1-1-2006

Peer Review Report 2006

Peer Review Report

Pipeline & Hazardous Materials Safety Administration

Pipeline Safety Research & Development Program

Peer Reviews Conducted
February 7-9, 2006

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EXECUTIVE SUMMARY

The Pipeline and Hazardous Materials Safety Administration's (PHMSA) Pipeline Safety Research & Development Program held its first structured peer review on February 7-9, 2006. Mandates by the Office of Management and Budget (OMB) and the Office of the Secretary of Transportation (OST) govern these reviews and are keeping PHMSA "Green" with research data quality. Conducting peer reviews via teleconference and the internet worked well with panelists and researchers and facilitated attendance from all U.S. time zones, Canada and the United Kingdom.

The peer review is building on an already strong and systematic evaluation process developed by PHMSA's Pipeline Safety R&D Program and recently certified by the Government Accountability Office. The panelists for the peer review consisted of nine government and industry experts. Four of the nine panelists are active government representatives from the National Institute of Standards and Technology and the Minerals Management Service. The remaining five panelists are retired government and industry personnel who have active roles as peers for the American Society of Mechanical Engineers and other standard developing organizations.

Thirty-one active research projects were peer reviewed by expert panelists using twenty-four evaluation criteria. These criteria were grouped within the following six evaluation categories:

1. Is the project relevant to the mission of PHMSA's Office of Pipeline Safety?
2. Is the project well designed?
3. Is the project well managed?
4. What is the approach taken to technology transfer?
5. Is the project well coordinated with other closely related programs?
6. Is the project producing high quality results?

The rating scale possibilities were "Ineffective," "Moderately Effective," "Effective," or "Very Effective." During the February review, the average research project rating was "Very Effective" for each of the above six evaluation categories. There were a wide range of scores and ratings in the sub-criteria within the evaluation categories. Even with this range, project averages kept within the "Effective" to "Very Effective" rating. Additional details are available in Section 7 of this report.

PHMSA is satisfied with the process performed for conducting these reviews as well as the findings and recommendations provided by the peer review panelists. PHMSA accepts the findings and recommendations summarized in the report. The official PHMSA response memorandum is found in Appendix A.

These reviews are planned annually with active research projects and will occur in the second quarter of each fiscal year.

1.0 Introduction

This document is reporting findings from the research peer reviews held February 7-9, 2006 for PHMSA's Pipeline Safety Research and Development Program. The findings and recommendations in this report derive from the scoring and comments collected from the peer review panelists.

Department of Transportation (DOT) Operating Agencies (OA) are required to begin a systematic process for peer review planning for all influential and highly influential information that the OA plans to disseminate in the "foreseeable" future.

Through the Information Quality Act[1], Congress directed Office of Management and Budget (OMB) to "provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information, (including statistical information) disseminated by Federal agencies." A resulting OMB Bulletin entitled, "Final Information Quality Bulletin for Peer Review" was issued prescribing required procedures for Federal programs.

The Office of the Secretary of Transportation (OST) produced procedures governing modal implementation of this OMB Bulletin. These procedures as well as the OMB Bulletin serve as the basis and justification for the PHMSA Pipeline Safety R&D Program peer reviews.

Peer reviews are intended to uncover any technical problems or unsolved issues in a scientific work product through the use of technically competent and independent (objective) experts. Peer review of a major scientific work product that will have the imprimatur of the Federal Government needs to be incorporated into the upfront planning of any action based in the work product. This includes obtaining the proper resources commitments (reviewers and funds) then establishing realistic schedules.

2.0 Research Program Background

PHMSA regulates safety in the design, construction, operation and maintenance, and spill response planning for over 2.3 million miles of natural gas and hazardous materials pipelines. It is focused on the continual reduction in the number of incidents on natural gas and hazardous liquid pipelines resulting in death, injury, or significant property damage and also aims to reduce spills that can cause environmental harm.

The vision of the PHMSA Pipeline Safety R&D Program is to support the pipeline safety mission of PHMSA which is "to ensure the safe, reliable, and environmentally sound operation of America's energy transportation pipelines." The mission of the PHMSA Pipeline Safety R&D Program is "to sponsor research and development projects focused on providing near-term solutions that will improve the safety, reduce environmental impact, and enhance the reliability of the Nation's pipeline transportation system."

[1] Pub. Law. No. 106-554-515(a)

PHMSA has regulatory responsibility for the safety of natural gas and hazardous liquid pipelines. Over the past several years, PHMSA has strengthened its role in assuring the safety of the nation's pipeline system in numerous ways, including promulgating new regulations on integrity management.[2,3,4] These new regulations, together with the new inspection processes being used by regulators to evaluate operator compliance, rely for their effectiveness on the operators' access to new technologies that support improved safety and integrity performance and on regulators' access to information on the appropriate use and limitations of these technologies. To address the need for new integrity-related technologies and information on the validity of these technologies, Congress has recently expanded the support for the PHMSA Pipeline Safety R&D Program.[5] As authorized by Congress, PHMSA is sponsoring research and development projects focused on providing near-term solutions that will increase the safe, reliable, and environmentally sound operation of America's energy transmission and distribution pipelines.

The R&D program has been designed to fully support achievement of the PHMSA mission. It manages achievement of its mission by promulgating regulations, inspecting operators for compliance with these regulations, and taking enforcement action as appropriate. The R&D Program contributes directly to achievement of the PHMSA mission by pursuing three program objectives:

1) Fostering development of new technologies that can be used by operators to improve safety performance and to more effectively address regulatory requirements;

2) Strengthening regulatory requirements and related national consensus standards; and,

3) Improving the state of knowledge of pipeline safety officials so industry and regulatory managers and PHMSA pipeline safety field inspectors can use this knowledge to better understand safety issues and to make better resource allocation decisions leading to improve safety performance.

The R&D Program is organized around eight R&D program elements. Each program element has associated safety issues, technology needs or gaps, and R&D opportunities. Ongoing and future planned projects are linked to at least one of these program elements. The program elements reflect the responsibilities of DOT in the Five Year Interagency R&D Program Plan[6] and guidance from pipeline experts and stakeholder groups.

Program goals are associated with each program element. The goals define the desired outcomes for the R&D projects. Each goal bears a direct relationship to longer-term enhancement of pipeline safety. Table 1 identifies these program elements and the improvements desired.

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[2] "Pipeline Integrity Management in High Consequence Areas for Hazardous Liquid Operators" (49 CFR Part 195); Rules effective May 29, 2001, and February 15, 2002 . <http://primis.phmsa.dot.gov/iim/ruletextamended.htm>
[3] "Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines)"; Final Rule. December 15, 2003. < http://primis.phmsa.dot.gov/gasimp/docs/GasTransmissionIMRule.pdf>
[4] "Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines)". Final Rule (as amended), May 26, 2004. <http://primis.phmsa.dot.gov/gasimp/docs/FinalRuleAmended_gas_full.pdf>
[5] Pipeline Safety Improvement Act of 2002 < http://ops.dot.gov/Pub_Law/107_cong_public_laws.pdf>
[6] Five Year Interagency R&D Program Plan < http://primis.phmsa.dot.gov/rd/psia.htm

Table 1. Program Elements of PHMSA Pipeline Safety R&D Program		
	Program Elements	**Program Element Goals**
1.	Damage Prevention	Reducing the number of incidents and accidents resulting from excavation damage and outside force
2.	Pipeline Assessment and Leak Detection	Identifying and locating critical pipeline defects using inline inspection, direct assessment and leak detection
3.	Defect Characterization and Mitigation	Improving the capability to characterize the severity of defects in pipeline systems and to mitigate them before they lead to incidents or accidents
4.	Improved Design, Construction, and Materials	Improving the integrity of pipeline facilities through enhanced materials, and techniques for design and construction
5.	Systems for Pipeline Mapping and Information Management	Enhancing the ability to prevent and respond to incidents and accidents through management of information related to pipeline location (mapping) and threats definition
6.	Enhanced Operation Controls and Human Factors Management	Improving the safety of pipeline operations through enhanced controls and human factors management
7.	Risk Management & Communications	Reducing the probability of incidents and accidents, and mitigating the consequences of hazards to pipelines
8.	Safety Issues for Emerging Technologies	Identifying and assessing emerging pipeline system technologies for opportunities to enhance their safety

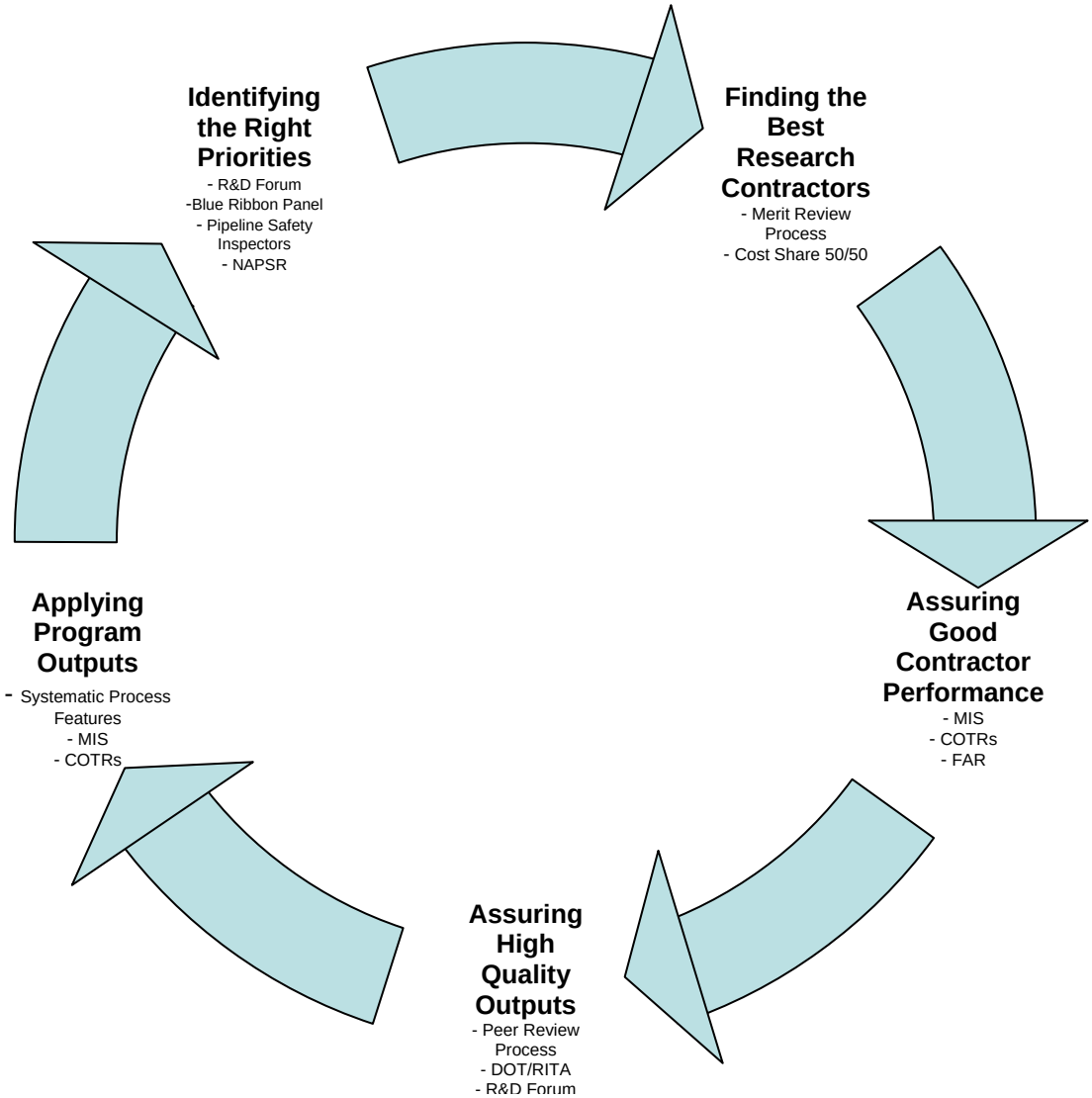
More information on the program strategy is outlined in the R&D Program Strategic Plan and found on the program website at http://primis.phmsa.dot.gov/rd/ .

Research Program Quality

While addressing program strategy, a systematic evaluation process was designed and implemented for raising and validating program quality. The process contains five steps and follows research projects from their inception to result implementation. Each step of this systematic process ensures that project outcomes will be of high quality, relevant to the mission of PHMSA and applied to the appropriate end users.

Figure 1 identifies the steps in the systematic evaluation process and how it follows the lifecycle of research projects.

Figure 1. Systematic Evaluation Process



The quality of the research projects is first established while identifying the right priorities. This pre-solicitation input at joint government and industry R&D forums and other meetings collaboratively identifies the right priority and structures projects to meet end user technical needs. This allows government and industry pipeline stakeholders to develop a consensus on the technical gaps and challenges for future R&D. It also reduces duplication of programs, factors in ongoing research efforts with other agencies and private organizations, leverages funds and broadens synergies.

These attributes of right priority and good project design are refined while finding the best research contractors. A merit review panel comprised of representatives from federal and state agencies, and industry operators and trade organizations uses strong evaluation criteria to review research white papers and proposals. In addition, a 50% cost share between the government and industry is required which forces researchers to organize with credible groups increasing the credibility and applicability of the proposed work.

A Management Information System (MIS) was developed and utilized to assure awarded projects are performing well. The MIS electronically monitors and tracks contractor performance as the project moves toward completion. This system provides the necessary oversight so specific contractual milestones and accounting are systematically followed as prescribed in the award documents. The system was designed to improve and maintain program quality, efficiency, accounting and accountability. Additional oversight is provided by Contracting Officer's Technical Representatives (COTR) who are trained, certified, and designated to each project in accordance to the Federal Acquisition Regulations.

The panel peer review is designed to further improve quality and to keep research projects on track to meet their ultimate goal(s). If the first three steps of the systematic evaluation process are applied correctly and efficiently, then PHMSA pipeline safety research projects are well on their way to be successful.

3.0 Peer Review Panelists

Peer Review Panelists are chosen on the basis of three criteria: expertise, balance, and independence. Specifics for choosing panelists are derived from the OMB Bulletin. Panelists can range from academics to active and or retired pipeline personnel from operators, regulators and industry trade organizations.

The panelists for the peer review consisted of nine government and industry experts. Four of the nine panelists are active government representatives from the National Institute of Standards and Technology and the Minerals Management Service. The remaining five panelists are comprised of retired government personnel and industry personnel having active roles with the American Society of Mechanical Engineers and other standards developing organizations. The non-government and retired panelists were contracted using honoraria to participate in the review process.

Each panelist provided a short bio describing their work history and qualifications of technical knowledge. These bios are found in Appendix B.

Table 2. Peer Review Panelists		
	Name	**Affiliation**
1	Richard E. Ricker, Ph.D.	Department of Commerce, National Institute of Standards and Technology
2	Chris N. McCowan	Department of Commerce, National Institute of Standards and Technology
3	Tom Siewert	Department of Commerce, National Institute of Standards and Technology
4	Richard Fields	Department of Commerce, National Institute of Standards and Technology (RETIRED)
5	Theresa Bell	Department of the Interior, Minerals Management Service
6	Kevin C. Bodenhamer, P.E.	Enterprise Products Operating L.P.
7	Louis Hayden, P.E.	Lafayette College
8	Thomas J. O'Grady II, P.E.	VECO ALASKA, INC.
9	Ronald W. Haupt	Pressure Piping Engineering Associates, Inc.

4.0 Panelist Charge

A "Charge" was developed and provided to each panelist prior to the review. It contains specific instructions regarding what is expected in terms of their review. This "Charge" is important for the following reasons:

1. It focuses the review by presenting specific questions and concerns that PHMSA expects the peer reviewers to address.
2. It invites general comments on the entire work product. The specific and general comments should focus mostly on the scientific and technical studies that have been applied in a sound manner.

The charge is a separate document not attached to this report. It is publicly available at http://primis.phmsa.dot.gov/rd/ and may be revised based from researcher and panelist post review feedback.

5.0 Scope of the Peer Review

During the annual peer review of projects, the members of the peer review panel witness focused, high level presentations given by researchers addressing twenty-four (24) evaluation criteria within 6 specific evaluation categories. Presentations are no more than 30 minutes with 10 minutes of panelist and 5 minutes of possible written public questioning. The aim is not to compare one project to another but to provide their best assessment of each project's performance with addressing the criteria. A scorecard for rating performance on the specific

categories was provided. Each category has equal rating from one (1) to five (5). The scorecard included the following questions in six performance categories:

1. Is the project relevant to the mission of PHMSA's Office of Pipeline Safety?
   - Does the project have the potential for enhancing pipeline safety or protecting the environment?
   - Does the project support rulemaking, statutory requirements, inspection activities, or stakeholder recommendations?
   - Does the project address a technology gap or consensus standard or general knowledge?

2. Is the project well designed?
   - How sound is the technical approach?
   - Does the project have appropriate objectives and milestones?
   - Are the deliverables well defined?
   - Is the scope of work clear, limited, and well defined?
   - Are the capabilities of the project team appropriate to the work?
   - Has the project a well designed plan for transferring results to end users?

3. Is the project well managed?
   - Does the project have an up-to-date work plan?
   - Is the project making progress toward the project and PHMSA's Office of Pipeline Safety goals?
   - Is the project being managed on budget and schedule?

4. What is the approach taken to technology transfer?
   - Is there a plan for dissemination of results, including publications, reporting, and patents?
   - Has a plan been developed for the applications of the results or technologies?
   - Have efforts been made to protect the intellectual property in a manner that allows for the greatest public impact?
   - For results that may include marketable products and technologies, have commercialization plans been established?

5. Is the project well coordinated with other closely related programs?
   - Does the project build on, or make use of, related or prior work?
   - Is the work of the project being communicated to other related research efforts?
   - Has consideration been given to possible future work?
   - Is the project coordinated with related projects or programs in PHMSA's Office of Pipeline Safety, industry, or other government agencies?

6. Is the project producing high quality results?
   - Are the intended results supported by the work performed during the project?
   - Are the intended results consistent with scientific knowledge and/or engineering principles?
   - Is the quality (and quantity) of intended results appropriate for the resources expended?

- Are the intended results presented in such a manner as to be useful for application or decision making?

These criteria will provide a numeric rating which will be converted and illustrated as "Ineffective", "Moderately Effective", "Effective", or "Very Effective." This rating conversion is illustrated in Table 3.

Table 3. Peer Review Rating Conversion	
Rating Scale	
Very Effective	3.9 - 5.0
Effective	2.6 - 3.8
Moderately Effective	1.3 - 2.5
Ineffective	0.0 - 1.2

6.0 Associated Research

Specific research project subject matter will vary from one annual peer review to another. Generally, subject matter falls within the eight program elements shown in Table 1. Technical issues usually address metallurgical, structural, technological and risk-based subjects commonly seen in the pipeline industry.

The research peered during the February 2006 review varied among metallurgical, technological and general knowledge focused projects. Specific technical subjects addressed corrosion, welding, fracture mechanics and material property issues. Projects focusing on technology included new tools for external and internal pipeline inspection, pipeline right of way monitoring and aerial leak detection systems. Research for general knowledge involved projects addressing risk assessment for liquefied natural gas and fatigue and control room design with human factors.

A complete list of the projects peered in this review including main objectives is found in Appendix C.

7.0 Peer Review Findings

On February 7-9, 2006, thirty-one (31) research projects were peer reviewed by nine (9) expert panelists using twenty-four (24) evaluation criteria. The review resulted in an average rating of “Very Effective” for each one of the six (6) evaluation categories. There was a wide range of scores and ratings in the sub-criteria within the evaluation categories. Even with this range of 3.5 to 4.8, project averages kept within the “Effective” to “Very Effective” rating. Table 3 summarizes these findings by category and sub-criteria as a numerical average based from panelist scoring. Table 4 itemizes the project ranking order where projects of the same score have an equal ranking.

At the snapshot of the February review, the PHMSA Pipeline Safety R&D Program is rated as “Very Effective” within the objectives of the evaluation criteria categories. The thirty-one (31) research projects reviewed were at an average stage of 67% complete.

Several recommendations were made by the peer review panelists in the course of the review. These recommendations were categorized into “Strong” and “Weak” points and associated for each project. Each panelist did not provide strong and or weak points for every project reviewed. None of the thirty-one (31) projects received rakings of “Ineffective” or “Moderately Effective” on any of the twenty-four (24) evaluation criteria. Having these high ratings precluded the need for itemization of recommendations on specific research projects. None of these comments identified critical actions required to salvage a project from failing but recommended actions further improve upon good performance.

Table 5 itemizes the strong and weak points collected from the nine (9) panelists. These points were consistent with several panelists and are reflected in the scoring between the fourth (4) and fifth (5) evaluation categories. Specific recommendations will be disseminated to researchers and COTRs so individual decisions on scope changes can be determined.

Table 3. Summary of Total Average Score & Rating for the Review Categories and Sub-Criteria		
Review Categories and Sub-Criteria	**Score**	**Rating**
1. Is the project relevant to the mission of the PHMSA's Office of Pipeline Safety?	**4.5**	**Very Effective**
• Does the project have the potential for enhancing pipeline safety or protecting the environment?	4.6	Very Effective
• Does the project support rulemaking, statutory requirements, inspection activities, or stakeholder recommendations?	4.4	Very Effective
• Does the project address a technology gap or consensus standard or general knowledge?	4.4	Very Effective
2. Is the project well designed?	**4.4**	**Very Effective**
• How sound is the technical approach?	4.4	Very Effective
• Does the project have appropriate objectives and milestones?	4.4	Very Effective
• Are the deliverables well defined?	4.4	Very Effective
• Is the scope of work clear, limited, and well defined?	4.3	Very Effective
• Are the capabilities of the project team appropriate to the work?	4.8	Very Effective
• Has the project a well designed plan for transferring results to end users?	4.2	Very Effective
3. Is the project well managed?	**4.2**	**Very Effective**
• Does the project have an up-to-date work plan?	4.3	Very Effective
• Is the project making progress toward the project and OPS goals?	4.2	Very Effective
• Is the project being managed on budget and schedule?	4.0	Very Effective
4. What is the approach taken to technology transfer?	**4.1**	**Very Effective**
• Is there a plan for dissemination of results, including publications, reporting, and patents?	4.0	Very Effective
• Has a plan been developed for the applications of the results or technologies?	4.1	Very Effective
• Have efforts been made to protect the intellectual property in a manner that allows for the greatest public impact?	4.2	Very Effective
• For results that may include marketable products and technologies, have commercialization plans been established?	4.2	Very Effective
5. Is the project well coordinated with other closely related programs?	**3.9**	**Very Effective**
• Does the project build on, or make use of, related or prior work?	4.4	Very Effective
• Is the work of the project being communicated to other related research efforts?	3.6	Effective
• Has consideration been given to possible future work?	4.0	Very Effective
• Is the project coordinated with related projects or programs in OPS, industry, or other government agencies?	3.5	Effective
6. Is the project producing high quality results?	**4.4**	**Very Effective**
• Are the intended results supported by the work performed during the project?	4.3	Very Effective
• Are the intended results consistent with scientific knowledge and/or engineering principles?	4.6	Very Effective
• Is the quality (and quantity) of intended results appropriate for the resources expended?	4.4	Very Effective
• Are the intended results presented in such a manner as to be useful for application or decision making?	4.3	Very Effective
Total Average Scoring and Rating:	**4.3**	**Very Effective**

Table 4. Summary Ranking & Rating of Individually Reviewed Research Projects					
Rank	**Project ID**	**Project Title**	**Contractor**	**Rating**	**Score**
1	DTRS56-03-T-0008	A Comprehensive Update in the Evaluation of Pipelines Weld Defects	Engineering Mechanics Corporation of Columbus	Very Effective	4.7
2	DTPH56-05-T-0001	Understanding Magnetic Flux Leakage (MFL) Signals from Mechanical Damage in Pipelines	Electricore, Inc.	Very Effective	4.6
3	DTRS56-04-T-0001	Nonlinear Harmonic-based Mechanical Damage Severity Criteria for Delayed Failures in Pipelines	Southwest Research Institute	Very Effective	4.5
3	DTRS56-05-T-0003	Model Modules to Assist Assessing and Controlling Stress Corrosion Cracking (SCC)	Battelle Memorial Institute	Very Effective	4.5
3	DTRS56-05-T-0001	Innovative Welding Processes for Small to Medium Diameter Gas Transmission Pipelines	Edison Welding Institute, Inc.	Very Effective	4.5
4	DTRS56-02-T-0001	Application of Remote-Field Eddy Current Testing to Inspection of Unpiggable Pipelines	Southwest Research Institute	Very Effective	4.4
4	DTRS56-04-T-0011	Optimizing Weld Integrity for X80 and X100 Linepipe	Edison Welding Institute, Inc.	Very Effective	4.4
4	DTRS56-05-T-0003	Integrity Management for Wrinklebends and Buckles	Battelle Memorial Institute	Very Effective	4.4
4	DTRS56-05-T-0003	A New Approach to Control Running Fracture in Pipelines	Battelle Memorial Institute	Very Effective	4.4
4	DTRS56-05-T-0005	Development of ICDA for Liquid Petroleum Pipelines	CC Technologies Laboratories, Inc.	Very Effective	4.4
5	DTRS56-03-T-0007	First Major Improvements to the Two-curve Fracture Arrest Model	Engineering Mechanics Corporation of Columbus	Very Effective	4.3
5	DTRS56-05-T-0004	Evaluation and Validation of Aboveground Techniques for Coating Condition Assessment	CC Technologies Laboratories, Inc.	Very Effective	4.3
5	DTPH56-05-T-0006	Pipeline Assessment and Repair Manual	CC Technologies Laboratories, Inc.	Very Effective	4.3
5	DTRS56-04-T-0012	Hazardous Liquids Airborne Lidar Observation Study (HALOS)	ITT Industries Space Systems, LLC	Very Effective	4.3
5	DTRS56-04-T-0010	Evaluation of Hydrogen Cracking in Weld Metal Deposited using Cellulosic Electrodes	Edison Welding Institute, Inc.	Very Effective	4.3
6	DTPH56-05-T-0003	Behavior of Corroded Pipelines Under Cyclic Pressure	Electricore, Inc.	Very Effective	4.2

6	DTPH56-05-T-0003	Remaining Strength of Corroded Pipe Under Secondary (Biaxial) Loading	Electricore, Inc.	Very Effective	4.2
6	DTPH56-05-T-0004	Use of Unmanned Air Vehicle (UAV) for Pipeline Surveillance to Improve Safety and Lower Cost	Electricore, Inc.	Very Effective	4.2
6	DTRS56-04-T-0005	Modeling and Assessing a Spectrum of Accidental Fires and Risks in a LNG Facility	Technology & Management Systems, Inc.	Very Effective	4.2
6	DTRS56-04-T-0009	Mechanical Damage at Welds	BMT Fleet Technology Limited	Very Effective	4.2
6	DTRS56-0-T-0002	Design, construction and demonstration of a robotic platform for the inspection of unpiggable pipelines under live conditions	Northeast Gas Association	Very Effective	4.2
7	DTRS56-0-T-0002	Validation and enhancement of long range guided wave ultrasonic testing: A key technology for DA of buried pipelines	Northeast Gas Association	Very Effective	4.1
7	DTPH56-05-T-0004	Use of Unmanned Underwater Vehicle (UUAV) for Pipeline Surveillance to Improve Safety and Lower Cost	Electricore, Inc.	Very Effective	4.1
7	DTRS56-03-T-0010	Alternate Welding Processes for In-service Welding	BMT Fleet Technology Limited	Very Effective	4.1
7	DTPH56-05-T-0003	Assessment of Older Corroded Pipelines with Reduced Toughness and Ductility	Electricore, Inc.	Very Effective	4.1
8	DTPH56-05-T-0003	Corrosion Assessment Guidance for Higher Strength Pipelines	Electricore, Inc.	Very Effective	4
8	DTPH56-05-T-0005	Cathodic Protection Current Mapping In-Line Inspection Technology	Shell Global Solutions (US) Inc.	Very Effective	4
8	DTRS56-0-T-0002	Design, Construction and testing of a segmented MFL sensor for use in the inspection of unpiggable pipelines	Northeast Gas Association	Very Effective	4
8	DTRS56-05-T-0003	Applying External Corrosion Direct Assessment (ECDA) to Difficult to Inspect Areas	Battelle Memorial Institute	Very Effective	4
9	DTRS56-04-T-0003	Human Factors Analysis of Pipeline Monitoring and Control Operations	Battelle Memorial Institute	Very Effective	3.9
10	DTRS56-04-T-0008	Stage 2 Phased Array Wheel Probe for In-Line Inspection	R/D Tech	Effective	3.6

Table 5. Summary of Strong and Weak Point Recommendations	
Strong Points	**Weak Points**
• Close technical support and coordination with industry end users	• Technology demonstrations need to be part of all projects developing technology
• Technology demonstrations are applied with most project scopes	• Improve researcher documentation of coordination with standard developing organizations
• High relevance to the mission of the PHMSA's Office of Pipeline Safety	• Improve coordination with other related projects within PHMSA and other related programs
• Project are mostly well designed	• Expand technology developments to all pipeline types and sizes
• Projects are mostly well managed	• Improve validation of models through field trials
• Technology transfer is working well	• Improve the clarity of researcher intellectual property plans for technology development projects
• Projects are producing high quality results	

8.0 PHMSA Response to Panelists Findings and Recommendations

Being the first structured peer review of its pipeline safety R&D program, PHMSA is satisfied with the process for conducting these reviews as well as the findings and recommendations provided by the peer review panelists. PHMSA accepts these findings and recommendations summarized in the report. No immediate actions are required for protecting peered research projects from not achieving contractual milestones. The official PHMSA response memorandum can be found in Appendix A.

PHMSA will refine the process for holding annual peer reviews from feedback submitted by the researchers and peer review panelists. Since none of the reviewed projects were rated "Ineffective" or "Moderately Effective", no immediate project modifications are warranted. Specific recommendations from panelists will be disseminated to researchers and Contracting Officer's Technical Representatives (COTR). The researchers and COTRs will decide if any scope changes are warranted.

A number of initiatives were recently implemented to ensure projects are well coordinated with other related programs and with end users. These initiatives address many of the weak points provided by the panelists. In addition, the guidance and presentation template provided to the researchers will be revised. This will improve the manner in which questions are answered, support effective reviews by the panelists and raise project and program quality.

APPENDIX A

PHMSA Official Response Memo

U.S. Department
of Transportation

**Pipeline and
Hazardous Materials Safety
Administration**

400 Seventh Street, S.W.
Washington, D.C. 20590

MEMORANDUM FOR THE RECORD

From: Stacey L. Gerard, Acting Assistant Administrator/Chief Safety Officer

Subject: Pipeline Safety Research Program Peer Reviews – February 7-9, 2006

SUMMARY

The Pipeline and Hazardous Materials Safety Administration (PHMSA) is pleased with the process for conducting these reviews as well as the findings and recommendations provided by the peer review panelists. No immediate actions were recommended for protecting peered research projects from not achieving contractual milestones. In addition, the average quality rating of the projects was "Very Effective."

PHMSA will refine the process for holding annual peer reviews from feedback submitted by the researchers and peer review panelists. Since none of the reviewed projects were rated "Ineffective" or "Moderately Effective," no immediate project modifications are warranted. Specific recommendations from panelists will be disseminated to researchers and Contracting Officer's Technical Representatives (COTR). The researchers and COTRs will decide if any scope changes are warranted.

RECOMMENDATION

PHMSA accepts the findings and recommendations summarized in the Peer Review Report.

The Acting Assistant Administrator/Chief Safety Officer

APPROVED: Stacey Gerard

DISAPPROVED: _____

COMMENTS: _____

DATE: JUL 21 2006

APPENDIX B

Peer Review Panelist Bios

Richard E. Ricker

BIOGRAPHICAL SKETCH
Dr. Ricker earned his B.S. and M.S. in Materials Engineering from N.C. State University and his Ph.D. from Rensselaer Polytechnic Institute. He has worked for NASA, The Babcock & Wilcox Co., and The University of Notre Dame. Currently, he is with the Metallurgy Division of the National Institute of Standards and Technology (NIST) where he conducts research into corrosion and deformation of materials. He has organized over 30 scientific meetings, edited two books, and published over 50 scientific papers and 40 technical reports. In addition, he has made over 40 invited presentations at technical meetings, sat on 18 special committees or review panels, and co-authored the chapter on stress corrosion crack (SCC) mechanisms in the "ASM Metals Handbook Volume 13 Corrosion" with R. H. Jones. At NIST he has handled numerous special assignments including directing the NACE-NIST Corrosion Data Program, Program Analyst in the NIST Director's Office, NIST Representative to the Technical Advisory Group of the PNGV program, Representative to the Committee on Civilian Industrial Technology of the National Science and Technology Council (NSTC), Manager of the National Rockwell Hardness Standards Program, Senior Scientific Advisor to the Director of the Materials Science and Engineering Laboratory, and Source Evaluation Board of the Advanced Technology Program (ATP).

PROFESSIONAL SOCIETIES
American Association for the Advancement of Science (AAAS)
American Physical Society (APS)
ASM International
ASTM International
Materials Research Society (MRS)
NACE International
Sigma Xi, The Scientific Research Society
The Electrochemical Society
The Minerals, Metals & Materials Society (TMS)
Washington Academy of Sciences (WAS)

AWARDS
T. W. Curry Memorial Award of the Foundry Education Foundation - 1975
Bronze Medal, United States Department of Commerce - 1991
Burgess Award for Research, ASM Intl., Washington DC Chapter - 1999

Chris N. McCowan

EMPLOYMENT Materials Research Engineer (1984 – Present): National Institute of Standards and Technology, Materials Reliability Division

EDUCATION B.S. Metallurgical Engineering, New Mexico Institute of Mining, 1984
M.S. Degree in Metallurgical Engineering, Colorado School of Mines, 1987

WORK EXPERIENCE Approximately 18 years of experience in evaluating the microstructure and fractures surfaces of base metals and welds, and relating these features to mechanical properties and failure criteria. My experience is based both on evaluating failed specimens from mechanical tests (fracture toughness, tensile, impact, fatigue, etc) and components that failed in service. My research has included work on high strength steel, stainless steel, micro alloy steel, aluminum, indium, and copper.

Tom Siewert

Education:

B.S.	Applied Math and Phys.	Univ. of Wis.- Milw.	1969
M.S.	Materials Science	Univ. of Wis.- Madison	1973
Ph.D.	Metallurgy	Univ. of Wis. - Madison	1976

Experience:
Government: Leader of structural materials, welding, then process sensing and modeling groups at NIST since 1984.
Publications in the areas of joining, cryogenic properties, nondestructive evaluation, and mechanical properties
Leadership in conference and workshop organization committees, Active in various societies.

Industry: Supervisory Research Engineer, then Manager of Research and Development, Alloy Rods (welding filler metal developer) 1976 to 1984.

Academic: Active with a number of Universities
Teaching short courses in Materials, Welding, and NDE for OSHA inspectors (OSHA Training Institute), about 20 one-day courses since 1989.
Adjunct Professor and Research Scientist in the Metallurgical and Materials Engineering Department, CSM

Professional Society Memberships
American Society for Metals
American Society for Testing and Materials
American Welding Society

International Institute of Welding
Welding Journal Reviewer

Active Committee Work
American Society for Testing and Materials
A01 Steel
E28 Mechanical Testing
E07 Nondestructive Evaluation
American Welding Society
American Council of the IIW
International Standards Activities Committee
Government Affairs Activity Committee

Theresa P. Bell

Theresa P. Bell started working as a Petroleum Engineer at U.S. Department of the Interior, Minerals Management Service (MMS) in 1991. Ms. Bell currently works in the MMS Pacific Outer Continental Shelf (OCS) Region's Office of Facilities, Safety and Enforcement and has worked on a variety of issues related to pipelines since 1994. She is the MMS Pacific OCS Region's representative on the pipeline research team. She also works on a variety of pipeline projects including repairs, inspections, leak detection systems, new pipeline permitting and installation, and regulations. Ms. Bell has extensive experience with pipeline inspections and integrity issues. She is also involved with the re-write of the MMS pipeline regulations. Ms. Bell has an Associates of Science degree in Laser/Electro-Optics and received her Bachelor of Science degree in Engineering with an emphasis on electrical control systems at California State University, Northridge (CSUN) in 1991. Her prior work experience included aerospace working on the International Space Station and military lasers.

Richard Fields

Education:
Undergraduate degrees in Chemistry and Metallurgical Engineering were awarded to R. J. Fields in 1971 by the University of Pennsylvania in Philadelphia. He received a Masters in Engineering and Applied Physics from Harvard University in 1973 and a PhD in Engineering Materials from Cambridge University in 1978 in England.

Work History:
From 1977 until 2004, R. J. Fields worked at the National Bureau of Standards/ National Institute of Standards and Technology (NIST). He retired in May of 2004, and now works for KT Consulting on a contract with NIST. Highlights of his career include 6 years as a Supervisory Metallurgist managing the Time Dependent Failure Group in NBS's Fracture and Deformation Division. This group ran the metallographic facilities as well as carrying out mechanical testing research for the US Navy, the Federal Railroad Administration, the National Transportation Safety Board, and the Nuclear Regulatory Commission. He was appointed twice (total of 6

years) to the Office of Pipeline Safety's Hazardous Liquid Pipeline Safety Committee and served as secretary for three years.

More recently, R. J. Fields also supervised the Materials Performance Group in NIST's Metallurgy Division for three years. Part of this group of 11 professionals runs the US national hardness standardization facility, certifying primary hardness standards. As the supervisor of the Materials Performance Group, he started a program on sheet metal forming with the auto industry. This is now the largest program in the Division.

From 2002 until 2004, he was the technical lead on metallurgical aspects of the congressionally mandated investigation of the collapse of the World Trade Center Towers. He also started a program on modeling bullets and armor for the National Institute of Justice and a program on fire resistant structural steels. He has an extensive list of publications, patents, and awards.

Professional Society Membership:
R. J. Fields is a member of the Metallurgical Society of AIME, ASTM International, and the American Academy of Mechanics.

Kevin C. Bodenhamer, P.E.

Kevin Bodenhamer is currently Director of Operations for Enterprise Products Operating L.P. and has responsibility for the operations and maintenance of over 10,000 miles of 49CFR195 jurisdictional HVL pipelines. He is a 1978 Civil Engineering Magna Cum Laude graduate of the University of Missouri – Rolla and has over 27 years of engineering and operational experience with gas and liquid pipelines. He serves as Chairman of the ASME B31.4 Code Section Committee, Vice Chairman of ASME B31 Standard Committee, and a member of the API Pipeline Operations Technical Committee. He is a Registered Professional Engineer in Alaska, Kansas, Oklahoma and Texas.

Louis E. Hayden Jr, PE

Louis Hayden has over 35 years of experience as a mechanical engineer, project manager and vice president of engineering. This experience has been in the design, analysis, fabrication, installation, start-up and maintenance of industrial piping and equipment Systems have included above and below ground piping and pipelines in process plants, fossil and nuclear power plants, transmission pipelines and industrial manufacturing facilities. He has managed and directed the manufacturer of high yield pipeline pipe fittings and developed new pipeline closure and flange products as well as managed the efforts of new product development and research groups.

Currently a consulting mechanical engineer and adjunct professor of mechanical engineering at Lafayette College, Easton, PA. Previous employers have been Fluor Corp., Houston; Brown&Root Inc., Houston; Tube Turns, Inc., Louisville; Victaulic Corp., Easton, PA.

Member of ASME B31 Piping Standards Committee since 1985

Vice Chair ASME B31 Piping Standards Committee 1990-1993 and 2001-2004
Chairman ASME B31 Piping Standards Committee 1993-2001
Member ASME Board on Pressure Technology Codes and Standards 1993-2005
Vice Chair ASME Board on Pressure Technology Codes and Standards 2005-present
Chairman ASME Task Group for development of B31.12 Hydrogen Piping and Pipeline Code.
Member Board on Pressure Technology Codes and Standards Materials for Hydrogen Service Task Group

Thomas J. O'Grady II, P.E.

Over 30 years experience in all phases of mechanical design and project engineering of pipelines, drill sites and oil and gas processing facilities in the Arctic. Providing engineering direction for a full range of technical services, with particular emphasis in the areas of pressure piping and pipelines, valves, pressure vessels and heat exchangers, stress analysis, material selection, coatings and insulation, and fabrication methods.
Education
Bachelor of Science - Mechanical Engineering, University of Alaska Fairbanks
Master of Science - Engineering Management, University of Alaska Fairbanks
WORK HISTORY

1999-Present VECO ALASKA, INC., Provided design and construction support for pipelines throughout Alaska, from the oil and gas wells on the North Slope to the Alyeska Pipeline Terminal in Valdez. Performed plant and facility piping design and analysis for pump stations, compressor stations, separation and injection facilities, and offshore platforms. Conducted failure investigation and analysis for facilities from Alaska to Greenland. Prepared client specifications for piping, pipelines, tanks, vessels, heaters and heat exchangers for BP Exploration (Alaska) and ConocoPhillips Alaska.

1976 – 1999 ARCO ALASKA, INC. (Atlantic Richfield Company), Progressed from Construction Engineer at Prudhoe Bay, to Resident Engineer in contractors' offices in Pasadena and Tulsa, to company Subject Matter Expert for piping and pipelines, located in Anchorage, Alaska. Wrote company specifications for design, materials, fabrication, installation, and inspection of piping and pipelines. Worked with manufacturers throughout the world to develop and qualify materials and equipment for use in the arctic. Supervised an ARCO engineering group working directly on projects from $1 million to $10 million and through engineering contractors for projects from $10 million to $500 million.
1975 – 1976 UNIVERSITY OF ALASKA FAIRBANKS Geophysical Institute, Field Assistant. Performed field studies along the Alaskan Arctic Coast, from Barrow to the Canadian border, to establish a winter construction baseline for Arctic Gas Pipeline Company.
1973 – 1975 MARTIN SWEETS COMPANY, Louisville, Kentucky, Engineer. Designed production line equipment to be used in the manufacture and handling of urethane foam
Professional
ASME B31 Pressure Piping Standards Committee - Member
ASME B31.4 Liquids Pipelines Subcommittee – Vice-Chair
ASME B31 Mechanical Design Technical Committee - Member

ASME B31.12 Hydrogen Piping and Pipelines Committee - Member
ASME A13 Scheme for Identification of Piping Systems Committee - Member
ISO TC67-SC02 Working Group 13 for ISO 13623 Pipeline Transportation Systems - Convener.

Ronald W. Haupt

Ronald W. Haupt has over forty-five years of professional experience in civil/structural and mechanical engineering, principally in the design, analysis, and maintenance of industrial process and energy-related structures, equipment, piping, pipelines, and supports. In his last twenty years as a consultant, he has performed piping and pipeline failure analyses, reviewed cold spring and critical systems erection procedures, been involved in the development of ASME code vessel and piping design and construction rules, and evaluated pipeline fitness for service criteria and pipeline repairs. Further, he has developed guidelines for seismic design of mechanical and electrical equipment, provided creep and high pressure (in excess of 5,000 psi) piping design services, developed layouts, designed, and repaired high pressure/high temperature power and process piping systems and cross-country gas and liquid pipelines, and developed and given power and process piping and pipeline design and analysis seminars for the ASME and private companies. Mr. Haupt holds Bachelor and Master of Science degrees from Stanford University and Massachusetts Institute of Technology, respectively, is a registered professional engineer in California and South Carolina, and is an active member in numerous national codes and standards writing committees (both ASME and ASCE), including the ASME B31 Code for Pressure Piping.

APPENDIX C

Peer Review Project Summaries

Additional summaries and publicly available reports are found at
http://primis.phmsa.dot.gov/matrix/

First Major Improvements to the Two-curve Fracture Arrest Model

Engineering Mechanicals Corporation of Columbus

Objectives are to make the first major improvements to the most common analysis for ductile fracture arrest toughness requirements for gas pipeline applications, as well as to develop experimental data that could be used for validation of more fundamental analyses in the future.

A Comprehensive Update in the Evaluation of Pipelines Weld Defects

Engineering Mechanicals Corporation of Columbus

This project will provide a major update to the alternative girth weld defect acceptance criteria. The focus of the project will be in two primary areas: 1) To update the alternative defect acceptance criteria to address the immediate need of pipeline construction in the USA, typically with pipeline longitudinal strains less than 0.5%; and 2) To develop alternative defect acceptance criteria for ultrahigh strength pipelines (e.g., X100) in geotechnically challenging environments, such as arctic areas and deep water offshore. Update Appendix A of API Standard 1104 for girth weld defect acceptance criteria as specified in Federal regulations (49 CFR, Parts 192 and 195), to reflect the increased use of mechanized welding and automated ultrasonic testing in new pipeline construction.

Evaluation of Hydrogen Cracking in Weld Metal Deposited using Cellulosic Electrodes

Edison Welding Institute, Inc

The objectives of the proposed project can be summarized as follows: 1) To determine the effect of electrode drying and arc length on weld metal chemistry, mechanical properties and hydrogen cracking susceptibility; 2) To determine the effect of electrode re-hydration on weld metal chemistry, mechanical properties and hydrogen cracking susceptibility; and 3) To develop practical guidelines on how to prevent hydrogen cracking in welds deposited using cellulosic covered electrodes.

Optimizing Weld Integrity for X80 and X100 Linepipe

Edison Welding Institute, Inc

The major objectives of this program are as follows: 1) To provide a better understanding of the factors that control strength and toughness in high strength girth welds; 2) To develop optimized welding consumables and welding procedures for high strength pipelines; 3) To develop best practice guidelines for the welding of high strength pipelines; 4)To disseminate best practice

information to the pipeline industry; and 5)To enable high integrity girth welds to be more reliably and economically achieved in high strength pipelines.

Innovative Welding Processes for Small to Medium Diameter Gas Transmission Pipelines
Edison Welding Institute, Inc

The project aims to develop innovative welding processes and technologies for single-sided pipeline girth welding. Root pass welding techniques will be emphasized since they have the greatest potential to improve pipeline integrity and facilitate the use of new and existing Gas Mechanized Arc Welding fill pass techniques. Advanced automation techniques will be used to improve weld quality, process control, seam tracking, and robustness.

Corrosion Assessment Guidance for Higher Strength Pipelines
Electricore, Inc.

This project will extend present guidance for assessing corrosion metal loss defects to material grades from X70 to X100.

Behavior of Corroded Pipelines Under Cyclic Pressure
Electricore, Inc.

This project will establish the potential for fatigue failure from corrosion, particularly under the loading conditions experienced by oil pipelines and the implications for corrosion assessments.

Assessment of Older Corroded Pipelines with Reduced Toughness and Ductility
Electricore, Inc

This project will develop proper guidance on the use of existing failure criteria for corroded linepipe operating in the ductile/brittle transition regime.

Remaining Strength of Corroded Pipe Under Secondary (Biaxial) Loading
Electricore, Inc.

This project will develop simplified guidance to assess corrosion metal loss defects in pipelines that are subjected to external loadings in service. Ongoing analytical work is developing simplified rules and methods to account for the effects of secondary loads on the behavior of corroded pipelines, avoiding the need to resort to complex numerical analysis using non-linear finite element analysis (FEA). Extension of this analytical work to address the full range of combined pressure/secondary loading and pipe/defect geometries, and validation of the simplified rules by conducting selected full-scale tests will provide the necessary information on which to base modifications to extend the current guidance beyond pressure-only loading. This work will also address buckling.

Applying External Corrosion Direct Assessment (ECDA) to Difficult to Inspect Areas
Battelle Memorial Institute

This project will validate the newly available direct assessment methodologies for both external corrosion and stress-corrosion cracking; development of improved modules for assisting operators with controlling the parameters that cause stress-corrosion cracking; approaches for improving the integrity of systems with wrinklebends and buckles; and a viable approach to running fracture that should help operators minimize its consequences when ruptures occur. Goals: 1) Select specific areas of concern to pipeline operators and identify candidate procedures for implementation of ECDA or confirmatory direct assessment in those areas; 2) Collect indirect inspection data for each site that will be excavated for subsequent direct examination; 3)Correlate excavation observations with aboveground measurement data; and 4)Validate, or describe any shortcomings of, the ECDA process for difficult to inspect areas.

Model Modules to Assist Assessing and Controlling Stress Corrosion Cracking (SCC)
Battelle Memorial Institute

This project will validate the newly available direct assessment methodologies for both external corrosion and stress-corrosion cracking; development of improved modules for assisting operators with controlling the parameters that cause stress-corrosion cracking; approaches for improving the integrity of systems with wrinklebends and buckles; and a viable approach to running fracture that should help operators minimize its consequences when ruptures occur. Goals: 1) Develop and validate a mechanism for near neutral stress corrosion cracking (NNSCC) that reflects operational and right-of-way scenarios typical of US pipelines; 2) Quantify field characteristics in terms of cracking colonies and pipeline operation for line pipe from X52 thru X65; 3) Establish hydrostatic retest protocols to assist in controlling high pH SCC in terms of pipeline operation represented by compressor discharge pressure and temperature for line pipe from X52 thru X65; 4) Package the high pH SCC model in user-friendly format, including graphical-user interface to provide output indicative of integrity implications related to hydrostatic retesting; and 5) Quantify hydrogen evolution and establish relationships between hydrogen and evolution of microplastic strain, as basis to establish related kinetics for NNpHHSCC.

Integrity Management for Wrinklebends and Buckles
Battelle Memorial Institute

This project will validate the newly available direct assessment methodologies for both external corrosion and stress-corrosion cracking; development of improved modules for assisting operators with controlling the parameters that cause stress-corrosion cracking; approaches for improving the integrity of systems with wrinklebends and buckles; and a viable approach to running fracture that should help operators minimize its consequences when ruptures occur. Goals: 1) Broaden the utility of severity assessment criteria to cover pipelines with diameters from 12" to 36" in Grades from B thru X60, for wall thickness typical of products and natural gas transport, and operational histories for such service, and validate by full-scale test; 2) Quantify effects of corrosion pitting on the corrosion-fatigue resistance of line pipe steels, and combine with analysis of the effects of ID and OD corrosion on wrinklebends, and modify

assessment criteria. 3) Quantify effects of pipe restraint applied local to the wrinkle or globally near the wrinkle, and assess implications for fieldwork on or nearby wrinklebends; 4) Quantify differences in hot-formed vs. cold-formed wrinkles in regard to fatigue resistance of line pipe and shape of the wrinkle; 5) Update severity assessment criteria to embed effects of corrosion, constraint, and forming temperature; and 6) Evaluate differences between wrinkles and large-scale buckles.

A New Approach to Control Running Fracture in Pipelines
Battelle Memorial Institute

This project will validate the newly available direct assessment methodologies for both external corrosion and stress-corrosion cracking; development of improved modules for assisting operators with controlling the parameters that cause stress-corrosion cracking; approaches for improving the integrity of systems with wrinklebends and buckles; and a viable approach to running fracture that should help operators minimize its consequences when ruptures occur. Goals: 1) Develop and validate fracture arrestor design basis in reference to fracture speed, wall hoop stress and toughness, and gas properties; 2) Quantify differences in flow properties, fracture initiation formulation, and backfill coefficient today vs initial empirical calibration, reformulate arrest model accordingly, and validate in reference to trends evident in full-scale test database; 3) Characterize essential differences for modern high strength grades vs historic steels, such as elastic strain energy and dissipation near the fracture; 4) Formulate a first-principles model reflecting active sources of dissipation; 5) Establish the implications for a shift from fracture-controlled to flow-controlled running fracture as processes other than fracture become significant as toughness increases; and 6) Quantify role of grade, yield to tensile ratio, toughness, and parameters that characterize line pipe properties and those of the transported product in reference to the fifth goal, and formulate a model for fracture arrest as the deliverable.

Alternate Welding Processes for In-service Welding
BMT Fleet

This project will support efforts towards the development and application of procedures for welding on in-service pipelines using alternate welding processes.

Mechanical Damage at Welds
BMT Fleet

In general, pipeline design standards require the repair of dents with depths exceeding 6% of the pipeline's outside diameter and the repair of all dents or signs of mechanical damage that interact with weld seams. This cautious damage disposition approach is based upon numerical and full-scale trials demonstrating the significant impact that weld seams have on the life of the mechanically damaged pipe segments. Weld seams are considered less damage tolerant than the line pipe base material for a number of mechanical property, weld geometry and residual stress related reasons. Recent advances in the understanding of mechanical damage failure suggest that the regulatory requirements could be made less restrictive for gas pipelines by considering the relatively smooth pressure history (low fluctuation) of gas transmission lines, type and extent of the mechanical damage, and position of the weld with respect to the mechanical damage. A

reduction in the conservatism associated with the existing repair criteria would eliminate costs to pipeline operators associated with unnecessary repairs, and these funds could then be better channelled into more significant pipeline integrity issues.

Nonlinear Harmonic-based Mechanical Damage Severity Criteria for Delayed Failures in Pipelines

Southwest Research Institute

Delayed failures of mechanically damaged pipelines can occur unexpectedly and with serious consequences due to time-dependent fracture mechanisms, such as fatigue, as illustrated by the catastrophic failure in Bellingham, WA. The objective of this proposed research is to derive fatigue life related defect severity criteria for pressurized pipelines containing gouged dents using the nonlinear harmonic (NLH) method for detecting surface strain anomalies left in the pipe after gouging. The work will involve gouging pressurized pipes and performing full-scale cyclic pressure tests to failure while periodically inspecting the pipes using NLH sensors. The proposed work will be co-funded by the Pipeline Research Council International (PRCI), with in-kind funding being provided by Tuboscope Pipeline Services who will develop software for implementing the derived NLH-based defect severity criteria in in-line inspection (ILI) equipment.

Evaluation and Validation of Aboveground Techniques for Coating Condition Assessment

CC Technologies

The overall objective is to determine the limitations/resolution of typically used modern aboveground ECDA techniques with respect to locating holidays and disbondments in the common coatings with varying spatial relationships and geometrical configuration, and to create an extensive test site which enables a wider array of variables to be investigated.

Development of Internal Corrosion Direct Assessment (ICDA) for Liquid Petroleum Pipelines

CC Technologies

This project will develop an ICDA method applicable to pipelines transporting liquid petroleum products (e.g., crude oil, fuels) so that liquid pipeline operators can utilize DA for integrity verification.

Pipeline Assessment and Repair Manual

CC Technologies

The objective of the project is to expand the electronic version of the PRCI Pipeline Repair Manual by adding guidelines for assessing the need for repair and incorporating guidance developed for the European repair manual. The results of this work will be produced as an expert software system for pipeline defect assessment and repair.

Modeling and Assessing a Spectrum of Accidental Fires and Risks in a Liquefied Natural Gas (LNG) Facility

Technology & Management Systems, Inc.

The objective of the research is to review potential LNG release scenarios in storage terminals and from LNG ships, and augment exiting analytical/computer models or develop new ones for different types and sizes (a spectrum) of LNG fires by properly considering important phenomena that have effects on the fire characteristics and the hazards they pose. A second objective is to develop protocols for using these models in performing a risk assessment of LNG transport in ships or storage in terminals. Additional objective is to provide mathematical tools with which to make regulatory assessments or LNG terminal siting decisions.

Design, construction and demonstration of a robotic platform for the inspection of unpiggable pipelines under live conditions

Northeast Gas Association/NYSEARCH

The objective of the project (part of a three project Consolidated R&D Program) is to develop a robotic platform (TIGRE) that will allow the inspection of presently unpiggable transmission pipelines. The platform, which is based on a locomotor developed for another robotic application in gas pipelines (Explorer; developed for visual inspection of distribution mains), will be able to propel itself independently of flow conditions, and will be able to negotiate all obstacles encountered in a pipeline, such as mitered bends and plug valves. The robot will be powered by batteries, which will have the capability of being recharged during operation by extracting energy from the gas flow. The operator will have live control of the robot using two-way through-the-pipe wireless communication, thus eliminating the need for any tether. The platform will be equipped with a segmented Magnetic Flux Leakage (MFL) sensor, also able to negotiate all pipeline obstacles, for NDE of the pipeline. The sensor will be developed through a parallel project, which is part of this Consolidated Program.

Design, Construction and testing of a segmented MFL sensor for use in the inspection of unpiggable pipelines

Northeast Gas Association/NYSEARCH

The objective of the project (part of a three project Consolidated Program) is to develop a segmented MFL sensor and respective module for integration in a robotic platform (TIGRE; being developed through a parallel project, which is part of this Consolidated Program) that will allow the inspection of presently unpiggable transmission pipelines. The sensor will cover only a portion of the pipe's internal surface but should be able to provide the same level of sensitivity and accuracy as a state of the art MFL sensor used in smart pigs. Through multiple passes of the pipe, or through rotation and translation of the sensor down the pipe, the entire surface of the pipe will be inspected.

Validation and enhancement of long range guided wave ultrasonic testing: A key technology for DA of buried pipelines
Northeast Gas Association/NYSEARCH

The objective of the (individual) project is to further validate and develop a product that can be used as a screening tool to detect external and internal corrosion and coating defects in gas pipes (with diameters from 2" to 60"). It is particularly useful where traditional DA or inspection technologies cannot be used. Propagation distances are claimed to be on the order of 50 – 100' in each direction from the transducer ring but distances vary based on pipe geometry, coating, content and presence of pipe appurtenances such as valves, tees, etc.

Application of Remote-Field Eddy Current (RFEC) Testing to Inspection of Unpiggable Pipelines
Southwest Research Institute

The project will conduct a technology assessment to determine the requirements for a new RFEC testing system.

Use of Unmanned Air Vehicle (UAV) for Pipeline Surveillance to Improve Safety and Lower Cost
Electricore, Inc.

The program will be comprised of four phases: Feasibility, Application Development, Testing, and Commercialization to be completed over a period of three years. The use of available UAVs and Unmanned Underwater Vehicles (UUVs) and automotive sensor technologies will allow the team to rapidly converge on a cost effective system solution to conduct aerial surveillance for right of way monitoring and leak detection. Electricore is confident that a Consolidated Program will maximize the results received through the investment by government and industry.

Use of Unmanned Underwater Vehicle (UUV) for Pipeline Surveillance to Improve Safety and Lower Cost
Electricore, Inc.

The program will be comprised of four phases: Feasibility, Application Development, Testing, and Commercialization to be completed over a period of three years. The use of available Unmanned Aerial Vehicles and UUVs and automotive sensor technologies will allow the team to rapidly converge on a cost effective system solution to conduct aerial surveillance for right of way monitoring and leak detection. Electricore is confident that a Consolidated Program will maximize the results received through the investment by government and industry.

Understanding Magnetic Flux Leakage (MFL) Signals from Mechanical Damage in Pipelines
Electricore, Inc.

The Pipeline Safety Research and Development project will provide for understanding, identification, and characterization of the MFL signals arising from the geometric and residual

stress components to enhance the reliability of employing MFL tools for mechanical damage detection.

Stage 2 Phased Array Wheel Probe for In-Line Inspection (ILI)
R/D Tech

This project will manufacture a Stage 2 phased array wheel probe for ILI detection of stress corrosion cracking (SCC). Specifically, to build a smaller wheel probe that can be utilized as-built for ILI.

Hazardous Liquids Airborne Lidar Observation Study (HALOS)
ITT Industries Space Systems, LLC.

ITT is proposing to extend its ANGEL (Airborne Natural Gas Emission Lidar) technology to the detection of small hazardous liquid and refined product leaks. The ANGEL system is designed to remotely detect, quantify, and map small plumes of methane and ethane, the principle constituents of natural gas. In addition to the hardware and software systems, Kodak has developed expertise in the spectroscopy, modeling, and empirical/physical testing and validation of airborne dispersed hazardous vapors. These tests have yielded preliminary results that indicate the detection of vapors from hazardous liquids is possible with minimal changes to the existing ANGEL system.

Cathodic Protection Current Mapping In-Line Inspection Technology
Shell Global Solutions, Inc.

The objective of this project is to develop a commercially viable in-line inspection tool that measures current traveling in the pipe due to cathodic protection or stray current from sources other than the pipeline system's cathodic protection system. The data will provide information used to diagnose problems with the cathodic protection system, coatings and others. The tool should provide data in an easily understood format.

Human Factors Analysis of Pipeline Monitoring and Control Operations
Battelle Memorial Institute

This project will systematically apply human factors research and development techniques in meeting two objectives. First, the study will establish an understanding of those human factors that adversely affect the safety, reliability, and efficiency of pipeline monitoring and control operations. Second, guidelines will be developed that can be used by industry to identify human factors problem areas in their operations and develop continuous improvement strategies to improve the effectiveness of pipeline monitoring and control operations.

APPENDIX D

The Peer Review Coordinator (PRC) organizes, coordinates, monitors, and facilitates the annual panel peer review. The PRC is the main contact for panelists and the researchers involved with a peer review and for public inquiries. The PRC for the February 7-9, 2006 peer reviews was Mr. Robert Smith of PHMSA.

Robert Smith

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