment has become successful in detecting sub-surface pipelines through modern locating techniques utilizing electromagnetic devices.*

*R.E. Moore's comment: Ultrasonic devices are not normally employed. Electromagnetic devices are employed onshore and sonar devices offshore.

and infrared monitoring of large gathering and transmission pipes via satellite would be useful in offshore and Arctic environments. Infrared techniques can detect gas pipeline leaks through temperature drops caused by gas escaping under pressure; however, they are not similarly useful for detecing oil pipeline leaks. Possible future application of satellites include: accurate surveying of pipeline locations, improved communication, enhanced pipeline operation, and leak detection. It was stated that a cost/benefit analysis should be performed before extended feasibility studies for a geo-stationary satellite are authorized. If further studies are justified, NASA and commercial laboratories should be consulted for technical assistance. The Department of Defense should be consulted regarding problems which might arise due to the high-camera resolution necessary for pipeline surveillance (i.e., sabotage and vandalism). Satellite pipeline surveillance is currently being studied at Jet Propulsion Laboratory.

5. Unconventional Gases & Fuels

Increasing energy requirements and diminishing supplies of conventional fuel sources mandate the exploration for new, economical hydrocarbons. Industry reports that these fossil fuels will have a higher hydrogen content making pipelines more susceptible to hydrogen embrittlement and blistering.

Slurry pipelines are used to transport coal in a liquid. At present, water is the most common solution, but studies are being conducted to test the feasibility of transporting coal with a liquid fuel such as methanol. Research is not needed to study the safety of flammable liquid transportation in combination with highly abrasive coal slurries, since coal immersed in a liquid (even though flammable) in a full airless pipeline cannot ignite or burn. Extensive research is currently being performed in the areas of pipeleak light-off and vapor cloud formation for heavier-than-air gases. Some of this research is being carried out by the U.S. Coast Guard at China Lake, California.

2. Remote Sensing

A. Determine the feasibility of satellite visual and infrared monitoring of large gathering and transmission pipes in offshore and Arctic environments.

B. Study possible future applications of satellite remote sensing which may include: accurate surveying of pipeline locations, improved communications, enhanced pipeline operation and leak detection.

3. Technology Forecasting

A. Consider a 50-year projection into future pipeline transportation of hazardous materials and its correlation with shifts in population centers.

B. TSC could possibly act as a U.S. Government clearinghouse for expertise in the area of pipeline transportation safety through computerized literature searches and formation of a specialized library.

5.5 CONCLUSIONS

It was the consensus of the working group that the U.S. Department of Transportation should center research efforts in non-technical systems; also, that the Department should coordinate pipeline safety efforts with other government agencies and establish liaison with industry, agencies, and universities to avoid unnecessary duplication of research projects.

Some research into interrupted-current cathodic protection is underway because of stress corrosion.

The possibility of new fuels which may be corrosive such as coal gas, synthetic fuel, etc., must be considered. Cathodic protection of cryogenic pipelines, changes in stress level due to altered Btu content (and thus working pressures) of the fuels, and leak detection methods through thermal insulation barriers should be considered.

All of the above considerations must focus on existing pipeline systems as well as those likely to be constructed in the future.

6.2 QUESTIONS

Specific questions and comments were prepared in advance by the Working Group II secretary and supplied to the attendees to assist in the starting of the session and to stimulate discussion. The questions and comments were the following:

1. Corrosion

   A. Question: What corrosion control methods are appropriate for cyrogenic pipelines?

   Comment: These are normally envisioned to be a "cold" version of concentric thermal piping systems used for steam, condensate, etc. The internal carrier pipe is made of a corrosion resistant material. A surrounding thermal insulator, which also allows for thermal expansion and contraction, is subject to moisture penetration if the outside piping corrodes.

   B. Question: How will increasing use of high voltage direct current (HVDC) distribution and of electric-powered mass transit systems affect the frequency of corrosion due to stray currents? Is research into this subject needed?

B. Question: Can continuous condition monitoring techniques be developed? Would they be useful and/or cost-effective?

Comment: Most current inspection techniques evaluate conditions during a defined inspection interval. Continuous monitoring appears to be expensive and of questionable utility.

6.3 MEETING REPORT

The group met and elected Dr. R. Baboian, head of the Corrosion Laboratory of Texas Instruments, Inc. (Attleboro, MA) as chairman. The secretary was R. Heidersbach, TSC Summer Faculty Fellow and professor of Ocean Engineering at the University of Rhode Island. The attendee list is given in Appendix B. This group was tasked with discussing leak detection, corrosion, and nondestructive evaluation (NDE). Chairman Baboian polled the group and found that roughly half were interested in "other things."

It later developed that three members of the working group (Singh, Serabian, and Ryan) were specifically interested in NDE but they also were interested in the discussions on leak detection and on corrosion as they provided background on needs and applications for NDE. Because of the organization of the overall meeting, these three members were unable to attend the simultaneous discussions on materials, welding, and fracture mechanics that occurred in Working Group III, Pipeline Design and Construction. Readers of this meeting report are thus cautioned that the NDE discussions that did occur were heavily weighted towards in-service inspection. The possibility of inadequate coverage of NDE aspects of new construction must be recognized.

Dr. Baboian led the discussion of each of the three assigned subjects in a sequential manner. In the following paragraphs, subjects are treated as they were discussed, followed by a listing of the recommended research needs. Unlike Working Group III, Dr. Baboian suggested, and it was agreed after some discussion,

C. Corrosion Mitigation Methods

(1) Materials

(a) Materials for hydrogen transport

(b) Erosion/corrosion-resistant materials for coal slurry transport

(2) Cathodic protection

(a) Improved efficiency magnesium anode systems

(b) Develop onshore zinc and/or anode systems

(c) Develop platinum-group anodes for onshore impressed current protection

(3) Cathodic protection of disbonded coating areas and other shielded areas

(4) Chemistry (inhibitors, etc.) was discussed but no recommended research topics were identified

(5) Design. No recommended research topics were identified. Degradation of plastics was discussed and it was agreed that this was a subject best left to discussion by Working Group II.

2. <u>Leak Detection</u>

The working group as a whole was not familiar with the U.S. DOT leak incident reporting system and the reports analyzing them. R. Kiefner, Battelle-Columbus Laboratories, was a member of the group and co-author of the Battelle report on the subject. He briefly described the results of his work (see Ref. 1). The analysis shows that damage by third parties and corrosion are the leading causes of leaks. A recent TSC report on the subject is also available (see Ref. 2).

Leak location seems to be a significant safety problem primarily in distribution systems because of higher public exposure. Migration paths in soils are complex and complicated by geotechnical permeability considerations. The presense of gas in the atmosphere cannot be easily traced to a buried leak at the present time.

research funds. One argument against NDE research for pipelines is the fact that sizeable research efforts in NDE are underway in other fields (e.g., nuclear, aerospace, etc.) and the likelihood of pipeline-specific research producing a significant advance in the state-of-the-art seems remote. Another argument against U.S. Government-funded research of this type is that it might tend to support one technique or company into an unfair competitive advantage over others. It seemed to many in the group that economic incentives for privately-funded research into NDE techniques (or pipeline adaptation of existing or developing techniques) was adequate. It should be noted that there was strong dissent to this majority opinion.

The discussion of in-service inspection was primarily concerned with corrosion (pitting, general, etc.). No need for crack detection (weld flaw, fatigue, etc.) was identified on in-service pipes.

The following recommended research in nondestructive evaluation was suggested:

A. Develop a reliable technique to evaluate the condition of in-service pipelines.

B. Welding and welds. No recommended NDE research was recognized.

C. Plastics. NDE of plastics was considered to be a research topic best left to discussion by Working Group III.

A condensed version of the above summary was presented by R. Baboian during the closing session of workshop. The following questions come from the audience:

<u>S. Gozzo (TSC)</u>: Asked if the working group discussed aging of welds and whether or not systems having older welds needed inspection.

(2) Effects of mechanical forces on corrosion

(3) Effects of ac currents on corrosion

(4) Effects of hydrodynamic conditions on corrosion

C. Corrosion Mitigation Methods

Materials

(1) Materials for hydrogen transport

(2) Erosion/corrosion-resistant materials for coal slurry transport

D. Cathodic Protection

(1) Improved-efficiency magnesium anode systems

(2) Develop onshore zinc and/or other anode systems

(3) Develop platinum-group anodes for onshore-impressed current protection

(4) Cathodic protection of disbonded coating areas and other shielded areas

E. Corrosion Detection

Develop a reliable technique to evaluate the condition of in-service pipelines.

2. Leak Detection

(1) Detection of unvented gas leaks

(2) Use of modern electronics technology in the development of new leak-sensing techniques

(3) Study of gas movement through various media (soils)

3. Nondestructive Evaluation

Develop a reliable technique to evaluate the condition of in-service pipelines.

A. Mechanical behavior

B. Chemical degradation.

The wide coverage implied by the foregoing list dictated that the working group deliberations be carefully organized to focus on important topics and to allot discussion time to each. It was suggested that some time be spent initially to formulate a set of specific questions to serve as the discussion agenda.

7.2 QUESTIONS

Specific questions and comments were prepared in advance by the Working Group III secretary and supplied to the attendees to assist in the starting of the session and to stimulate discussion. The questions and comments were the following:

1. Mechanics and Mechanical Engineering

A. Question: Is there any benefit to be gained by arresting a pipeline fracture within inches or feet, as opposed to pipe length?

Comment: Such rapid arrest probably requires extremely expensive approaches, e.g., materials with nil ductility temperatures lower than 60°F to 120°F below lowest anticipated service temperature. Collars or other mechanical crack arrestors may be better able to meet the safety-reliability-economy goal. Liquid and gas pipelines may require different approaches. The potential benefit for plastic pipeline is not clear because of the lower operating pressures used in these lines.

B. Question: Should additional emphasis be placed upon research into the mechanics of pipeline buckling?

Comment: A research program on the mechanics of external pressure induced buckling of underwater pipelines is planned to start under DOT sponsorship in FY'81. This type of instability may result from surges or leaks which reduce internal pressure, and the buckle may

E. Question: Is there sufficient understanding of the effects of concentrated external forces on pipelines?

Comment: Concentrated forces involve third-party damage by construction equipment (onshore) or anchors (offshore). In contrast to the case of diffuse forces, it appears to be straightforward to estimate bounding values for concentrated forces, but the penetration mechanics necessary to estimate their effects may require extensive development. The goal of an "impenetrable" pipe is impractical, but research may indicate that threshold penetrations might be eliminated by means of minor section changes.

F. Question: Are currently available plastic/metal joint couplings able to cope with extremes of service temperature?

Comment: Differential thermal expansion occurs at the plastic/metal interface. Sudden leaks or gradual pull-aparts may result from temperature cycles.

G. Question: Can benefits be gained from research on safety requirements for special-purpose components?

Comment: Bellows-type or woven elbows may have application to some pipelines in special situations, e.g., tight corners in city distribution systems where other utilities compete for the same space, or load-relief loops in cryogenic systems. Self-sealing components may have application in underwater lines where access for repair is particularly difficult.

H. Question: Are there any particular types of operating equipment for which service reliability/safety might be improved by research on mechanical design?

Comment: Some accidents reported in the pipeline accident statistics data base are attributed to equipment failures. However, it is not clear how significant

C. Question: Is there a need for research on improved methods for material quality control?

Comments: Material quality control (QC) tests must be standardized, rapid and inexpensive to be practical. Metal and plastic base material QC appears to be adequately covered by procedures such as the nil ductility test, the Charpy qualification tests and the Izod impact tests. Similar tests of a routine nature would be desirable for characterizing material affected by joining. Base material properties can be degraded in the heat-affected zones of metal pipe welds or polyethylene pipe fusion joints. Other plastics such as PVC have bonded joints which require testing of peel strength or lap shear strength.

3. Plastic Materials and Joining

A. Question: Is there a need for research and development to improve the safety characteristics of line pipe plastics?

Comment: There exists a wide variety of plastic materials, many of which are currently used in distribution piping, e.g., polyethylene, PVC and epoxy or polyester based FRP. Materials such as HDPE, Teflon, and reinforced polyimides have been developed for other needs but may find application to pipelines. Possible improvement goals are: (1) lower glass transition temperature to avoid embrittlement at minimum service temperature; (2) better resistance to aging crystallization; (3) improved manufacturing uniformity; and (4) use as anti-corrosion liners.

B. Question: Are the potential effects of static charge buildup in plastic pipe adequately understood?

Comment: Static charge can build up to high potentials across plastic piping having electrical resistivity sufficiently high to inhibit leakage currents. In one case, the passage of JP4 through Teflon piping in USAF

5. General

A. Question: Does the group perceive a better potential payoff in improved joining technology, as opposed to improved nondestructive evaluation (NDE)?

Comment: Current NDE techniques are sometimes unreliable in the field and depend upon operator training. In some cases, NDE may indicate a flaw which exceeds specification requiring rework of a joint which would really have been fit for its purpose, but the rework itself may result in structural damage.

B. Question: Has research on improved material properties reached the point of diminishing returns for pipelines?

Comment: It is thought that the answer may be affirmative for metal pipelines, but additional research appears to be justified for plastic materials.

R.J. Eiber, Section Manager of Battelle-Columbus Laboratories (Columbus, Ohio) took the opportunity, after the meeting, to prepare a summary of the session's comments on many of the above questions (see Appendix C).

7.3 MEETING REPORT

The group met and elected R.J. Eiber, Section Manager of Battelle-Columbus Laboratories as chairman. The secretary was O. Orringer of TSC. The meeting was initiated with a discussion of whether past and ongoing research had to be transferred to DOT/TSC or whether the research results as reported and represented by the various individuals, organizations and universities represented an adequate data base for the industry and DOT. The DOT response (and the group's assumption) was that it did not have to duplicate the capability at TSC, but only have a source of information available and to catalogue the information. The group discussion furthermore indicated that on most of the items introduced by the secretary (7.1 and 7.2) efforts had been completed or are underway at the present time. This appears to

Pipeline Research Committee (PRC)*, the Welding Research Council and the Welding Institute of Canada. The working group suggested support for the research, commenting that before additional research is initiated, a clear assessment should be made to determine if the present research is likely to define the fitness-for-service acceptance standards that are required.

(4) Techniques for underwater joining. Much research has been performed, but much of it is proprietary. Research scope should cover hyperbaric welding, laser, flash, explosive welding, etc. The research should also cover sizing or inspection techniques for defects.

(5) Characteristics of pipeline plastics. Research in this area would help the industry and government to better evaluate current and future polyethylene materials used and to be used in pipe. Much of this research has been performed by suppliers and is classified or proprietary. Again a fitness-for-service criterion and cost/benefit basis should be kept in mind.

Priority 2

(1) Fracture Control Plans for LPG, Dense Phase, and LNG pipelines. Considerable research has been done in this area. The initiation of fractures is not distinctly different from the initiation of fractures in natural gas and liquid pipelines. The aspects of fracture propagation and the crack

*Pipeline Research Committee is part of the American Gas Association. The Committee was created in 1952.

is a unique causative factor associated with a rupture which if controlled would always eliminate this potential source. The study is not aimed at identifying the accidental ignitions due to sparks, automobiles or other obvious ignition sources.

B. Areas in Which Present Research is Considered Sufficient

The following areas were discussed and the present levels of research were considered adequate by a majority of the group.

(1) Fracture arrest requirements for pipelines. These requirements are adequately defined. It is not considered economical to confine fracture lengths to be a few inches or feet on a gas pipeline. To confine the fracture length a few inches or feet it is necessary to restrict the fracture to a leak. If a defect is of a geometry that will produce a rupture, then the fracture will, under gas loading, be in the range of 5 to 10 diameters long assuming the pipe toughness is adequate to immediately arrest the crack.

(2) Mechanics of pipelines buckle formation. No additional research was considered justified. The existing research appears extensive and adequate for offshore and onshore.

(3) Response of pipeline to external forces (earthquakes, blasting, subsidence, frostheave, and thermal stress). Research in this area was considered to be adequately covered with existing tools. The level of load imposed on the pipeline was not considered to be predictable because of the multiplicity of possible conditions that might exist on pipelines.

(4) Plastic/metal joint couplings. Current research in this area appears to be adequate.

7.4 SUMMARY

The working group identified present and future problem areas whose solutions are possible with research. These areas are re-organized in this summary under heading A below and identified in the objectives of the working group meeting (see Section 7.3.A). The priorities under a given heading are indicated with top (1), intermediate (2) and low (3). The working group identified present and future problems for which present levels of research were considered adequate. These areas are listed under heading B below.

1. Fracture Mechanics

   A. (1) Ductile fracture (Priority 1),

   (2) Fracture control plans for LPG, Dense Phase and LNG pipelines (Priority 2), and

   (3) Repair procedure (Priority 2).

   B. (1) Fracture arrest requirements for pipelines, and

   (2) Safety requirements for special-purpose components on operating equipment.

2. Welding and Other Joining Technologies

   A. (1) General techniques for underwater joining including joint material properties, inspection, and defect sizing techniques including hyperbaric welding, laser welding, flash welding, etc., and

   (2) NDE methods for fusion joints in plastic pipe.

   B. (1) Plastic/metal coupling joints, and

   (2) General techniques for improved NDE not related to fitness-for-service criteria.

3. Hostile Environment, Offshore, Arctic, Etc.

   A. (1) Convene a body of experts to review a design stress basis for gas transmission pipelines (Priority 1),

4. The research needs identified during the meeting of Working Group III are related to "areas of change or extension of existing practices" and in all areas reviewed none was found in which no research was in progress.

The working group recommended that the proceedings of the meeting be distributed to others (besides the participants of the workshop) who are key individuals in the steel and pipeline industries.

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APPENDIX A

PIPELINE TRANSPORTATION SAFETY R&D WORKING GROUP MEETING

JUNE 30 - JULY 1, 1980

FINAL AGENDA

Monday, June 30, 1980

8:00 REGISTRATION
Transportation Systems Center*

9:00 WELCOME
Dr. Robert J. Ravera
Deputy Director
Transportation Systems Center*

9:15 TRANSPORTATION SYSTEMS CENTER HAZARDOUS MATERIALS AND PIPELINE TRANSPORTATION SAFETY R&D

Ronald J. Madigan, Chief
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Transportation Systems Center*

9:30 COFFEE BREAK

9:45 TRANSPORTATION PROGRAM BUREAU PIPELINE TRANSPORTATION SAFETY MISSION

Dr. Michael Lauriente
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10:00 WORKING GROUP OBJECTIVES

Gerald Schutz, Chief
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*The Transportation Systems Center and the Transportation Programs Bureau are part of the U.S.-DOT Research and Special Programs Administration.

APPENDIX B

ATTENDEE LIST

PIPELINE TRANSPORTATION SAFETY R&D WORKING GROUP MEETING*

June 30 - July 1, 1980 Transportation Systems Center

FINAL LIST OF ATTENDEES

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APPENDIX C

ANSWERS BY BATTELLE LABORATORIES TO QUESTIONS ON PIPELINE DESIGN AND CONSTRUCTION

A series of questions (see 7.2) were prepared in advance by the Working Group III Secretary and supplied to the attendees to assist in the starting of the session and to stimulate discussion. R.J. Eiber, Section Manager of Battelle-Columbus Laboratories (Columbus, Ohio) took the opportunity after the meeting, to prepare a summary of the session's comments on many of the questions. The comments were sent* to TSC and received on July 31, 1980.

1. <u>Mechanics and Mechanical Engineering</u>

   A. <u>Question</u>: Is there any benefit to be gained by arresting a pipeline fracture within inches or feet, as opposed to pipe lengths?

   <u>Comment</u>: No benefit could be cited for arresting a pipeline fracture within inches or feet, as opposed to pipe lengths. Research has indicated that if a critical flaw size occurs in a pipeline, the frature will propagate 4 to 5 diameters in each direction before it arrests, assuming the pipe has adequate toughness to arrest the fracture. To confine the fracture length to a few inches, the failure would always have to be a leak. Research has indicated that leaks versus ruptures are dependent upon the shape of the flaw that occurs, and a pipeline situation control of the flaw shape is not achievable because of the variety of uncontrolled conditions that exist. In addition, one of the worst failures which occurred on a gas transmission pipeline occurred where the fracture simply ran a few feet which concentrated the released gas and the resulting fire into a single location

*Comments under cover letter July 28, 1980 to H. Ingrao.

The research indicates that there does not appear to be a threshold in terms of puncture resistance. There is continuing research in progress in the area of mechancial damage defects in the AGA Pipeline Research Committee research being sponsored under Project NG-18.

F. Question: Are currently available plastic/metal joint couplings able to cope with extremes of service temperature?

Comment: Differential thermal expansion occurs at the plastic/metal interface. Sudden leaks or pull-aparts have resulted from temperature cycles or mechancial loads applied to the system. With the awareness of the failure probability in this type of joint, steps are being taken to improve joint couplings to resist this type of failure.

G. Question: Can benefits be gained from research on safety requirements for special purpose components?

Comment: No comment offered.

H. Question: Are there any particular types of operating equipment for which service reliability/safety might be improved by research or mechanical design?

Comment: No comment offered.

2. Metallic Materials and Welding

A. Question: What are the significant modes of failure associated with defects, in metals, and how much is known about the distribution of defect sizes and growth rate characteristics?

Comment: In agreement with the Working Group III secretary's comment. In addition there is a definite need to define allowable defect sizes in girth welds. Considerable research is in progress, both by industry and the government, and before additional research is sponsored, the current research progress should be clearly assessed.

B. Question: Are the potential effects of static charge buildup in plastic pipe adeqately understood?

Comment: In agreement with the Working Group III secretary's comment. In addition no further research is required, since adequate research has been done to allow understanding of the problem.

C. Question: Can the rate of migration of solvents through soils be predicted? Is the available "sniffer" hardware adequate to detect the presence of solvent concentrations?

Comment: In agreement with the Working Group III secretary's comment. In addition this problem has limited application and work is in progress to investigate the effects of solvents on plastic pipes. No research in this area is considered necessary.

4. "Other"

A. Question: Can basic research in combustion contribute to reduction of fires and explosions?

Comment: No comment offered.

B. Question: Is adequate information available for the reliable prediction of heat loss from insulated warm oil pipes?

Comment: In agreement with the Working Group III secretary's comment. In addition no further research is required in this area. Existing information is adequate.

5. General

A. Question: Does the group perceive a better potential payoff in improved joining technology, as opposed to improved nondestructive evaluation (NDE)?