BANFF/99 PIPELINE WORKSHOP

Managing Pipeline Integrity - Technologies for the New Millennium

Tutorials: April 12, 1999
Workshop: April 13-15, 1999

Banff Centre for Conferences
Banff, Alberta, Canada

Proceedings

CAPP

CEPA

National Energy Board
CANADA

OMAE
Calgary Chapter

Corrpro Canada, Inc.
"A Commitment to Excellence"

GREENPIPE INDUSTRIES LTD

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NORWEST LABS

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Alberta Energy and Utilities Board

CAMPIPE

TransCanada

PRUDENTIAL STEEL LTD.

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Pipeline Integrity
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Welland Pipe

INDUSTRIES INC.

Pipetronix

ENBRIDGE

ROSEN

BG Technology

CANMET

BANFF/99 PIPELINE WORKSHOP
Managing Pipeline Integrity -- Technologies for the New Millennium
Tutorials: Monday, April 12, 1999
Max Bell Building

9:00 - 4:30 Max Bell Auditorium

In-Line Inspection

Part 1 - 9:00 - 12:00

ILI tool selection, defect assessment and interaction criteria, coordination of ILI programs, and the use of low-resolution vs. high-resolution ILI technology from the operator's perspective.

Introduction of Case Histories	Arti Bhatia
Trans Mountain Pipe Line Inc.	Greg Toth
Enbridge Pipelines Inc.	Arti Bhatia
TransCanada PipeLines	Blaine Ashworth/Reena Sahney
Pipeline Integrity International Inc.	Patrick Vieth

Part 2 - 1:30 - 4:30

ILI vendors will present the current technologies available and the rationale for use of specific tools for various pipeline inspection applications.

BJ Pipeline Inspection Services	David Hektner
Pipeline Integrity International Inc.	Keith Grimes
Pipetronix Limited	Neb Uzelac
Tuboscope Vetco Pipeline Services	Patrick Porter

9:00 - 4:30 Room 253

Risk Assessment/Risk Management

Ian Dowsett, Conor Pacific, and Mark Stephens, C-FER Technologies Inc.

This tutorial will outline how quantitative risk analysis (QRA) can assist decision-makers with decisions about pipeline risks. The principal areas addressed include:

- The risk management process,
- Examples of risk analysis and risk assessment of pipeline systems, and
- Discussion of risk analysis and risk assessment within an overall risk management context.

Individual topics covered include: Definitions and terminology, the goals and objectives of risk management, hazard identification, consequence analysis, frequency analysis, risk estimation (with implications for linear systems) and risk acceptability.

9:00 - 12:00 Room 252

Application of GIS Technologies to Integrity Management

Overview of Technology	Bruce Dupuis, Integrated Integrity Inc.	
Case studies by operating companies	Amoco Canada	Donald Powell
	Foothills Pipe Lines Ltd.	Kyle Keith
	TCPL	Martin Cairns

1:30 - 4:30 Room 251

Database Development, Maintenance and Use

Introduction	Keith Leewis, GRI, and Bruce Dupuis, Integrated Integrity Inc.
What You Should Know about Databases	John Wester, Net Shepherd
CEPA Database	Bruce Dupuis, Integrated Integrity Inc.
PRASC Database	Wayne Feil, Imperial Oil
Data Models, ISAT and POD	Keith Leewis, GRI

Tuesday, April 13, 1999

Max Bell Building

Plenary Session - Max Bell Auditorium

9:30 **Workshop Opening**, Larry Drader, AEC Pipelines
9:45 **Technologies for the New Millennium**
Scott Rowland, IBM Canada Ltd.
10:20 **CEPA Integrity Management Plan**
Richmond Graham, TransGas Limited

10:40 Break/Individual Contact Meetings

10:55 **Pipeline Risk Assessment Steering Committee (PRASC) Database**
Ian Fraser, Imperial Oil Resources Limited
11:10 **A New MFL In-Line Tool to Detect Longitudinal Cracks**
François Jacquiot and Patrick Viltart, TRAPIL, Paris, France
11:35 **Land Use Planning/Encroachment and Abandonment**
Ian Scott, CAPP
11:50 **International Pipeline Conference 2000 (IPC 2000)**
Robert Hill, Canadian Energy Pipeline Association
11:55 **Presentation of Plaques**
12:00 **Introduction of Facilitators**
Doug Macdonald, SNC Lavalin Engineers & Constructors

12:05 **Lunch**

1:15 **Working Groups:** **Session A**
Working Group 1: **Construction, Repair, Maintenance, and Geotechnical**
Working Group 2: **Stress-Corrosion Cracking**
Working Group 4A: **Risk Assessment/Risk Management -- General**

2:45 Break/Individual Contact Meetings

3:30 **Working Groups:** **Session B**
Working Group 1: **Construction, Repair, Maintenance, and Geotechnical**
Working Group 2: **Stress-Corrosion Cracking**
Working Group 4A: **Risk Assessment/Risk Management -- General**

5:00 Adjournment for the Day

Wednesday, April 14, 1999

8:15	**Working Groups:**	**Session C**
	Working Group 1:	**Construction, Repair, Maintenance, and Geotechnical**
	Working Group 4D:	**Risk Assessment/Risk Management -- Communications, Public Consultation, and Planning**
	Working Group 5:	**Information Management: Database Development, Maintenance, and Use**
	Working Group 7:	**External Corrosion**
9:45	Break/Individual Contact Meetings	
10:30	**Working Groups:**	**Session D**
	Working Group 4D:	**Risk Assessment/Risk Management -- Communications, Public Consultation, and Planning**
	Working Group 5:	**Information Management: Database Development, Maintenance, and Use**
	Working Group 7:	**External Corrosion**
12:00	Lunch	
1:15	**Working Groups:**	**Session E**
	Working Group 3:	**Coatings**
	Working Group 4B:	**Risk Management/Internal Corrosion -- Producers**
	Working Group 4C:	**Risk Assessment/Risk Management -- Transmission**
	Working Group 6:	**In-Line Inspection**
2:45	Break/Individual Contact Meetings	
3:30	**Working Groups:**	**Session F**
	Working Group 3:	**Coatings**
	Working Group 4C:	**Risk Assessment/Risk Management -- Transmission**
	Working Group 6:	**In-Line Inspection**
5:00	Adjournment for the Day	
6:30	**Reception**	

Thursday, April 15, 1999

8:15	**Working Groups:**	**Session G**
	Working Group 1:	**Construction, Repair, Maintenance, and Geotechnical**
	Working Group 2:	**Stress-Corrosion Cracking**
	Working Group 3:	**Coatings**
	Working Group 4A:	**Risk Assessment/Risk Management -- General**
	Working Group 4B:	**Risk Management/Internal Corrosion -- Producers**
	Working Group 4C:	**Risk Assessment/Risk Management -- Transmission**
	Working Group 4D:	**Risk Assessment/Risk Management -- Communications, Public Consultation, and Planning**
	Working Group 5:	**Information Management: Database Development, Maintenance, and Use**
	Working Group 6:	**In-Line Inspection**
	Working Group 7:	**External Corrosion**
	Plenary Session	**Max Bell Auditorium**
9:30	Working Group 1:	Co-Chairs' Report and Discussion
9:45	Working Group 2:	Co-Chairs' Report and Discussion
10:00	Working Group 3:	Co-Chairs' Report and Discussion
10:15	Break/Individual Contact Meetings	
10:30	Working Group 4A:	Co-Chairs' Report and Discussion
10:45	Working Group 4B:	Co-Chairs' Report and Discussion
11:00	Working Group 4C:	Co-Chairs' Report and Discussion
11:15	Working Group 4D:	Co-Chairs' Report and Discussion
11:30	Working Group 5:	Co-Chairs' Report and Discussion
11:45	Working Group 6:	Co-Chairs' Report and Discussion
12:00	Working Group 7:	Co-Chairs' Report and Discussion
12:15	Workshop Wrap-Up, Distribution of Proceedings	
12:25	Workshop Adjournment	
12:30	Lunch	

Working Groups and Co-Chairs:

Working Group 1: **Construction, Repair, Maintenance and Geotechnical**
Co-Chairs: Reynold Hinger (TMPL), Paul Wong (Skystone Engineering)

Working Group 2: **Stress-Corrosion Cracking**
Co-Chairs: Martyn Wilmott (Bredero Price), Blair Carroll (Enbridge)

Working Group 3: **Coatings**
Co-Chairs: John Baron (Shell), Matt Cetiner (Anteris Corrosion)

Working Group 4A: **Risk Assessment/Risk Management -- General**
Co-Chairs: Ian Dowsett (Conor Pacific), Mark Stephens (C-FER)

Working Group 4B: **Risk Management/Internal Corrosion -- Producers**
Co-Chairs: Dave Kopperson (PanCanadian), Karol Szklarz (Shell)

Working Group 4C: **Risk Assessment/Risk Management -- Transmission**
Co-Chairs: Kevin Cicansky (TCPL), Glenn Yuen (Dynamic Risk Assessment)

Working Group 4D: **Risk Assessment/Risk Management -- Communications, Public Consultation, and Planning**
Co-Chairs: Dave DeGagné (AEUB), Terry Gibson (Gecko)

Working Group 5: **Information Management: Database Development, Maintenance and Use**
Co-Chairs: Keith Leewis (GRI), Bruce Dupuis (Integrated Integrity)

Working Group 6: **In-Line Inspection**
Co-Chairs: Arti Bhatia (Enbridge), Bruce Lawson (Westcoast)

Working Group 7: **External Corrosion**
Co-Chairs: Susan Miller (Enbridge), Bob Worthingham (TCPL)

In-Line Inspection Tutorial

Bryan Scott and Arti Bhatia, Enbridge Pipelines Inc.

The tutorial was divided into two segments. The first segment dealt with In-Line Inspection (ILI) tool selection, defect assessment and interaction criteria, coordination of ILI programs, and the use of low-resolution vs. high-resolution ILI technology from an operator's perspective. The presentation summaries are as follows:

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Trans Mountain Pipe Line Inc.

Title: **Standard Resolution to High Resolution ILI Transition - An Operator's Perspective**
Presenter: Greg Toth

The presentation dealt with the difficulties of an operator moving from the use of low resolution ILI technology to high resolution inspection technology. The presentation identified the difficulties with physically launching and receiving the longer inspection tools; however the main focus appeared to be the volume of data received, the analysis and prioritization of the information.

Enbridge Pipelines Inc.

Title: **The Use of In-Line Inspection Technology as an Integral Part of Integrity Management at Enbridge Pipelines Inc.**
Presenter: Arti Bhatia

The focus of this presentation was the use of in-line inspection data as a method for performing dynamic analysis of repeat sections with high resolution data. The presentation also emphasized the need for proper communication with ILI vendors in order to obtain the information most useful to the operator for long term strategic integrity management.

TransCanada Pipelines (TCPL)

Title: TransCanada Pipelines MFL In-Line Inspection Program
Presenter: Reena Sahney – TCPL
Blaine Ashworth – TCPL
Patrick Vieth – Pipeline Integrity International

The presentation provided a company overview identifying the acceleration of the original 10-year program to a three-year program. The main focus of the presentation was how to deal with data analysis and prioritization.

Vendor Presentations
ILI vendors presented the current technologies available and the rationale for use of specific tools for various pipeline inspection applications. The presentation summaries are as follows:

BJ Pipeline Inspection Services

Topic: **Geopig - Caliper tool and Vectra - MFL tool**
Presenter: David Hektner

The presentation provided an understanding of the Geopig's capabilities and its move from sonar to mechanical finger caliper assessment. The tool's capabilities include:

- high speed and high resolution pipeline caliper information,
- GPS location of features,
- pipeline mapping and GIS integration,
- bending strain (structural analysis)

The second part of the presentation focussed on the technology associated with the Vectra MFL tool.

- speed control
- GPS feature for pipeline mapping
- triaxial sensor usage for defect sizing
- VectraView Software

Pipeline Integrity International (PII)

Topic: **Current Available Technolgies**
Presenter: Keith Grimes

This presentation provided an outline of ILI tool and software technologies available in the industry today. An update was also provided on PII inspection tools and advancements in software. The discussion of PII equipment included the following:

MFL – Metal Loss Technology
TFI – Transverse Field Inspection
UT – Ultra Sonic Shear Wave Technology
Velocity Control
Software Improvements
GIS Platforms
Tool Development - Dual Diameter

Pipetronix Limited

Topic: **In-line Inspection of Pipelines – Available Technologies and Tools**
Presenter: Neb Uzelac

This presentation outlined the various technologies available through Pipetronix Limited.

- CalScan - caliper
- ScoutScan – inertial
- Leak Detection
- MagneScan SR – Standard Resolution MFL
- MagneScan HR – High Resolution MFL
- MagneScan XHR – Extra High Resolution MFL
- UltraScan WM - Ultrasonic Wall Measurement
- UltraScan CD – Ultrasonic Crack Detection

Pipetronix is also involved in the integration of their data into a GIS platform as well as providing turnkey inspection, data analysis, and investigative and dig program execution.

Tuboscope Vetco Pipeline Service

Topic: **State of In-Line Inspection**
Presentor: Patrick Porter

This presentation summarized the preceding presentations and provide information on equipment and software advancements within Tuboscope Vetco. Topics discussed included:

MFL Technology in general
Data Analysis Advancement within Tuboscope Vetco and the industry
Strain Analysis Tools and Software
EMAT Technology
Velocity Control
Mechanical Damage the leading cause of pipeline failure

ILI Tutorial - Attendance

Name	Affiliation
Winston Revie	CANMET
Bob VILYCLS	Pipeline Integrity International, Inc
MO MOHITPOUR	TRANSCANADA INTERNATIONAL
KEITH GRIMES	PIPELINE INTEGRITY INTERNATIONAL INC.
Reena Sahney	TRANSCANADA PIPELINES.
PATRICK VIETH	PIPELINE INTEGRITY INTERNATIONAL
Blaine Ashworth	TRANS Canada PipeLines.
Mimoun ELBOUJDAÏNI	CANMET/OTTAWA
CRISTINA CASTRO	ENBRIDGE
ARTI BHATIA	Enbridge Pipelines Inc.
BRYAN SCOTT	ENBRIDGE PIPELINES INC.
Bruce Lawson	WEI
Martin Phillips	PIPELINE INTEGRITY INTERNATIONAL
DARYL ROWSKY	"
Guy Desjardins	Morrison Scientific Inc.
Guy Hervieux	Atco Pipelines
Bruce Nestleroth	BATTELLE
DOUG HILL	PETRO-CANADA OIL + GAS
Bruce Moore	Petro-Canada Oil and Gas
BRIAN NESBITT	NATIONAL ENERGY BOARD.
BERRIN WANG	TRANS-NORTHERN PIPELINES
H. PAREKH	INDIAN OIL CORPORATION LTD. (PIPELINES DIVISION) NEW DELHI, INDIA
A. Demoz	CANMET/WRC
S. PAPAVINASAM	CANMET/Materials Technology Laboratory
Robert Wade	Nova Chemicals
ROD TREFANENKO	GULF MIDSTREAM SERVICES
BILL TYSON	MTL/CANMET
Bob Lessard	Welland Pipe Ltd.

NAME	
RAY GOODFELLOW	CHEVRON CANADA RESOURCES.
BOB KLICIAK	HUSKY OIL OPERATIONS LIMITED
Jeremy Nielsen	Husky Oil Operations Ltd
Tom Morrison	Morrison Scientific Inc.
Say Shapro	MSI
GRANT FIRTH	Corrpro Canada, Inc.
GEORGE CHERRINGTON	PEMBINA PIPELINE
David W. Murray	Univ. of Alberta
MARTY WELDAN	KOCH PIPELINES CANADA.
MICHELLE SORENSEN	AEC PIPELINES
FERENC PATAKI	BC GAS UTILITY
RON COOPER	WESTERN FACILITIES
LAWRENCE GALES	TRANSPORTATION SAFETY BOARD
NEB UZELAC	PIPETRONIX
Detlef Dirksen	Pipetronix
Herbert Willems	Pipetronix
Jim Zakowski	Greenpipe
DARRYL SHYIAN	IMPERIAL OIL RESOURCES
Mike Webb	Hunter McDonnell
GARRY SOMMER	CORRPRO CANADA, INC.
Stefan Papenfuss	Tuboscope Vetco P/L Serv.
RICK STELMACHUK	ROSEN PIPELINE INSPECTION
BRYCE BROWN	" " "
Richard Kruger	IPSCO Inc.
Dave Grzyb	AEUB
Bin Fu	BG Technology
Audrey Van Aelst	Cimarron Integrity Ltd
Jules Choquey	TransGas Ltd.
Fraser King	NOVA Research
LEN DANYLUK	PENGROWTH CORPORATION
Paul Trudel	NEB

ILI Tutorial - Attendance

Name	Affiliation
ED BOGG	WESTCOAST ENERGY
Meredyth Gretzinger	Westcoast Energy
WALTER SODERQUIST	WESTCOAST ENERGY INC.
DARREN WAIT	WESTCOAST ENERGY.
ED McCLARTY	WESTCOAST ENERGY INC.
DON SINCLAIR	WESTCOAST ENERGY INC.
Brian Majewski	Westcoast Energy Inc.
Jim Cone	Tuboscope Vetco Pipeline
DON PERSAUD	Natural Resources & Energy, NB.
KEVIN THIESSEN	P.R. Inc.
DON Mc NABB	APACHE PIPELINE PRODUCTS.
RICK STELMACHUK	ROSEN PIPELINE INSPECTION
BRYCE BROWN	ROSEN PIPELINE INSPECTION
Richard Kruger	IPSCO Inc.
Dave Grzyb	AEUB
Bin Fu	BG Technology.
Audrey Van Aelst	Cimarron Integrity Ltd.
Jules Chorney	TRANSGAS Ltd.
Fraser King	NOVA Research
LEN DANYLUK	PENGROWTH CORPORATION
Paul Trudel	National Energy Board.
Dave Hektner	BJ Pipeline Inspection Service
Steve Cooper	CANSPEC Group Inc.
Siu TSAI	TRANSCanada Pipe Lines
François Jacquinet	TRAPIL
CYRIL KARVONEN	TRANSCANADA MIDSTREAM
Matt Cetiner	Anteris Corrosion Inc.
Jane Dawson	Pipeline Integrity International.
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Overview of Risk Management, Risk Assessment and Risk Analysis

Ian Dowsett, Conor Pacific Environmental Technologies Inc.

Development, aging, and encroachment onto pipeline systems impose change. Change introduces risk and the perception of risk. There is a need to manage change and ensure that the risk and the perception of risk are acceptable (to industry, government and to the public). This session advances examples of the use of risk management, risk assessment and risk analysis as a means of managing change. The goals and objectives of the tutorial are to:

- demonstrate how risk management, risk assessment and risk analysis can benefit the pipeline industry in dealing with these issues;
- understand the concepts of risk management, risk assessment and risk analysis;
- apply risk management, risk assessment and risk analysis techniques to pipeline systems, and;
- apply this information to identify solutions to issues facing the pipeline industry.

The roles and responsibilities of industry, the public and government were advanced:

- industry is responsible for managing the risks through individual company activities (due diligence) and through industry organizations and associations: e.g., CAPP, CEPA

  These responsibilities include:
  - identifying and understanding the consequences and risks associated with a proposed development;
  - demonstrating an industry based and a corporate commitment to address and minimize outcomes and risks;
  - demonstrate sufficient resources and an ability to implement the proposed activities and actions;
  - inform interested and affected parties of the proposed development and its potential effects and of the actions and activities planned to address them, and
  - provide a meaningful opportunity for input into the project planning process, including the development of risk management strategies, and;
  - earn the public's trust and confidence in all of these activities.
- The public has a role in understanding the issues and becoming involved in the process.
- The regulator holds the responsibility for facilitating decision-making, the decision itself, and for ensuring that agreed-upon provisions (designed to address the risks) are met (NEB, AEUB, US-EPA) through: Acts and Regulations and Standards & Guidelines.

Definitions and examples of risk management, risk assessment and risk analysis are provided and applied to pipeline systems and the role of industry. Copies of the presentation overheads can be obtained from the presenter by email at ian.dowsett@conorpac.com.

Risk-based Decision Making
Based on Quantitative Risk Analysis

- **The process of risk control**
  - To select and implement measures to ensure an acceptable level of operating risk
- **Questions answered**
  - How much should the risk be reduced?
  - At what cost?

Note: The preferred risk control strategy achieves an acceptable level of risk at the minimum cost

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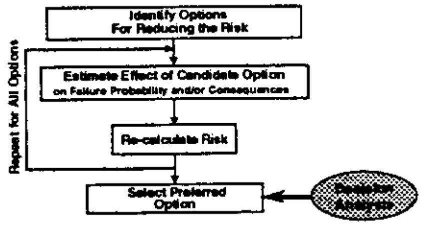
Risk Control Process



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Decision Analysis

- **Decision analysis** - an approach that utilizes risk analysis results in the decision making process
- **Comments on the use of decision analysis**
  - a formal process for choosing the best course of action in the presence of uncertainty
  - acknowledges that uncertainty and adverse consequences are influencing factors in any decision

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Comments on Formal Decision Analysis Methods

- Can provide a rational answer to "How safe is safe enough?"
- Can achieve a balance between costs and risks
- Can reflects decision makers preferences
- Requires
  - Detailed analysis
  - Explicit answers to difficult questions required
- Are there Alternatives?

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Simplified Approaches to Risk-based Decision Making

- **Available approaches**
  - Fixed incremental cost of risk reduction
  - Predefined maximum risk level
  - Predefined maximum probability level
- **When to use**
  - Routine decisions
  - Application of regulations
  - To avoid explicit quantification of consequences

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Summary

- **Decision Analysis based on QRA***
  - a basis for objective risk management
  - ensure acceptable operating risk at minimum cost
- **Requirements of QRA***
  - relevant historical incident date, or
  - analytical models and line condition data
- **Benefits of QRA***
  - Gives pipeline-specific solutions
  - Quantifies the impact of proposed actions

***quantitative risk analysis**

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a.m. session

Risk Assessment / Risk Management Tutorial - Attendance

Name	Affiliation
Guown Shen	CANMET
WARREN WALDEGGER	ENBRIDGE (SASK)
Terris Choney	Enbridge Pipelines
~~Su Xu~~	CANMET
Keith Carr	Western Facilities
FRED BAINES	BC GAS
Stephen Gosse	West Coast Energy.
PHIL MICHAILIDES	AEC PIPELINES
MIKE GORDON	BASS-TRIGON SOFTWARE
CARLO SPINELLI	SNAM ITALY
GORDON DAW	N.E.B.
TED HAMRE	CANSPEC
Frank Christensen	FMCMCI
Jayma Makomaski	Enbridge Consumers Gas
Greg Van Boven	Nova Research & Tech
Bob Shapka	Talisman Energy.
NOEL BILLETTE	Natural Resources Canada
Miles Haukeness	Centra Gas Manitoba
Mike Cameron	TransGas Ltd.
DARREN HILL	HILLTECH CONSULTING LTD.

Risk Assessment/Risk Management Tutorial - Attendance

Name	Affiliation
TIM BALDWIN	BG TECHNOLOGY
TIM ELDWALD	BASELINE TECHNOLOGIES INC
Bruce Fowlie	Nutrac. M'mant Consulting LTD
Patrick Viltart	TRAPIL
CORAL LUKANIUK	TCPL
DAVID KUKCSAR	GIBSON PETROLEUM
PAUL MEANWELL	UNION GAS LIMITED

C-FER Technologies Inc.

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Date 12 APR

Project

ATTENDANCE _

RISK - PM

Mike Cameron	TransGas Ltd.
Terry Churney	Enbridge Pipelines
WARREN WALDEGGER	ENBRIDGE (SASK)
Keith Carr	WESTERN FACILITIES
Stephen Gosse	WestCoast Energy.
WALTER SODERQUIST	WEST COAST ENERGY INC.
MIKE GUVON	BTS - ALBERTA. CO.
DAVID KUKCSAR	GIBSON PETROLEUM
CORAL LUKANIUK	TCPL
SHU C. LEE	EUB
Bruce Fowlie	Nu-Trac Management Consulting
TIM BALDWIN	BG TECHNOLOGY
LYLE GERLITZ	JLG ENGINEERING LTD
CARLO SPINELLI	SNAM S.p.A
GORDON DOW	N.E.B.
TED HAMRE	CANSPEC
FRANK CHRISTENSEN	FMCMCI
NOEL BILLETTE	Natural Resources Canada

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			Project

Miles Haukeness - Centra Gas Manitoba

Max Buck - CONOCO PL CO.

Joanna Makomaski - Enbridge Consumers Gas.

LAWRENCE GALES - TRANSPORTATION SAFETY BOARD

SCOTT OLIPHANT - CHEVRON CANADA RESOURCES

Andrew Francis - BG Technology

Leo Hansen. - National Energy Board.

GREG VAN BOVEN NOVA R&D.

D W Murray - Univ of Alberta

Application of GIS Technologies to Integrity Management
Chair: Bruce Dupuis, Integrated Integrity Inc.

Overview of GIS — Bruce Dupuis
Integrated Integrity Inc.

Introduced the structure and functionality of GIS and covered issues to consider in implementing a GIS

Utilizing GIS for an Integrity Management Project — Don Powell
Amoco Canada Petroleum Company

Presented an example of the application of a GIS to manage data from multiple ILI inspections (different vendors and opposite directions). Additionally, the value of a GIS to manage class location assessment was highlighted.

Using GIS to Choose Excavation/Investigation Sites — Kyle Keith/Erwin Kautz
Foothills Pipe Lines Ltd.

Presented an example of an application of GIS to correlate multiple parameters for the purpose of selecting and prioritizing investigative excavation locations. The queries and correlations were built in a real time demonstration of the Foothills Pipe Lines GIS.

Application of GIS Technologies to Integrity Management Tutorial

Attendance — a.m. SESSION

Name	Affiliation
Tom Cook	The Cook Group
Wayne Feil	Imperial Oil
Bob Hill	CEPA
DELTON GRAY	ATCO PIPELINES.
Minh Ho	NEB
PISTONE VALENTINO	SNAM
LARRY HUNT	WESTCOAST ENERGY
GASTON LECLERC	TQM Pipeline
LYLE GERLITZ	JLG ENGINEERING LTD
PATRICK PORTER.	TUBOSCOPE
BRAD WATSON	TRANSCANADA P/L
Mark Yeomans	TransCanada P/L
ARNOLD BELL	FEDERATED PIPE LINES LTD.
KATHLEEN GRIFFIN	ENBRIDGE
TIM EDWARD	BASELINE TECHNOLOGIES INC
Wes MacLeod	KOMEX INTERNATIONAL LTD.
Katherine Ikeda-Cameron	Nova Research & Technology
RON MAURIER	CORRPRO CANADA, INC.
Mark Ottem.	Trans Mountain Pipe Line
NORM TRUSLER	BC GAS UTILITY.
MIKE REED	TRANS MOUNTAIN PIPE LINE
Rob Pryor	Ellipse Spatial Services Ltd.
MIKE GLOVER	BTS
STEPHEN JACOBSON	FOOTHILLS PIPE LINES LTD.
KYLE KEITH	FOOTHILLS PIPE LINES LTD.
ERWIN KAUTZ	FOOTHILLS PIPE LINES LTD.

Name	Affiliation
Jim MARSTON	PIPETRONIX
Don Powell	Amoco Canada Petroleum.
PAUL GRECO	UNION GAS
Hanno Figon	GIS Consultant

Database Development, Maintenance and Use
Chair: Bruce Dupuis, Integrated Integrity Inc.

Databases and Things That Go Bump
The Rough Guide to Data Collection — John Wester, Net Shepherd

Overview of the different aspects of database development, more specifically:

- Data model and problem identification
- Data collection issues
- Single user, multi user and replication
- ODBC and what it means
- Back Ends: file based vs. server based
- Front Ends: integrated vs. separate

CEPA Data Capture Application: SCCdb32 — Bruce Dupuis, Integrated Integrity Inc.

Overview of the history and scope of the application as well as the structure and data fields utilized. A real time demonstration of the application was given. A demo version of the application can be downloaded from the CEPA web site at cepa.com

PRASC Incident Database — Wayne Feil, Imperial Oil Resources; Don Kosolofski, CGI Information Systems

An overview of the PRASC mandate and their vision towards database development. The existing version of the Internet based incident database is to be revised. PRASC is currently determining what direction to go with their next version.

PODS (Pipeline Open Database Structure) — Keith Leewis, GRI

Overview of the initiative of GRI to develop an industry standard data structure to facilitate data sharing and reduce costs associated with application development and customization. GRI, in association with a number of application providers, is putting forward a process to create an independent organization to manage the continued development and maintenance of this standard.

Database Development, Maintenance and Use - Tutorial

Attendance List

P.M. session

Name	Affiliation
KEITH LEEWIS.	GAS RESEARCH.
Wayne Feil	Imperial Oil
Daniel Kosolofski	C&I Group Inc.
KRIS MAJURY	ENSIGHT INFO.
SANKARA PAPAVINASAM	CANMET
BILL TYSON	MTL/CANMET
NEAL THOMASSEN	THOMASSEN ENERGY CONSULTANTS
Mark Ottem.	Trans Mountain Pipe Line.
Don Powell	Amoco Canada Petroleum
Bill Ho	Greenpipe Industries Ltd.
STEPHEN JACOBSON	FOOTHILLS PIPE LINES LTD
Rob Pryor	Ellipse Spatial
Erwin Kautz	Foothills Pipe Lines Ltd.
Audrey Van Aelst	Cimarron Integrity Ltd.
Joshua Johnson	CC Technologies
Tom Cook.	The Cook Group
Bob Eiber	Robert Eiber, Consultant
RAY FESSLER	BIZTEK CONSULTING, INC.
Minh Ho	NEB
PISTONE VALENTINO	SNAM
GARRY SOMMER	CORRPRO CANADA, INC.
Bob Hill	CEPA
BRUCE DUPUIS	INTEGRATED INTEGRATES INC
GASTON LECLERC	TQM Pipeline
TOM DRIEDGER	PYXIS GEOMATICS
ANDREW WOZNIEWSKI	IMPERIAL OIL RESOURCES
[illegible]	[illegible]

BANFF99 PIPELINE WORKSHOPOPENING ADDRESS

By Larry Drader
Vice-President, Operations & Engineering
AEC Pipelines Ltd.

Introduction

Thank you Doug for the kind introduction. Ladies and gentlemen, I would like to take this opportunity to welcome all of you to the Banff/99 Pipeline Workshop. Not only can I guarantee you an enjoyable stay here in Banff and the majestic Rocky Mountains over the next few days, I can also assure you the experience of a world-class interactive forum dedicated to the prevalent issues and technologies associated with pipeline integrity. We must commend the work and effort put forth by this years' Workshop Co-Chairs in planning such an exciting four-day program. I would like to take this opportunity to thank the entire organizing committee on behalf of all the workshop delegates.

The theme of this year's workshop is **"Managing Pipeline Integrity – Technologies for the New Millennium"**. It is a two-part title focussing on technology, and the management of this technology. Ultimately, the effective integration of these two components should assist us in maintaining pipeline integrity. I'd like to briefly discuss both components of the theme and their importance in the overall direction pipeline companies will be taking in the new millennium.

Technology

Like so many other industries, the pipeline industry is about to embark on an era where technology will be heavily called upon to assess, remedy, and monitor several important issues. Pipeline integrity is no different. But why should we even embark on such a journey based on our industry track record? As we are all aware, pipeline infrastructures have been providing an efficient, economically viable and safe means of transport of petroleum-based products for several years. Statistics readily associate pipeline transport with safety records orders of magnitude better than other modes of transport. So why fix or change the way we do things if they seem to providing favorable results (i.e. safety wise, efficiency wise and financially)?

Certainly many pipeline companies have profited from these systems over the years, and if the efficiencies of these systems can be maintained at or near initial operating levels, without radically changing operating philosophies, why embark on potentially disruptive and costly changes? These mindsets are obviously affected by external forces (e.g. political issues, regulatory requirements, commodity prices, etc.) which directly affect the dynamics of the operation. A very competitive and global marketplace now also plays an important role in the type of operating decisions made. However, the danger of falling back onto standard 'modus operandi' based on past performances, techniques and accomplishments, still exists, and can literally dictate how an operation should be run. So why then should we adopt a "proactive" approach to pipeline integrity as opposed to a "reactive" one? Quite simply: aging pipeline infrastructures.

The majority of pipeline systems in operation today are obviously not new. They have not been new for many years now and they will not become new anytime in the near future. It is inevitable: everything ages, even newly constructed pipelines incorporating the most modern systems, technologies and advancements. Like anything else, aging also brings deterioration with it. The forces directly responsible for deterioration and the time-scales associated with them may differ from one phenomenon to another, but nonetheless, they exist.

Pipelines experience a multitude of forces and "other" significant events in their lifetime which contribute to their deterioration and eventually, their integrity (e.g. geotechncial forces, external/internal corrosion, product specification and quality, pressure, temperature, coating damage, 3rd party damage, material defects, etc.). Recognition that some or all of these forces exist to some degree on all systems (i.e. no pipeline is immune) is the first step in a proactive approach to integrity management. Getting to the next phase is where hang-ups can occur: *the efficient and effective implementation of technologies aimed at counteracting these forces and/or their effects*. In no way does this statement imply that we abandon or limit the value of inputs, decisions and techniques formulated on past experiences when trying to implement new technologies. This "know-how" must still remain an integral part of the implemented pipeline integrity management program.

On the other hand, one must also be cautious to not stumble into the "techno-trap" of wanting to implement, incorporate, run and/or own every latest technological advance/device unless a value-added justification to the overall integrity management of the system can be realized. The tested and proven technologies of today, as well as those we will be embracing in the future, are all vital tools in maintaining pipeline integrity and should be used in the right circumstances. You don't need to buy a Ferrari to go 4 x 4-ing! Such approaches almost inevitably become costly undertakings, with very little realized gains. Important questions regarding the applicability of specific integrity technologies to a specific pipeline system need to be addressed prior to implementation. This in itself requires a very thorough understanding of the pipeline system and its' specific operational history. Such thinking now sends us back to the gathered "know-how" component previously discussed.

As you can see, a balance between past experiences and technological advancement must be created to establish an effective integrity management program. By doing so, we ensure that pipeline systems are maintained and operated at their safest levels as all avenues of due diligence are covered. Tipping the scales in either direction could have serious consequences from a safety, environmental, cost of repair, stakeholder and public perception/opinion perspective. Let us not discount the experiences and knowledge databases accumulated via past events, nor discount the technological advances that are being developed today and in the future.

Pipeline Integrity Management System

The other component of this year's theme is Managing Pipeline Integrity. It does us no good to simply expend resources, time and dollars on integrity issues if we continually fall back into a "reactive" mindset. When a functional balance between technological implementation and expertise gained from past experiences has been established, the next step should be the creation of a system aimed at managing this marriage. The integrity management system/philosophy represents one component of the overall operations management system of a pipeline company. It's mandate, at the most basic level, should be to provide a "safe, prompt and continual delivery of product". How this is accomplished from one pipeline company to another will vary based on operating philosophies and situational differences. Hand this mandate over to any level of management and almost assuredly the words "efficiently" and "cost-effectively" will be incorporated. Further refinement of the mandate would also include "environmentally responsible" and "satisfaction of all regulatory requirements". As you can see, there are several factors that need to be constantly scrutinized and addressed if a pipeline integrity management program is to be successful in satisfying all concerning issues.

To manage pipeline integrity is to essentially manage risk. All factors affecting the integrity of a pipeline pose a risk to the realization of the adopted mandate, if not attended to. Each risk also comes with an associated consequence and potential loss. Consequences and losses in the pipeline industry can be in the form of unscheduled outages, leakage, ruptures, environmental damage, human suffering and/or loss, financial loss, etc. As a result, the risk assessment phase becomes the most important one in the risk management process. The cause and effect relationships established at this level allow us to prioritize and focus our efforts on the most critical scenarios affecting integrity. From, this, cost-effective control and mitigation strategies can be created and executed. Once again, a balance between technology and system expertise must be utilized at this stage. To assess effectiveness, performance evaluation of the mitigation strategy must also be conducted. This determines whether or not the desired result was achieved whilst satisfying the mandates' requirements of safety assurances, cost-effectiveness, efficiency, etc.

Risk assessment/risk management systems as those just described do indeed work. There are obviously several more details and concepts that need to be incorporated into a formal risk management plan. This would include things such as the tools designed to assist decision-makers with risk analysis (i.e. statistical models, software), the numerous informational databases which have been and are currently being developed, the evolution of geographic information systems, etc. The intent here was simply to highlight the fundamental concepts behind such plans.

However detailed and structured an integrity management plan becomes, its success will ultimately depend upon the commitment given to the plan. The New Oxford Dictionary of English defines commitment as " *the state or quality of being dedicated to a cause or activity (a pledge or an undertaking)"*. This dedication must come from all parties associated with pipeline integrity. From the front-line individuals directly involved (i.e. the engineers, operators, technicians, vendors, research and development teams) to those who are directly affected by the achieved results (i.e. management, shareholders, regulators, etc.). Commitments at all levels will only strengthen the direction our industry takes in ensuring safe and efficient pipeline infrastructures, new and old. An indication of commitment is present here today. Attendance at this workshop, regardless of the level of your involvement in the overall integrity management plan of your company, indicates a commitment to the advances in technologies and methodologies showcased at this gathering. Hopefully, what is learned and discussed here this week will help form significant parts of several integrity management frameworks.

Closing Remarks

Ladies and gentlemen, over the next few days, you will all get the opportunity to focus on and discuss several state-of-the-art technologies as well as share experiences related to the design, construction, operation, maintenance, performance and abandonment of pipelines. Forums like these are necessary in ensuring that the transfer of knowledge and information related to new advancements takes place within our industry. Never has this been as important as it is now, mere months before we embark on a new millennium.

We are experiencing change in our industry as we have never experienced at any other time. The rate of change (i.e. predominately technological) is unfathomable. Just sit back and think for a moment at how a certain task accomplished today was handled 5, 10 or even 20 years ago! Now speed up the rate of change. One can only imagine how the execution of this task will now be handled in the future! Now incorporate a similar rate of change to the entire pipeline integrity industry via enhancements and continued research/development into in-line inspection tools, on-line real-time ROW monitoring, predictive models, coatings, and construction practices and operating procedures

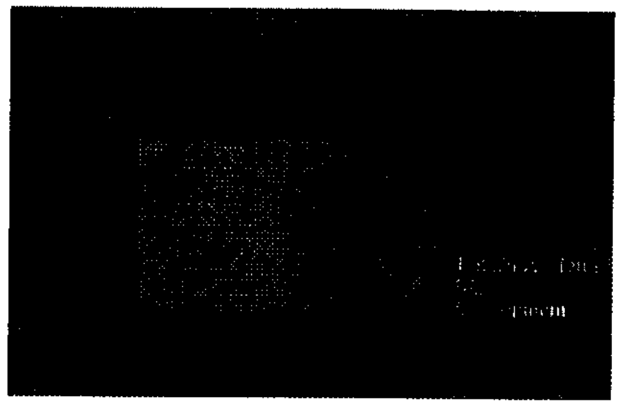
Although exciting in nature, it can also be quite an intimidating time if we don't properly prepare ourselves for these inherent breakthroughs. Let's not forget what got us to where we are today. Let's not forgot how we do things today. Additionally, let's systematically and efficiently embrace the technologies of the future that will become essential in ensuring that all pipelines will be capable of operating at the highest standards of safety in the next millennium.

I thank you for your attention and wish you all a very successful four-day workshop.

Agenda

- Technology trends
- Themes for the millenium
- Key emerging technologies
- Impact on business

CMOS Technology Capability



Storage and Bandwidth

- **Storage**
  - 1999: Can store a bit on an atom !
  - Library of Congress on a dime !
- **Bandwidth**
  - 1988: 45 Million bits / second
  - 2000: 1 Trillion bits / second (200 million faxes)

PC System Evolution

	SPECint92	MHz	DRAM	DASD	Display	MODEM
1980	1	4	16KB		[illegible]	[illegible]

PC System Evolution

	SPECint92	MHz	DRAM	DASD	Display	MODEM
1980	1	4	16KB		CGA 320x200	300 bps
1983	4	12	64KB		EGA 640x400	1200 bps
1986	9.4	33	256KB	20MB	VGA 640x480	2400 bps
1989	55	50	1MB	70MB	XGA 1024x768	9600 bps
1992	198	90	4MB	300MB		19200 bps
1995	320	200	16MB	1GB	SXGA 1280x1024	28800 bps
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

PC System Evolution

	SPECint92	MHz	DRAM	DASD	Display	MODEM
1980	1	4	16KB		CGA 320x200	300 bps
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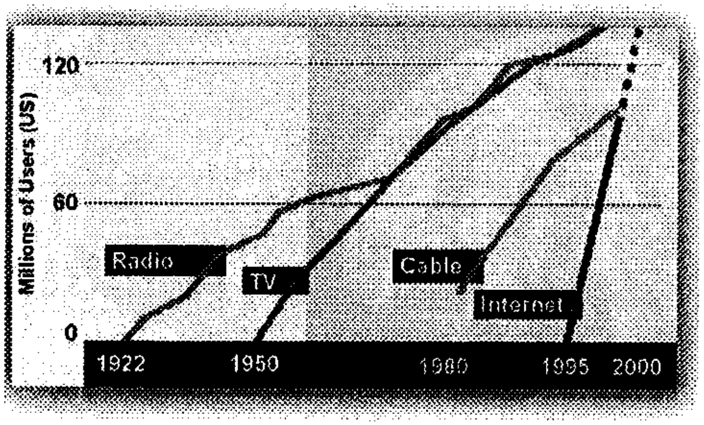
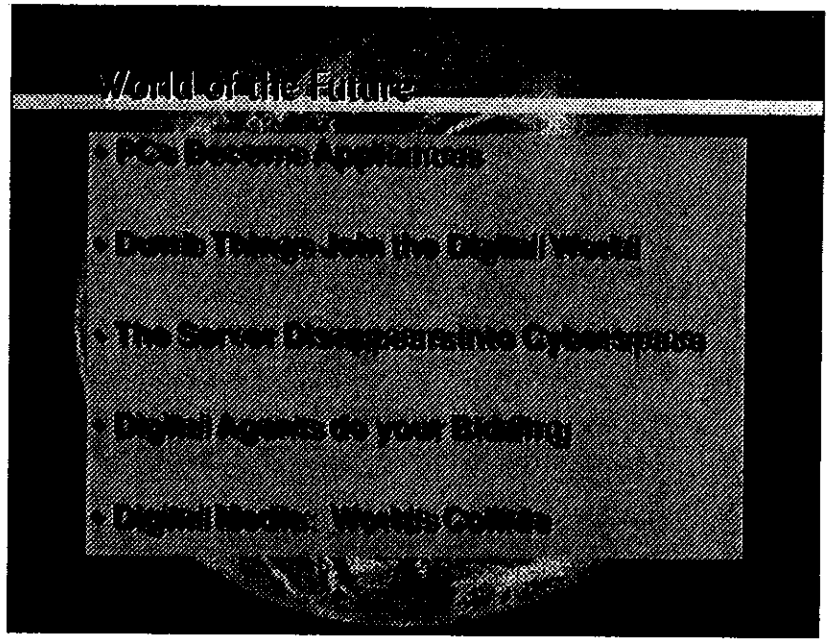
1989	56	50	1MB	70MB	XGA 1024x768	9600 bps
1992	196	90	4MB	300MB		19200 bps
1995	320	200	16MB	1GB	SXGA 1280x1024	28800 bps
1998	750	300	64MB	6GB		56000 bps
2001	2100	1000	256MB	20GB	UXGA 1600x1200	1 Mbps cable/ADSL
2004	6000	1500	1GB	80GB		4 Mbps cable
2007	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

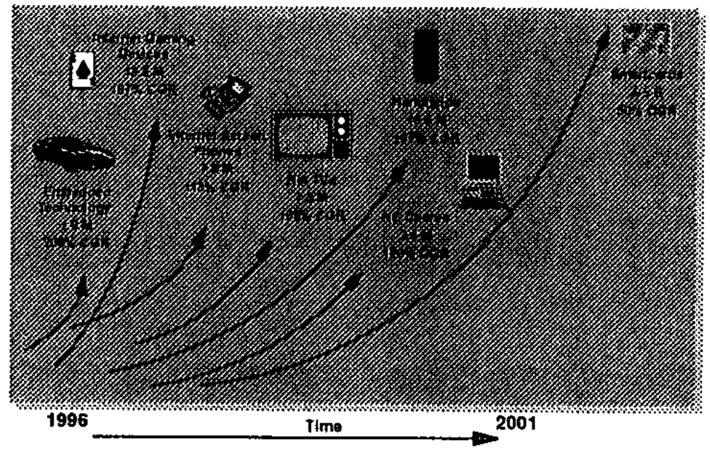
Internet Adoption



Source: Morgan Stanley Research

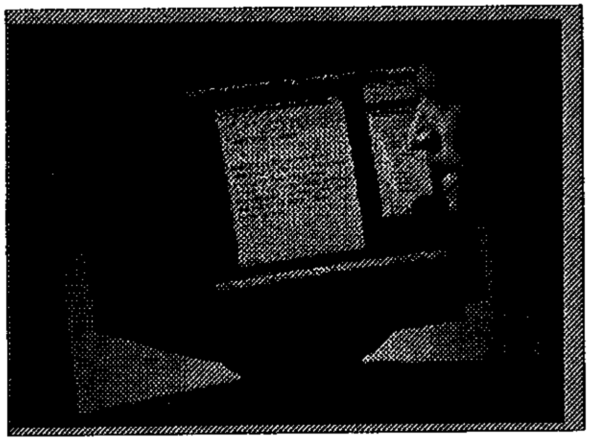


Exploding Growth in Network Access

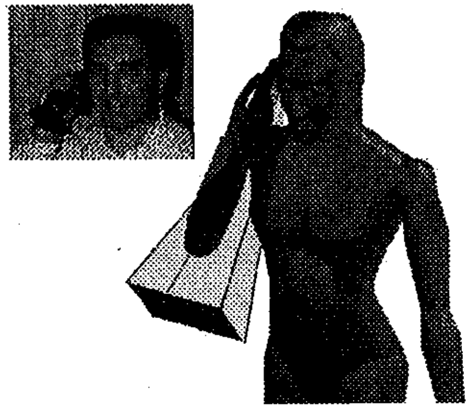


Source. IDC Information Appliance 12/97, Kalen Associates 11/97

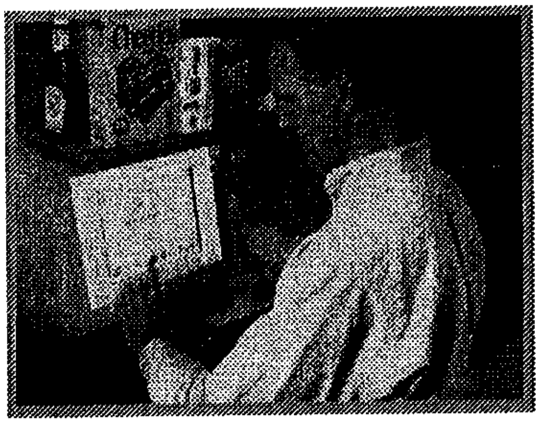
Speech/Voice Recognition

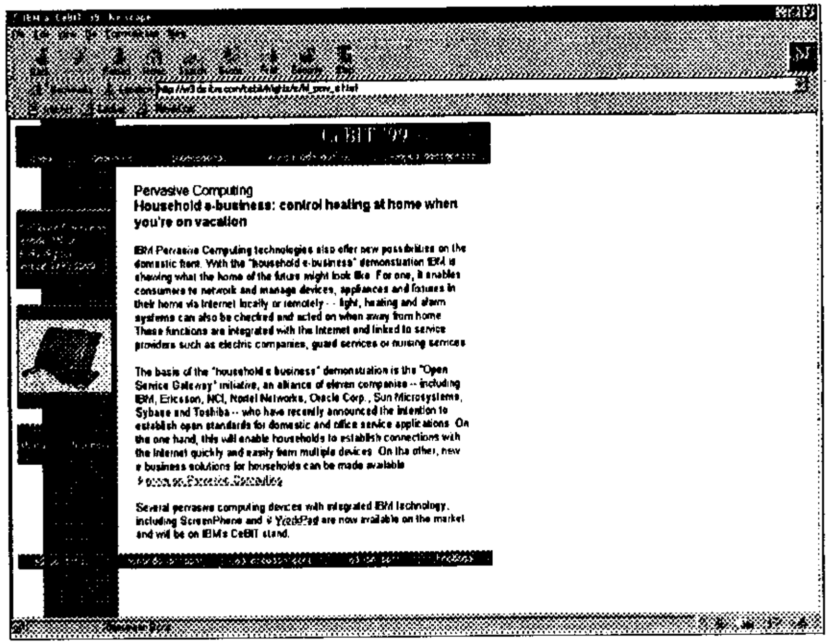


CyberPhone



Cyberhome 2000

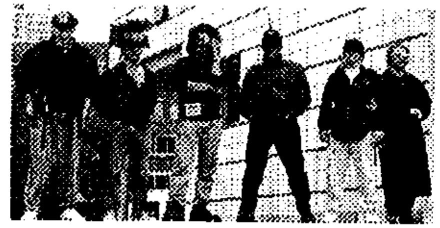




Personal Area Networks

Wearable Computing - Clothes that Think

- Conductive Threads
- Personal wireless local area network
- Sensors: GPS, cameras, microphones...
- Portable while operational
- Hands-free use



***Purpose:* Technician Support, Medical Monitoring, Memory Enhancement, Fun!**

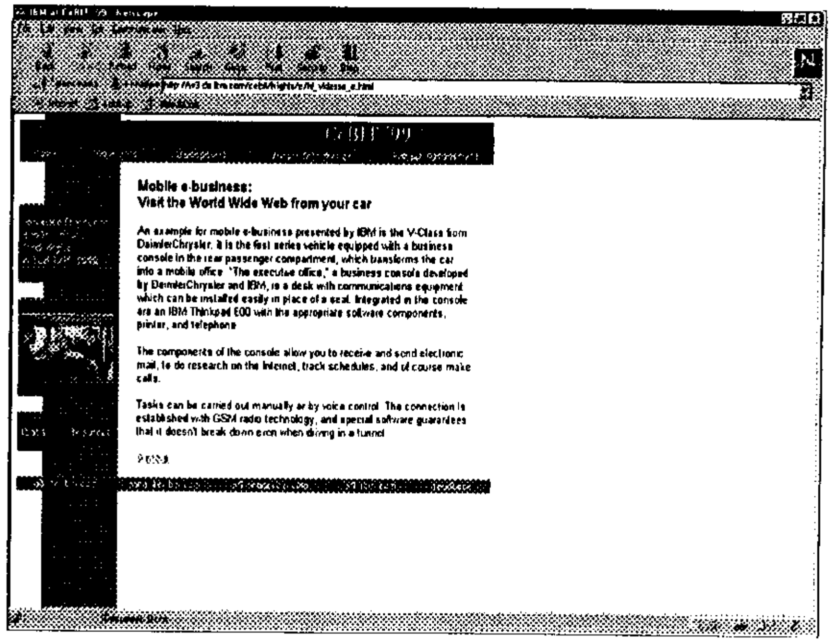
Source : IBM & MIT Media Lab

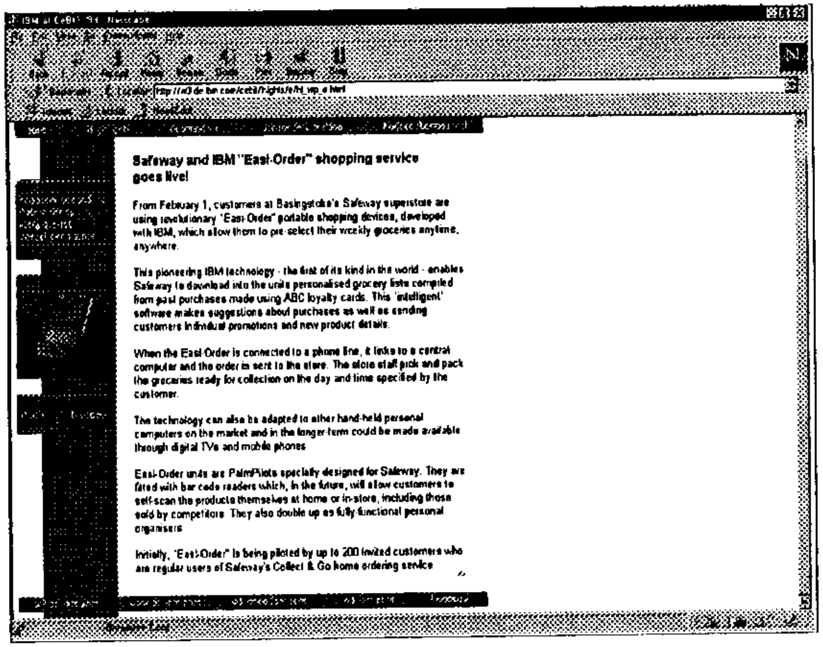
IBM at CeBIT: "We're Driving Toward An e-Society"

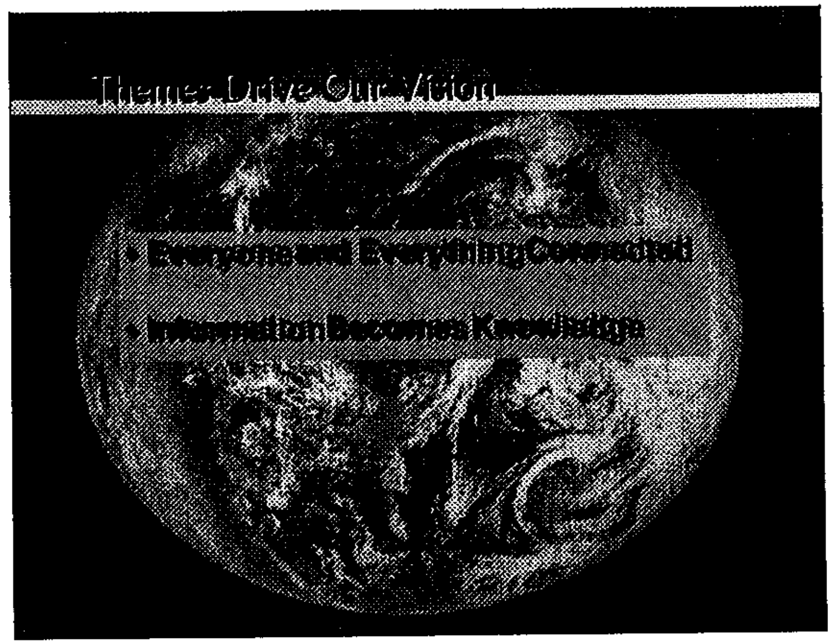
IBM's message at CeBIT '99, the tradeshow billed as the world's largest for information and telecommunications technology, was "That's e-business." IBM and its partners showcased a wide variety of e-business products, technologies and services that show how the network is pervading everyday life and will create an e-society.

Several pervasive computing solutions with integrated IBM technology, based around screenphones, workpads, smart cards and wearable PCs are now entering the market and were shown this month at CeBIT.

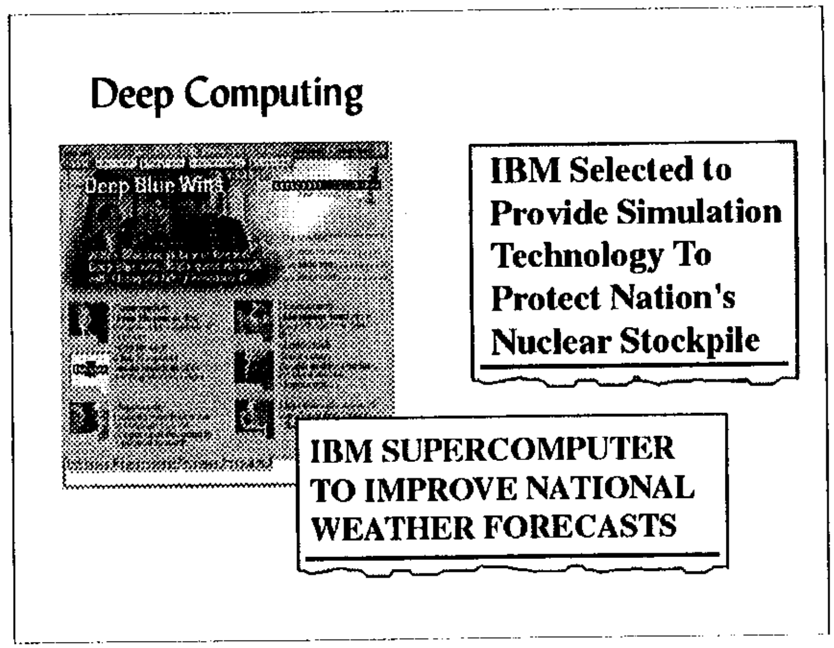
Other CeBIT '99 highlights included the virtual EXPO 2000, examples of Deep Computing and the digitization of Michelangelo's




Safeway and IBM "East-Order" shopping service goes live!
From February 1, customers at Basingstoke's Safeway superstore are using revolutionary 'East-Order' portable shopping devices, developed with IBM, which allow them to pre-select their weekly groceries anytime, anywhere.
This pioneering IBM technology - the first of its kind in the world - enables Safeway to download into the units personalised grocery lists compiled from past purchases made using ABC loyalty cards. This 'intelligent' software makes suggestions about purchases as well as sending customers individual promotions and new product details.
When the East-Order is connected to a phone line, it links to a central computer and the order is sent to the store. The store staff pick and pack the groceries ready for collection on the day and time specified by the customer.
The technology can also be adapted to other hand-held personal computers on the market and in the longer term could be made available through digital TVs and mobile phones
East-Order units are PalmPilots specially designed for Safeway. They are fitted with bar code readers which, in the future, will allow customers to self-scan the products themselves at home or in-store, including those sold by competitors. They also double up as fully-functional personal organisers
Initially, "East-Order" is being piloted by up to 200 invited customers who are regular users of Safeway's Collect & Go home ordering service


Themes Drive Our Vision
• Everyone and Everything Connected
• Information Becomes Knowledge


Deep Blue vs. Garry Kasparov
May 1997 - Deep Blue wins its six-game rematch with Garry Kasparov
Deep Blue 3.5
Kasparov 2.5


Deep Computing
Deep Blue Wins
IBM Selected to Provide Simulation Technology To Protect Nation's Nuclear Stockpile
IBM SUPERCOMPUTER TO IMPROVE NATIONAL WEATHER FORECASTS

Data Mining With *TEIRESIAS*

>EVENT STREAM
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GYAGCCYACJUARRVAZTENXQEEBZNNFSDUUXNCRRGVBBBPKCACOFOZJHLZISPX

Data Mining With *TEIRESIAS*

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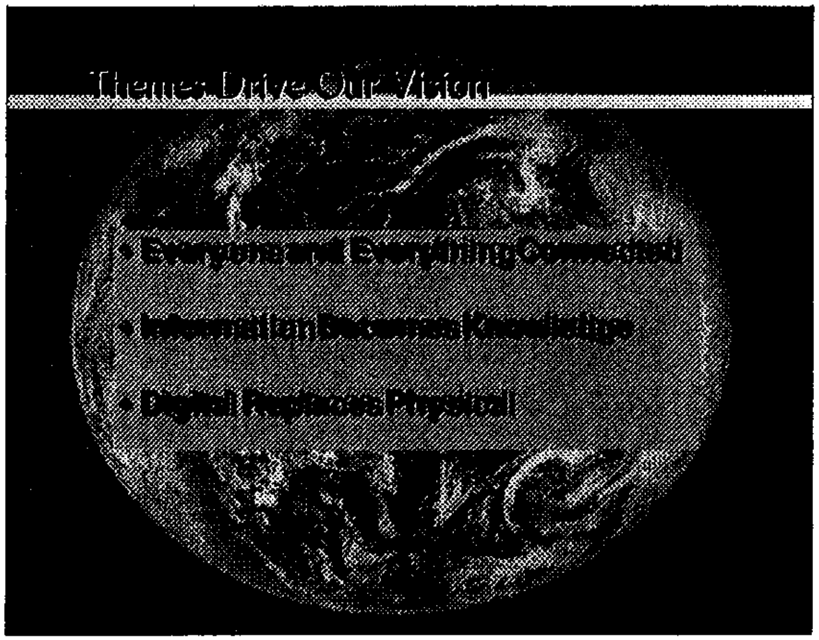
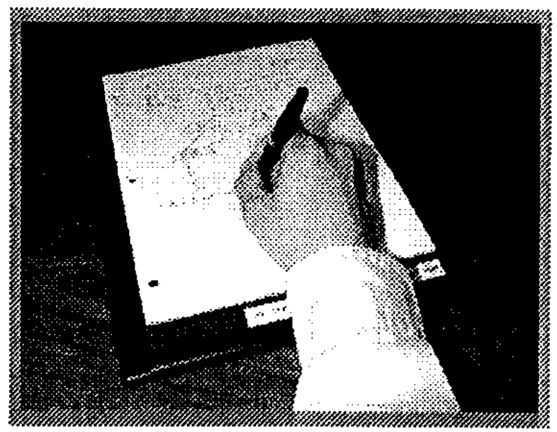
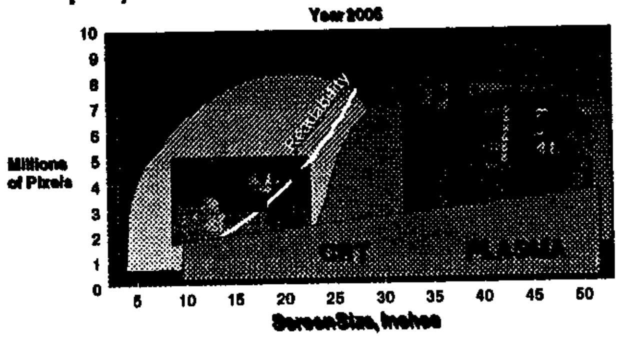
AC CUR ATE



ThinkScribe



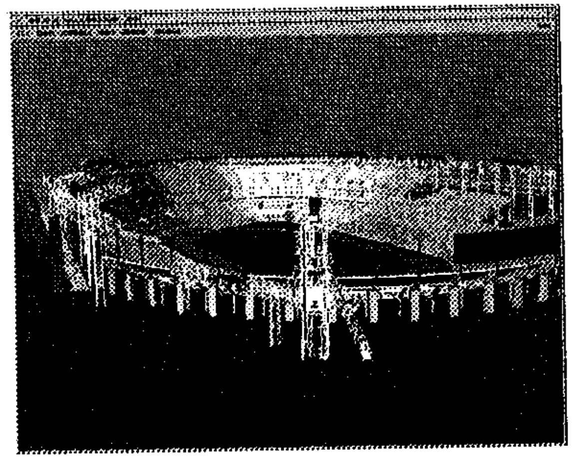
Displays



- New Clients
- Readability Threshold

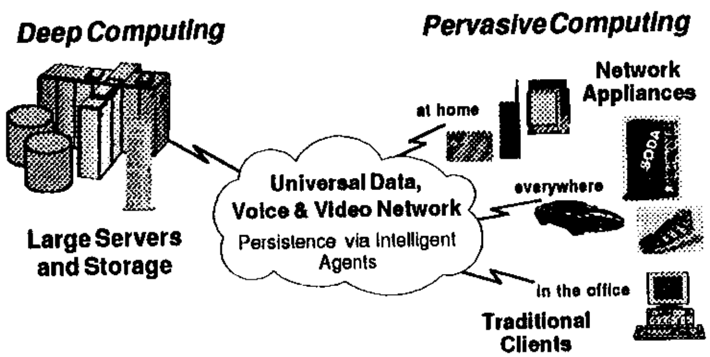
Liquid Crystal Displays Will Dominate

3DIX: Interactive 3D Visualization



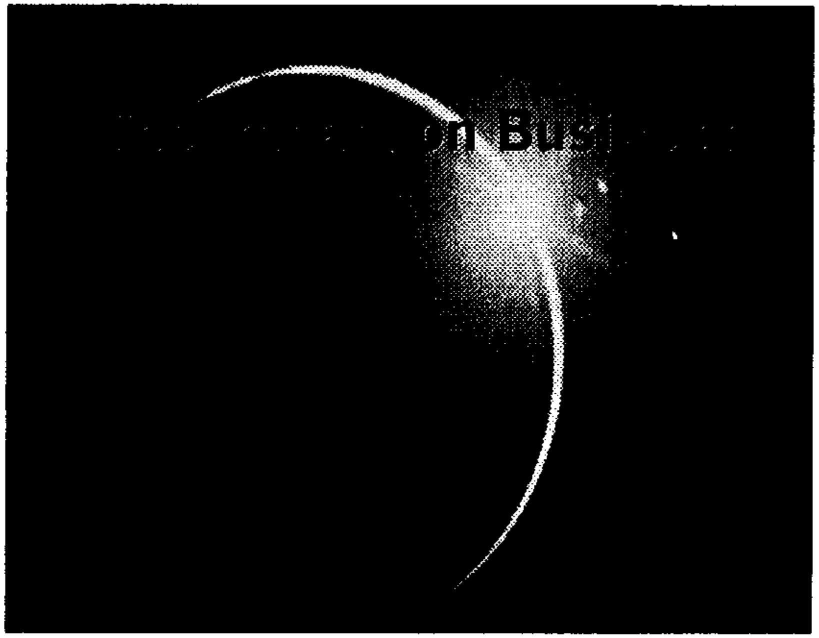
Courtesy: ACDG

We need to shift our mindset from one market of millions to a million markets of one



Summary

- Pace of technology will continue to accelerate
- The key will be to exploit these trends business advantage



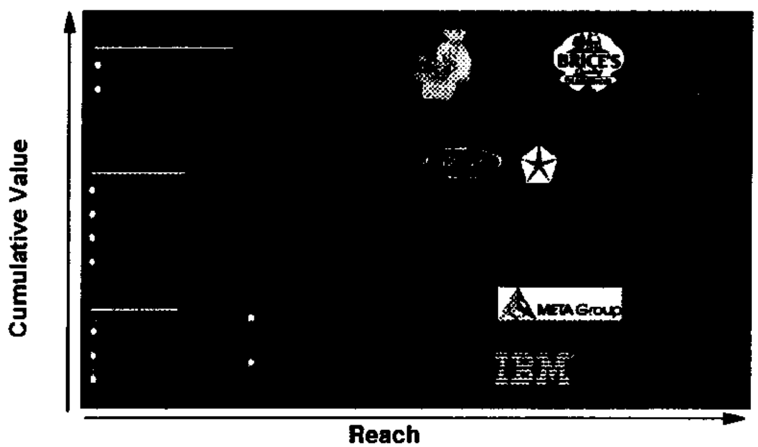
What is e-business ?

- **Solvingyour businessproblemsby**

the transformingof key businessprocesses using Internettechnologies

e-businesslinks employees, suppliers, partners and customers

e-business Value



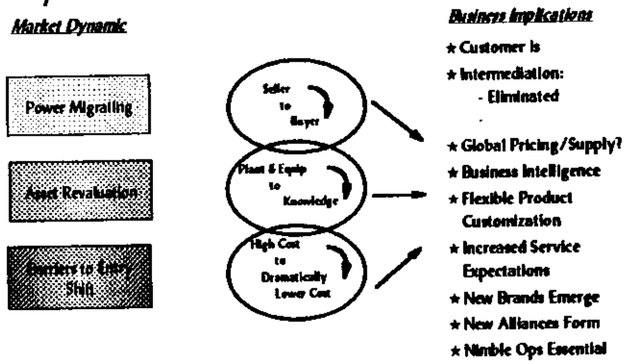
New Business Designs are Emerging

e-business Spectrum

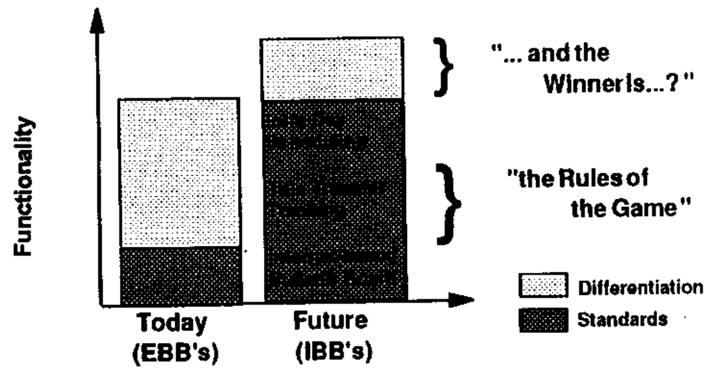
Seller Side			Buyer Side	
e-Businesses	Aggregators	e-Markets	Customer Nets	Portals
• Boeing	• Amazon	• Alba	• Branch Out	• AOL
• British Airways	• Boxman	• AuctionOne	• Hecklers	• GeoCities
• Cisco	• e-Schwab	• Auto-by-Tel	• Motley Fool	• Netcenter
• Dell	• GE BuyerNet	• eBay	• Parent Soup	• Snap! Online
• IBM	• JC Penney	• e*Trade	• Polysort	• Tesco
• Karstadt	• Wal*Mart	• Oasis	• Six Degrees	• Virtual Helsinki
• Marriott		• On Sale	• Tripod	• Yahoo!
		• Priceline		

Key Business Impacts

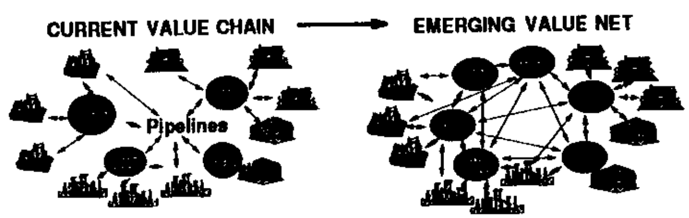
e-business Transforms Traditional Business Dynamics



In the face of mandated standardization, how can Gas Pipelines differentiate themselves?



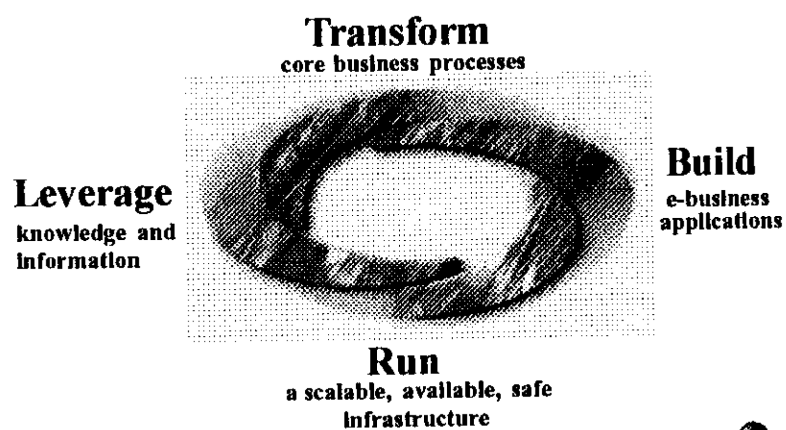
The Natural Gas Industry is experiencing fundamental changes to the way business is done



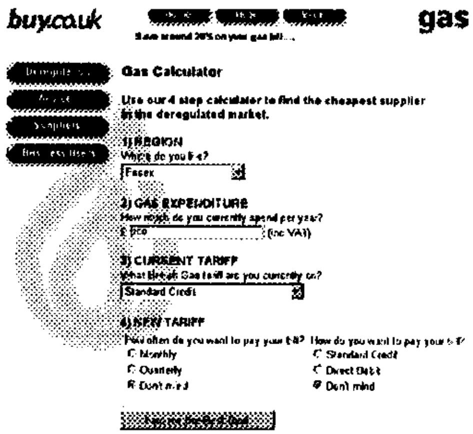
- A greater number and diversity of players, all dynamically interconnected, requiring more information more frequently.
- Who will have which roles in the emerging environment?
- Deregulation and re-regulation
- Who are the competitors?
- Who is the customer?

Source: Rick Santerre, TransEnergy Mgmt, Inc.

The e-business cycle

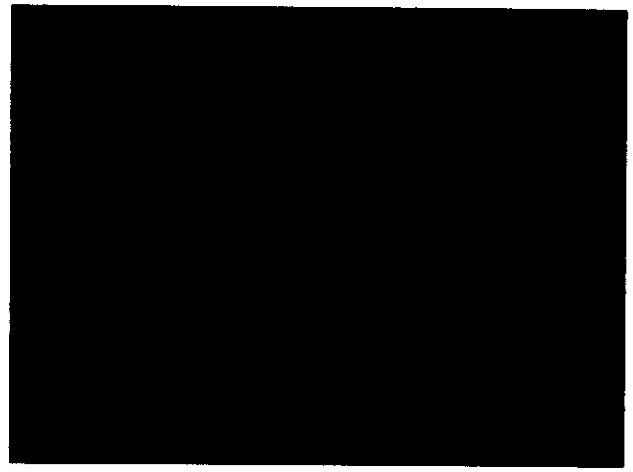


Aggregator:
U.K. On-line Gas Supplier Calculator



- UK Gas Market has 18M households
- Fully competitive marketplace
- Service helps consumer locate cheapest gas supplier
- buy.co.uk receives fee from utility when customer is referred

Amazon.com of the Chemicals industry: e-Chemicals



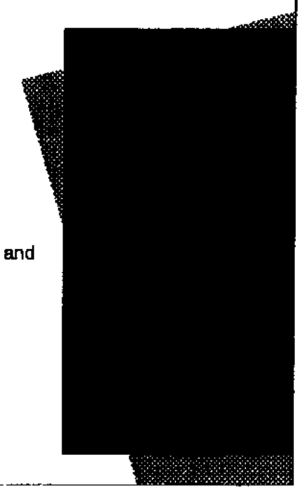
Data Mining to serve the "market of one": Safeway (UK)

Challenge
- Leverage existing data to better understand customer buying

Solution
- Application that mines data on purchases of 6 million customers

Business Value
- Clearer picture of customers has enabled smarter tradeoffs between customer loyalty and product profitability

Products
- DB2, Intelligent Miner



Summary

- **Pace of technology will continue to accelerate**
- **The key will be to exploit these trends business advantage**

CEPA Pipeline Integrity Management

Share, Collaborate, and Leverage for success

1

Technology

- "a body of knowledge"
- "intellectual capital"

2

CEPA

- Member Companies (11)
- Technical Members (3)
- Operate 90,000 km of pipelines
- Transport 95% Natural Gas and Crude oil produced in Canada

3

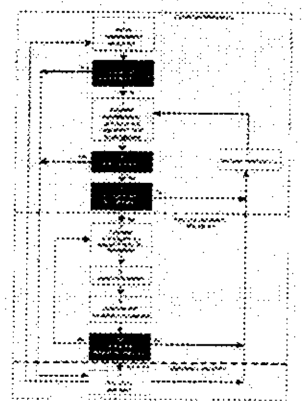
CEPA - Pipeline Integrity Management

- Safe and Reliable system top industry priority
- CEPA have focused on SCC and General Corrosion

4

Framework for Pipeline Integrity Management

- Integrity Management Framework
- Developed for SCC
- Can be applied to General Integrity Issues



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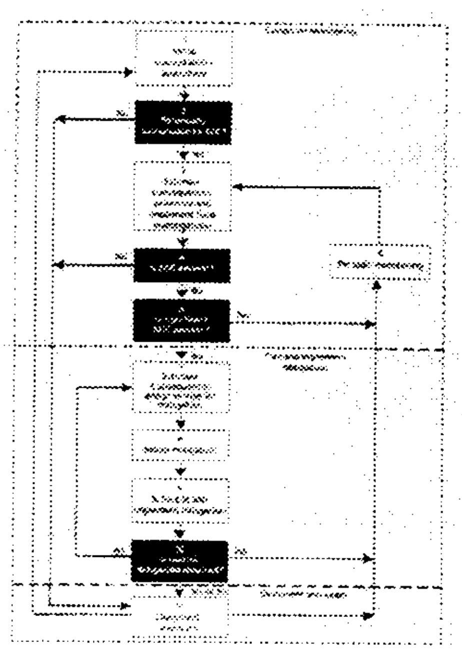
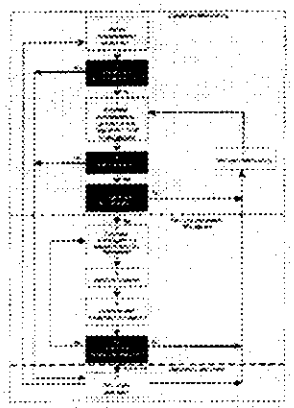
SCC Recommended Practices available at *www.cepa.com*



Condition Monitoring

- Susceptibility Assessment
- Investigative Programs
- Periodic Monitoring



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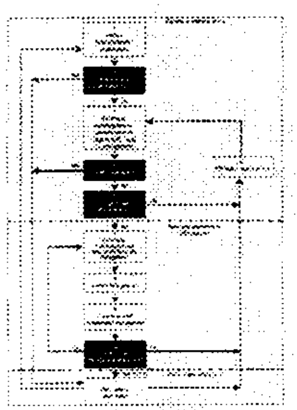
Plan & Implement Mitigation

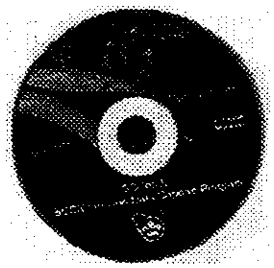
- Prioritize for mitigation
- Select & Schedule mitigation



8

Document and Learn

- SCCdb32
- Data Trending
- Share
- R&D



SCCdb32 available at *www.cepa.com*

9

CEPA - Current Activities

- Corrosion White Paper
- Circ. SCC RP's
- Consequence Assessment
- Pipeline Integrity R&D

10

CEPA - Looking Forward

- Pipeline Safety & Reliability will continue to be CEPA's #1 focus
- CEPA will continue to share, collaborate, and leverage among it's members to address complex technical and operating challenges

11

I leave you with this thought...

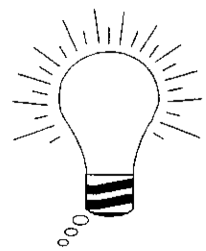
- Technologies for the new Millennium
  - What can you learn this week?
  - What can you share?
  - How can you contribute?

12

Vision

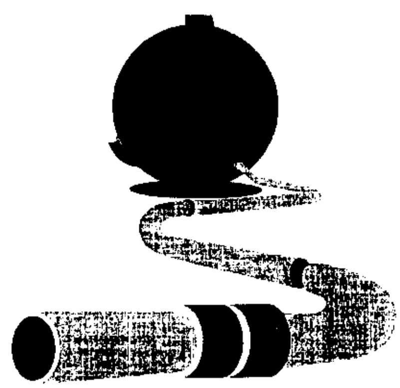
Enhanced pipeline operations safety performance

- manage pipeline risk through informed decision making
- industry acceptance and utilization
- harmonization of data collection and reporting
- computer based tools for better analysis



Pipeline Risk Assessment Steering Committee (PRASC) Database Development

Ian Fraser



PRASC Database Steering Committee

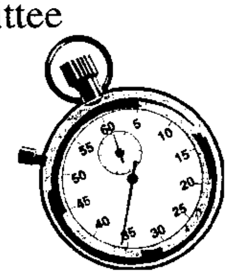
Name	Employer	Representing
Barry Broderick	CWNG	CGA
Ian Fraser	Imperial Oil	CAPP
Lawrence Gates	TSB	TSB
Bob Hill	CEPA	CEPA
Dave Kopperson	PanCanadian Petroleum	CSA Risk Management
Ron Maas	Westcoast Energy	CEPA (co-chair - PRASC)
John McCarthy	National Energy Board	NEB (co-chair - PRASC)
Tom Pesta	Energy Utilities Board	EUB
Jim Pirye	MIACC	MIACC
Brian Rothwell	TransCanada PipeLines	CSA Z662
Ian Scott	CAPP	CAPP

PRASC Database Task Force

Name	Employer
Wayne Feil	Imperial Oil
Hugh Harden	BC Gas Utility
Bryce Nolan	TransCanada Pipelines

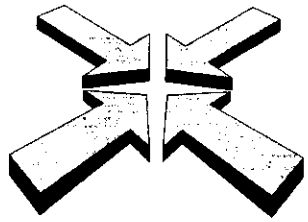
History

- PRASC was created to guide the development of processes to determine and manage the risks associated with pipeline operations
- Co-operative effort of CAPP, CEPA, CGA, MIACC, EUB, NEB, TSB, CSA
- Directed by independent steering committee
- Supported by task force
- Funded by CAPP, CEPA and CGA



Database Task Force Mandate (cont.)

- Acting in a liaison role with related industry initiative/groups
- Evaluating and recommending an appropriate database & process solution
- Initially for downstream liquids and gas pipelines - upstream at a later date



Database Task Force Mandate

- Identifying all essential database elements
- Defining standards, measurement criteria and terminology
- Determining statistical and quantitative requirements
- Outlining the process for data collecting & reporting
- Estimating industry/corporate impacts

Opportunities

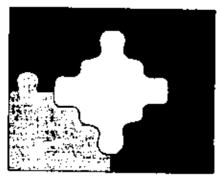
- Reduced reporting by pipeline operators
- Use for maintenance planning
- Access to a well designed data management product for the pipeline operator
- Access to a much larger base of data for risk management and statistical analysis

Achievements to Date

- Designed and developed prototype database
    - Preliminary load testing completed
- Internet Access
    - Domain Name: Can-Pipeline-Incidents.Org

Next Steps

- Compile all existing database elements
- Team of industry/regulators to compile required database elements
- Agreement of a common database data dictionary
- Agreement to and development of a harmonized database
- Develop an administration program
- Promote database to industry
- Database population
- Database reporting



Go Forward!

Harmonization of databases (Regulatory & Industry)

- common data dictionary
- data sharing

Database Administration

- database population
- data entry support
- development of data query protocol
- security issues

A NEW MFL IN-LINE TOOL TO DETECT LONGITUDINAL CRACKS

Introduction:

Axial flaws are certainly the most dangerous defects for pipeline operators as their location is a real challenge for the ILI industry. In addition, long or short axial defects are potentially a threat in very various forms: cracks, mechanical damages, grooving corrosion…

TRAPIL, the multi-product pipeline operator leader in Europe, has developed an original rotating transverse MFL tool to detect these flaws.

This tool has successfully inspected a refined product line affected by a SCC phenomenon. The inspection allowed the location of sevèral critical cracks before staring the hydrotesting program and has saved this pipeline from a definitive interrupt of operations.

1 Transverse magnetisation for the detection of longitudinal cracks

The detection principle is the well known MFL used for metal loss location. But as defects are mainly axially orientated, the magnetic field has to be applied in the transverse orientation instead of the axial one. The transverse MFL measurement principle is reminded fig1: a magnetic flux is imposed by the two poles of a magnet in the pipe wall, the presence of a flaw with an axial component induces a distortion of the field lines which is measured by sensors.

During the feasibility studies, the field lines in the vicinity of the cracks have been modelled by using finite element calculations, an example of radial flux leakage generated by such a crack is shown fig2.

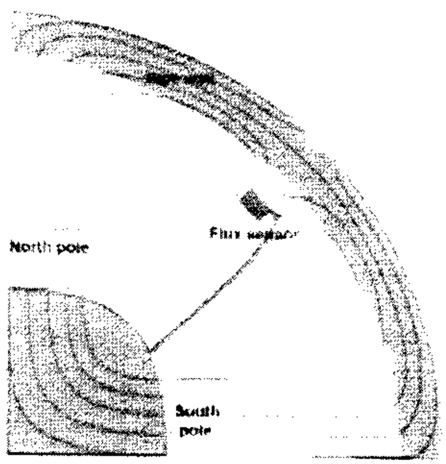


Fig1 : transverse field magnetisation

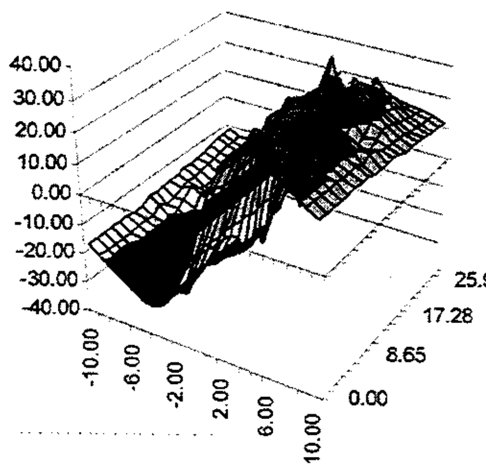
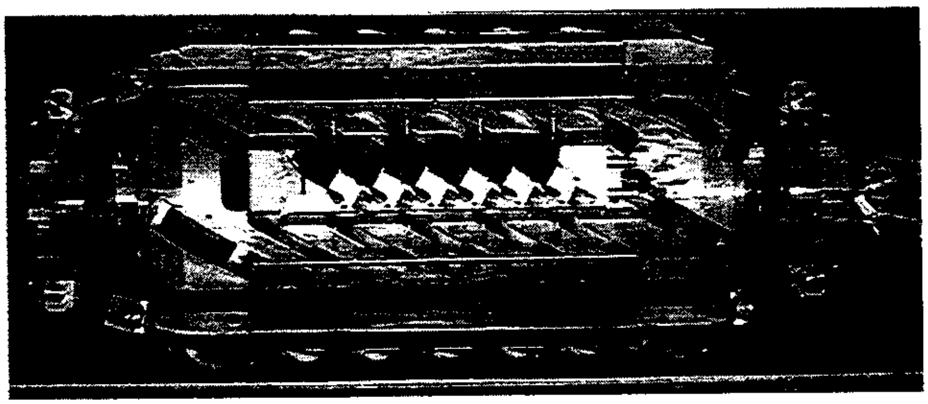


Fig2: flux leakage on a crack 2.5mm deep and 30mm long.

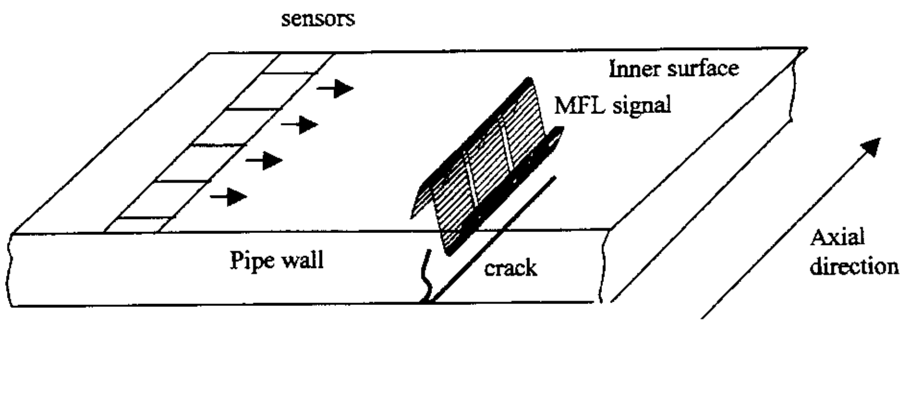
2 The transverse magnetisation applied by the CORRO-T

The tool is made up of 5 cars: a car for traction, a car for the power supply, a car for the processing and the storage of the data, the two last cars inspect the whole of the pipe wall. Each inspection car inspects 50% of the pipe wall. An inspection car includes four magnetic circuits with sensors in the middle of each circuit (see fig3). The free wheels of these modules are inclined at 30°, they induce a rotation of the tool on itself during its progression in the line. So, the whole of the pipe wall is integrally inspected according to eight spirals, each spiral is defined by the progression of a magnetic circuit and its sensors.



Rotating: an efficient way to improve the signal/noise ratio

Thanks to the rotating system, the sensors pass through the MFL signal not only on its axial direction but on its radial direction where it offers a large surface easier to catch by the sensors. In this way, all the energy of the signal is recorded by several sensors and the emergence of the signal is better than recorded on the axial direction.



3 The tool in operation

In 1998, this tool has successfully inspected twice a 12'' diameter 240 km long line of refined products. This line is affected by a stress corrosion cracking phenomenon called 'near neutral pH SCC'. After the runs, 18 SCC colonies threatening the integrity of the line were located by the tool. Since then, several 110% MAOP hydrotests (79% of the SMYS) have been conducted without any ruptures.

Two examples of SCC colony after wet magnetic particle inspection are presented hereinafter fig4 and fig5, the scale is in centimetres.

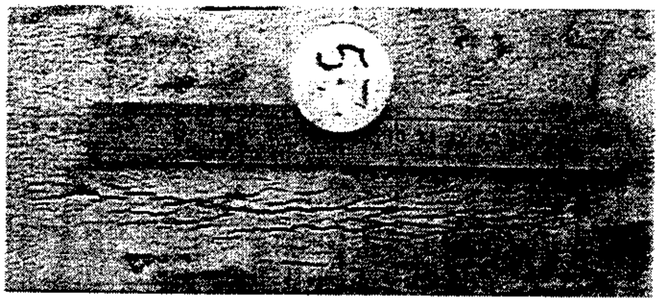


Fig4 : SCC colony 3.5 mm deep

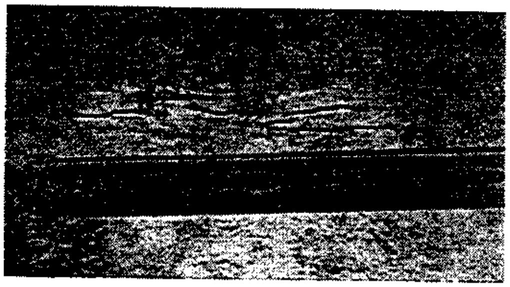
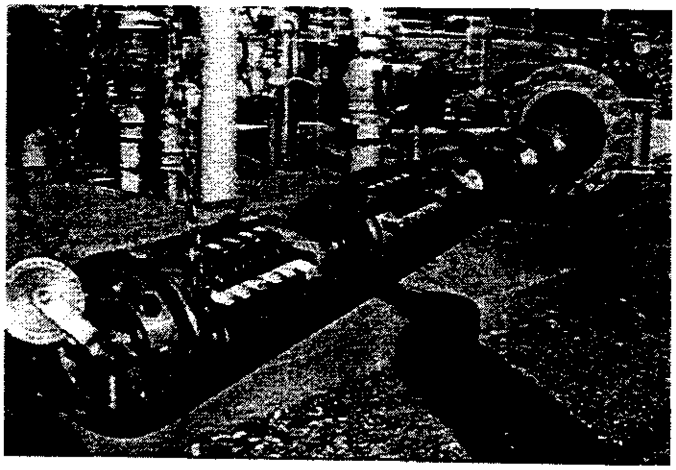


Fig5 : non coalesced cracks, one is 2.5mm deep

4 Capabilities of the tool

At the issue of the inspections, 192 features were recorded by the tool. Till now, about one hundred of them were excavated by the owner of the pipeline. Each excavation has lead to a defect : SCC cracks, grooving corrosion, gouges, deep laminations and midwall defects.

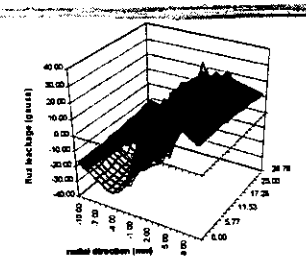


Société des Transports Pétroliers par Pipeline TRAPIL
7-9 Rue des Frères Morane
75738 PARIS Cedex 15, France
☏ 33 1 55 76 80 01 ☎ 33 1 55 76 80 00

PLAN

- TECHNOLOGY USED
- INTRODUCTION OF THE TOOL
- INSPECTION RESULTS
- CAPABILITIES OF THE TOOL

FINITE ELEMENTS CALCULATIONS



Radial flux leakage on a crack 2.5mm deep

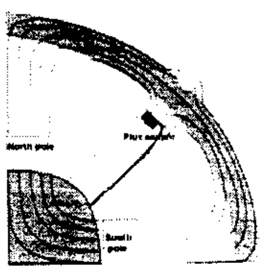
TECHNOLOGY USED

- Transverse MFL principle
- NdFeBo magnets
- Up to date storage capacity technology

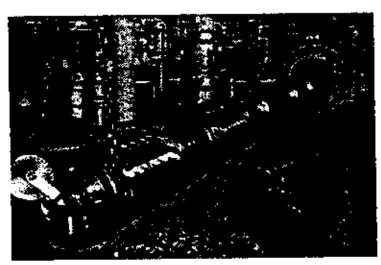
BACKGROUND

- 1995-1997: Feasibility studies in collaboration with the university of GRENOBLE (France), design and building of the 12" tool.
- 1998: Successful inspection campaign on a refined products pipeline.
- 1999: Second inspection campaign in progress

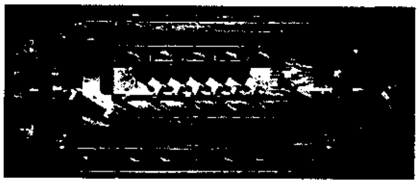
TRANSVERSE MAGNETISATION PRINCIPLE



THE CORRO-T

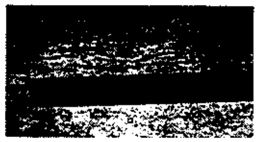


AN INSPECTION CAR



SCC COLONIES DETECTED BY THE TOOL

SCC colony
3.5mm deep



Non coalesced SCC cracks
One is 2.5mm deep

DEFECTS LOCATED

192 features recorded

- SCC cracks
- grooving corrosion
- mechanical damages
- deep laminations
- mid wall defects

CAPABILITIES

- Detection threshold in pull through tests conditions is a single crack 1mm deep and 30mm long.
- This detection threshold is to be confirmed in operation after the collect of field data during the inspection campaign in progress.

INSPECTION RESULTS

- 100 features have been excavated
- No false calls, 57% of the defects had lead to a repair
- 18 SCC colonies detected
- Several axial metal loss defects located
- No ruptures have occurred during the several 110% MAOP hydrotests conducted after the inspection campaign

"Pipeline Encroachment"

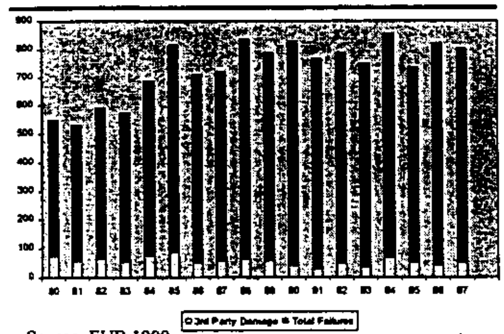
1999 Banff Pipeline Integrity Workshop

Presented by

Ian F.H.Scott
Manager
Pipelines, Environment and Frontier

April 13, 1999

Encroachment -Failures due to 3rd Party

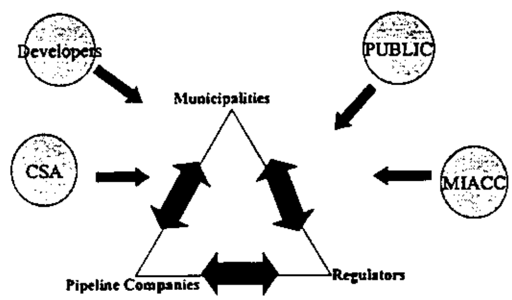


Source: EUB 1999

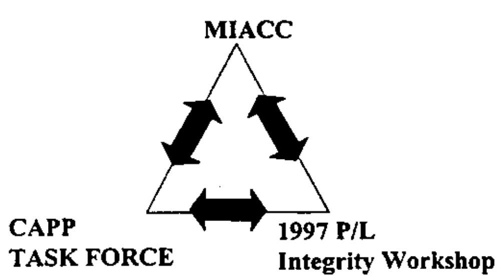
Encroachment - 3rd Party Damage

Source: EUB 1999

Pipeline Encroachment - Stakeholders



Encroachment - Initiatives



Encroachment - 1997 P/L Integrity Workshop

- Key Issues raised:
  - No single source of data &/or incomplete
  - One Call Organizations
  - Improved Communication
    - shared responsibility
    - consistency of message
    - safety of P/Ls
- Roles & Responsibilities

Encroachment - MIACC

- Initiative began 1992 - meeting between CPA, ERCB and the NEB
  - Task Force currently chaired by John Whittaker, U of A
- Workshop held in October 1997
  - "SWG" formed to rewrite document
  - CAPP,CEPA,CGA, EUB,TSB, City of Regina] developed new draft
  - Land Use Planning With respect to Pipelines "A Guide for Local Authorities Developers and Pipeline Operators"

CAPP

Encroachment - MIACC

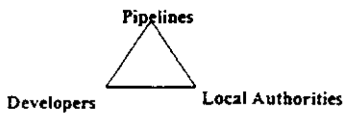
- Purpose:

"Increase awareness & encourage dialogue among key stakeholders when considering changes to existing land uses or new land use development near to or surrounding existing pipelines, or new pipelines adjacent to existing land developments."

CAPP

Encroachment - MIACC

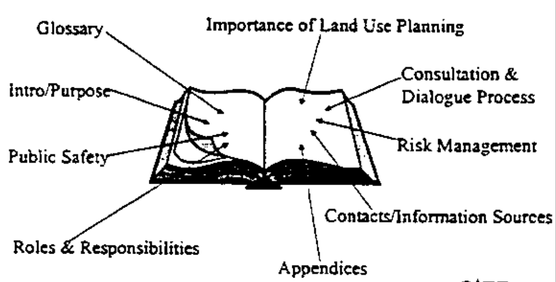
- Key stakeholders include:



- Dialogue should occur when:
  - proposed development - 200m edge of R/W
  - adjacent to existing P/Ls
  - proposed P/Ls adjacent to existing developments

CAPP

Encroachment - MIACC



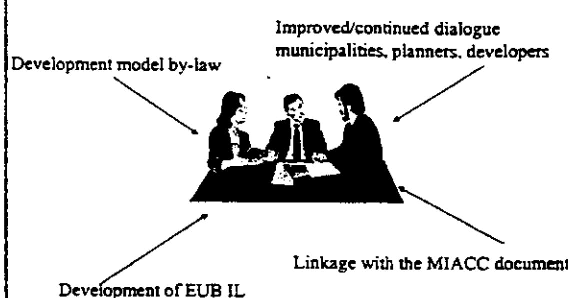
CAPP

Encroachment - CAPP Task Force

- Established April 1996 to:
  - Raise awareness with municipalities and counties
  - address implication s od developments
  - inform municipalities, developers & planners about sources of P/L information
  - Utilize a consultative communications process

CAPP

Encroachment - CAPP Task Force - Proposals



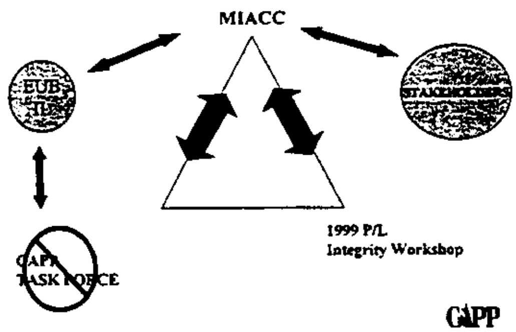
CAPP

Encroachment - CAPP Task Force

- Workshop in October 1997
  - Reviewed proposed IL
  - Reviewed Model By-law
  - Addressed Issue of Compensation
  - Communication
  - Improved data sources
- Awaiting MIACC document

CAPP

Encroachment - Summary



CAPP

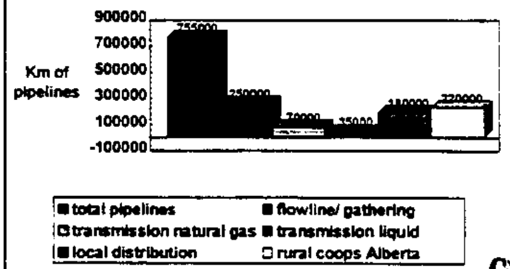
"Pipeline Abandonment"

1999 Banff Pipeline Integrity Workshop

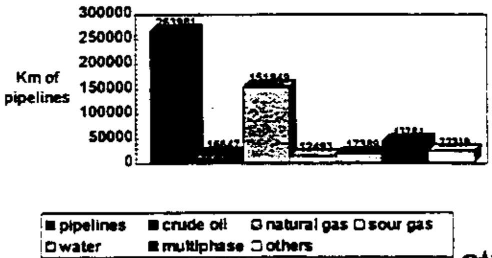
Presented by

Ian F.H. Scott
Manager Pipelines, Environment & Frontier
April 1999

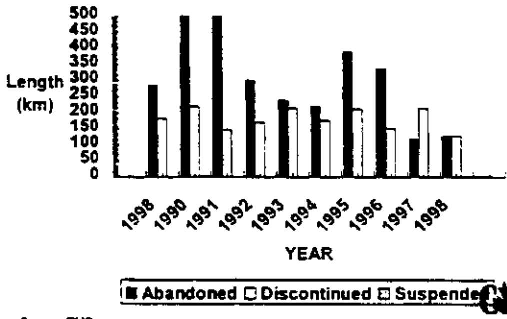
Pipelines in Canada



PIPELINES IN ALBERTA Regulated by EUB

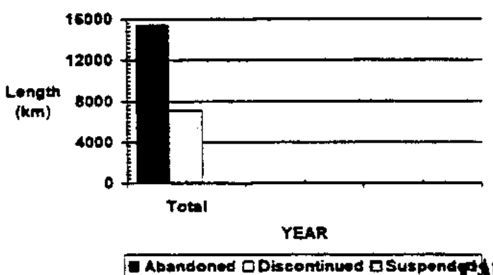


Pipelines - Abandoned/Discontinued Alberta [1989-1998]



Source: EUB

Pipelines - Abandoned/Discontinued Alberta [1998]



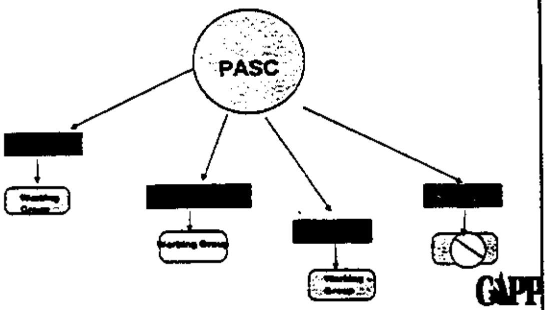
Abandonment Options

- Abandon in place
  - no right-of-way maintenance or "CP"
  - right-of-way maintenance with "CP"

2. Remove the pipeline

Note: Large projects likely combine options

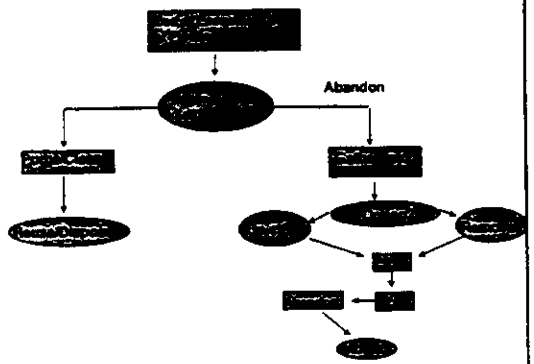
Pipeline Abandonment Steering Committee



Pipeline Abandonment

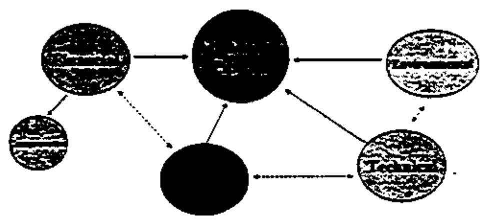
- Two Discussion Papers developed:
  - ➡ Environmental/Technical Issues
  - ➡ Legal Issues

Pipeline Abandonment Plan
Flow Chart



Pipeline Abandonment

- 1997 Banff Pipeline Integrity Workshop:



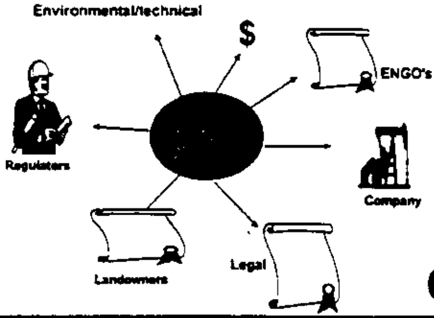
Pipeline Abandonment Plan

- Goals
  - Public Safety
  - Environmental Protection

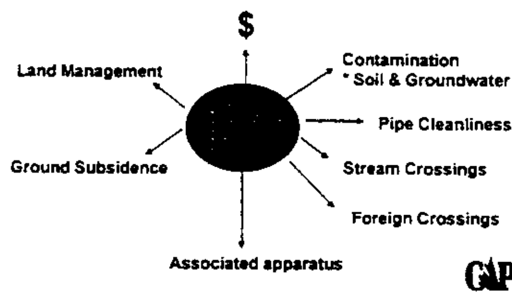
Pipeline Abandonment Plan

- Key Characteristics of abandonment plan:
  - Project Specific
  - Opportunity for Public and Landowner Input or other stakeholders
  - Cognizant of regulatory requirements
  - Provides for post-abandonment activities

Abandonment Plan



Abandonment Plan



Pipeline Abandonment - Issues

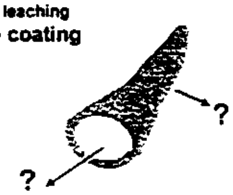
Land Management
- Current uses
  - parks, protected areas, agric.
- Future uses
- equivalent capability

Pipeline Abandonment - Issues

Ground Subsidence/Erosion
- Corrosion of pipe left in place
- Removal of (large) diameter pipe
  - instability of slopes

Pipeline Abandonment - Issues

- **Contamination Soil & Groundwater**
- Internal pipe cleanliness (how clean?)
  - corrosion
  - leaching
- pipe coating



Pipeline Abandonment - Issues

Stream Crossings, Muskeg, Wetlands
- Pipe exposure - erosion, buoyancy
- Cleanliness
- Drainage

Pipeline Abandonment - Issues

Pipe Cleanliness

- How clean is clean?
- What is intended use of removed pipe?
- Prevent Water conduits

CAPP

Pipeline Abandonment - Issues

Foreign Crossings

- road, rail, utilities, pipelines
- proper notification/agreements

CAPP

Pipeline Abandonment - Issues

Associated apparatus

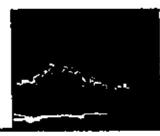
- remove tanks, valves, fencing, etc.
- signage

CAPP

Pipeline Abandonment Issues

Legal

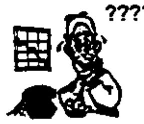
- Extent of corporate liability on abandoned in place pipeline and for how long?
  - existing versus non existing company
- What are the conditions for removal of land title caveat?



CAPP

Cost Considerations

- Abandonment Plan
- site assessment
  - Pipe abandonment
  - monitoring
- legal
- regulatory
- (Alberta - security deposit)
- disposal costs
  - pipe if removed
  - abandonment debris



CAPP

Conclusions

- Pipeline abandonment is current issue
- Abandonment Plan = responsibility + diligence
- Operators must be accountable and responsible
- Communicate with stakeholders throughout
- Legal and financial issues important elements

CAPP

IPC 2000

IPC has evolved into a premier world class event

IPC '98 a huge success

- 700 delegates from 30 countries
- 160 papers from 17 countries
- Positive feedback from delegate survey
- Strong support to hold IPC 2000 in Calgary

Third International Pipeline Conference

IPC 2000

Presented by: Robert A. Hill

IPC 2000

Tentative symposium topics:

- Integrity and Corrosion
- Design and Construction
- Environmental Issues
- GIS/Database Development
- Rotating Equipment
- Innovative Projects and Emerging Issues
- Regulatory, Codes and Standards
- Pipeline Automation and Measurement

Workshops/Panel Sessions/Tutorials

IPC 2000

IPC 2000 scheduled for October 1-5, 2000, in Calgary, Palliser Hotel - ASME primary sponsor

(World Petroleum Congress to be held in Calgary in June takes all hotel and convention space)

Added feature: Technology Exposition to be held in conjunction with IPC 2000 at Telus Convention Centre focused on pipeline industry and related products and services

IPC 2000

Tentative schedule for recruiting papers:

Call for papers issued	Mid-June, 1999
Abstracts received	October, 1999
Abstracts accepted	January, 2000
Manuscripts received	March/April, 2000
Manuscripts accepted	June/June, 2000
Final papers submitted for publication	July/August, 2000

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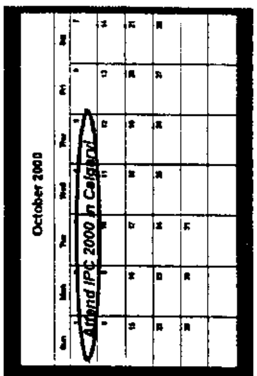

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Contacts for further information:

General Conference Information
Linda Abercrombie - Conference Co-ordinator
Phone: (403) 228-6374 or E-mail laandmrb@home.com

Technical Sessions
Daphne McIntyre - Technical Co-ordinator
Phone: (403) 287-1804 or E-mail: daphnem@netcom.ca

Technology Exposition
Behrooz Sadre-Hashemi
International Events & Marketing Promotions (IEMP)
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The 3rd biennial International Pipeline Conference (IPC 2000) is an American Society of Mechanical Engineers (ASME) conference. The conference patrons are the Canadian Energy Pipeline Association (CEPA), the Calgary Chapter of OMAE-ASME, the Canadian Association of Petroleum Producers (CAPP) and the Canada Centre for Mineral & Energy Technology (CANMET).

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Working Group #1 Construction, Maintenance, and Geotechnical

Co-Chairs: R. Hinger (TMPL); P. Wong (Skystone)
Rapporteur: G. Hill (Corridor / TMPL)

Tuesday, April 13, 1:15 P.M. Session
Topic: Bar Coding of Pipe

Session 1 Speakers: Paul Poirier - Shaw Pipe Protection; R. Pryor - Ellipse Spatial Services

Bar Coding Technology (Paul Poirier, Shaw)

- Shaw Pipe Protection has been using bar coding technology for pipe for 6 years in Canada, the USA, Australia, and the North Sea.
- Shaw is moving to more comprehensive integration of bar coding - automated bar coding will be standard in all Canadian plants.
- Why use bar coding?
    - traceability for Q/C programs - data is not lost or misread
    - efficiency in the plant - less manual transfer of data
    - inventory control - electronic tracking of materials in stockpiles
    - safety in the field - less manual transfer in the ditch
- Types of bar coding:
    - one dimensional, based on bar spacing (Code 39, Code 128, etc.)
    - two dimensional, allowing for more information (PDF 417, etc.)
    - matrix, allowing for significant amount of data in a small space (primarily used in small parts manufacturing)
- CSA has sanctioned Code 39 and PDF 417.
- Shaw is recommending that Code 128 be adopted by industry and will try to convince CSA that this is the right choice for the following reasons:
    - Code 128 allows for more data than Code 39
    - Code 128 can be printed smaller than PDF 417 and so is easier to read in bright sunlight
    - Code 128 does not require labelling technology so is less expensive than PDF 417
- Disadvantage of bar coding in general is that the bar code is difficult to find on the pipe, particularly in stockpiles or in ditches, unless put on in a number of locations.
- Disadvantage of Code 128 is that it does not provide redundancy so data is lost if bar code is damaged.
- To remedy these problems to date Shaw is generally using multiple labels on each joint (up to 6 only - more is too expensive).
- Shaw is now pioneering the ultimate solution - continuously repeating spiral bar code stencil applied using ink jet technology - trials are underway.

Bar Coding Advantages in the Field (Ellipse):

- Bar code data can be collected with scanners in the field with the following advantages:
    - elimination of manual data entry errors
    - one person can collect all the data
    - material data is immediately accessible in a database
- Bar code data can be overlaid with survey (GPS) data, bend information, weld numbers, pipe features (weights, etc.) to form a complete pipeline database.

General Discussion:

- Reynold Hinger stated that the continuously repeating spiral bar code stencil concept appeared to be the key to the success of bar coding in this application.
- It was noted that the continuous stencil concept would have significant advantages where a pup is cut from a joint - traditionally material data can be lost in this case.
  - Question: Can data be customized for clients?
    Answer: Shaw believes data should flow from pipe mill to coating mill to client, who can then do with the data as they see fit.
  - Question: Are different users of bar codes standardizing in any way?
    Answer: All industries that have adopted bar codes in the past have ended up standardizing on common data sets and rules - the pipeline industry will have to do the same. Otherwise, data could be inadvertently duplicated and become useless in the future. Shaw is trying to be proactive in this area.
  - Question: How long will the bar codes last in the ground?
    Answer: Ink suppliers only warranty for 5 years. In reality it is highly dependent on ground conditions - could last 1 year or 20 years.
  - Question: Is yellow jacket stencilling longevity a relevant experience source?
    Answer: No - inks are different.
  - Question: Is PDF 417 in use anywhere?
    Answer: American Steel Pipe still uses this type of bar code - field experience with A.S. Pipe was disappointing due to data reading and interpretation capability.
- It was noted that the ultimate extension of bar code technology is a visible code or electronic signature of some type that could be read by an in-line inspection tool. The tool could then be used to "as-built" the pipeline material data.

Tuesday, April 13, 2:15 P.M. Session
Topic: Integrity Management on the Echo Pipeline
Speaker: D. Kulcsar - Gibson Petroleum Company Ltd.

- The Echo Pipeline is a 12" diameter, 153 km pipeline from Elk Point (N.E. Alberta) to Hardisty, which has been operating since March 1, 1997.
- Echo is a hot oil line transporting 0.986 SG material at temperatures between 50°C and 95°C.
- Conventional pipelines can operate with material viscosity up to 1000 cS, but at conventional temperature of 5°C to 25°C this requires diluent content of up to 20%.
- The Echo Pipeline line operates in the same viscosity range, but with no diluent - thus the requirement for the high temperatures.
- The reason for operating with no diluent at high temperatures is capital cost savings due to the following:
    - half the amount of cooling required at the upstream end (1 cooler instead of 2)
    - no return diluent line required
    - smaller pipeline diameter required (or 20% higher capacity), due to no diluent in the oil
- Another advantage is increased marketing flexibility (custom blends can be made at the downstream end) - current blending is with condensate at Hardisty (to Enbridge 350 cS spec)
- Disadvantage is non-diluted oil must be kept moving so excessive cooling doesn't occur and cause the oil to reach non-pumpable viscosities (oil could reach ground temperature in 10-15 days).
- Contingency plan for planned shut-downs is to add diluent ahead of time. Contingency plans for un-planned events include provisions for fast (2-3 day) response times.
- Design considerations with respect to heat loss to the ground included:
    - the effect on oil viscosity
    - the effect on the soils (interference with the natural freeze-thaw cycle) and root zone temperatures (for plant life)
- 2" of insulation and 6' of cover was required to mitigate heat loss effect to acceptable levels.
- Multi-layer coating system was required:
    - primer
    - corrosion protection tape
    - polyurethane foam insulation
    - rockshield tape
    - polyethylene jacket
- This coating had the following disadvantages:
    - it was difficult to apply over field welds
    - it was difficult to bend (a mandrill had to be used)
    - it prevents the cathodic protection system from working effectively (no soil/pipe bond)
-

- Other design problems included:
  - -40°C ambient to +100°C design temp range exceeds CSA-Z662 max. range of 59°C - hot air was used to raise temperature to 55°C prior to installation
  - detailed stress analysis had to be done at valves, traps, and riser - traps and valves were located near bends; risers were installed with 2" foam to allow movement
  - all station piping had to be insulated to prevent burns to operating personnel and overheating of equipment
- Proactive integrity management is required, since heat and lack of effective CP protection may accelerate corrosion - corrosion inhibitors are required.

Discussion:

- Question: What type of pumps are used?
  Answer: PD pumps due to extra capability during upset (low viscosity) conditions. It was noted that some pump failures have occurred due to high sand content in the heavy oil.
- Question: What type of fuel is used? Was the pumped product considered?
  Answer: Natural gas and no, the oil was not seriously considered as a fuel source.
- Question: Has an in-line inspection tool been run? Would it be run in the heavy oil?
  Answer: No, the line has only been in service since 1997 and no, unless the tool could withstand the temperatures - diluent could be added for a tool run.
- Question: Were there any special considerations (for coating protection) for crossings?
  Answer: All crossings were bored or drilled and no special protection was incorporated.
- Question: What would Echo do to repair the pipe in case of a failure (in time to prevent excessive cooling)?
  Answer: For a minor leak or puncture - sleeve and plan a cut-out later; for a catastrophic failure - stopple and replace.
- Question: How often is pigging required?
  Answer: Once per month.
- Question: Are higher temperatures being considered for other projects?
  Answer: Gibsons may look at 85°C to 110°C for other projects.

Tuesday, April 13, 3:30 P.M. Session
Topic: Non-Destructive Techniques for Measurement of Pipeline Corrosion
Speaker: Richard Kania - RTD Quality Services

- Existing technology for corrosion defect mapping includes:
  - pit gauges (external corrosion)
  - bridging bars (external corrosion)
  - ultrasonic pencil probes (internal corrosion)
  - ultrasonic mapping systems (internal corrosion)
  - laser based mapping systems (external corrosion)
- Why laser based mapping?
  - better accuracy of measurements
  - better repeatability
  - not reliant on operator skill
  - faster than manual methods
- Laser based mapping tools provide plan and profile plots and can do an automatic RSTRENG analysis if desired.
- RTD initially developed the MK I Laser Pipeline Inspection Tool (LPIT) but numerous problems were encountered during field trials:
  - baseline assumed perfectly straight, round, smooth pipe: in fact seams, bends, sags, dents, and bulges affected the accuracy of readings
  - map size was limited to 27" x 8"
  - tool stood 25" above the pipe surface - use below the pipe was limited
  - operating temperature was limited to 0°C
- As a result of the above problems, only 30% of corrosion defects could be mapped accurately.
- RTD has now developed the MK II LPIT, which has the following enhancements:
  - new software is capable of coping with surface irregularities, welds, etc.
  - the scan area is 103° circumferentially, unlimited length
  - grid is 1 mm x 1 mm
  - profile is only 8" above the pipe surface
  - resolution is +/- 0.2 mm
  - spot laser eliminates shadowing effects
  - operating temperature is -30°C to +50°C
- When trials are completed, the MK II LPIT should be much more successful than the MK I.
- RTD has two other tools for corrosion measurement:
  - PipeScan for MFL measurement of internal corrosion
  - MapScan for ultrasonic measurement of internal corrosion

Discussion:

- Question: Does the MK II have B31G or CSA-Z662 analyses built in as well as RSTRENG?
  Answer: No, these analyses are based only on defect length and maximum depth - there is no point in doing laser mapping if a B31G or CSA-Z662 analysis is planned.
- Question: What surface preparation is required?
  Answer: The tool measures what it sees - for accurate measurements, all corrosion products must be removed and sandblasting is best for this purpose.
- Question: How quick is the set-up?
  Answer: Very quick - the tool just has to be placed on the pipe.
- Some discussion ensued on RSTRENG, including the inference that with use of in-line inspection tools, RSTRENG is not required. It was noted that the discussion was not intended to spark debate about the appropriateness of methods of corrosion defect assessment. If a pipeline operator has already decided that RSTRENG is the appropriate method to use, manual methods of data collection do not necessarily provide enough data or enough good quality data to ensure that an RSTRENG analysis can be properly undertaken. The MK II tool, if successful, will provide operators with good quality data, quickly and efficiently.

Wednesday, April 14, 8:15 A.M. Session
Topic: Quality Control Systems for Construction, Repair, and Alteration of Pipelines
Speaker: L. Gerlitz - JLG Engineering

- Survey of representation in the room:
  - Regulators: 4
  - Involved in Codes / Standards: 6
  - Owners / Users: Producers - 4; Transmission - 15; Distribution - 3
  - Manufacturers: 2
  - Contractors: Construction - 2; Service - 3
  - Outside Canada: 1
- Who's doing what?
- Regulators:
  - Provincial regulators do not require formalized QC/QA procedures for pipelines
  - Provincial regulators do require formalized QC/QA procedures for plants
  - Federal regulators (NEB) do have some non-specific QA requirements
- Industry Codes / Standards:
  - CSA standards require formalize procedures for equipment manufacture
  - CSA does not require formalized procedures for construction, repair, alteration
- Owners / Users:
  - Some require contractors to have approved QC/QA programs
  - Others require contractors to follow Owners programs

- Manufacturers:
    - Required by CSA to have formalized programs
- Contractors:
    - Generally have documentation systems, but these are not standardized throughout the industry
- What is the experience here today? / What should the future hold?

Discussion:

- Question: CSA-Z662 requires that all companies have Operating and Maintenance Manuals. Isn't that the same as a QC/QA program? Isn't the difference just semantics?

  Answer: No, most company O&M Manuals lack critical elements:
    - commitment by management to QC/QA
    - clearly defined responsibilities for QC/QA
    - documentation requirements
    - defined audit processes
- A consultant, who writes O&M Manuals noted that he agreed with the previous answer.
- The attendee from the India noted that the India Oil Corporation operates 7000 km of pipelines and rigorously follows ISO 9000 and ISO 14000 Series QC/QA programs in materials, construction, and maintenance.
- A contractor noted that his company has recognize that more QC/QA service is required - they currently provides detailed QC/QA records on CD ROM to owners at the completion of construction.
- Another contractor echoed the previous comment and stated that their QC/QA documentation system has arisen from proactivity on their part - not because of requests from owners.
- John Hendershot noted that the NEB does distinguish between O&M Manuals and QC/QA Programs.
- Paul Wong asked (rhetorically) - do owners really always follow the procedures in our O&M Manuals?
- Reynold Hinger asked - are there any other ISO 9000 or 14000 Series owners in the room? There were not.

Wednesday, April 14, 9:15 A.M. Session
Topic: NEB Pipeline Integrity Management Program
Speaker: John Hendershot - National Energy Board

- NEB is an independent tribunal with a mandate under the NEB Act to ensure the safe design, construction, and operation of pipelines which cross provincial or national borders.
- There have been 22 major pipeline failures since 1991, most from corrosion, 5 from SCC, 3 from slope stability problems, a few from other causes.
- The 1996 SCC Inquiry recommended SCC Management Programs and the NEB mandated these, but the NEB is also concerned with broader pipeline integrity issues.
- NEB representatives met with 13 pipeline companies to assess the status of their Integrity Management Programs and begin the process of broader regulations.
- The new regulations include:
    - an emphasis on maintenance
    - a requirement for proactivity by owners
    - Integrity Management Guidelines
- The Integrity Management Guidelines are not a regulations. Instead they:
    - represent industry "best practices"
    - allow a degree of flexibility
    - allow enforcement based on "intent" and using an audit process
- The ultimate goal is safe and reliable pipeline systems.
- The Guidelines include four key elements:
    - a Management System
    - a Working Records Management System
    - Condition Monitoring
    - Mitigation
- The Management System contemplates:
    - lines of responsibility and reporting to senior management
    - training
    - change management
    - an audit process
- The Working Records Management System contemplates:
    - access to integrity data within 24 hours
    - documentation of procedures to track, analyse, and trend pipeline condition
    - documentation of records of pipeline condition
- Condition Monitoring contemplates:
    - baseline in-line inspection (ILI) within 6 months of construction
    - engineering assessments of pipeline integrity at 10 year intervals (pipeline integrity assessment will be addressed in the new version of CSA-Z662 but the NEB has added the time limit)
    - risk assessment (recognition that qualitative rather than quantitative can be valid)

- identification and prioritization of failure causes
- methods used to evaluate integrity (ILI, hydrotest, etc.)
- incident reporting procedures
- monitoring and surveillance programs

- Mitigation contemplates:
  - criteria for evaluation and action
  - consequences
  - procedures for repair
  - long term plans
- Current status of the Guidelines and future plans:
  - Onshore Pipeline Regulations and Guidelines currently out for industry review
  - NEB will be changing its approach to audits and inspections
  - will be developing facility (stations, tanks, etc.) guideline in 1999
  - will be developing a gas plant guideline in 2000
- The "intent" of the Integrity Management Program is:
  - proactive, comprehensive, and continuous integrity management processes
  - encouragement to use latest technologies
  - a common language in a single document
  - senior management support
- Measurements of the Program effectiveness will be:
  - the level of proactivity achieved
  - the level of information sharing achieved
  - increased research
  - direct CSA involvement
  - reduced pipeline failures

Discussion:

- Question: Is the sharing of information referred to company to company or company to NEB?

  Answer: The key will be company to company to develop best practices.
- It was noted that the NEB has mandated information sharing for SCC - this could presumably be extended to all aspects of pipeline integrity.
- Question: What is the intent with respect to CSA-Z662?

  Answer: Hopefully the Guidelines will eventually become part of CSA-Z662.
- Question: The 6 month ILI suggestion - is this really practical?

  Answer: The actual wording uses the term "consideration". Common practice in industry is to do some form of baseline tool run.
- It was noted that the NEB's apparent recognition of qualitative risk assessment is a very positive step - in addition, guidelines should be issued for carrying out qualitative risk assessment.

- It was noted that some companies have developed structured qualitative risk assessment methods.
- Question: Are CEPA and CAPP involved in the review process?
  Answer: Yes.
- Question: Are any training specifics included?
  Answer: No, concepts only
- It was noted that the representatives in the room generally support guidelines rather than regulations. However, guidelines often become regulations later and care has to be taken to ensure this does not happen.
- It was noted that one of the key advantages to guidelines is that they can be easily changed - regulations can take years to change.
- It was noted that the NEB intends to make the guidelines scalable to be appropriate for the size of companies involved.
- Question: How often will changes be made?
  Answer: Not piecemeal but when necessary.
- Question: How will the IMP be enforced?
  Answer: By audit, based on an evaluation of the level of risk.
- Question: Won't that be a major change from current NEB practice?
  Answer: Yes, and will require a major change in audit procedures and training of auditors.
- Question: What about the AEUB?
  Answer: They have been kept informed.
- It was noted that the AEUB often follows NEB lead as practices become industry standard.
- It was noted that the fundamental premise is "due diligence", which crosses jurisdictional lines.
- Question: How do companies currently rank in IMP's from the NEB's viewpoint.
  Answer: On a scale of 10 - some 2's and 3's, some 8's and 9's.
- Question: Current regulations require self-audit. Will this still be the case?
  Answer: Yes.

Recorded by GTH on April 13/14, 1999.

Working Group 1
Construction, Repair, Maintenance and Geotechnical
(Wednesday Morning)

CO-CHAIRS: Reynold Hinger – TMPL
Paul Wong – Skystone Engineering

TOPIC: Steel Epoxy Compression Reinforcement Repair Sleeve

PRESENTER: Robert Smyth, Petro-Line Group

Objective of the Presentation: To present information regarding new technology.

It should be noted that the device discussed is not intended to be a pressure retaining device and is only used as reinforcing repair over defects found such as those described below. Note that none of these sleeves have yet been applied to pipelines in NEB jurisdiction. The sleeves have been applied to sizes up to 24-inch but larger sizes are possible. Larger sizes would require a heater device rather than hand held devices. Note that if corrosion were considered still active, then a pressure-retaining device would have to be installed.

A patent has been applied for.

This presentation covered Petro-Line's efforts to develop a new external corrosion repair technique for in-service pipelines. The CSA code (Z662) indicates that steel reinforcing sleeves are satisfactory for corrosion repairs and Petro-Line has developed an innovative way to install a steel reinforcing sleeve for that purpose. The subject sleeves have been used successfully for SCC and general corrosion repairs and for the repair of dents, arc burns, and various other defects – when the pipeline is in operation. They do not have to be welded to the pipe.

Historically the following have been used:
- Weld on sleeves
- Bolt on sleeves
- Fiberglass reinforced sleeves
- Cut-outs

The "Petrosleeve":
- Is easy to install
- Does not require line interruption
- Provides 100% support for the pipe
- Requires no welding
- Can be applied in a very severe (cold) environment
- Stays tight on the line
- Has no problem with disbondment

After installation the original pipe wall ends up in compression, which is confirmed by dial gage or caliper measurements.

Petro-Line has a computer program, which uses such data as diameter, wall thickness and grade to determine the installation parameters. The program tells you if the pipe wall will always be under compression at all pressures.

The pipe wall is sandblasted and:

- Epoxy is applied by hand to the wall of the pipe
- the sleeve is clamped in place
- jacks are used to hold the clamp in place, (jacks are not used for applying the correct degree of compression)
- heat is applied
- welders conduct 2 fillet welds on the attachment bars
- sleeve cools and shrinks the sleeve putting the pipe in compression

The time needed from sand blasting to completion of welding is about one hour.

The welds are given a magnetic particle inspection, coating is applied and the line is buried.

Verification testing has been conducted using strain gauges and cycling tests. Two samples were tested using pre-manufactured cracks. One test sample was not sleeved and the other was sleeved. In the latter case, under pressure, the pipe yielded outside the sleeve, while the unsleeved sample failed (ruptured). Another test was conducted using dents, where the dents were filled with epoxy and a sleeve was installed. The sleeve constrained the dent from moving as shown by measurements taken through a hole drilled through the hole and the epoxy. Petro-Line has installed these sleeves on a total of 504 repair sections since the spring of 1995 without failure. Five installations have been excavated and inspected to confirm integrity.

QUESTIONS AND DISCUSSION:

Does welding affect the epoxy?
The bars are 50% prewelded, and the field welding burns the adjacent epoxy without deleterious effect.

Purpose of the jacks?
To hold the sleeve in place only – the heat applied to the sleeve and subsequent cooling applies the compression to the pipe. A chain is applied with the jacks to hold the sleeve in place.

How do you control cooling?

Crude oil in the pipeline does not cool quickly. HVP materials cool quickly so the temperature applied is much higher than needed. No heat is applied after the first 2 passes of weld are applied to the bars. The weld must be completed before the pipe is sleeve is cooled down.

With regard to weld cracks?
Normally the tack welds on the bars are not magnetic particle inspected. The finished welds are inspected using magnetic particle methods.

Have these sleeves been used on spiral weld?
Not to date – but if done a cap would be ground in the weld cap or the sleeve. Butt welds would be similarly treated.

What about the very abrupt shoulder on the sleeve?
Epoxy is squeezed during installation so that moisture ingress is prevented. Close attention must be applied to the "zippers" during the application of the exterior protective coating. If a tape system is being used – then mastic is applied to the zipper area.

How is temperature measured during application of the sleeve?
By using heat guns and tempil sticks.

Questions regarding temperature effects/soak time?
The epoxy needs to set and cure. The sleeve must be applied before the epoxy has set. The "trick" is to heat as quickly as possible.

Has a finite element analysis been conducted?
No!

Any additional testing?
Two sleeves were applied to 10-inch pipe and then dismantled. With no epoxy installed under the sleeve, 2800 pounds of force were required to remove the sleeve. In the case where epoxy was applied – 40,000 pounds of force were required to remove the sleeve.

What weld rods are used?
7018 – small diameter.

Required labor skill?
Within Petro-Line, the same crews have always been used for the installations.

BAR CODING

Information Update

Why Bar Code

- Traceability
- Pipe Tracking and Inventory Control
- Safety, Accountability and Efficiency
- Information Transfer

Symbologies can be broken down into three categories

- Linear or one dimensional
- Two dimensional
- Matrix

Linear Bar Codes

Linear or 1 dimensional bar codes are the most popular and they are referred to as Code 39, Code 128, 12 of 5 UPC to name a few.

Dimensional bar codes include Code 49, 16K and PDF 417. These symbologies are used to encode data in a very small area as on a circuit board or for applications that require a large amount of data to be encoded as on a shipping manifest

Matrix Symbologies

- Matrix symbologies have the capacity of storing a significant amount of data in a small space. They are most frequently used in small parts making in the electronics and medical industries and for sortation and tracking applications in the transportation and freight industries. The most popular matrix symbologies include Data Matrix, Code 1 and Maxicode.

What Symbology Will The Industry Use?

- Code 39 or 128
  - Easy to print/inexpensive
  - Limited information
  - Most compact
  - Shaw Pipe Protection choice

CSA Standard

Pipelines conform to CSA Standard

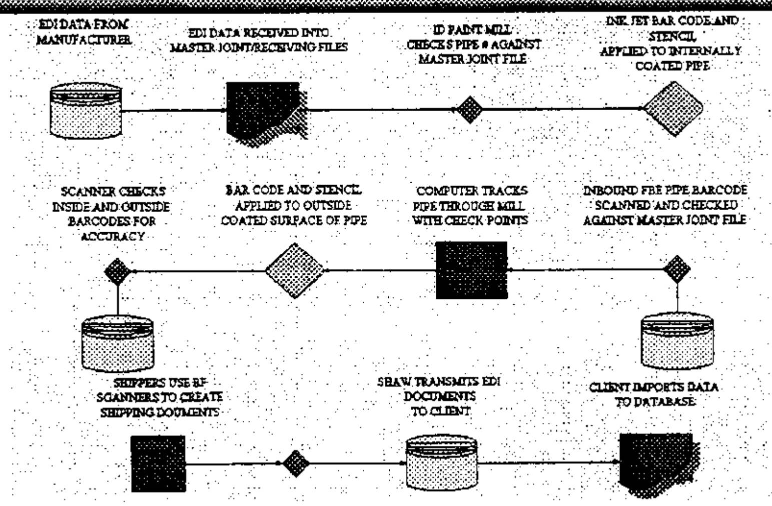
Pipeline steel/coating standard updated every two years

CSA bar code standard adopted in 1998

What is Shaw Pipe Doing?

- Implementing automated bar coding at Canadian plants
- Working with manufacturers and clients on EDI of information
- Developing technology to print 1 dimensional bar codes directly on surface of coated pipe

Automated Bar Code System



The ECHO Pipeline

Integrity Management on the ECHO Pipeline

Presented to: **Banff99 Pipeline Workshop:**

Managing Pipeline Integrity - Technologies for the New Millennium

Date: **April 13, 1999**

Presented by: **David Kulcsar**

Hardisty Operations Engineer

Gibson Petroleum Co. Ltd.

Background

- the ECHO (East Central Heavy Oil) Pipeline is a 12" pipeline that delivers heavy crude from the Elk Point area (S.G.=0.986) to Hardisty a distance of 153 km
- it was constructed by Gibson and Ranger and has been operated by Gibson since March 1997

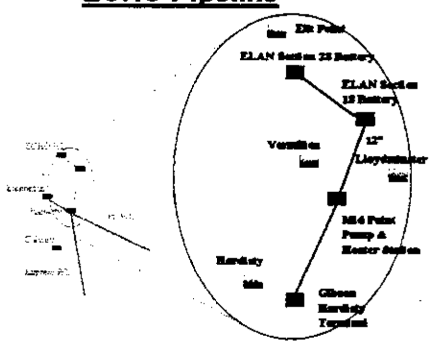
ECHO PIPELINE Presentation

- Background
- Pipeline Design
- Construction
- Operational Issues

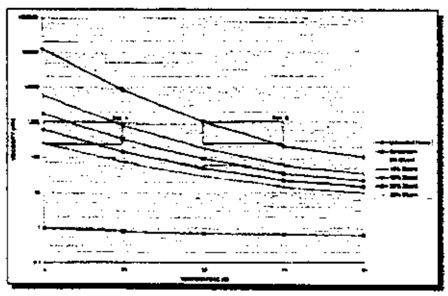
Background

- what makes this pipeline unique is that it is a hot oil pipeline
  - the design operating temperature is 50°C to 95°C
  - no condensate is required
- ECHO heated pipeline technology uses higher crude temperatures to reduce viscosity

ECHO Pipeline



Viscosity Comparison Graph



Background

- advantages of a heated oil pipeline include
  - lower pipeline/producer capital costs
  - lower pipeline/producer op costs
  - increased pipeline capacity (~20%)
  - simplified pipeline operations (no blending)
  - inc. Marketing flexibility (custom blends)
  - no additional investment to meet 350 cSt

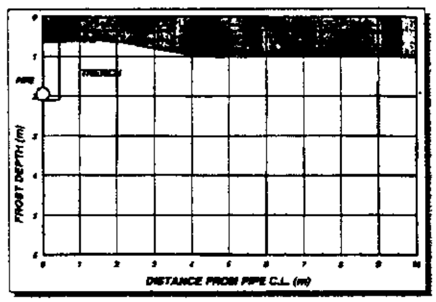
Pipeline Design & Construction

- the initial design parameter was to minimize the heat loss to the environment in order to maintain an acceptable viscosity
- during the design it became apparent that there were overriding environmental factors
  - freeze/thaw cycle on the Right-of-Way
  - root zone temperature effects on the ROW
- during construction, 2" of insulation and 6' of cover were required (environmentally)

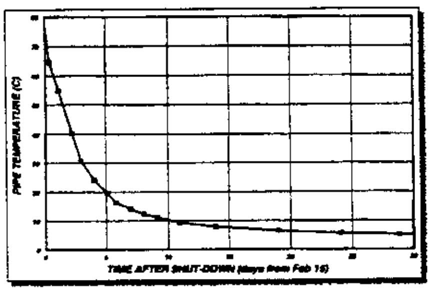
Background

- disadvantages of a heated oil pipeline
  - the pipeline *must* remain in motion as the oil in the line is continually cooling and could set up if its temperature drops too low
  - response time to an upset is critical (2-3 days)
  - contingency plans include diluting the pipeline with condensate prior to a planned, prolonged shutdown

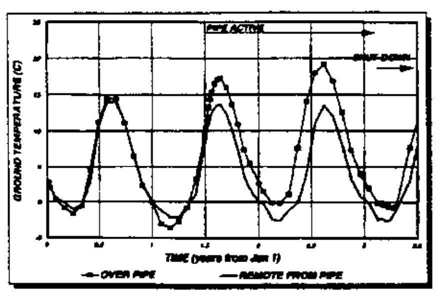
Seasonal Frost Depth



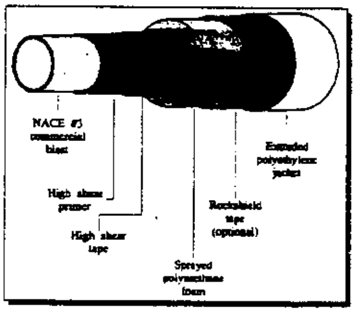
Response Time



Root Zone ΔT



Pipeline Coating System



Pipeline Design & Construction

- during construction, hot air was blown into the pipe to raise its temperature to 55°C
  - large sections of unrestrained pipeline were heated and then backfilled (typical ~ 1.5 km took 6 hours)
  - prior to doing tie-ins of two large sections, the pipe was heated in both directions for a minimum of 100 meters (virtual anchor)
  - the insulation allowed 4 to 5 hours for the tie-in to be completed

Pipeline Design & Construction

- other design/construction issues that arose from the insulation were
  - each pipe joint had to have the Coating System applied in the field
  - consistent compressive strength is required in the insulation to accommodate bending (or use a mandrill)
  - cathodic protection is not effective through insulation (great care is required to ensure the integrity of the coating system)

Pipeline Design & Construction

- a detailed stress analysis was performed to allow flexibility on the pipeline and eliminate the use of anchor blocks which could impose stress onto the system
  - block valve sites and pig traps were located in close proximity to pipe bends
- during construction, foam was installed around all risers to accommodate movement (2" at the block valves)

Pipeline Design & Construction

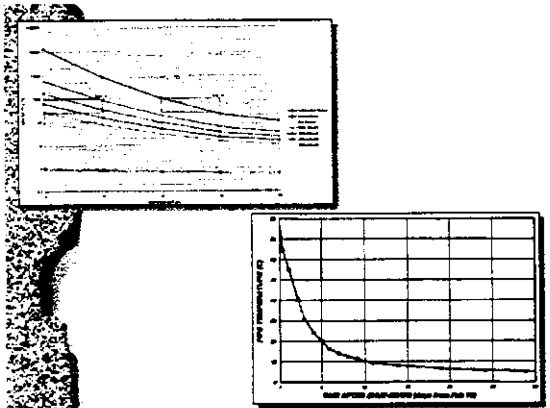
- combined Hoop and Longitudinal Stresses (Z662-94) imposed a design limitation of 59°C - maximum pipe ΔT
  - ambiant temperature during construction was - 40°C
  - normal operating temperature is as high as 100°C
  - at some sections of the pipeline ΔT= 140°C
  - thus, the installation temp had to be changed

Operational Issues

- The heat will promote the activity of any corrosion cells if they can get started
  - CP will have little effect through the insulation
  - be proactive in minimizing corrosion activity (chemicals)
  - routinely monitor for corrosion activity (pig yield, In-Line-Inspection)

Operational Issues

- all above ground piping must be insulated
  - personal protection (pipe temperature)
  - equipment operating conditions (ambient air temperature)
- pipeline operating temperature
- response time



Conclusion

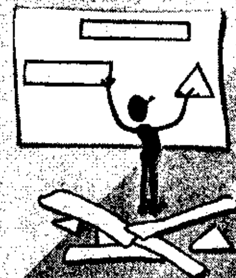
The ECHO Pipeline had many design considerations that had to be addressed before it could become operational, but once all issues were addressed, it can be seen as a pipeline with a bright future.

Non-Destructive Techniques For Measurement Of Pipeline Corrosion

RTD Quality Services Inc.

Investigative Excavation Programs

- Corrosion, SCC and Mechanical Damage Investigations
- Data Management - **Field Database**
- Specialized **Training**
- Specialized **Equipment**



Corrosion Investigation Programs

- Existing Coating Evaluation
- Corrosion Product Analysis, Bacterial Testing
- Detailed Wall Loss, Mechanical Damage Investigation and Assessment
- Specialized Wall Loss Measurement Equipment

External Corrosion Measurement Techniques

- Pit Gages
- Bridging Bars with Depth Micrometers
- Ultrasonic Pencil Probes
- Ultrasonic Mapping Systems
- **Laser-Based Mapping Systems**

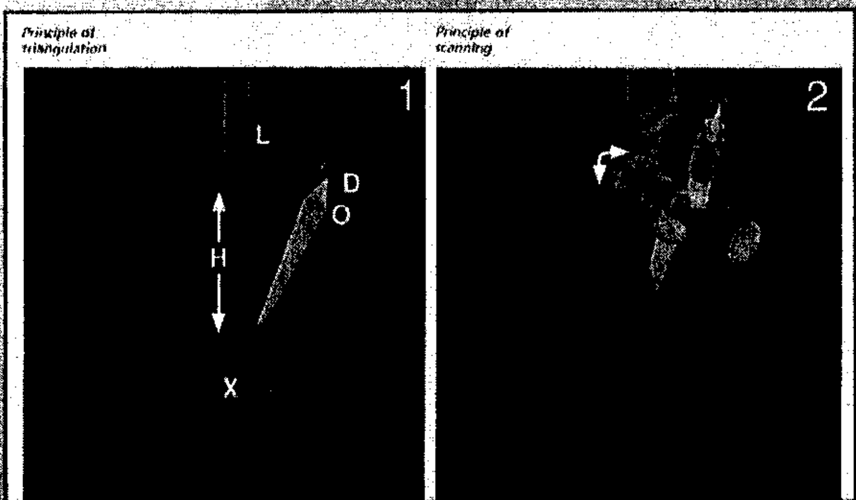
Purpose - Mechanized Inspection Tools

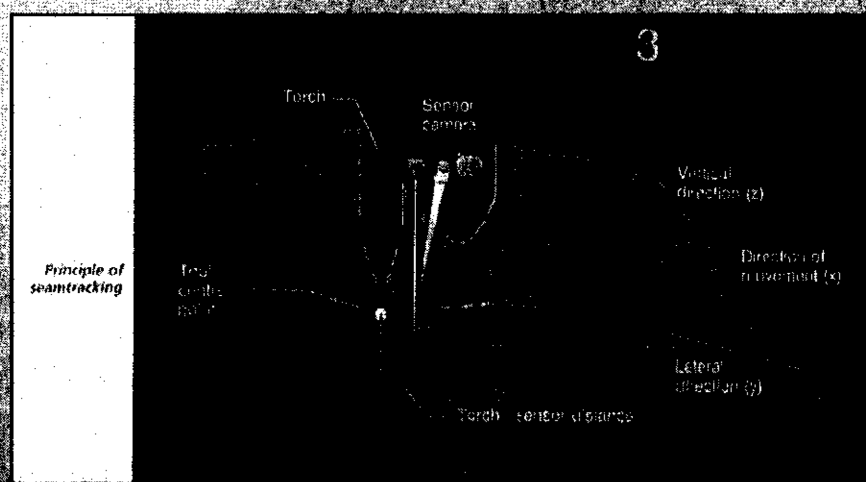
- Inspection Data Confidence
- Accurate Measurements and Assessments
- Increase Repeatability of Measurements
- Operator Independence
- Reduce Inspection Time

Laser-Based Pipeline Inspection Tool (LPIT)

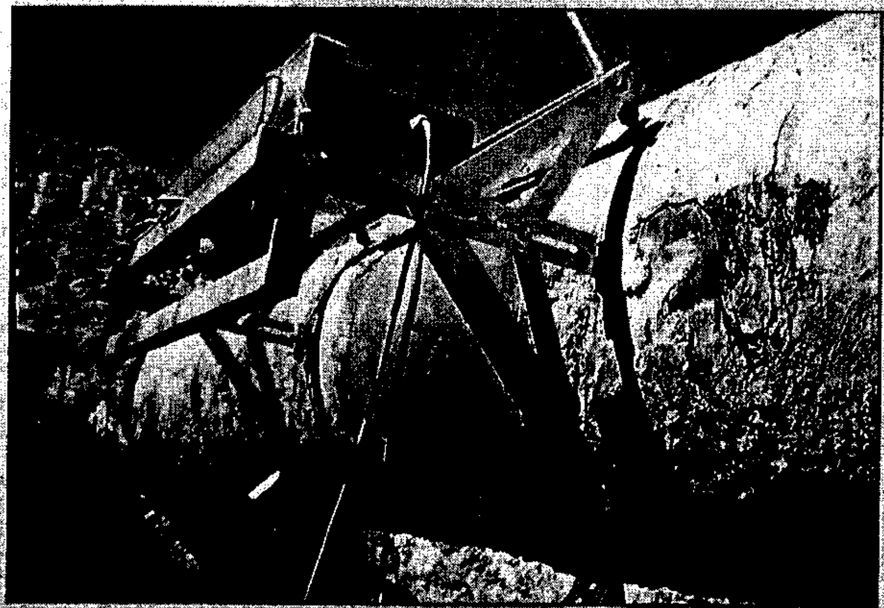
First generation LPIT

Mk II LPIT

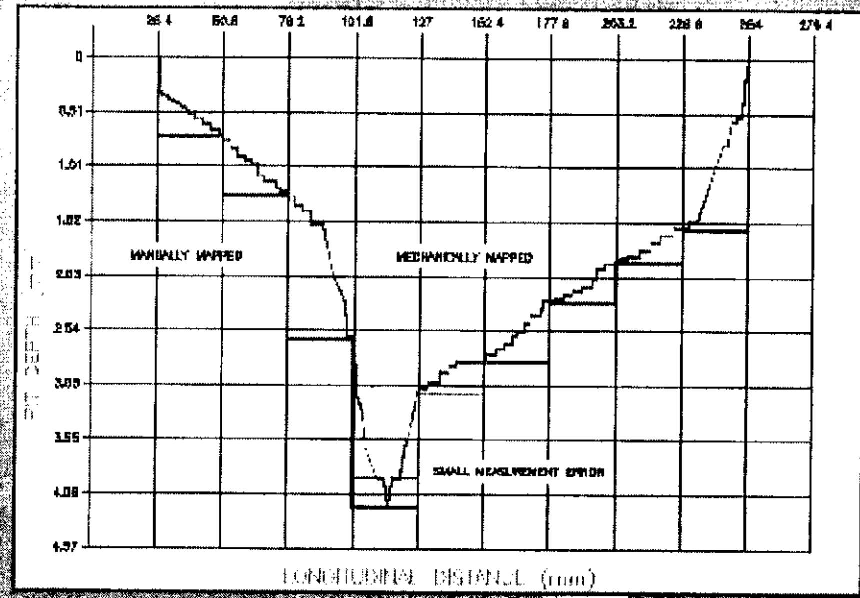




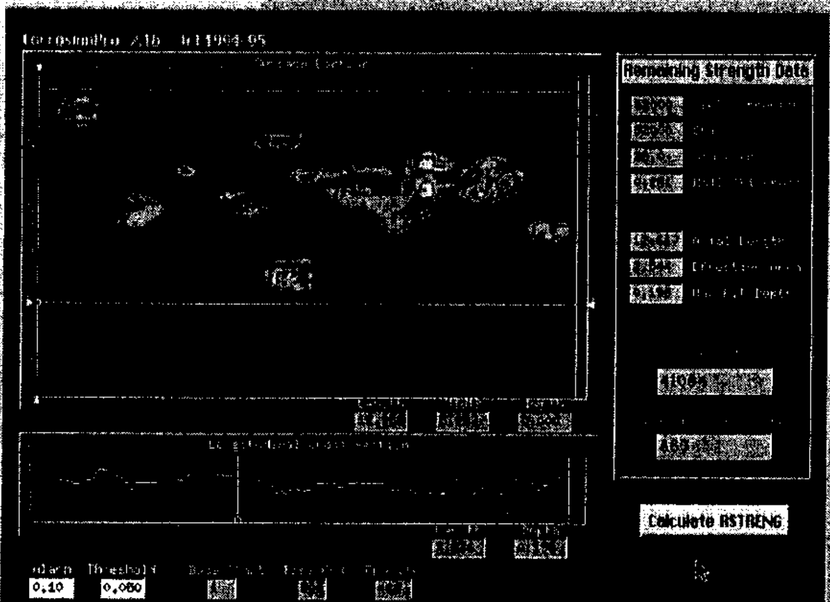
First Ge...ation LPIT



LPIT Data Collection Density



Laser System Output - First Generation LPIT



Why Mk II LPIT?

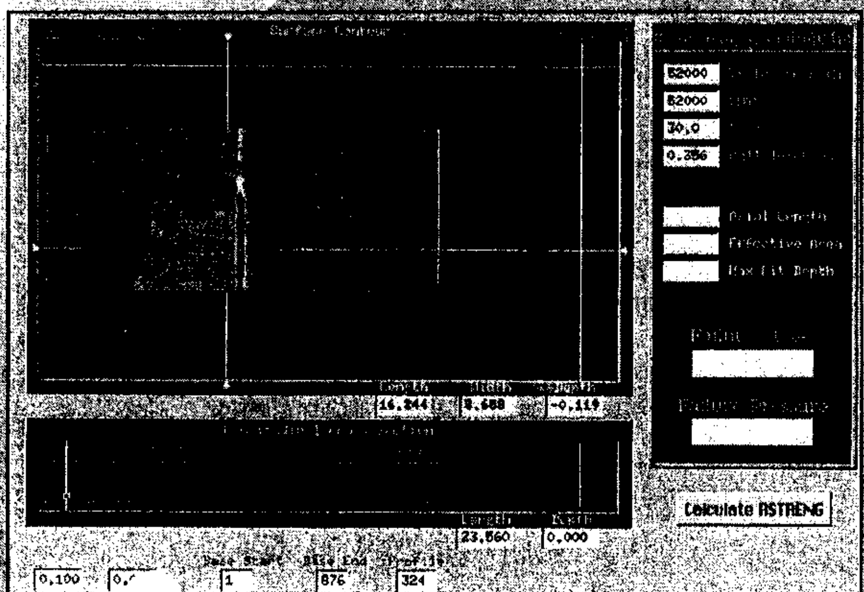
- Pipes are not straight and round!
- Extensive field trials and projects define **limitations** of first generation LPIT
- **Industry need** for efficient and accurate external corrosion mapping system.

Limitations of First Generation LPIT

- Unable to accurately map corrosion in the presence of long seams, circ. welds, side and over bends, sags, dents, bulges
- High system profile (25 in.)
- Limited single scan area (8 in. x 27 in.)
- Operating environment 0º C + (without hoarding and heating)

Illustration of Bulging of Corroded Area

Topographical View Illustrating a Girth Weld On a Bend Section

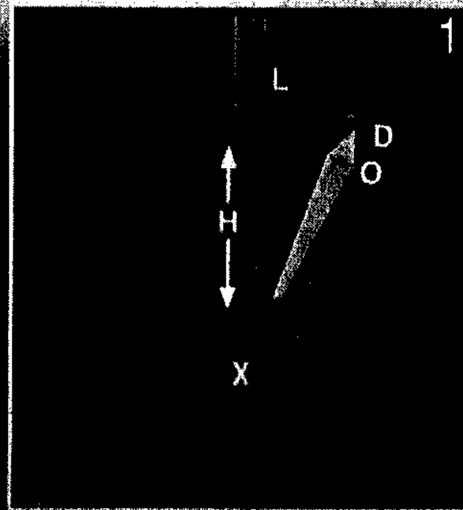


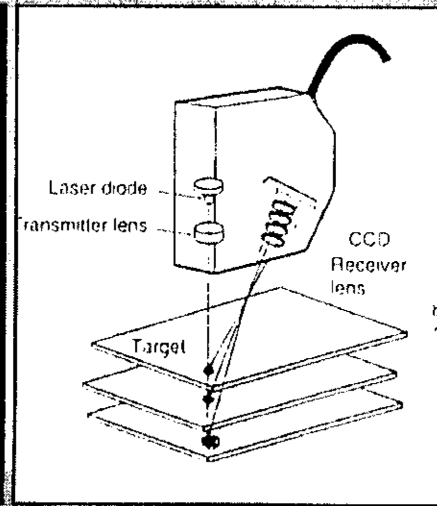
Mk II LPIT Specification

- Software capable of coping with surface deformations and welds
- Increased scan area - max. 103° of any pipe diameter circumference x unlimited length (1mmx1mm grid)
- Low profile - 5 in.
- Fast setup, efficient data collection

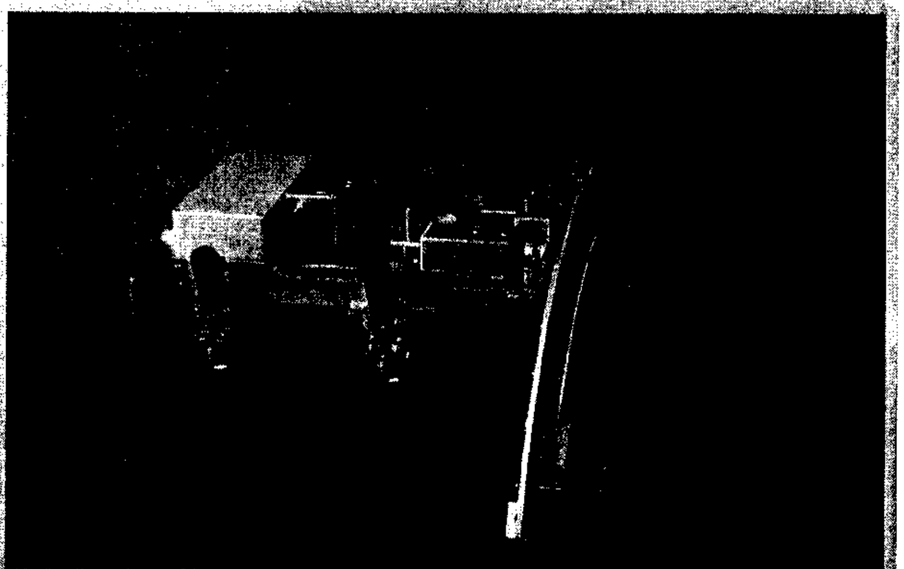
Mk II LPIT Specification (cont.)

- Built in RSTRENG module for quick data assessment in the field
- Depth measurement resolution - +/- 0.2 mm (preliminary tests)
- Flying Spot laser sensor eliminates shadowing effect
- Working environment -30º C / +50º C
- Text format of data output





Mk II LPIT

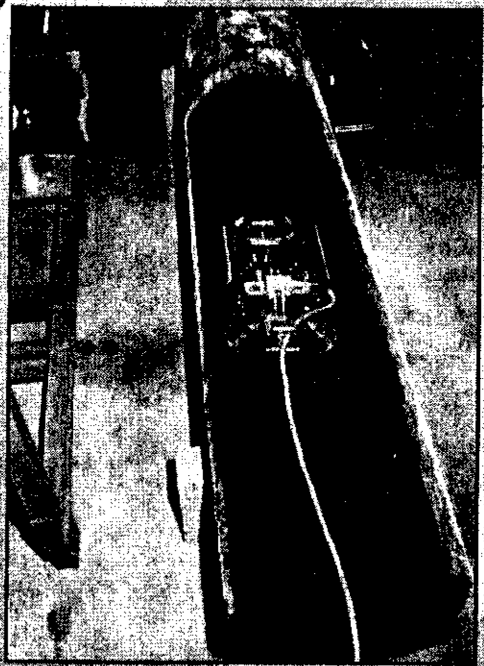


Internal Corrosion Measurement Techniques

- Manual ultrasonic hand scan/B-scan
- **Pipescan** - MFL scanner
- **Mapscan** - ultrasonic c-scan mapping

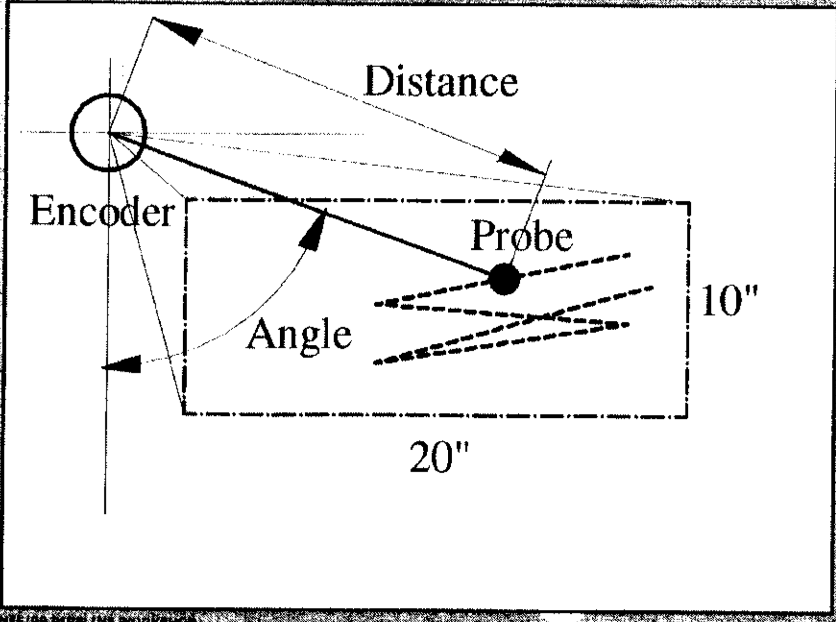
PIPESCAN Magnetic Flux Leakage Scanner

Pipescan
MFL scanner for quick detection of internal corrosion

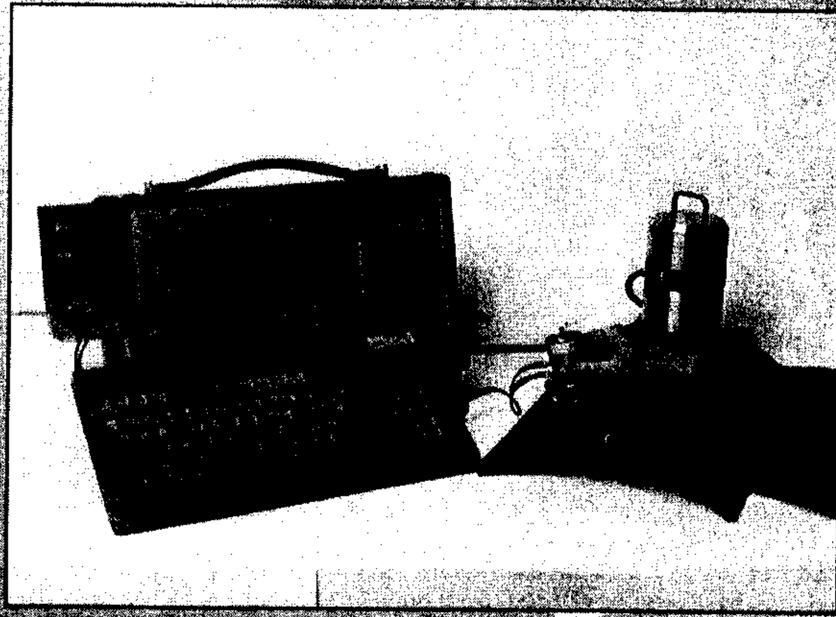


MAPSCAN Ultrasonic Semi-Automatic Scanner

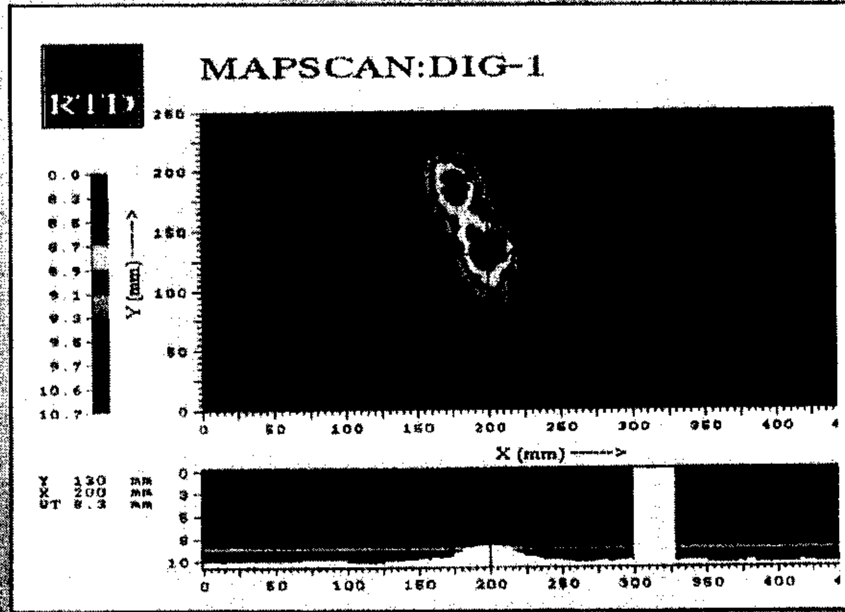
Mapscan principle



Mapscan - Ultrasonic C-scan Mapping System



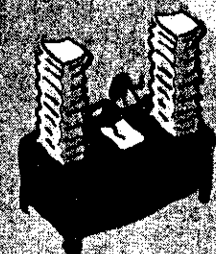
Color coded map of internal corrosion



Benefits

- Data Collection **Efficiency/Reduced** Inspection and Data Assessment **Time**
- Operator Independence
- Increased **Data Quality** and **Integrity**
- **Baseline** for Comparison With Other Technologies i.e. Calibration for ILI Inspection
- **Growth Model** Development

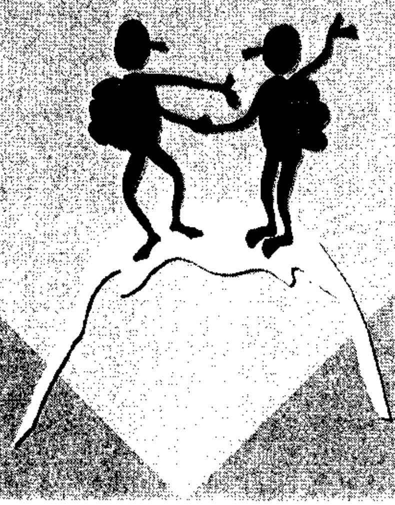
Summary



- **Efficient delivery** of corrosion Investigation Programs
- **Qualified Staff**
- **Reduced Risk** of Non-Conservative Assessments
- **Reduced Repairs**
- **Fewer Excavations**

The End

RTD Quality Services Inc.



QUALITY CONTROL SYSTEMS

for the CONSTRUCTION, REPAIR and ALTERATION of PIPELINES

Banff/99 Pipeline Workshop
Lyle Gerlitz

WHOSE DOING WHAT?

- GOVERNMENTS
- INDUSTRY CODES AND STANDARDS
- OWNER/OPERATING COMPANIES
- MANUFACTURERS
- CONTRACTORS

SOME CURRENT INFO

- GOVERNMENT REGULATORS
  - NO REQUIREMENTS BY THE PROVINCIAL REGULATORS OF PIPELINES(?)
  - FOR PIPING IN PLANTS UNDER PROVICIAL REGULATORS (e.g.ABSA, SPSB)
    - an approved QC System is mandatory for the Construction, Repair and Alteration of Pressure Piping (by all that do it)
  - SOME REQUIREMENTS BY THE NEB Onshore Pipeline Regulations
    - Materials Control 'A company shall develop a quality assurance program for the purpose of ensuring that the pipe and components to be used in the pipeline meet the specifications referred to in section 14'

SOME CURRENT INFO

- INDUSTRY CODES/STANDARDS
  - CSA STANDARDS for 'equipment' (pipe, fittings, flanges, valves) in the Z245 series call for the manufacturer to have a 'documented quality program in accordance with'
    - CAN/CSA-ISO 9000,
    - ISO 9000, or
    - API Q1
  - CSA STANDARD Z662, 'Oil and Gas Pipeline Systems' does not require a quality program for the construction, repair or alteration of the pipeline.

SOME CURRENT INFO

- OWNER/USERS
  - Some require contractors to have documented and approved QC Systems but don't have them for their own owner/user run jobs
  - Some require contractors to have documented and approved QC Systems and require owner/user run jobs to be under the owner/user documented (and audited) QC System
  - Some owner/users use the ABSA approved QC System (for piping) for their pipeline jobs

SOME CURRENT INFO

- MANUFACTURERS
  - for CSA pipelines, 'equipment' manufacturers are required to have a documented quality program under:
    - CSA CAN/CSA-ISO 9000
    - ISO 9000, or
    - API Q1

SOME CURRENT INFO

- CONTRACTORS
  - most have an documented quality control system that is offered to the owner/user for approval
  - the quality control system is not necessarily to a recognized industry standard

WHATS HAPPENING NOW?

- What is the experience of those here today?
  - Locally
  - Canada
  - other countries
    - Government Regulations
    - Industry Code/Standards
    - Owner/Users
    - Manufacturers
    - Contractors
    - Producing vs Transmission vs Distribution Companies

WHAT DOES (SHOULD) THE FUTURE HOLD?

- What do you think needs to be done in the future?
  - Government Regulations
  - Industry Code/Standards
  - Owner/Users
  - Manufacturers
  - Contractors

  - Producing vs Transmission vs Distribution Companies

NEB Pipeline Integrity Management Program Guidelines

John Hendershot

Canada

Topics of Discussion

- Background and Objectives
- Content of Guidelines
- Status and Future Guidelines
- Conclusions

Canada

Role of the NEB

- Independent regulatory tribunal reporting to Parliament through the Minister of Natural Resources... NEB Act/Onshore Pipeline Regulations
- ensure safe design, construction, operation and abandonment of international and interprovincial pipelines
- Jurisdiction over 40,000 km pipelines currently 48 gas/ 29 oil

Canada

Background

- 22 pipeline failures since 1991
- Stress Corrosion Cracking Inquiry in 1996 recommended extensive SCC management program
- Board also concerned with broader aspects of pipeline integrity
- Dialogue with 13 regulated companies

Canada

Revised Onshore Pipeline Regulations

- move from prescriptive to performance - based, goal-oriented regulations
- increased emphasis on pipeline maintenance
- requires companies to be more proactive in managing risks
- guidelines accompany revised regulations

Canada

Guidelines Vs Regulations

- Guidelines are not regulations but...
  - are advisory in nature and represent " best practices"
  - allow degree of flexibility not possible with regulations
  - enforcement of regulations will be based on the "intent" of the guidelines through audits

Canada

Objective of Guidelines

- ensure companies have comprehensive integrity management plan in place and provide the NEB with audit baseline
- ultimate goal...pipeline systems that are "suitable for continuous safe, reliable and environmentally responsible service"

Canadä

Content of Guidelines

- Four components
  - Management System
  - Working Records Management System
  - Condition Monitoring
  - Mitigation
- CSA Z662 and OPR references
- Continuous process

Canadä

Management System

- Scope (facilities, objectives)
- Lines of responsibility and reporting requirements to senior management
- training requirements
- change management procedures
- measure of effectiveness (audits)

Canadä

Working Records Management System

- access to data within 24 hours (pipe specs, mapping data, repair and inspection history)
- documentation of procedures to track, analyze and trend condition of pipeline
- documentation and records of pipeline condition (maintenance procedures, safety audits, system changes, historical records)

Canadä

Condition Monitoring

- In-line inspection within 6 months of construction
- Engineering Assessment of pipeline integrity
  - 10 year intervals or less
  - addressed in revised CSA Z662
  - ILI, hydrostatic test, dig data, metallurgical analysis
- Risk Assessment to rank segments
  - thought process invaluable
  - qualitative Vs quantitative

Canadä

Condition Monitoring (continued)

- identification and prioritization of failure causes (corrosion, manufacturing defects)
- methods used to evaluate pipeline integrity (ILI, hydrostatic test, digs, CP surveys)
- incident reporting procedures/failure cause analysis
- monitoring and surveillance programs (line patrols, slope movement)

Canadä

Mitigation

- criteria and procedures for evaluation of imperfections/ repair
- consequence analysis to establish repair priorities
- mitigative measures (cutout, sleeving, hot taps, hydrostatic retesting, pressure reduction)
- plans and priorities (short/long term)

Canadä

Guideline Status and Future Plans

- OPR and guidelines issued for comment in January...industry comments pending
- NEB changing approach to audits and inspections
- Facility Guidelines (e.g. stations, tanks) target late 1999
- Gas Plant Guidelines target year 2000

Canadä

Conclusions

- The "intent" of the Integrity Management Program Guidelines
  - proactive, comprehensive, continuous process
  - encourage technology and analytical methods (ILI, RA, EA)
  - common language in one document
  - Senior Management support is key

Canadä

Conclusions (continued)

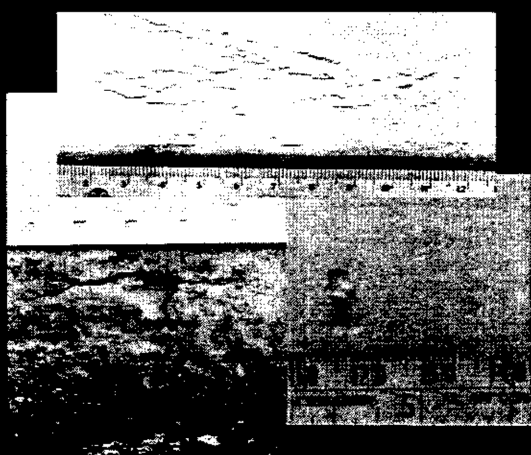
- Measures of guideline effectiveness
  - companies proactive
  - companies sharing information
  - increased industry research activity
  - direct CSA Z662 involvement
  - ultimately, a reduction in pipeline failures

Canadä

PETROSLEEVE STEEL REINFORCEMENT SYSTEM

- Permanent Repair for Pipeline Defects
- Designed to be Installed without Interrupting Pipeline Service
- Designed to be Installed without Welding to the Pipe

DEFECT TYPES

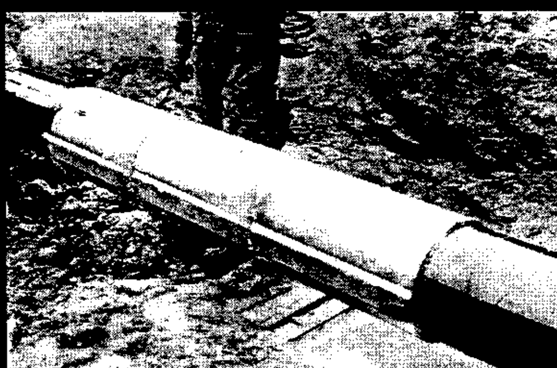


- Corrosion
- Stress Corrosion Cracking (SCC)
- Mechanical Damage
- Pipe Body Cracks
- Arc Burns
- Dents
- Weld Defect

PETROSLEEVE ADVANTAGES

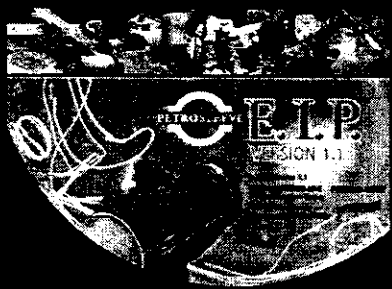
- Easy to Install
- No Interruption to Pipeline Service
- 100% Support of the Pipe
- Repairs Cracks & Corrosion
- Repairs Dents

PETROSLEEVE ADVANTAGES cont...



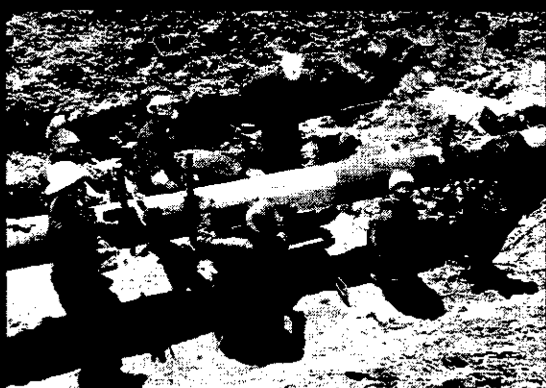
- No Welding to the Pipeline
- Can be Installed in Severe Working Environments
- Serviceable for all Operating Pressures
- Steel on Steel

PRE-INSTALLATION ASSESSMENT



- Carrier Pipe Information
  - Diameter
  - Wall Thickness
  - Grade
  - Seam Type
- Pipeline Operating Conditions
  - Operating Pressure & MOP
  - Operating Temperature
  - Product Type
  - Flow Rate

INSTALLATION PROCESS

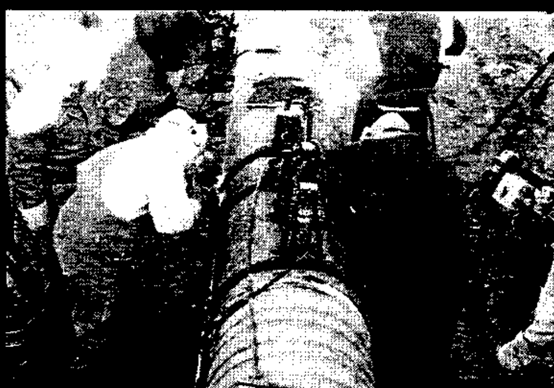


- Clean Pipe and Sleeve
- Apply Thin Epoxy Interface

INSTALLATION PROCESS cont....

- Assemble Sleeves
- Apply Compression Devices

INSTALLATION PROCESS cont....



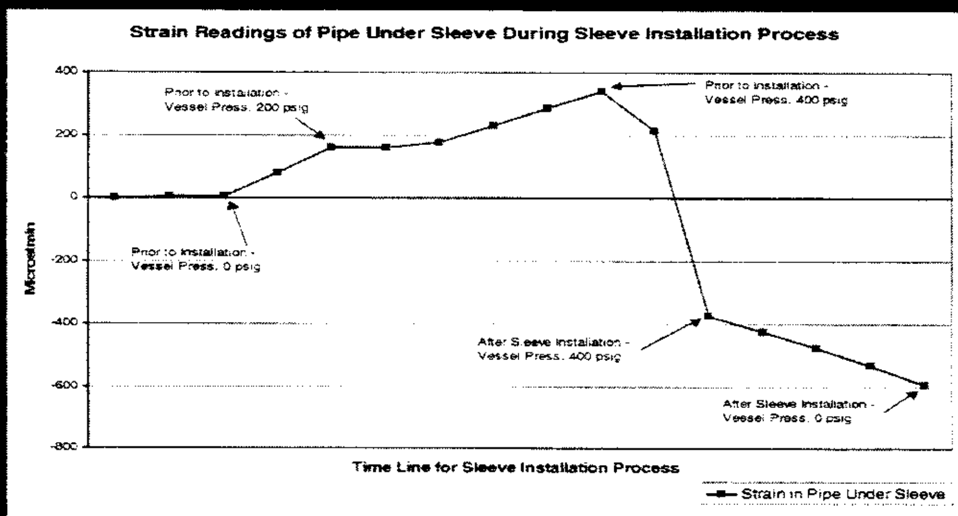
- Raise Temperature to EIP Requirement
- Complete Welding

INSTALLATION PROCESS cont....

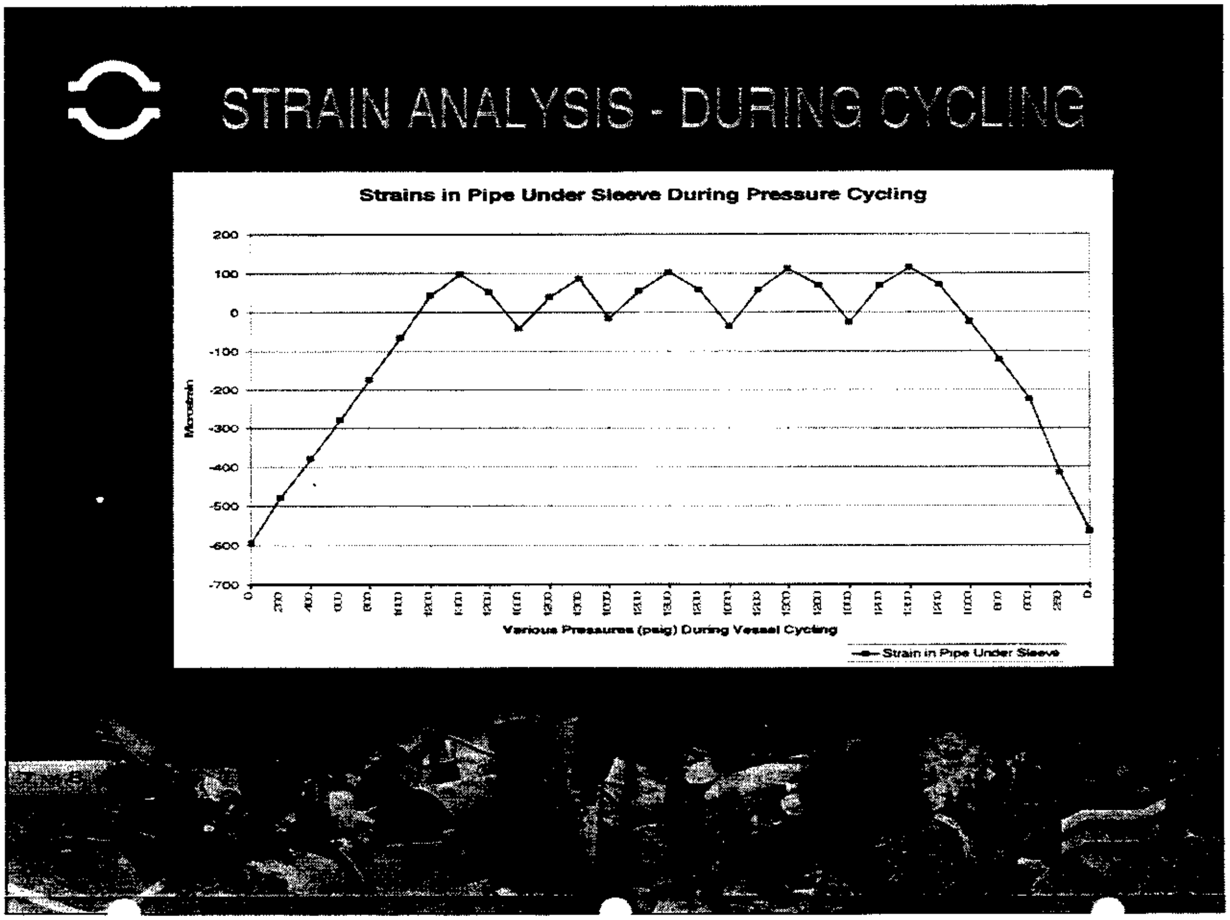
- Apply Coating and Backfill

20

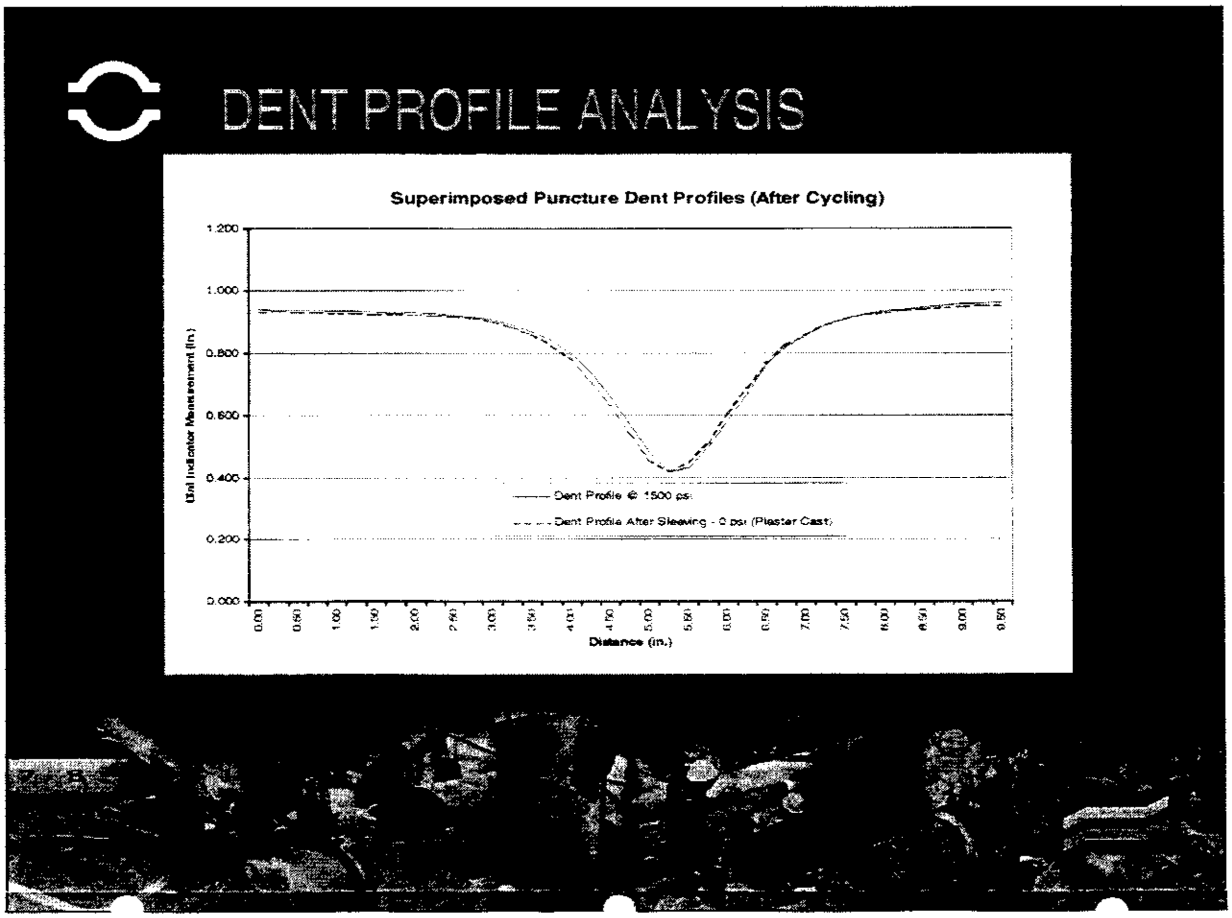
STRAIN ANALYSIS - DURING INSTALL



23


STRAIN ANALYSIS - DURING CYCLING
Strains in Pipe Under Sleeve During Pressure Cycling
Microstrain
Various Pressures (psig) During Vessel Cycling
Strain in Pipe Under Sleeve

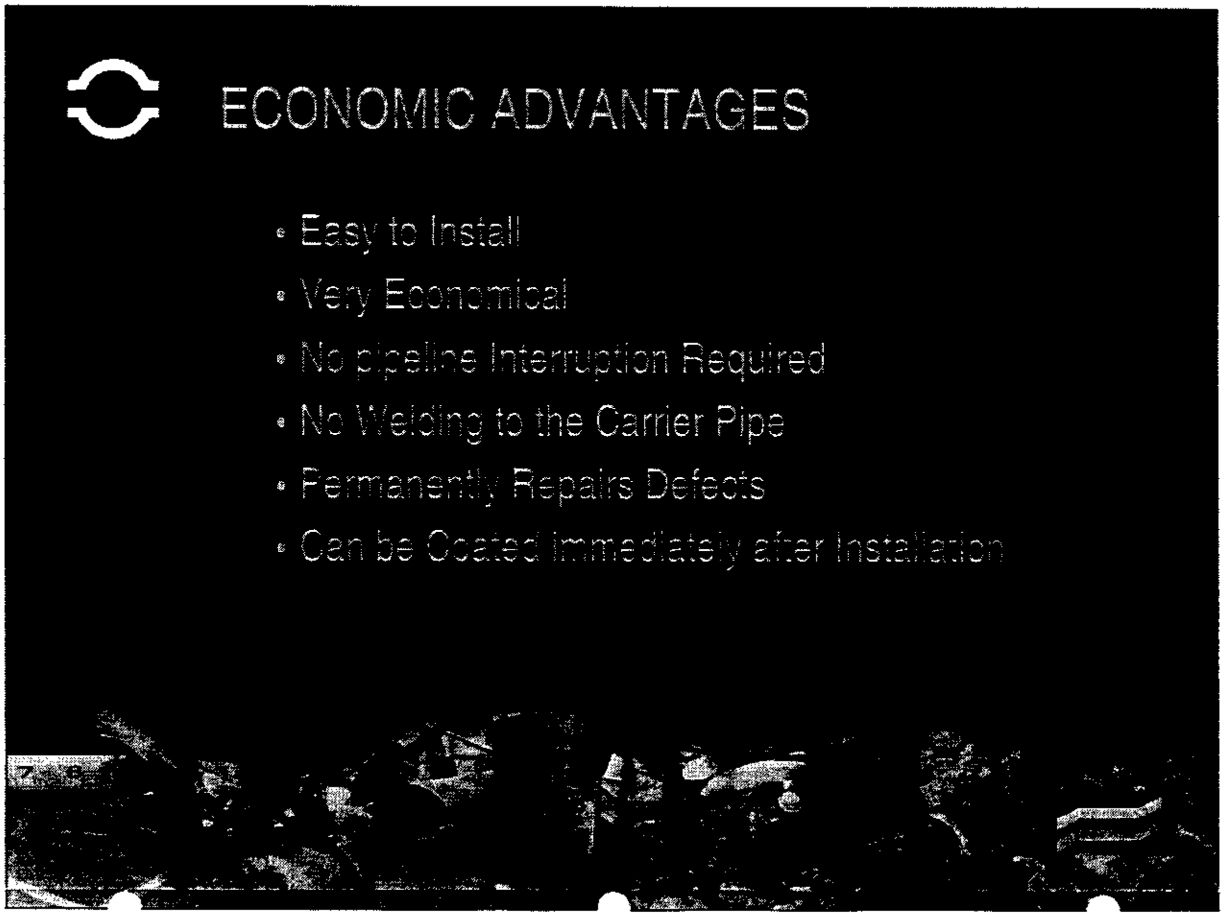
24


DENT PROFILE ANALYSIS
Superimposed Puncture Dent Profiles (After Cycling)
Dial Indicator Measurement (in.)
Dent Profile @ 1500 psi
Dent Profile After Sleeving - 0 psi (Plaster Cast)
Distance (in.)

27

PETROSLEEVE INSTALLATION HISTORY

PIPE DIAMETER (NPS)	NUMBER OF SLEEVES INSTALLED	PRODUCT	CORROSION	DENTS	SCC	ARC BURN	TESTING	OTHER
24	449	CRUDE	174		253			22
20	7	CRUDE	4				3	
18	4	SOUR GAS			4			
16	1	GAS		1				
12	2	CRUDE & LPG		2				
10	37	LGP, SOUR GAS	33			1	3	
8	3	CRUDE	1	1			1	
6	1	CRUDE	1					
TOTALS:	504		213	4	257	1	7	22



WORKING GROUP #1

Tuesday 1^st

Name	Affiliation
DENIS TRUDEAU	CORRPRO
DON MCNABB	APACHE PIPELINE PRODUCTS.
BRYAN SCOTT	ENBRIDGE PIPELINES INC.
CYRIL KARVONEN	TRANSCANADA MIDSTREAM
GEORGE CHERRINGTON	PEMBINA PIPELINE
Bernie Frost	A.E.U.B
BERT JOHNSON	GULF CANADA RESOURCES LIMITED
BOB KLICIAK	HUSKY OIL OPERATIONS LIMITED
Rudy Steiner	Husky OIL OPERATIONS LIMITED
Jeremy Nielsen	" "
Robert Smith	Minerals Management Service
David Taplin	Komex International Ltd.
D W Murray	Univ of Alberta
JIM BRONSON	Canusa
STEVE COOPER	CANSPEC Group Inc.
H. PAREKH	INDIAN OIL CORPORATION LTD. PIPELINES DIVISION, NEW DELHI, INDIA
Jim Steeves	Proactive Technologies Int'l. Inc.
Mack Kuppe	J P Kenny Canada Ltd.
Sandy Williamson	Shaw Pipe Protection Ltd.
I Kam Wu	3M Canada
DAVID KUKCSAR	GIBSON PETROLEUM
GREG HILL	CORRIDOR PIPELINE (TRANS MOUNTAIN)
DALE DYE	KEMACOAT INTERNATIONAL INC
Kob Prez	Ellipse Spatial

WORKING GROUP #1

Tuesday 1:15

Name	Affiliation
GLEN SCOTT	B.C. GAS.
LYLE GERLITZ	J.L.G. ENGINEERING LTD.
STEVE LEMON	GREENPIPE
Bruce Fowlie	Nu-Trac M'ment Consulting
Brian NESBITT	NATIONAL ENERGY BOARD
ED McCLARTY	WESTCOAST ENERGY INC.
Reena Sahney	TRANSCANADA PIPELINES.
Howard Wallace	Colt Engineering
Alex Afaganis	Camrose Pipe Co.
Doug Clark	Gulf Midstream Services Ltd.
LEN DANYLUK	PENGROWTH CORPORATION
Brad Watson	Trans Canada P/L
Mark Yeomans	TransCanada P/L
DON PERSAUD	Province of New Brunswick Dept. of Natural Resources & Energy
Paul Trudel	NEB
Frank M. Christensen	FMCMCI
Mark Ottem.	Trans Mountain Pipe Line
Scott Oliphant.	Chevron Canada Resources.
ANTON KACICNIK	ENBRIDGE CONSUMERS GAS
BERRIN WANG	TRANS-NORTHERN PIPELINES INC.
Richard Kania	RTD Quality Services
NOEL BILLETTE	NATURAL RESOURCES CANADA
Bin Fu	BG Technology.

WORKING GROUP #1

TUESDAY 3:30

NAME	AFFILIATION
BERRIN WANG	TRANS-NORTHERN PIPELINES IN[illegible]
ANTON KACIGNIK	ENBRIDGE CONSUMERS GAS
Frank M. Christensen	FMCMCI
Mark Ottem.	Trans Mountain Pipe Line
SCOTT OLIPHANT	CHEVRON CANADA RESOURCES
NEAL THOMASSEN	THOMASSEN ENERGY CONSULTANTS LTD.
BRAD WATSON	TCPL
Mark Yeomans	TCPL
DON PERSAUD	NAT. RES. & ENERGY N.B.
Paul Trudel	NEB
Howard Wallace	Colt Engineering
MICHELLE SORENSEN	AEC PIPELINES LTD
LEN DANYLUK	PENGROWTH CORPORATION.
BRIAN NESBITT	NATIONAL ENERGY BOARD
ED McCLARTY	WESTCOAST ENERGY INC.
Reena Sahney	TransCanada PipeLines
LYLE GERLITZ	JLG ENGINEERING LTD.
GLEN SCOTT	B.C. GAS
FERENC PATAKI	B.C. GAS UTILITY
Sy Shapiro	Mamron Scientific Inc.
NOEL BILLETTE	Natural Resources Canad[illegible]
ROB HADDEN	TRANS MOUNTAIN PIPE LINE
Tim McMullen	Gibson Petroleum
DAVID KULCSAR	GIBSON PETROLEUM
STEVE LEMON	GREENPIPE
Marie-Chantal Labrie	National Energy Board

WORKING GROUP # 1

TUESDAY 3:30

NAME	AFFILIATION
Rob Pryor	Ellipse Spatial
DALE DYE	Kemacoat International
GREG HILL	CORRIDOR PIPELINE (TRANS MOUNTAIN)
Ken Wu	3M Canada
Sandy Williamson	Shaw Pipe Protection Ltd.
Mark Kopp	J P Kenny
Jim Steeves	Proactive Technologies Int'l
HARSUKH PAREKH	INDIAN OIL CORPORATION LTD INDIA (PIPELINE DIVISION
STEVE COOPER	CANSPEC GROUP INC.
Dave Murray	Univ. of alberta
BOB KLICIAK	HUSKY OIL OPERATIONS LIMITED
Rudy Steiner	Husky OIL OPERATIONS LTD
Jeremy Nielsen	" "
Robert Smith	Minerals Management Servic
Bin Fu	BG Technology.
Bernie Frost	AEUB
BERT JOHNSON	GULF CANADA RESOURCES LTD.
Roy W. SCHUBERT	SHELL CANADA LIMITED
DENIS TRUDEAU	CORRPRO

WORKING GROUP #1

WEDNESDAY 8:15

NAME	AFFILIATION
John Hendershot	NEB
Bob Smyth	PETROLINE
John Craig	PNG
GERRY Hill	HILLTECH Cons.
Jules Charney	TRANSGAS Ltd.
STEVE LEMON	GREEN PIPE
Sandy Wilkinson	Shaw Pipe Protection Ltd.
Blaise Ashworth	TCPL
Reena Sahney	TransCanada Pipelines
Guy Hervieux	Atco pipelines
LEN DANYLUK	PENGROWTH CORPORATION
CYRIL KARVONEN	TRANSCANADA MIDSTREAM
DON PERSAUD	NAT. Res. & Energy - New Brunswick
ROY W. SCHUBERT	SHELL CANADA LIMITED
LYLE GERLITZ	JLG ENGINEERING LTD.
DAVE HARPER	TRANS MOUNTAIN PIPE LINE
Brian Majewski	Westcoast Energy Inc.
RON COOPER	WESTERN FACILITIES
Paul Trudel	NEB
Marie-Chantal Labrie	NEB
BRIAN NESBITT	NATIONAL ENERGY BOARD
RAY GOODFELLOW	CHEVRON
DALE DYE	KEMACOAT INTERNATIONAL INC
TERRY KLATT	FOOTHILLS PIPE LINES LTD.

Working Group #1

14 APR 1999, Wednesday 8:15.

NAME	AFFLIATION
1. H. PAREKH	INDIAN OIL CORPORATION LTD (PIPELINES DIVISION) NOIDA, INDIA.
Bob Hill	CEPA
Jeremy Nielsen	Husky Oil Operations Ltd.
Howard Wallace	Colt Engineering
BRAD WATSON	TRANSCANADA PIPELINE
Doug Clark	Gulf ~~Canada~~ Midstream
LARRY HUNT	WESTCOAST ENERGY
NOEL BILLETTE	Natural Resources Canada
Bruce Fowlie	Nu-Trac Management
BERRIN WANG	TRANS-NORTHERN PIPELINES
JOANNA MAKOMASKI	ENBRIDGE CONSUMERS GAS
Roy W Schubert	SHELL CANADA LIMITED
Don Persaud	Nat. Res. & Energy - New Brunswick
Robert Sutherby	TRANSCANADA PIPELINES.

WORKING GROUP #1

WEDNESDAY 10:30

NAME	AFFILIATION
DAVE HARPER	TRANS MOUNTAIN PIPE LINE
HA PAREKH	INDIAN OIL CORPORATION LTD. (PIPELINES DIVISION) NOIDA INDIA
GLEN SCOTT	B.C. GAS
Jeremy Nielsen	Husky Oil Operations Ltd.
Howard Wallace	Colt Engineering
BRAD WATSON	TCPL
Aaron Dinovitzer	Fleet Technology Ltd.
DELTON GRAY	ATCO PIPELINES
Noël Billette	Natural Resources Canada
Marie-Chantal Labrie	NEB
Paul Trudel	NEB
Ron Cooper	Western Facilities
FERENC PATAKI	BC GAS UTILITY
Errol Batchelor	Westcoast Energy Inc.
Kyle Gerlitz	JZG ENGINEERING LTD.
Jim Bronson	Canusa
Rory Belanger	Ludwig & Associates Eng Ltd.
Brian Majewski	Westcoast Energy Inc.
Su Xu	CANMET
John Hendershot	NEB
Rob Hadden	TRANS MOUNTAIN PIPE LINE

WORKING GROUP # 1

WEDNESDAY 10:30

NAME	AFFILIATION
TERRY KLATT	FOOTHILLS PIPE LINES LTD.
GERRY HILL	HILLTECH CONSULTING
John Craig	PNG
Sandy Williamson	Shaw Pipe Protection Ltd.
NEAL THOMASSEN	THOMASSEN ENERGY CONSULTANTS LTD
DARIUS BOUCHER	COLT ENGG.
Kam Wu	3M Canada
BRIAN NESBITT	NATIONAL ENERGY BOARD
RAY GOODFELLOW	CHEVRON
DALE DYE	KEMACOAT INTERNATIONAL INC.
REENA SAHNEY	TRANSCANADA PIPELINES
Mike Bell	Westcoast Energy Inc
BOB KLICIAK	HUSKY OIL OPERATIONS LIMITED
Rudy Steiner	Husky OIL OPERATIONS LIMITED
William Jarvis	Williamson INDUSTRIES
BILL TYSON	CANMET
LEN DANYLUK	PENGROWTH CORPORATION
Jim Steeves	Proactive Technologies Int'l.
David W Murray	Univ. of Alberta
WALTER ~~SOUTHERN~~ SOUT	WESTCOAST ENERGY INC
DON SINCLAIR	WESTCOAST ENERGY INC

Working Group 2A - Stress Corrosion Cracking
Tuesday, April 13, 1999 1:15 p.m.

Evaluation of SCC Defects

Co- Chairs: L. Blair Carroll, Enbridge Pipelines Inc.
Dr. Martyn Wilmott, Brodero Price Coaters (Absent)

Objectives:
- Familiarization with SCC assessment models
- Identify applicability and limitations of models
- Identify future work if required

Presentation – Evaluation of SCC Defects: How do we determine pipeline integrity
Dr. Carl Jaske, CC Technologies Inc.
(Refer to presentation slides)

Open Discussion Period 1:44 pm

- **Bill Tyson** (CANMET), Work is being done in collaboration with the industry on the approximation of crack failures using finite element analysis. Many current models are based on empirical results rather than FEA.
- **Carl Jaske** (CC Technologies): advances in crack failure mode predictions will include ductile tearing of cracks.
- **Blair Carroll** (Enbridge Pipelines), Question: For SCC inside corrosion, how accurate are the current models for estimating failure pressure? Group, Answer: general agreement that models are applicable provided that the total defect depth used is depth of corrosion plus depth of cracking.
- **Valentino Pistone** (SNAM), Question: Has the Canadian industry found bacteria to be associated with SCC? How about corrosion pitting? **Barry Martin** (Rainbow Pipeline), Answer: No bacteria has been found and from Rainbow's experience, very little pitting corrosion is associated with SCC occurrences.
- **Barry Martin** (Rainbow Pipelines): In dry soils we have found SCC and it has been noted that little corrosion has been associated with it.
- **Peter Merreck** (Rainbow Pipelines): SCC is proportional to tape application. If tape is in good condition, it is likely that SCC will not be found. The morphology of SCC appears to be linked with soil conditions.
- **Jim Marr** (Marr & Associates): What actions are being taken by individual pipeline companies to address the issue of coatings? How do we document what we're looking at? Rainbow program included new parameters – look at tape overlaps. Must be careful not to destroy evidence when doing digs. SCC without corrosion has been seen. At the end of the day, this all boils down to integrity concerns. Documentation is critical. Measuring amount of disbondment is becoming an issue for companies.
- **Blair Carroll** (Enbridge Pipelines), Question: What are the current capabilities of in-line inspection for detecting coating disbondment? **Martin Phillips** (Pipeline Integrity International), Answer: Efforts through the

Elastic Wave User's Group are looking into detection capabilities of disbonded coating but, cannot comment current capabilities of the EW Tool to direct minor disbondment. We could use the help of pipeline companies in collecting field data of disbonded coatings to compare to the data gathered by the ILI tools.

- **Mimoun Elboujdaini** (CANMET), Question: What role does hydrogen play on the SCC and how does it affect the life prediction? **Carl Jaske** (CC Technologies), Answer: We know hydrogen plays a role and is considered one of the mechanisms in crack growth. The experimental data that has been used in modeling crack growth does incorporate the effects of hydrogen.

- **Mimoun Elboujdaini** (CANMET), Question: Are the effects of hydrogen more evident in clean steel? What about the heat affected zone? **John Beavers** (CC Technology), Answer: Not identified as a real issue.

- **Blair Carroll** (Enbridge Pipelines), Question: Current assessment models are based on evaluating defects in the pipe body. Are these models also applicable to defects located in the weld region? **John Beavers** (CC Technologies), Answer: There are small changes that need to be considered due the weld profile as well as toughness and HAZ near the weld region.

- **John Beavers** (CC Technologies), There does not appear to be any work done in comparing differences between SCC in liquid and gas lines.

- **Blair Carroll** (Enbridge Pipelines): Should the industry be looking into differences in morphology in the SCC found on liquid vs. gas pipelines?

- **Susan Miller** (Enbridge Pipelines): Enforced Blair Carroll question – the industry should compare the experience of SCC occurrences between liquid lines and gas lines. We should promote better investigation efforts into differences of SCC found on liquid lines vs. gas lines.

- **Herbert Willems** (Pipetronix): There have been some notable differences in SCC found between gas and liquids lines. SCC in gas lines is found mostly near weld seams. With the oil lines, SCC has been found mostly the pipe body and there has been no notable correlation with SCC found on the weld seams.

- **Tom Morrison** (Morrison Scientific), Question: Is the information regarding differences between SCC on liquids vs. gas lines readily available from sources like the SCC CEPA database? Group consensus identified that this information is not readily available and helpful information such as the Rainbow data is not included in the CEPA database.

Session Summary 2:40 pm

Blair Carroll – Summary of Relevant Action Points

1. Projects investigating the differences in defect morphology, initiation and growth between liquids and gas pipelines might assist in refining assessment and susceptibility models

2. Careful characterization of coating condition is needed to identify the minimum extent of disbondment necessary for SCC initiation and the information should be shared throughout the industry

Banff 99
SCC Session

SCC Colony Assessment

J.E. Marr Associates

BANFF/99
PIPELINE
WORKSHOP

Scope

- To assist with the characterization, documentation and assessment of SCC

Presentation Overview

- theory of MPI
- inspection techniques
- classical and non classical SCC
- SCC characteristics
- colony interpretation
- colony documentation
- colony assessment

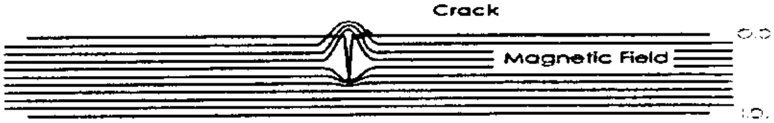
Magnetic Particle Inspection (MPI)

Fig. 1 represents a longitudinal cross section through a piece of magnetized material.

No discontinuities

Figure 1

Fig. 2 represents a longitudinal cross section through a piece of magnetized material with a surface discontinuity.

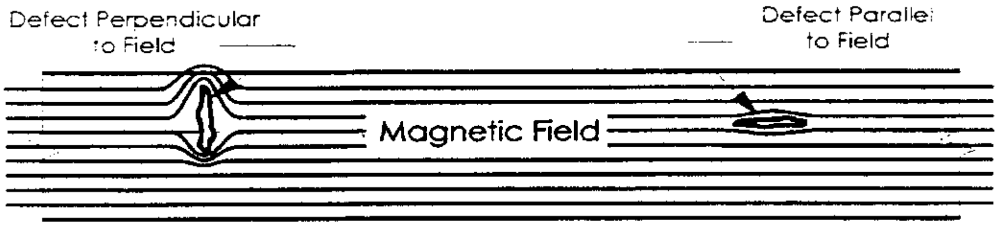


Surface discontinuities

Figure 2

Magnetic Particle Inspection (MPI)

Fig. 3 represents how a discontinuity oriented parallel to the magnetic field in the object will have far less effect on the field than a discontinuity perpendicular to the field.



Orientation of Discontinuites

Figure 3

Source: Magnetic Particle Testing
Mechanical Trades & Technologies Department
Southern Alberta Institute of Technology
MT 9013

Magnetic Particle Inspection (MPI)

- Wet fluorescent (WFMPI)
- Black on contrast white (BWMPI)
- Dry powder

Wet Fluorescent MPI

- **Advantages**
  - Generally less expensive than BWMPI method
  - Inspection rate quicker than BWMPI method on longer investigative sites
  - Higher sensitivity
  - Weld indications more easily identified

- **Disadvantages**
  - Longer set up time
  - Requires more inspection equipment and personnel
  - Difficult to document SCC
  - Difficult to photograph

Black on Contrast White MPI

- **Advantages**
  - Less set up time
  - Requires less inspection time
  - Easier to document SCC
  - Easier to photograph SCC
  - Easier to present SCC
  - Can be completed by a single person

- **Disadvantages**
  - Can be expensive
  - Pre-mixed solutions requires larger supply on hand
  - Mis-interpretation of SCC like indications

Pipe Preparation Requirements

- Requires a system that adequately removes coatings, primers and hard corrosion product deposits
- A surface preparation that promotes MPI inspection

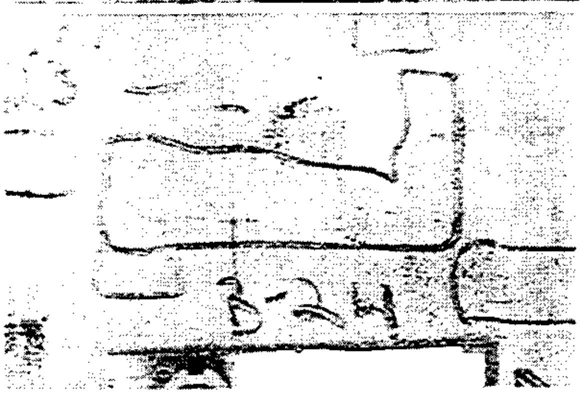
Managing Pipeline Integrity:Technologies for the New Millenium

Classical vs Non-Classical SCC

Parameter	**Classical**	**Non Classical**
Other Names	• high pH	• low pH, near neutral
Location	• typically within 12 miles (30 km's) downstream from a compressor station • decrease in number of failures moving downstream from a compressor station, with decreasing temperature	• colonies detected immediately from compressor to 75 miles downstream; more significant SCC within first valve section from a compressor station (i.e. first 15 miles)
Electrolyte pH	• high pH (electrolyte pH between 8.5 and 11) • concentrated carbonate - bicarbonate solution	• low pH (electrolyte pH between 6.0 and 8.5) • dilute bicarbonate electrolyte solution
Temperature	• growth rate decreases exponentially with temperature decreases	• no apparent correlation with temperature of pipe
Electrochemical Potential	• narrow C.P. range in the presence of a bicarbonate / carbonate environment, ranging from -600 to -700 mV - use "off" potentials to determine C.P. level	• at free corrosion potential (-760 to -790 mV) for asphalt, no a factor for tape coatings - use "off" potentials to determine C.P. level for asphalt coated sites
Terrain Conditions	• soils generally dry, well drained - cannot achieve C.P. levels (C.P. <850 mV - "off potential") • condition that damage coating	• variable depending on coating - i.e. tape and asphalt • conditions that decrease coating adhesion and increase shielding
Crack Location	• generally in pipe body, beneath disbonded coating	• generally associated with weld areas - longseam and girthwelds, essential to have disbonded coating • can be associated with high stress areas, such as dents, gouges or toe cracks
Crack Morphology	• intergranular, narrow tight cracks with no evidence of secondary corrosion along crack walls • may be branched	• transgranular, mix mode at crack tip, wider cracks with evidence of corrosion along crack walls

Classical vs Non-Classical SCC

- Classical SCC



- Classical SCC distribution pattern

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Classical vs Non-Classical SCC

- Non-classical SCC (magnified)

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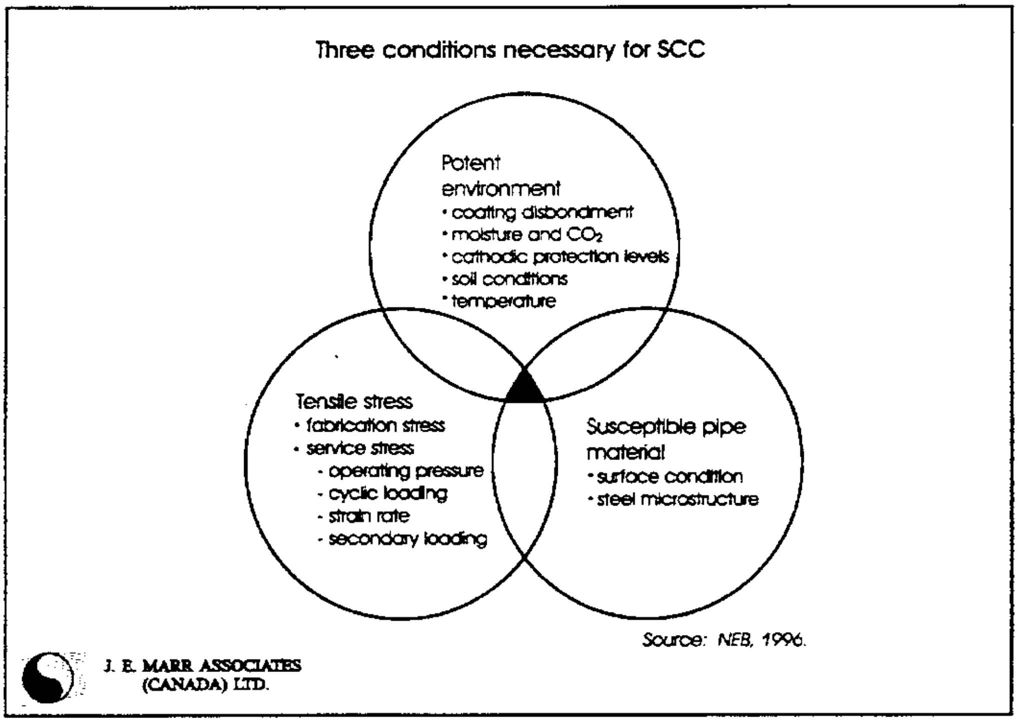
SCC Conditions



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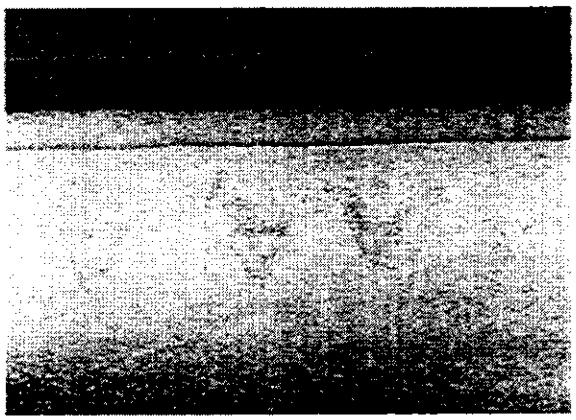
Colony Identification

- All colonies require an unique identifier
- document position on pipe - location
- orientation of colony - shape
- identify severity or significance of colony

Location of SCC

- Body
- Longseam
- Girthweld

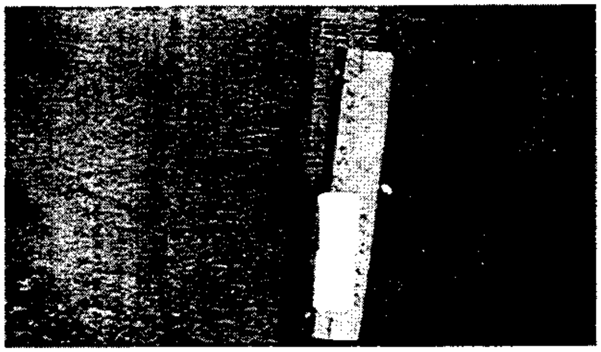
Location of SCC



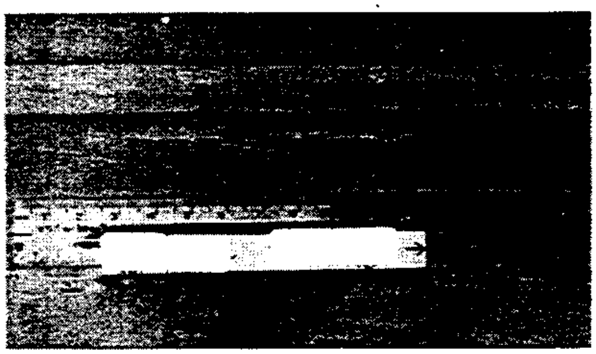
- SCC along longseam (beneath disbonded coating)

- SCC across girthweld

Location of SCC



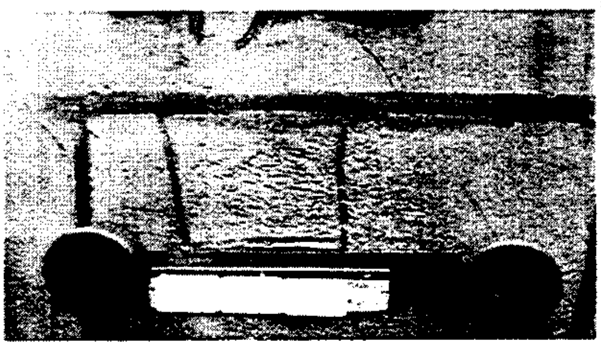
- SCC near longseam on spiral weld



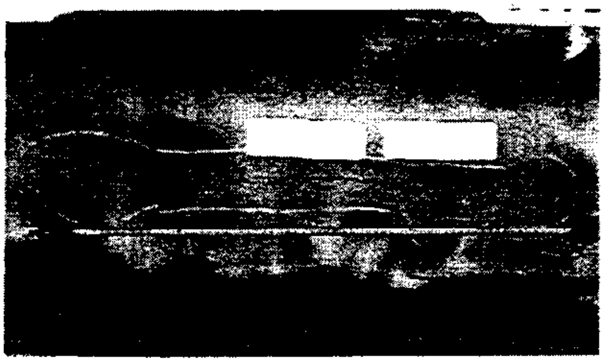
- SCC along longseam

Location of SCC

- SCC within pipe body



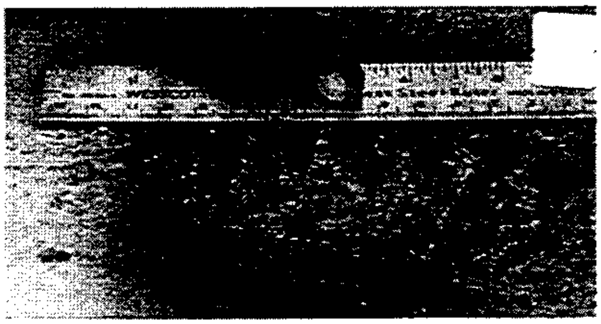
Location of SCC



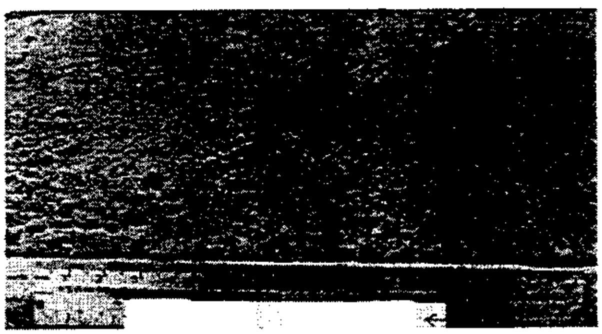
- SCC in channel corrosion

- SCC in pitted channel corrosion

Location of SCC

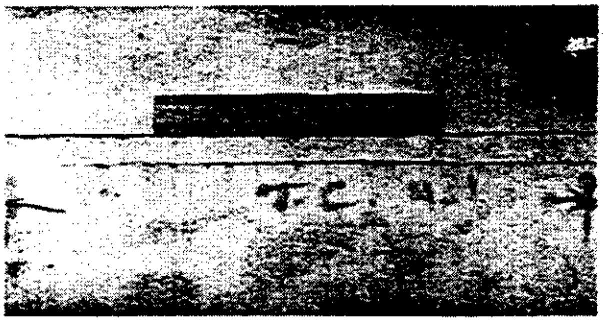


- SCC in pitted corrosion



- SCC in combination corrosion (general and pitting)

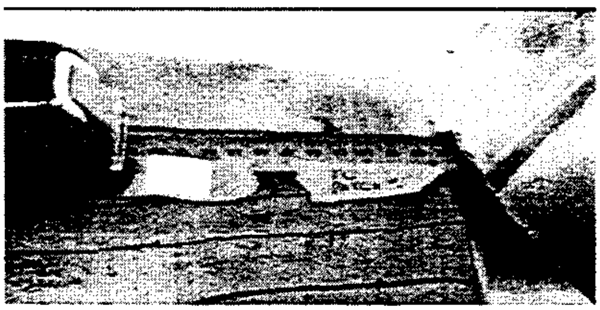
Location of SCC



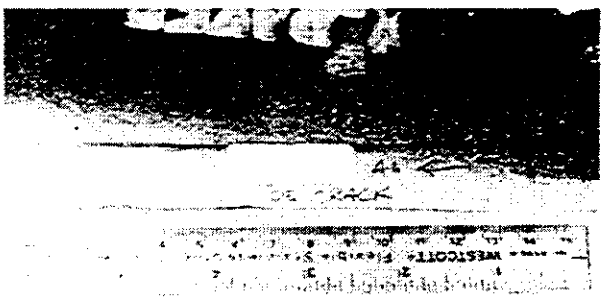
- Toe crack before buffing

- Toe crack associated with SCC (after buffing)

Location of SCC



- Toe crack before buffing



- Toe crack before buffing

Location of SCC

- Toe crack after removing weld cap

Managing Pipeline Integrity:Technologies for the New Millenium

SCC Colony Shapes

- Linear
- Axial
- Circumferential
- Diagonal

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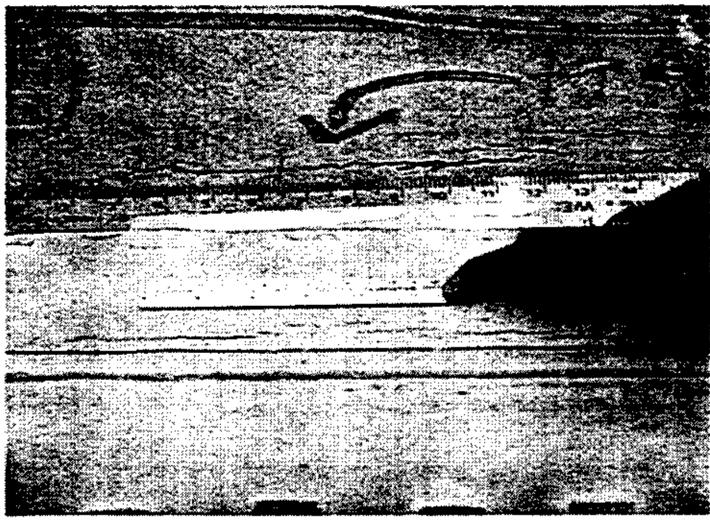
SCC Colony Shape

- Linear SCC colony shape



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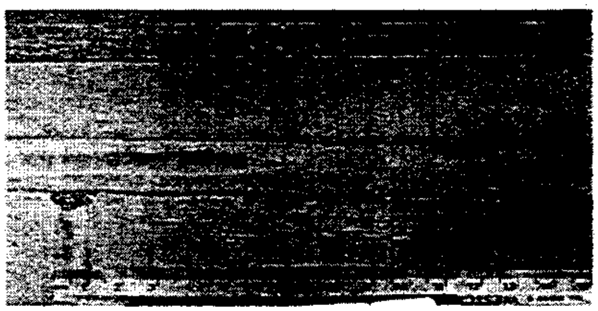
SCC Colony Shapes



- Axial SCC colony shape

- Circumferential colony shape

SCC Indications

- Longitudinal
- Circumferential (transverse)
- 45 degree

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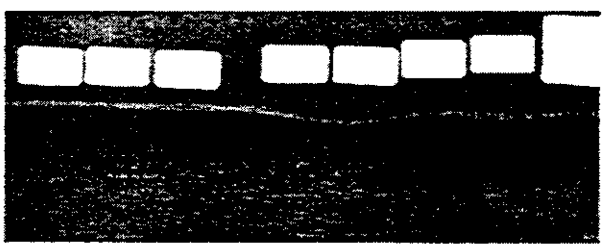
SCC Indications



- Longitudinal axis SCC colony in corrosion

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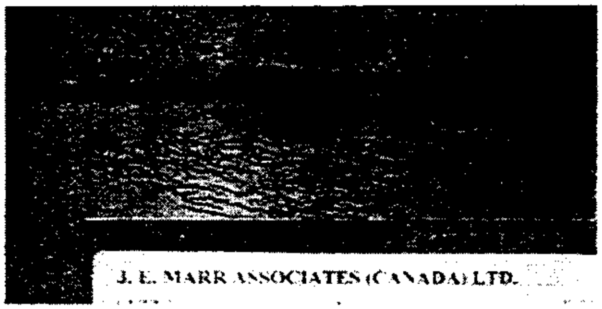
SCC Indications



- SCC at a 45 degree orientation

- Transverse cracking

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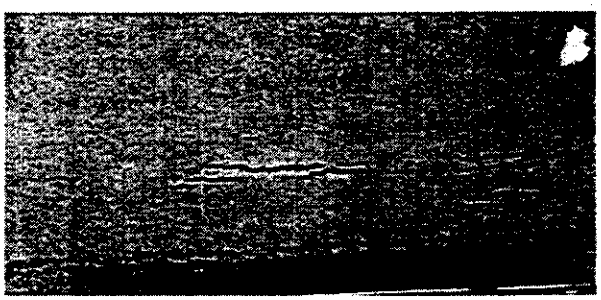
SCC Indications



- Short deep cracks

- Shallow SCC in linear corrosion

Managing Pipeline Integrity:Technologies for the New Milienium

SCC Documentation

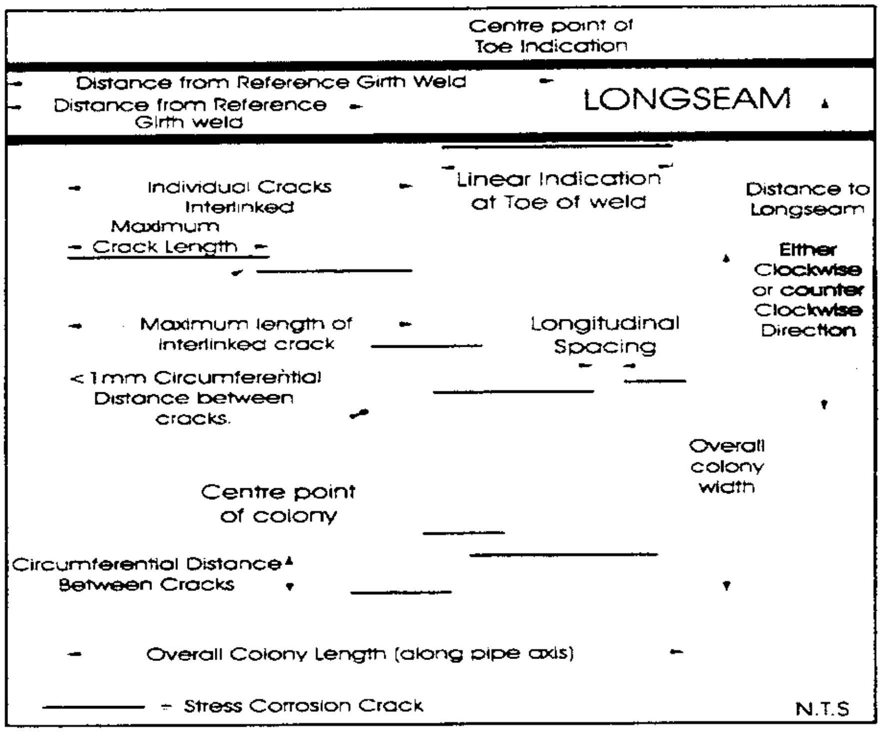
- Identify joint and colony
- Colony dimension
- Longitudinal reference
- Circumferential reference
- Average crack length
- Maximum crack length
- Horizontal distance between cracks
- Colony location
- Interlinking
- Maximum interlinked length
- Crack depth
- Associations
- UT wall thickness measurement
- Photographs

SCC Documentation

- Splitting up SCC colonies

- ERW longseam - interlinked cracking

Colony Characterization



Managing Pipeline Integrity:Technologies for the New Millenium

SCC Colony Assessment - Depth Evaluation

- At present, there are two common field methods to quantify the depth of a crack.
- Advanced ultrasonics (non-destructive)
- Buffing (destructive)

Significant SCC

- An SCC colony is assessed to be significant if the deepest crack in a series of interacting cracks, is greater than 10% of the wall thickness and the total interacting length of the crack is equal to or greater than 75% of the critical crack length of a 50% throughwall crack at a stress level of 110% of SMYS - source CEPA

Managing Pipeline Integrity:Technologies for the New Millenium

Significant SCC Assessment

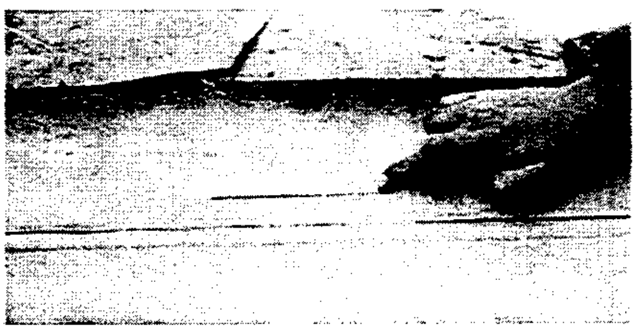
- Determine the critical length for rupture of a 50% throughwall defect at 110% SMYS
- determine the cumulative interacting length of the cracks - dependent on circumferential and axial separation
- if one of the cracks within the cumulative, interacting length has a depth greater than 10% of the wall thickness - compare the interacting length of the colony to the critical length
- if the interacting length exceeds 75% of the critical length, the colony is considered significant
- source - CEPA

SCC Colony Assessment - Evaluation

- To properly evaluate the potential impact of a SCC colony, the depth and length of a colony should be accurately determined.
- The determination of critical crack sizes is dependant on the individual company.
- Fracture mechanics based calculations can be used to determine the critical crack size of a given pipeline for a known set of metallurgical and operational parameters

SCC Colony Evaluation

- Significant SCC



Weld Indications

- Manufacturing defects
- Lack of Fusion (ERW & SAW)
- Undercut (SAW)
- Roll over (SAW)
- Slag (SAW)
- Hook cracks (ERW)

- In-service defects
- SCC cracking (environmentally assisted)
- Fatigue cracks (cyclic)

Non-SCC Indications

- Laminations
- Surface blisters
- Corrosion
- Inclusions and stringers
- Mill scale

Reporting

- Future reference
- Creating/maintaining pipeline profile databases
- Monitoring programs

Photography

- Future reference
- Aiding in engineering assessments
- Monitoring programs

Banff 99
SCC Session A

EVALUATION OF SCC DEFECTS: HOW DO WE DETERMINE PIPELINE INTEGRITY?

by Carl E. Jaske and John A. Beavers
CC Technologies

CC Technologies

BANFF/99 PIPELINE WORKSHOP

Working Group 2 - SCC Carl Jaske, CC Technologies

Topics to Be Addressed

- Definition of Integrity Assessment
- Why Is It Needed?
- Uses of Integrity Assessment
- Information Needed for Assessment
- Overall Methodology
- Prediction of SCC Life

Working Group 2 - SCC Carl Jaske, CC Technologies 2

Definition of Integrity Assessment

- An Analytical Procedure to Determine If Pipeline Can Operate Without Risk of Failure

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Why Integrity Assessment Is Needed

- Maintain Safety
- Avoid Environmental Impact
- Maintain Reliable Operation
- Optimize Maintenance Programs

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Uses of Integrity Assessment

- Establish In-Line Inspection (ILI) Intervals
- Prioritize ILI Results for Field Inspection
- Establish Hydrostatic Testing Intervals
- Determine If Pressure Must Be Reduced
- Decide to Repair or Cut Out Defect
- Prioritize Inspection, Re-Coating, or Repair
- Estimate Remaining Life

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Information Needed

- Dimensions: OD and WT
- Material Properties: YS, UTS, and CVN
- Pressure: MAOP and Actual Operating
- Defect Size, Shape, and Orientation
- Defect Location: Welds, Bends, Dents, etc.
- Optional: Flaw-Depth Profile, Fracture Toughness, Stress-Strain Curve

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Overall Methodology

- Two Failure Criteria for Crack-like Flaw
  - Flow Strength
  - Fracture Toughness
- Stress Reaches Flow Strength Locally
- Use a Model to Calculate the Failure Stress for Locally Thinned Area (LTA)
  - Effective Area Method: Rstreng or CorLAS™
  - $\sigma_{fail} = \sigma_{flow} [(1\text{-}A/A_0)/(1\text{-}A/(MA_0))]$

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Overall Methodology

- Fracture Toughness (K_c, J_c, or $CTOD_c$)
- Failure When Applied K, J, or CTOD Reaches a Critical Value
- Estimate Fracture Toughness from CVN or Measure Using Test Specimens
- Current Approach Conservative for Very Long Crack-Like Flaws

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Overall Methodology

- Models Developed for Single Axial Defects
- Some Address Linking of Co-Linear Flaws
- Conservative for Non-Co-Linear Flaws
- May Be Inaccurate for Complicated Shapes
- Generally Provide Conservative Results for SCC Colonies Where Cracks in a Colony Are Assumed to Be Inter-Linked

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Typical Applications

- Remaining Life Calculation
  - Prioritize ILI Results for Field Inspection
  - Prioritize Inspection, Re-Coating or Repair
  - Establish Hydrostatic Testing Intervals
  - Establish ILI Intervals
- Burst Pressure Calculation
  - Assess Whether to Repair or Cut Out Defect
  - Determine Whether Temporary Pressure Reduction Is Required

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Prediction of SCC Life

- Establish Existing Dimensions of Flaw
  - ILI Inspection
  - Hydrostatic Testing and Calculations U
    Integrity Assessment Models
  - Statistical Estimates Based on Field Digs
- Estimate Critical Flaw Size at MAOP
- Estimate Flaw Growth Rate
- Calculate Remaining Life

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Summary

- Evaluation of SCC Defects Is a Critical Component of Integrity Managem
- It Helps the Pipeline Operator Priorit System for Inspection and Repair
- It Provides Valuable Information Neede for Long-Range Planning

Working Group 2 - SCC   Carl Jaske, CC Technologies   12

Working Group 2A: Stress Corrosion Cracking
Tuesday April 13, 1999 - 1:15 pm

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Working Group 2A: Stress Corrosion Cracking
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Working Group 2A: Stress Corrosion Cracking
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Working Group 2A: Stress Corrosion Cracking
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Working Group 2A: Stress Corrosion Cracking
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Working Group 2A: Stress Corrosion Cracking

Tuesday April 13, 1999 - 1:15 pm

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118			( )		
119			( )		

WORKING GROUP 3
COATINGS WORKSHOP
WEDNESDAY APRIL 14, 1999
1315 TO 1700 HRS
ROOM 251 - MAX BELL BUILDING

Co-Chairs: John Baron – Shell Canada
Matt Cetiner – Anteris Corrosion

Background – John Baron
- CSA Z 662-96 definition of coatings does not specify how to ensure the quality and integrity of the coating
- CSA Z 662 Materials subcommittee formed a group to address NEB SCC inquiry from 1996 report
- Offshore in east coast Canada pipe line installation in environmentally sensitive areas
- Challenge for the next Millennium – "Objectives"
- "To select and apply pipeline coatings in a manner which significantly lowers the probability of external corrosion occurring over the life of the pipeline"

Workshop objectives
- Increase awareness – coatings design criteria and life assessment (Influence CSA activity)
- Consistency in-service coating assessment methodology, fit for service evaluations
- Improve field joint coatings
- Improve field repair coatings
- Identify future areas of research, test method development

PAPER # 1 – PIPELINE DYNAMICS; IMPACT ON COATINGS DESIGN
Graeme King – Greenpipe Industries Ltd.

- Solutions for long term reliability are to be implemented at the design stage
- The CSA code identifies the minimum requirements and at times additional requirements must also be implemented
- Movement at Bends can be calculated for Longitudinal Compressive Force and Lateral Bearing Load
- CSA Z 662 requires additional wall thickness to keep hoop & longitudinal stress below 90% SMYS
- (Appendix C offers an alternative to Subsection 4.6.2.1)
- The extra wall increases axial force & hence lateral load
- Longitudinal movement can apply large longitudinal shear stresses on the coating
- **In summary damage to pipe coatings due to movements between the pipe and the soil can be prevented by a combination of:**
  - **Reducing forces:**
    - **Use long radius bends to reduce bearing loads at bends**
    - **Specify good backfill compaction to prevent settlement**

  - **Reduce wall thickness, operating temperature & pressure**
  - **Good pipelining procedures to reduce locked-in stresses**
  - **Avoid unstable slopes**
- **How many companies carry out stress tests?**
  Not too many to Graeme's knowledge. Shear tests are not specifically specified anywhere whether it is in a code of practice or standard
- **What are if any effects on coating are cyclic temperatures?**
  Assumptions made – temperature & pressure cycling is on-going Graeme believes this to be natural and not to be a problem. The coating takes max. shear stresses and is able to take abrasion of pipe moving back & forth.
- **Super compaction with fine materials like sands can cause abrasion in a vibrating service.**
- Super compaction also increases shear stress.
- Slick surface coatings, i.e.: FBE coatings will reduce shear stress-also depends on internal angle of friction
- Backfill is important in that it must be filled in under the pipe and proper compaction obtained
- **Line with Tape coating has sagging at 5 and 7o'clock positions. Line is low temp. What could the cause be?**
- Most likely cause is voids around the bottom of pipe backfill and as the soil moves the mastic also for creep and the movement and sagging of the tape
- **What is required for design for stress?**
- Relatively all the normal information, use of industry standards for backfill, and the fact that stress on the pipe coating is calculated and the resistance of the coating to this stress.

PAPER # 2 CONSISTENCY IN ASSESSMENT OF IN-SERVICE COATINGS
Dale Temple – Anthers Corrosion

- CSA does not give a methodology for how coatings behave in a lifetime
- References to NACE RP 0169-69 Clause 5-3-34 External Coating System Qualification
- Inconsistency lies in :
  - Lack of understanding of failure mechanisms to design realistic testing
  - Incorrect use of testing standards and acceptance criteria
  - Inconsistent standards for specific coating types (i.e.: CSA addresses FBE and not Liquid applied epoxies
  - Definitions of what are failures and their mechanisms
  - Inconsistent reporting
  - Sampling & Test methods, testing of coatings not always conducted in applicable operating environment
- **Testing is very important for testing to be conducted in appropriate field operating environments. Mechanisms in lab should display this.**
- **Standards require some flexibility (i.e.: FBE has rigid requirements for bend flexibility which applies to the bends and needs not to be applied to straight sections of pipe)**

PAPER # 3 INCREASING DESIGN LIFE OF PIPELINES
Peter Singh – Shaw Pipe Protection Limited

- Designing a coating and not just selecting one off the shelf!
- Consideration to Operating conditions, Construction and installation practices and others (i.e.: abrasion & UV stability)
- Arrhenius Equation can be used to determine Lifetime Extrapolation for insulated coated systems
- Stresses affect the shear strength (Pipeline Weight, Thermal, Hydraulic and Soil)
- **What standard shear tests are conducted ?**
- No specifications for stand alone coatings, and there is the Alyeska Shear test for insulated-coated systems. Peter indicated this might not be considered a true shear test as it puts a load on and time is recorded when there is a shift.
- **What is CP capability with the coating mean?**
- No real answer discussion on conductive coatings being developed.
- Coating life needs to match pipeline design life; i.e. 7 years vs. 50, 60, 80 need same requirements?
- **What is the status of external corrosion in marine environments with regard to shielding?**
- **PAPER # 4 FIELD JOINT COATINGS**
  John Baron – Shell Canada Limited

- Field joint coatings usually applied by the contractor
- Currently no standards on system capability and performance on interface
- Issue with personal training and material qualification
- European countries have specialized contractors for joint application, good quality and not left with mainline contractor. North America behind.
- Field coatings should have the same quality as the shop-applied coatings. Challenge for material supplies and contractors.

PAPER # 5 REPAIR COATINGS
Aida Lopez – Trans Canada Pipelines Limited

- Coating selection was start of the art during initial construction and has been subjected to aging due to increased operating temperatures, soil stresses and increase CP
- Recoating program direct costs about 60% of replacement cost
- Have done extensive lab testing to qualify 5 liquid epoxies and their application
- Urethane girth weld coating failures have occurred and putting together a field investigation and repair program

- Challenge of overcoating existing polyethylene systems with liquid epoxies. Testing is required for the overlap area for tape, asphalt and coal tar systems
- Very good success with brush applied liquid epoxies on girth welds and discrete digs
- Identified in-house training for coating inspectors , 3 day course with exam
- All coating applicators shall be pre-approved

Working Group 3.

GREENPIPE

Understanding Pipeline Dynamics and its Impact on Coating Design

by Graeme King
V.P. Engineering
Greenpipe Industries Ltd

GREENPIPE

Introduction

- We see a number of pipelines with coatings damaged by relative movements between the pipe and the soil.
- The problem is worse near bends and areas with poor backfill compaction.
- Solutions, which are best implemented during design & construction, are limited to:
  - reducing the magnitude of the movements & forces, and/or
  - increasing the toughness and adhesion of coatings.

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CSA Z662 Requirements

- The relevant minimum requirements specified by CSA Z662 for coatings are:

  Designers must make sure that coatings have sufficient strength and adhesion to resist soil shear stresses at service conditions (including maximum temperature) for the life of the pipeline. (CSA Z662 §4.2.4.2 and §9.2.8.1(d))
- And for the soil backfill are:

  The pipeline must fit the contour of the ditch, and it must be backfilled to prevent damage to the pipe or coating, and to prevent subsidence of backfill and support material. (CSA Z662 §6.2.6.4, §6.2.7.2 and §6.2.7.4)

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Pipe-Soil Interaction

- Although CSA Z662 Appendix C §8.8 talks about pipe-soil interaction forces and 3-D soil spring models, the code doesn't specify how to evaluate soil shear forces.
- Basically, any movement between the soil and the pipe can cause shear forces.
- The shear forces can act either across the pipe (lateral shear) or in the direction of the pipe (longitudinal shear).

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Back-Filling Practice

- Customary backfill procedures aim to prevent damage to the coating during backfilling rather than to get good backfill compaction under and around the sides of the pipe.
- Poor compaction contributes to:
  - unnecessary lateral movement at bends that can abrade the coating and tend to pull it off the pipe.
  - soil settlement that can pull coating off hot pipes if coatings have mastics that soften at high operating temperatures.

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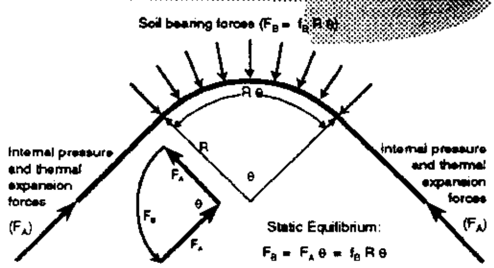
Movement at Bends



G. King, Greenpipe

GREENPIPE

Calculation of Soil Bearing

- What is the soil bearing load at a 40D bend in NPS12 pipe with an 8.4 mm wall, operating at 10 MPa & at 60°C above tie-in temperature?
- Longitudinal Compressive Force:

  $F_A = (1 - 2\nu)\, P \pi D^2/4 + E \alpha \Delta T \pi D t$

  $= 330 + 1{,}280 = 1{,}610$ kN $= 164$ tonnes
- Lateral Bearing Load:

  $f_B = F_A / R$

  $= 124$ kN/m run $= 12.7$ tonnes / m run ($= 56$ psi)

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Lateral Load at Bends

- Backfill cannot handle lateral bearing loads of this magnitude & pipes move laterally at bends, damaging pipe as well as coatings.
- The problem is made worse by CSA Z662 §4.6.2.1 which requires extra wall thickness to keep combined hoop & longitudinal stress below 90% SMYS. The extra wall increases axial force & hence lateral load.
- (Appendix C offers an alternative to §4.6.2.1.)

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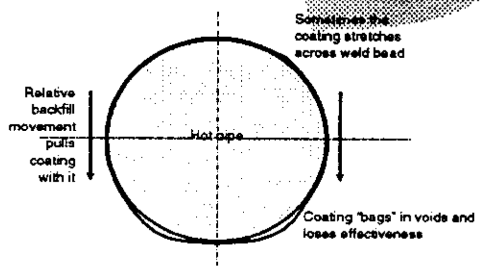
Lateral Movement



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Longitudinal Shear

- Lateral movement at bends also causes longitudinal movements in the straight pipe near the bends.
- The longitudinal movement can apply large longitudinal shear stresses on the coating.
- High operating temperatures make the problem worse. Mastics soften and the pipe can move longitudinally inside the coating.

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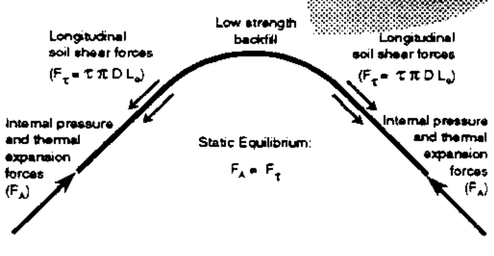
Equilibrium at Bends



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Calculation of Soil Shear

- What is the shear stress on the pipe coating if the angle of friction between the coating and the soil is 30°, the soil density is 2,000 kg/m³, and depth to pipe centerline is 2.0 m?

  $\tau = \gamma g h \sin\varphi = 2000 \cdot 9.8 \cdot 2 \cdot \sin 30 = 20$ kPa (= 2.9 psi)
- This is a low estimate because it ignores cohesion, the bulking of soil in shear, and the presence of rocks in the backfill.
- An F_S of 3 would be appropriate for design.

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Other Causes of Shear

- Other causes of shear between the pipe and the backfill include:
  - A tendency to lock stresses into the pipe during construction.
  - Soil movement on unstable slopes.
- These and the other situations already discussed can all cause both lateral and longitudinal shear forces between the pipe and the soil at localized points along the line and consequently cause coating damage.

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Summary

- Damage to pipe coatings due to movements between the pipe and the soil can be prevented by a combination of:
  - Reducing forces:
    - use long radius bends to reduce bearing loads at bends
    - specify good backfill compaction to prevent settlement
    - reduce wall thickness, operating temperature & pressure
    - good pipelaying procedures to reduce locked-in stresses
    - avoid unstable slopes
  - Increasing toughness and adhesion of coatings.

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Working Group 3.

Consistency In Assessing In Service Coatings

- NACE RP0169-96, Clause 5.3.3.1 External Coating System Qualification
  - laboratory tests
  - application under recommended practices
  - installation under recommended practices
  - in-service field performance tests

ANTERIS Corrosion Inc

Consistency In Assessing In Service Coatings

- Laboratory testing for coating selection
  - lack of understanding of failure mechanisms to design realistic testing
  - incorrect use of testing standards and acceptance criteria

ANTERIS Corrosion Inc

Consistency in Assessing In Service Coatings

- For epoxy, at a given temperature, the rate of water absorption is proportional to the inverse of the square of the thickness (Dennis Neal)
- 14 mil coating, 0.005
- 28 mil coating,0.0012
- Twice as thick, 4 times longer for H_2O (0.005/0.0012)

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M. Centiner & D. Temple

Consistency In Assessing In Service Coatings

- Test Methods CSA Z245.20-98
  - 28 day, 1.5 volts, 65 °C cathodic disbondment test and adhesion

14 mils	28 mils	CSA
8 mm-r	7 mm-r	8 mm-r
1 rating	2 rating	1-3 rating

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Consistency In Assessing In Service Coatings

- FBE powder coatings have to meet CSA Z245.20-98 requirements
  - Change in location of manufacture or formulation, coating has to be qualified again (Table 1 and Table 2- 16 tests)
  - Incoming powder must pass QC check before application (Table 3-5 tests)
  - Test ring cut to verify coating application (Table 4-7 tests)

ANTERIS Corrosion Inc

Consistency In Assessing In Service Coatings

- Liquid coating systems
  - Manufacturers may tweak formulation
  - QC testing done on materials before application?
  - Testing of coating is usually thickness and holiday detection
  - Critical parameters usually not addressed such as mixed material temperature and cure testing.

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Consistency In Assessing In Service Coatings

- FBE typically exhibits cathodic disbondment, blistering and loss of bond
- Kendig confirmed chemical breakdown of the oxide layer at high pH is the predominant mechanism for disbonding.
- Industry indicating blistering is not a concern
  - passage of CP
  - no corrosion

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Consistency In Assessing In Service Coating

- Coating type identification
  - FBE coatings made by same manufacturer are difficult to distinguish
  - Asphalt
  - Primer, tape backing and adhesive combinations
  - Liquids
  - Shrink sleeves

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Consistency In Assessing In Service Coatings

- Information collected at coating sites
  - Thickness
  - Samples
    - coating, liquids, soil
  - Adhesion testing
  - Parameters such as:
    - Soil type and constituents
    - Pipe surface pH
    - On /off pipe to soil potential
    - Operating temperature

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Consistency In Assessing In Service Coatings

- Challenges
  - Develop consistent sampling and test methods. For example a pull off or knife adhesion test, compensation for temperature. Use ASTM standards for describing size and blister density
  - Definition of what is a coating failure
  - Consistent reporting
  - Test new coatings in worst case operating environment, not where easy to install

ANTERIS Corrosion Inc

COATINGS DESIGN AND SELECTION - Predicting Coating Performance at Elevated Temperatures

P. Singh
Shaw Pipe Protection Limited

BREDERO-SHAW

DESIGN CONDITIONS

OPERATING	CONSTRUCTION	OTHER
Temperature - degradation Stresses - compressive - shear (axial and longitudinal) Environment - chemical - biological - electrical	Bending Impact	abrasion UV stability

TEMPERATURE

- Significant effect on all other properties of polymeric coatings
  - degradation, creep, adhesion, chemical resistance

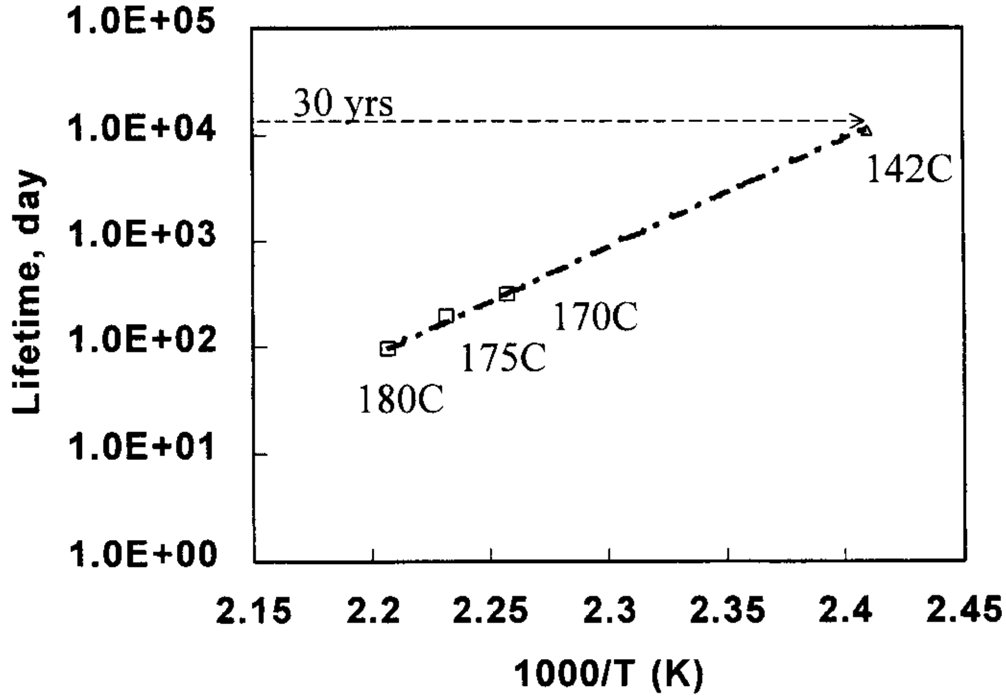
- Continuous service temperature rating
  - provide acceptable long term behavior

- Determined by following methods:
  - Safety factor below critical temperatures
    - Tm for thermoplastics
    - Tg for thermosets
  - Studies of property vs aging time at temperature
  - Accelerated aging studies
    - Increasing temperature speeds up degradation
    - based on Arrhenius equation $A=k\,E\,\exp(-E/RT)$
    - measure critical property

LIFETIME EXTRAPOLATION

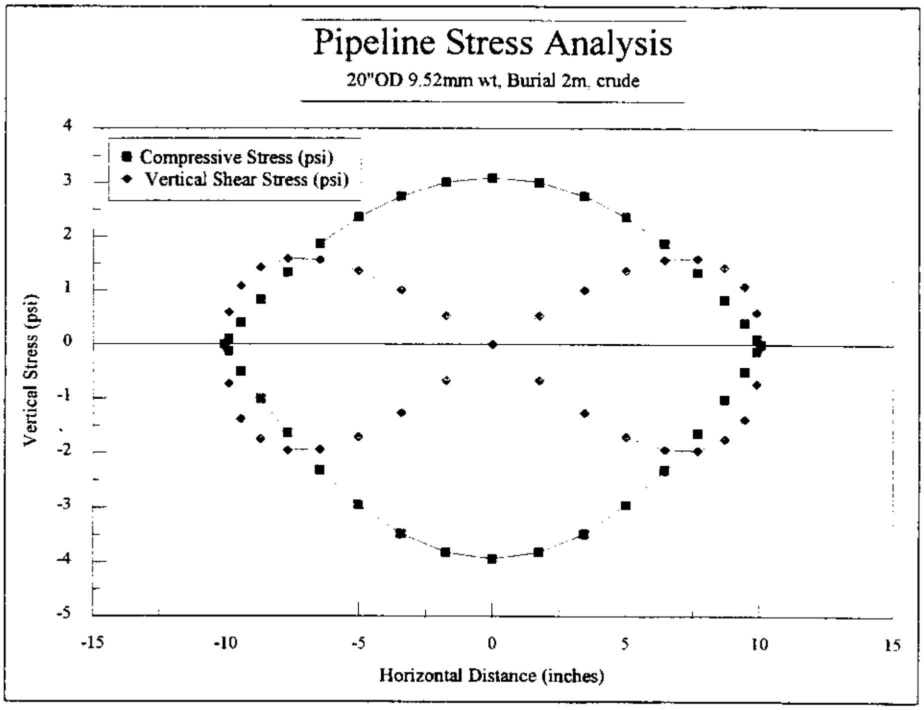
Aging Temperature, C	Time for property to fall below acceptable value, days (Shear < .08N/mm2)
180	94
175	190
170	305

Lifetime Extrapolation based on Arrhenius Equation

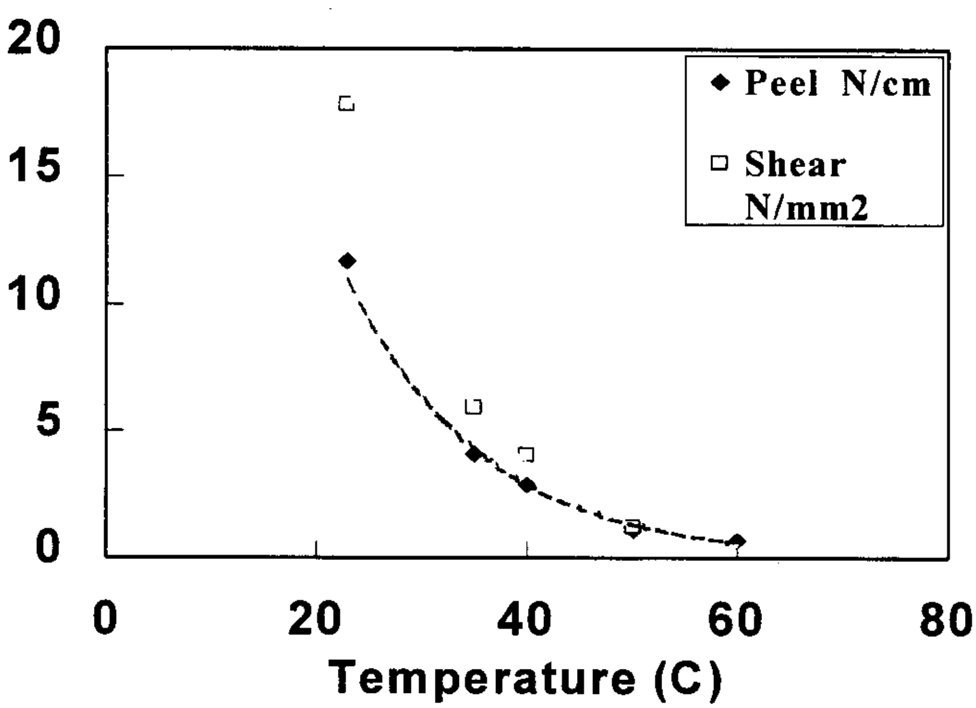


STRESSES

- Weight
  - pipe, content, soil
  - resolved into compressive and shear stress on coating
- Thermal
  - operating vs burial temperature
  - depends on pipeline design, delta T, pipe, etc.
- Hydraulic
- Soil



EFFECT OF TEMPERATURE ON PEEL/SHEAR



ENVIRONMENT

- Chemical (moisture)
  - Absorption - effect on bulk properties
    - compressive, shear
  - Transmission - effect on interfaces
    - adhesion to pipe surface
- Electro-chemical
  - Effect of generated species on:
    - adhesion to pipe surface
    - chemical degradation

Working Group 3

FIELD-JOINT COATINGS (FJC'S)

Banff/99 Pipeline Workshop
Managing Pipeline Integrity-
Technologies for the New Millennium

FJC's - BACKGROUND

- Field-applied, primarily to girth welds
- covers the shop-applied coatings cut-back length plus weld.
- usually applied by the construction contractor
- coating materials normally specified by the end-user, based on experience,etc

FJC'S- OBSERVATIONS

- External corrosion at girth welds is a significant problem
- Problem due to design and application quality
- CP compatibility problem exists with some FJC products

FJC'S - DESIGN

- Design criteria specified by inference only within current codes
- Shop-ctg + FJC = Ctg System
- No industry standards on systems compatibility, performance of interface
- FJC's often evaluated independantly

FJC'S- APPLICATION

- Application standards generally based on "manufacturer's recommendations"
- most pipeline companies have in-house standards for application
- personnel training & material qualification limited (but improving)
- no code requirements for application quality verification

Minimum FJC Installation Specification

- Steel preparation cleaning, drying, pre-heat, weld splatter grinding, weld bead condition
- Materials and application equipment
- Application procedure
- Qualification of materials and personnel
- Quality verification

J. Baron, Shell Canada

W.G.3

FJC's- What's Needed??

- Industry Design standards to address FJC's
- Specifically:
  - alignment with shop-applied coatings design performance criteria
  - shop-applied coatings/interface performance
  - CP compatibility
  - application quality - personnel, QA tests

FJC's- "The future?"

- FJC materials will further evolve to match shop-applied coatings evolution.
- Increased specialist vendors to supply and apply FJC's.
- FJC quality will match or be very close to shop-applied coating quality.
- Codes will require materials qualification and applied quality performance.

J. Baron, Shell Canada

TransCanada PipeLines Coating Systems

Aida Lopez, P. Eng. - TransCanada PipeLines

Pipeline System Infrastructure

- 14,500 km of Transmission Pipelines
  - 6 Parallel Lines in West (looping line 7)
  - 4 Parallel Lines in Central
  - 2 & 3 Parallel Lines in East
- 56 Compressor Stations
- 182 Meter Stations

System Construction Details

- Line 100-1 Completed in 1958
  - 34” Coated with Asphalt and Coal Tar
- Line 100-2 Completed in 1969
  - 36” Coated with Asphalt, CoalTar and some Tape
- Line 100-3 Completed in 1971
  - 36” Coated with Asphalt (FBE in Central and East)

System Construction Details

- Line 100-4 Completed in 1977
  - 42" Coated with Tape and some Asphalt
- Line 100-5 Completed in 1982
  - 48" Coated with Fusion Bonded Epoxy and some Tape
- Line 100-6 Completed in 1986
  - 48" Coated with Fusion Bonded Epoxy

Coating Selection

- State-of-Art During Initial Construction
  - Aging due to increased temperatures
    - 35 °C versus 60°C
  - Aging due to soil stresses
  - Increase in current required to Maintain CP criteria

Cathodic Protection Requirements

- Increasing beyond system capabilities
  - Technically feasible but not cost effective
  - Damage to coatings on newer well coated lines (FBE)
    - Blistering
    - Disbondment

Coating Initiatives

- Knowledge of degradation lead to
  - 1982 - All new construction used FBE
    - 1996 a 70°C FBE approved
  - 1995 - A 55°C Tape repair system instituted
  - 1995 - Liquid Epoxy developed for 65°C
    - Field welds, valves and fittings

Coating Initiatives

- 1996 - Liquid Epoxy with 95°C temperature rating approved
  - Station piping, Mainline recoating, field welds, valves and fittings

Remedial Actions

- Mainline Recoating Program
- Station Recoating Program
- PMP and SCC digs
- FBE digs

Mainline Recoating Program

- Carried out since 1996
- Line travel equipment
- Spray applied epoxies
- Feasible for large scale pipeline recoating (distance > 5km)
- 1998 Mainline recoating trial test

Mainline Recoating Program

- Direct cost of recoating estimated to be 60% of the cost of replacing the pipe
- Future programs are based on pig data results, CP data and soil aggresiveness

Station Recoating Program

- Program started 1997
- Recoating with liquid epoxy rated for high temperature service (up to 95°C)
- Factors considered to select stations for recoating:
  - CP data
  - Discharge temperatures

Station Recoating Program

- Field observations of coating degradation
- Age of piping
- Soil corrosivity

• Results:

- Coating disbondment was significant (100%)

PMP and SCC Digs

- 25 to 75 metres long digs
- Based on pig runs and SCC program
- Coating repairs - Liquid Epoxies
- Tie-ins repair varies with previous coating

FBE Digs

- Confirm that FBE in the presence of other coatings is holding on
- Investigate that there is no corrosion or SCC
  - To date no corrosion/SCC problems

FBE Digs

- To establish long term degradation modes for FBE coatings
  - Blistering/Disbondment
  - CP limits (-1100mV)
- Verify the joint coating (urethane)
  - Girth weld problems

14/04/99

Working Group 3 - Coatings 3:30 Session

Name	Company
Ray W. Schubert	Shell Canada Limited
Jim Steeves	Proactive Technologies Intl
John Craig	PNG
Miles Hawkeness	Centra Gas Manitoba
DELTON GRAY	ATCO PIPELINES
JAKE ABES	Pipeline Safety Consulting Inc
Howard Wallace	Colt Engineering
Sandy Williamson	Shaw Pipe Protection Ltd
DARCUS BOUCHER	COLT ENG'G.
WARREN WALDEGGER	ENBRIDGE (SASK)
MEREDYTH GRETZINGER	Westcoast Energy
Brian Majewski	Westcoast Energy Inc
ED BAGG	WESTCOAST ENERGY
Frank M. Christensen	FMC MCI
Alex Afaganis	Campipe
Bob Lessard.	WELLAND PIPE
LEN DANYLUK	PENGROWTH CORPORATION
DON MARR.	CORRPRO CANADA
Jeremy Nielsen	Husky Oil Operations Ltd
Rudy Steiner	Husky Oil Operations Ltd.
ROD TREFANENKO	GULF MIDSTREAM SERVICES
A. DeMOZ	CANMET
GRANT FIRTH	CORRPRO CANADA INC.
ROB HADDEN	TRANS MTN. PIPE LINE
BOB SIMMONS	RTD QUALITY SERVICES
NATHAN TOWNLEY	IPSCO Inc
Weixing Chen	University of Alberta
DON PERSAUD	DNRE, NEW BRUNSWICK
DARRYL SHYIAN	IMPERIAL OIL RESOURCES

GERRY HILL	HILLTECH CONSULTING
STEVE COOPER	CANSPEC GROUP INC.
SIU TSAI	TCPL
RAY GOODFELLOW	CHEVRON
Barry Martens	Rainbow Pipe Line
Doug Clark	Gulf Midstream Services
Dale Temple	ANTERIS Corrosion Inc.
GLENN MACINTOSH	DENSO NORTH AMERICA INC.
P. K. Deb	Indian Oil Corpn. Ltd.
Jim Bronson	Canusa
LYLE GERUTZ	JLG ENGINEERING LTD.
Greg Toth	Trans Mountain PipeLine
Dave Harper	"
MIKE REED	"
FERENC PATAKI	BC GAS UTILITY
John Beavers	C.C. Technologies
Kam Wu	3M Canada
ANTON KACICNIK	ENBRIDGE CONSUMERS GAS
KEVIN GARRITY	CC TECHNOLOGIES CANADA, LTD.
AidA Lopez	TRANSCANADA PIPELINES
DALE DYE	KEMACOAT INTERNATIONAL LTD
Jules Chorney	TRANSGAS Ltd
LINDA GRAY	ALBERTA RESEARCH COUNCIL
GRAEME KING	GREENPIPE INDUSTRIES

1:15pm

WORKING GROUP 3 - COATINGS 14/4/99

Name	COMPANY
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John Craig	PNG
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Sandy Williamson	Shaw Pipe Protection Ltd.
Peter Singh	Shaw Pipe Protection Ltd
Howard Wallace	Colt Engineering
JAKE ABES	Pipeline Safety Consulting Inc.
Jim Steeves	Proactive Technologies Int'l
RON COOPER	WESTERN FACILITIES
ED BAGG	WESTCOAST ENERGY
Brian Majewski	Westcoast Energy Inc.
Meredyth Gretzinger	Westcoast Energy
ROD TREFANENKO	GULF MIDSTREAM SERVICES
Rudy Steiner	Husky Oil Operations Ltd
Jeremy Nielsen	" "
Bernie Frost	E.U.B
LEN DANYLUK	PENGROWTH CORPORATION
Tim McMullen	Gibson Petroleum
NATHAN TOWNLEY	IPSCO Inc
STEPHEN JACOBSON	FOOTHILLS PIPE LINES LTD
Kyle Keith	Foothills Pipe Lines Ltd.
Glenn CAMERON	Greenpipe Industries
Bob Worthington	Transcanada Pipelines
Bob Lessard.	WELLAND Pipe.
GRANT FIRTH	CORRPRO CANADA, INC
DON PERSAUD	D.N.R.E., New Brunswick
DARRYL SHYIAN	IMPERIAL OIL RESOURCES
GERRY HILL	HILLTECH CONSULTING
Graeme King	Greenpipe Industries

STEVE COOPER	CANSPEC GROUP INC
Siu TSAI	TCPL
BRAD WATSON	TCPL
Greg Van Boven	NOVA R&D
weixing chen	University of Alberta
P. K. Deb	IOCL
Dale Temple	ANTERIS Corrosion Inc.
GLENN MACINTOSH	DENSO NORTH AMERICA INC
Jim Bronson	Canusa
LYLE GERLITZ	JLG ~~ENG~~ ENGINEERING LTD.
BoB Simmons	RTD QUALITY SERVICES
DAVE HARPER	TRANS MOUNTAIN PIPE LINE
Stan Wong	M+C Integrity Engineering Ltd
FERENC PATAKI	BC GAS UTILITY
MIKE REED	TRANS MOUNTAIN PIPE LINE
John Beavers	CC Technologies
Kam Wu	3M Canada
Lorne Carlson	Alliance Pipeline
KEVIN GARRITY	CC TECHNOLOGIES CANADA, LTD
Aida Lopez	TransCanada PipeLines, LTD
DALE DYE	Kemacoat International Inc
Jingli Luo	University of Alberta
Frank M. Christensen	FMC MCT
LINDA GRAY	ALBERTA RESEARCH COUNCIL

RISK ASSESSMENT / RISK MANAGEMENT – General Session

Session Objectives

To provide an interactive forum to identify and prioritise general risk management issues.

Key Issues Brought Forward

General Comment

Many of the issues advanced during this session have been identified and advanced at previous Banff Workshops. Their reoccurrence at this workshop underscores that these issues are still revenant and should continue to be advanced.

Qualitative versus Quantitative Methods

The approach applied to estimating and assessing risk needs to be consistent with the objectives of the analysis.

It was emphasised that a progressive or staged approach is required to address the broad range of risk management issues within the pipeline industry. Tools and processes are required covering the range from qualitative through to quantitative analysis.

Currently, different companies are using a wide variety of methods and approaches for assessing different types of risks (e.g., life safety, environmental, and financial). While industry sees advantages in moving toward common approaches as a longer term goal, it was felt that it is too early to attempt to standardize these processes.

In support of the use of more quantitative methods it was recognised that more specific guidance on establishing acceptable risk levels should be developed, however this is also seen as a longer term goal. It is suggested that in the interim, quantitative assessments should key on relative as opposed to absolute measures of risk.

Data for Frequency Analysis

There is ongoing concern regarding the quality, availability and relevance of the data currently being used for risk analysis.

This emphasises the importance of current industry initiatives in the area of database development and data collection. It is recommended that guidelines should be developed for screening and validating the incident data used in the context of failure frequency estimation. In addition, given the ongoing development of failure prediction models based on line condition data collected in the course of monitoring, maintenance and repair, it is recommended that the current data sets be expanded to include this other data.

Performance Measures

There is a need for meaningful near-term performance measures to help industry and regulators evaluate the effectiveness of ongoing risk management programs.

The current focus on failure incidents as the sole performance measure does not necessarily promote proactive pipeline integrity management. In the near-term, these measures (i.e., failures) can be misleading due to the rarity of pipeline failures. It is recommended that additional consideration be given to measures related to practises involving monitoring, inspection and preventative maintenance (e.g., efforts at finding and eliminating defects or reducing the frequency of mechanical interference events).

Knowledge Sharing

Within the industry there is a need to promote understanding and share information on the use and benefits of pipeline integrity and risk management programs.

As most companies are on a learning path, thought should be given to developing an ongoing process for the sharing of information and ideas. This process must include the smaller companies who may not currently be involved due to resource constraints.

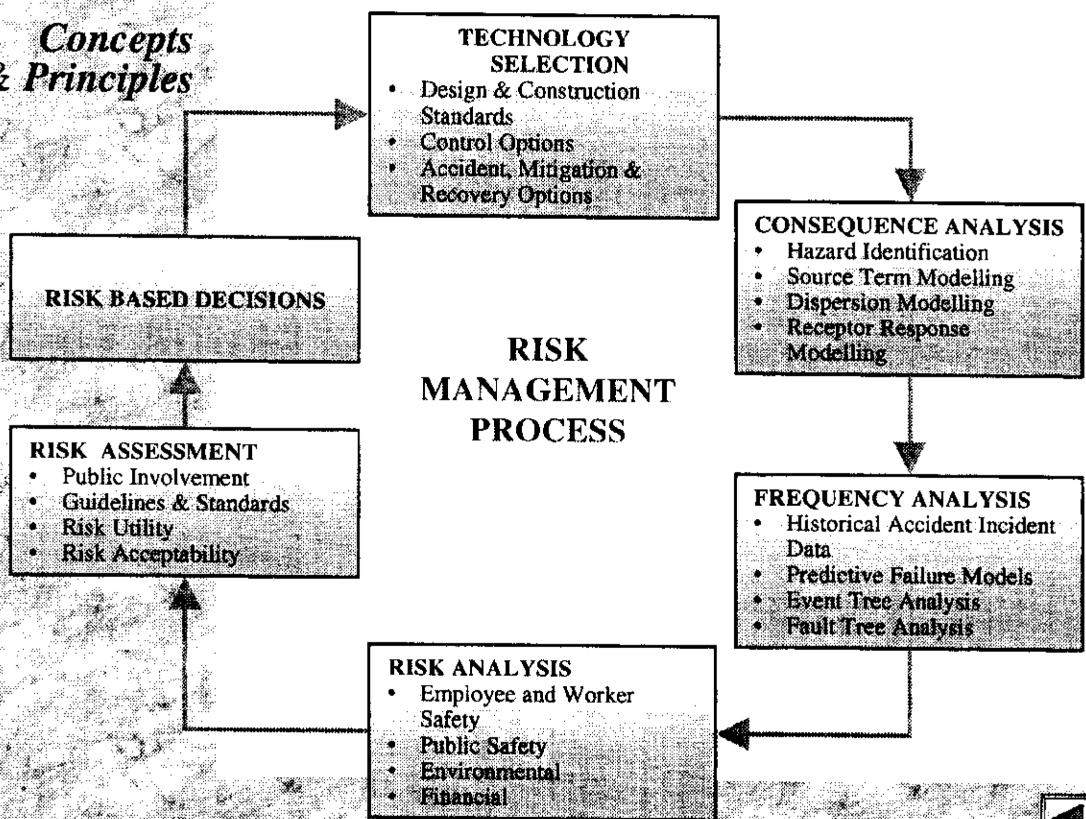
Corporate Commitment

It was emphasised that the development and success of risk management programs within individual organisations is highly dependent upon the degree of corporate commitment to and belief in the merits of risk-based methods for managing pipeline integrity.

Session: Agenda

- **WHY WE'RE HERE**
  - **Objectives of the Session**
  - **The Jargon of Risk**
  - **Where we've been**
  - **What's Working / Issues**
- **PATH FORWARD**
  - **Prioritization of Actions & Issues**
  - **Recommendations**

Concepts & Principles



C-FER Technologies Inc.	Attend. Sheet I	Page 13 Apr 99
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Greg Toth	Trans Mountain Pipe Line	—		
Terris Chorney	Enbridge Pipelines			
WARREN WILDESGER	ENBRIDGE PIPELINES (SASK)			
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Max Buck	Conoco PipelineCo			
S. Gosse	Westcoast Energy			
LARRY SOMMER	CORRPRO CANADA, INC.			
Alebachew Demoz	CANMET / WRC			
ARNOLD BELL	FEDERATED PIPE LINES LTD.			
Bob Shapka	Talisman Energy Inc.			
CARLO SPINELLI	SNAM SpA			
Jane Dawson	Pipeline Integrity International Ltd (PII)			
TIM BALDWIN	BG TECHNOLOGY			
LAWRENCE GALES	TRANSPORTATION SAFETY BOARD			
Blaine Ashworth	TCPL			
Graeme King	Greenpipe			
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C-FER Technologies inc.		RISK - GNL SESSION ATTENDANCE SHEET 1	Page
			Date 13 APR 99
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C-FER Technologies inc.

Attend. Sheet I

RISK - GENERAL

Page 13 Apr 99

Date

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ROB TREFANENKO	GULF MIDSTREAM SERVICES
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MARC SPENCER	M & C INTEGRITY ENGINEERING.
BRIAN GRIFFIN	GOLDER ASSOCIATES
Graeme King	Greenpipe
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TIM BALDWIN	BG TECHNOLOGY
Kevin Cicansky	TCPL
David DeGagne	EUB
Glenn Yuen	Dynamic Risk Assessment
Wayne Feil	Imperial Oil
DARRYL SHYIAN	IMPERIAL OIL RESOURCES

C-FER Technologies Inc.

Designed by	Checked by

RISK - GNL SESSION

ATTENDANCE SHEET II

Page 2/2

Date 13 APR 99

Project

IBRAHIM KONUK	Geological Survey of Canada
Stephen Gosse	West Coast Energy.
GARRY SOMMER	CORRPRO CANADA, INC.
AREBACHEW DEMOZ	CANMET/WRC
Terris Chorney	Enbridge Pipelines
WARREN WALDEGGER	ENERGY (SASK)
Mike Webb	Hunter McDonnell
Max Buck	Conoco Pipeline Co.
PAUL GRECO	UNION GAS
PAUL MEANWELL	UNION GAS
NORM TRUSLER	BC GAS
William Jarvis	WILLIAMSON INDUSTRIES
Greg Toth	Trans Mountain Pipe Line
Miles Hawkeness	Centra Gas Manitoba
DARIUS BOUCHER	COLT ENG'G.
KEITH CARR	WESTERN FACILITIES
TOM WRIDDELL	PYXIS GEOMATICS
FRANK GAREAU	NATIONAL ENERGY BOARD
MARTIN ELSEMAN	PYXIS GEOMATICS LTD.
Wes MacLeod	KOMEX INTERNATIONAL
R. K. Lele	Indian Oil Corpn. Ltd India

Working Group 4B
Risk Management/Internal Corrosion
Producers

Review of Issues

Directions for the New Millennium

14 April 1999

1

1993-06 Materials Working Group
Six Priorities Identified

- **Correlation of laboratory testing with the real world (inhibitors & coatings)**
- **Internal protection of high water cut pipelines**
- **Failure assessment of corroded pipe (ECA)**
- **Predictive capability for HIC**
- **External SCC - mechanisms of and laboratory tests for**
- **Elastomers resistant to explosive decompression**

14 April 1999

2

1994-06 Materials Working Group
Highest Priority Issues Identified

- Environmental cracking (SCC & HIC)
- Failure assessment of corroded & cracked pipe
- Corrosion mitigation in high water cut pipelines and under disbonded coatings
- Assessment of alternative materials such as:
  - polymer liners
  - high-strength steel pipe
  - fibre-glass pipe
  - composite wrapped pipe
  - materials properties database development to enable modelling of SCC & HIC

14 April 1999 3

1995-10 Internal Corrosion Mechanisms Working Group
Important Issues at this Time

- Controlling internal corrosion (454 or 60% of failures in 1994)
- Ineffective inhibition at localized areas
- Verification of threshold levels of inhibitors determined in the laboratory by field monitoring
- Preliminary selection of inhibitors so data is applicable to field conditions and not based on specific test methodologies
- Quality management of pipeline maintenance systems (eg. Inhibition, training, staffing, pigging)
- Definition of critical parameters, such as:
  - fluid composition
  - levels of chlorides
  - elemental sulphur
  - flow regimes
  - CO_2/H_2S ratios

14 April 1999 4

1997-04 Risk Management/Internal Corrosion Issues Identified

- **We cannot predict internal corrosion well enough**
- **We do not have coordinated industry action with respect to internal corrosion**

14 April 1999 5

Are We There?

1993
- **713 pipeline failures**
- **419 due to internal corrosion**

1997
- **750 pipeline failures**
- **455 due to internal corrosion**

14 April 1999 6

Producers Issues 1993-1997

Issues	Action To Date	Priority
Internal Corrosion Inhibition • Ineffective at localized areas • Verification of threshold levels • Preliminary selection • Correlation of lab with field	 • Canmet project • Canmet project • Canmet project	
Internal Corrosion Prediction • Can't predict well enough • Definition of critical parameters	• Canmet project • Chemical suppliers • Consultants/contractors	
ECA of Corroded & Cracked Pipe		
Maintenance Quality Management		
Assessment of Alternative Materials • Polymer liners • High-strength steel • Fibre-glass • Composite wrapped pipe	 • Shell JIP	
HIC & SCC • Materials properties database • Mechanisms of & lab tests for • Prediction of HIC & SCC		
Others?		

CAPP guidelines **is it possible**
Rule of thumb
Focusing on internal corrosion

Involve regulators

Bob, Tailisman Different treatment in different districts

Focus on global monitoring rather than one site monitoring

Bert, Gulf Monitoring crew does not know technical details
Educate them

Reg **Identify significant issues**
For company
For regulators
For public

Dave With increase spending the failure rates can be reduced

Consequence of spilllong term effects, problems
Wrap them now

Alberta Pipeline Environment Steering Committee (APESC)

Industry, public and government

Make this committee aware

Bob **Make EUB to give public input, announcement, that spill volume is going down**

Other issues

INTERNAL CP

MONITORING

4B - Risk Management/Internal Corrosion - Producers

Direction for the New Millennium

Issues from Previous Workshops:

1993: Internal protection of water-cut pipelines
Failure assessment of corroding pipelines
Prediction of HIC/SSC

1994: SSC/HIC
Failure assessment
Corrosion of high water-cut pipelines
Polymer lines

1995: Internal corrosion mechanism
Predictive modeling of internal corrosion

1997: Risk management/Internal corrosion
Coordinated industry action
We can't predict

Actions taken:

Methodologies for inhibitor evaluation	CANMET
Internal corrosion models	CANMET/Suppliers
Polymer lines	Shell/JIP
High-strength steels	Not an issue

1999 Workshop

Objectives

- Decide key issues
- Recommendation for future direction

Discussions

Ray, Chevron: Newer technologies available for monitoring, e.g., noise.
Local expertise not available
Not many companies to set up electrochemical monitoring
Expertise comes from other countries, e.g., Scotland, U.S.

How to use new techniques

Dave	Low cost equipments available Suppliers not using them
Recommendation	Producers tell suppliers how to select inhibitors
Reg	Historically use higher concentration of inhibitors in the field
Ray, Chevron	Higher inhibitor cost – shutting down well Noise – good, instantaneous response
Dave	Monitoring at one point not representative of the pipe
Ion, CAPP	Statistics has not changed over the years When regulators is going to step in?
Dave	Regulators already stepping in
Reg	We do not inhibit marginally producing lines Economically robust
Reg:	Do inhibitors work in the presence of slug Lots of lines.. Should not paint the same conclusion for all lines
Dave:	spill number or volume to be considered for consequence Industry wide/provincial wide guidelines Consequence side of the risk should be considered What is acceptable risk
Bert Johnson, Gulf	Natural gas lines.. Internal corrosion big issue
Dave	No complaints from residents Landowner/company good relationship
Reg	untreated lines Semi-log plot...cumulative vs. time...number of failures decreasing Success story or not ...

Dave Failure can't be zero
Focus on detection
Minimizes failures
Consequence in risk assessment

New board members Educate them
EUB data do not tell full story

Don Currie, ACR What is the consequnce to the producers

$ 5000 to 2,000,000

Regulators do not see the financial side

Reg EUB information ladder
See if there is a common industry process (approach) that can involve the regulators

Predictive Models

Bob, Talisman Use both qualitative and quantitative approach

Dave Concentrate on the consequence of risk

Producers/CAPP/ group sit with regulators

Gain support
Address their concerns
Is not too late

EUB Database

Better version being made
Role into PRASC database

Role of CAPP

How to present data, e.g., failure, volume of spill etc.

New techniques Have potential
Location of placement of monitoring device is important

Concept of risk

How to get board involved

CAPP form task force

Model that everybody can use

Form Task Forces

CAPP producing 4 years of oil pipeline performance including

Industry/Regulator meeting

Additional R&D Work

Flow regime	CANMET Model considers flow as well

Industry should be aware of other work, e.g., Ohio university

Reg	Not everybody is using all the available techniques
Flow line models	good for gas lines Not for multi phase lines

Field monitoring important

Not the corrosion rate, but the probability important... say from B to C

Ray:	Mitigation type to be modelled Some lines are better than others ... inspect Tune your models
Pan Canadian	No of failures/year decreasing Does regulators aware of this
Gulf Canada	No. of failures/year increasing

Forum to share information

W.G. #4B Risk Management/Internal Corrosion - Producers

Name	Affiliation
Winston Revie	CANMET
Ian Scott	CAPP
BERT JOHNSON	GULF CANADA RESOURCES LTD.
SANKARA PAPAVINASAM	CANMET
RAY GOODFELLOW	CHEVRON.
A. DEMOZ	CANMET/WRC
D Currie	ACR
Bob Shepka	Talisman Energy
Reg MacDonald	Mobil oil Canada.
DAVE KOPPERSON	PANCANADIAN

Working Group 4C: Risk Assessment/Risk Management – Transmission

Co-Chairs: Kevin Cicansky (TCPL)
Glenn Yuen (Dynamic Risk Assessment)

SESSION E: Tools and Techniques

INTRODUCTION

- Reviewed summary of three principal recommendations from last workshop (1997)
- Items have been addressed by individual organizations but mnor progress from industry groups (ie PRASC)
- SCC was a big issue and since then some companies are looking at more issues such as general corrosion

SESSION OBJECTIVES: To review new developments and applications of tools and techniques for risk analysis of transmission pipelines.

PRESENTATION 1: Pipesafe Risk Assessment Package for Gas Transmission Pipelines
Tim Baldwin, British Gas Technology

SUMMARY: Attached

DISCUSSION:

- What is the range of diameters for validation of Pipesafe in large scale tests – full scale – 6 in to 36 in + up to 12,000 KPa
- Focus on human casualties – do you look at property damage cost – much less concern
- Is there a prescribed value for acceptable risk level – No – ALARP principle – what is the value of human life – ¾ to 1.5 million pounds, but higher values are implied
- Pipesafe only used for sweet natural gas – the future may look at sour gas
- How long does it take to carry out a risk analysis – normally most of time is spent with input parameters – perhaps a day – normally look at specific 'hot spots' not the complete line
- Can you change input data (for application say to N America) – yes
- Exposure is dependent principally on distance to pipeline
- If there was a house within the 'hazard' zone, have BG ever bought it out – no
- Proximity distance is not necessarily a 'safe' distance
- HSE have advised against building at some distance at times where a company may not – HSE have different laws compared to planning commissions
- Who pays for analysis and mitigation – HSE/BP/Developer combination

PRESENTATION 2: Risk Based Decision Management (RBDM) Applied to Large Scale Assets
Rob Bruce, RMRI

SUMMARY: Attached

DISCUSSION:

- Expected utility – presentation mentioned that share activity can be used to determine utility curve for company – use expected utility for large losses relative to corporate assets (or returns) only
- Theory of utility – have to separate shareholder risk vs management risk – management will be more risk adverse because they have fewer alternatives – have used series of paired questions – have looked at such techniques – concluded they are not too useful – questions are highly hypothetical (hard for person answering to envision) – personal bias comes in – better to put in all the costs and this will 'incorporate' risk aversion

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SESSION F: Company Experiences with Risk Assessment

SESSION OBJECTIVES: To use case histories for demonstrating the successful application of risk assessment techniques

PRESENTATION 1: Visions and Issues for Pipeline Risk Management at TransCanada
Bob Sutherby, TCPL

SUMMARY: Attached

DISCUSSION:

- Customization – what is the opportunity to integrate risk management program into ISO 9000 – few ISO discussion held at this time but quality assurance is an important issue
- ISO 9000 has monitoring component – how does such a large program incorporate some sort of validation step of models – problem is recognized – hope to use historical information – will implement what we have now and validate as we go
- How do we measure the success of such a program
- Defect Management (eg external corrosion) – how does this mesh with risk management
- What is acceptable for risk measurements – no number on what is acceptable – will continue to address

- Who is driving this program – initiated with Pipeline Integrity Dept –Designed by IT (&Business) Dept. – Pipeline Integrity Groups – 1) Long range plan 2) 1 year program 3) Long term strategy, facilitate risk management 4) Data management
- Need to be concerned with scope creep from other internal department
- Will program determine level of spending or prioritize spending within a level – doing both right now but need to develop a strategy
- The more quantitative the model the more useful it is? –depends on the stakeholders
- Model will consider business consequences – considers multiple regulator ? require constituency of philosophy across the board – many issues with different regulators

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PRESENTATION 2: The Northwest Risk Management Program
Sean. Black, Northwest Pipelines (Williams Energy)

SUMMARY: Attached

DISCUSSION:

- You can address the risk but still be out of compliance with code – they enter into an agreement with regulator – like a waiver – they have been trying for a couple of years to get into the demonstration program
- Example applications for risk were associated with sections out of code (Eg class locations)
- What is the confidence level of using risk vs regulations – what makes pipeline less safe if one additional house means a class change – this was a cultural change within the company
- In the segments where risk was used, was there any impact on operations of other segments? Yes, the experience was useful for consideration of other segment – learning process
- General view from Europe that US regulators want zero risk – if legal system says you knew there was a risk but didn't eliminate it, how do you respond? We are making our pipeline safer and are trying not to let such concerns derail system – lawyers have looked at program
- How are you identifying the highest risks and convincing the regulator – use past history – last 5 years of William's system –25,000 km - e.g. 3-4 rupture from earth movement and monitoring shows concern
- Legal criteria may be based on what the common man might due – benchmarking to industry is important – common industry approach provides due diligence
- Trying to find the best way of mitigating risk from a large segment (not a specific small segment) – what is public perception – not in my backyard syndrome – to date acceptance has been good – in some areas, open discussion with public has helped – would not be surprised if future problems
- What happens after 4 year demo concludes – grandfathered, risk work applicable for future operations

SESSION CONCLUSIONS AND RECOMMENDATIONS

- Measurement – how can we keep track of all the data and keep it up to date
- Incorporate models/programs into quality assurance system
- Need system for tracking how data is used
- Tend to have focussed on public safety and should include reliability in the future
- May not need to discuss database management and risk management together – separate (but both important)
- Requirement for top management buy in – value in something like best practice documentation, further meetings
- Should consider what are the uncertainties associated with all the risk models – tradition has been to err on the conservative side – end result is we do not know how conservative – a lot of work has been done in other applications e.g. environmental risk assessments
- Many engineering applications add safety factors to design and then we use this conservative information for risk – combined approaches introduce problems
- Need to look at what kind of data you need for risk models – separate session for this group, not the database group
- What are the objectives for carrying out a risk assessment – there can be many but need to be documented – determines the data requirements and management process
- Can use Baysian methods to handle rare incident data

Risk Assessment of Onshore Gas Transmission Pipelines and the PIPESAFE Package

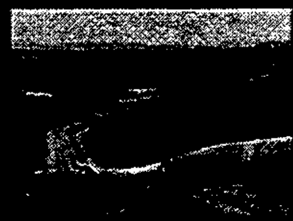
Tim Baldwin - BG Technology

BG Technology

PIPESAFE

Overview

- Introduction
- Elements of a Pipeline Risk Assessment
- Individual Mathematical Models
- PIPESAFE Validation
- Applications of PIPESAFE in Transco



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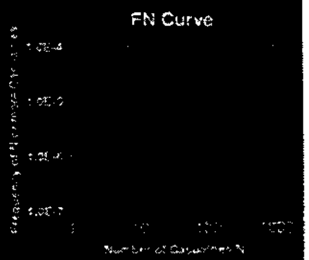
Introduction

Background

- Risk - likelihood of an undesired event, e.g. casualty
- Individual Risk - frequency of an individual at a specified location being a casualty
- Societal Risk - relationship between the frequency of an incident and the number of casualties



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Introduction

TRANSPIRE

- Developed by BG (formerly British Gas)
- Software Package
  - DOS application
  - Validated mathematical models
  - Individual and societal risk
- Used extensively by BG and other operators under licence

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Introduction

PIPESAFE Collaboration

- International Collaboration
  - BG (UK)
  - DONG (Denmark)
  - ENAGAS (Spain)
  - Gasunie (Netherlands)
  - Statoil (Norway)
  - TransCanada Pipelines (Canada)

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Introduction

PIPESAFE Collaboration

- Phase 1 (1994 - 96)
  - 1st version of PIPESAFE, based on TRANSPIRE
  - New models for corrosion, fatigue, fireball
  - Pipeline damage database
- Phase 2 (1996 - 98)
  - PIPESAFE validation and improvement
- Phase 3 (1999 - 2001)
  - To address issues raised in Phase 2

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Elements of a Pipeline Risk Assessment

- Failure cause
- Failure frequency
- Failure mode
- Gas outflow
- Dispersion
- Ignition
- Thermal radiation
- Thermal effects

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Elements of a Pipeline Risk Assessment
Failure

- Failure Causes
  - External interference
  - Corrosion
  - Fatigue
  - Ground movement
  - Material or construction defects
- Failure Modes
  - Leaks (punctures)
  - Breaks (ruptures)

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Elements of a Pipeline Risk Assessment
Gas Outflow

- Rapid depressurisation
- Crater formation
- Pipeline alignment
- Jet release (or releases)
- Initial transient release (mushroom shaped cap)
- Quasi steady plume
- Gas outflow initially balanced
- Decay rates determined by system

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Elements of a Pipeline Risk Assessment
Ignition

- Immediate ignition
  - Transient "fireball" phase
  - Up to ca. 30 seconds duration
  - Followed by quasi-steady fire
- Delayed ignition
  - Quasi-steady fire only

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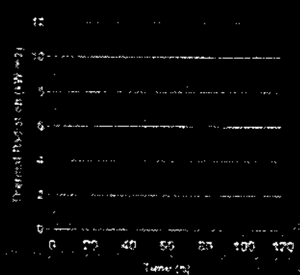
Elements of a Pipeline Risk Assessment
Thermal Radiation

- Varies with time
- Varies with distance
- Varies with shape, nature and extent of fire
  - Determined by source and atmospheric conditions
- Varies with atmospheric transmissivity
  - Determined by humidity



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Elements of a Pipeline Risk Assessment
Thermal Radiation Effects

- People
  - Affected by high thermal radiation doses
- Buildings
  - Ignited by high thermal radiation doses or secondary fires

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Failure Frequency Models

Third Party Interference

- Third Party Interference
  - Predictive model
  - Models pipeline diameter, wall thickness, design factor, grade, and toughness
  - depth of cover, sleeving, slabbing, surveillance
- Corrosion
  - validated by comparison with on-line inspection
- Fatigue
  - probabilistic crack growth model

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Consequence Models

General

- Models developed using theoretical understanding and results from small scale tests
- Many processes scale dependent
- Essential to validate at large scale
- BG Technology Spadeadam Test Site

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Consequence Models

Gas Outflow

- Standard Model
  - Dynamic simulation model
  - Pressure, pipeline internal diameter, friction effects, position of failure, boundary conditions
- Gasunie Model
  - Designed to model networks

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Consequence Models

Initial Fireball

- Physically based model
- Predicts fire size and thermal radiation levels
- Source, fluid flow, combustion and radiation sub-models
- Effects of wind and soil
- Validated against large scale tests

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Consequence Models

Initial Fireball

- 11 large scale tests
- 6" (150mm) diameter pipeline
- Initial pressures 30, 60, 120 bar
- Sandy, clay and no soil
- Flames ca. 100m high

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Consequence Models

Quasi Steady-state Fire - Ruptures

- Physically based model
  - Source, flame structure, combustion and radiation sub-models
  - Validated against large scale tests with range of release conditions
- Empirical model
  - Based on many large scale steady-state fire tests

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Consequence Models

Thermal Effects

- Transient event
- Fire models run at ten times
- Thermal effects model sums dose:
  - Stationary targets (buildings)
  - Moving targets (people)
- Calculates
  - Burning distance (buildings)
  - Escape distance (people)
- Mitigating effect of shelter

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Risk Calculation Routines

- Failure position unknown
- Effects considered over "interaction length"
- First routine
  - Individual risk
  - Generic societal risk
- Second routine
  - Societal risk for specified site
  - FN curve
  - Expectation value

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PIPESAFE Validation

Software Testing

- Comprehensive Programme in 3 Phases
  - "Quicktest"
  - "Test of Data Flow Cycle"
  - "Module Test"

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PIPESAFE Validation

Incident Comparison

- PIPESAFE predictions of burnt areas compared with documented incidents
- Predicted values slightly conservative
- Some incidents had features not modelled
  - Flame jetting
  - Two fire plumes
- Correctly predicted response of people (e.g. Edison, New Jersey)

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PIPESAFE Validation

Sensitivity and Uncertainty Analysis

- Sensitivity Analysis
  - High sensitivity of failure frequency models, but inputs well known
  - High sensitivity to fire source conditions
- Uncertainty Analysis
  - Wind conditions
  - Pipeline failure orientation

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Future Developments

- Phase 3
  - Probabilistic treatments
    - Weather
    - Fire source
  - Refined failure frequency models
  - Improved thermal response model
  - Increased flexibility in risk calculations

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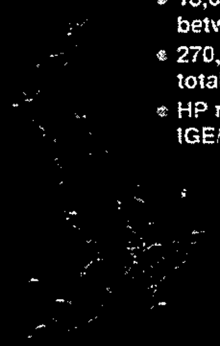
TRANSCO'S HIGH PRESSURE NETWORK



- 18,000 km operates between 7 bar and 75 bar
- 270,000 km pipelines in total
- HP network operates to IGE/TD/1

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PIPESAFE APPLICATIONS

- Encroachments
- Code infringements
- Uprating
- Routing
- Emergency Planning

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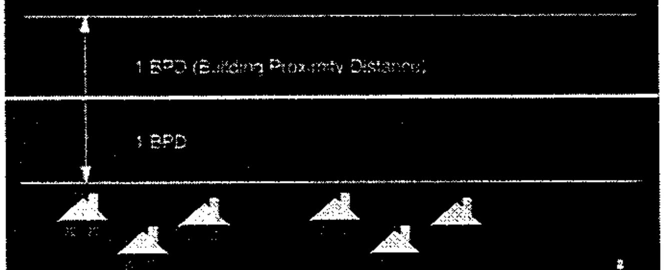
Encroachment

- Proximity infringements
- Population density infringements



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Encroachments picked up by

- Pipeline Surveys
- Land Use Planning Regime

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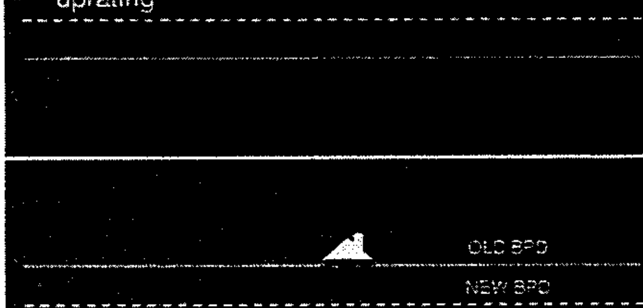
Survey essential for uprating



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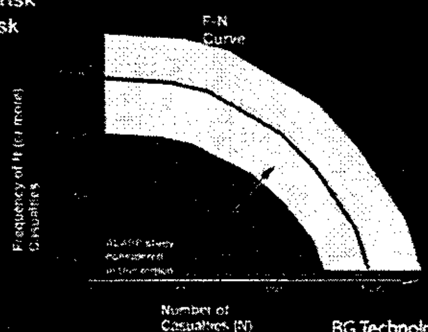
PIPESAFE used to calculate

- Individual risk
- Societal risk



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Several risk reduction measures considered:-

- Relay in thick wall
- Divert
- Concrete slab
- Increased surveillance

Decision based on ALARP

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Summary

PIPESAFE

- Integrated hazard and risk assessment package
- Extensive validation:
  - Large scale testing
  - Incident comparison
  - Software testing
  - Uncertainty and sensitivity analysis
- It is a tool that
  - has evolved over a long period
  - is in constant use
  - is flexible
  - is beneficial in decision making

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Risk Based Decision Management (RBDM)

Outline

- Introduction
- Axioms of RBDM
- Application to Pipeline Management
- Examples
- Summary

CAMD

Management/Decision Making

- Rational, consistent decision-making ⇒ improved asset/organisation performance
- Improved performance ⇒ improved return on investment
- Quality of decision depends on quality of data

CAMD

Axioms of RBDM

1. Decision making ≡ management
2. Risk - capital staked under conditions of uncertainty
3. Balance - risk, returns and uncertainty
4. All associated capital - voluntary/involuntary
5. Risk aversion
6. Optimum decision maximises 'expected' return

CAMD

Pipeline Hazards (1)

- Corrosion/Material Defects
- Settlement of Foundations/Support Structures
- Landslides
- Ice/Frost Damage
- Vehicle Impact
- Storm Damage/Scour
- Maintenance Errors

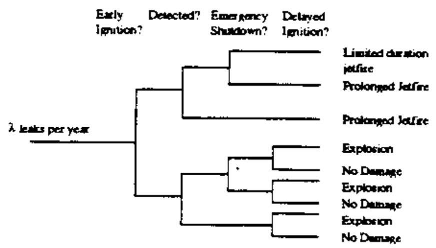
CAMD

Pipeline Hazards (2)

- Process (Overpressure/Pressure Transients)
- Sabotage
- Earthquake
- Wave/Current Action (offshore)
- Dropped Objects (offshore)
- Anchor Damage (offshore)

CAMD

Gas Pipeline Event Tree



CAMD

Decision Criterion

The optimum strategy is that which has the lowest expected cost.

$$E[\text{cost}] = \sum_{i=1}^{N} f_i C_i$$

= sum over all scenarios of 'frequency' x 'cost'

CAMD

Repair Decision

- **Scour damage identified**
- **Decision: repair now or wait?**
  - **wait for better weather?**
  - **Wait for scheduled shutdown?**

If $E[\text{cost}]^{\text{Immediate}}_{\text{Repair}} < E[\text{cost}]^{\text{Deferred}}_{\text{Repair}}$

—

CAMD

Bayesian Analysis

The definition of the relationship between inspection strategy and the chance of detecting damage can be progressively refined using a statistical technique known as Bayesian Analysis

CAMD

High Frequency Inspections

- **High Frequency Inspections:**
  - **High Inspection Cost**
  - **High Chance of Detecting Damage**
  - **Low Probability of Loss of Containment**
  - **Low Expected Damage**

CAMD

Low Frequency Inspections

- **Low Frequency Inspections:**
  - **Low Inspection Cost**
  - **Low Chance of Detecting Damage**
  - **High Probability of Loss of Containment**
  - **High Expected Damage**

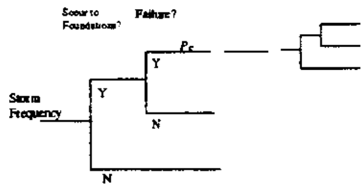
CAMD

Mixed Strategies

Strategy	Frequency	Areas	Hazards
A	High	All	All
B	High	High Risk	Selected
	Low	High Risk Low Risk	Other All
C	Low	All	Selected
	Medium	All	Other
D			
⋮			

CAMD

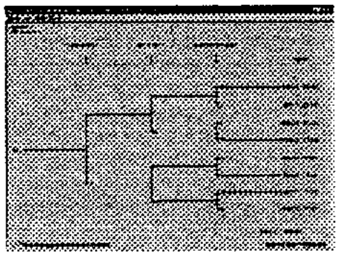
Repair Decision



P_f = Failure Probability, a function of existing state

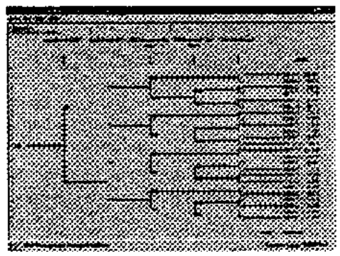
CAMD

Tanker/Pipeline Decision



CAMD

Tanker/Pipeline Decision



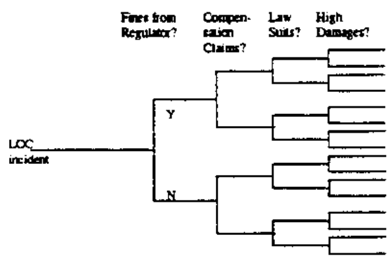
CAMD

Tanker/Pipeline Decision

NPVs and Expected NPVs for Tanker vs Pipeline Options	Base Case (with Tanker)	Pipeline	Pipeline (with tie-in guarantees)
E[NPV] of Revenues with P90 reserves	$292 M	[illegible]	[illegible]
E[NPV] of Revenues with P50 reserves	[illegible]	$2130 M	$2130 M
E[NPV] of Revenues with P10 reserves	$870 M	$1090 M	$1090 M
E[NPV] of Cost of Oil spills	-$2 M	-$1 M	-$1 M
E[NPV] of Revenues From Field A tying-in	0	$234 M	[illegible]
E[NPV] of Revenues From Field B tying-in	0	$234 M	[illegible]
E[NPV] of Tanker Cancellation Penalty	0	-$80 M	-$80 M
Sub-Total of E[NPV] from Risk Profiles	[illegible]	$4077 M	[illegible]
NPV of Cost of Pipeline	0	-$1300 M	-$1300 M
NPV of Cost of Tie-in Guarantees	0	0	-$80 M
TOTAL Expected NPV	[illegible]	$2777 M	[illegible]

CAMD

Stakeholder Effects



CAMD

Summary

- RBDM provides a Rational Framework for Decision Support
- Identify Alternatives
- Produce Risk Profile for each Alternative
- Include all Capital
- Compare Expected Loss/Return of each
- Allow for Risk Aversion (if appropriate)
- Manage data in an auditable manner (DDMT)

CAMD

Vision and Issues for Pipeline Risk Management at TransCanada

R. Sutherby
D. Diakow
B. Nolan

TransCanada

OUTLINE

- Pre-Merger Integrity Approaches
- Concepts for Future Integrated Integrity Program
- Risk Management Approach
- Issues: Data collection, Database management, Assessment Tools

Pre-Merger TCPL

- Zero Rupture Tolerance
- Two Main Integrity Challenges:
  - SCC
  - Corrosion
- Mainline System
- Linear System & Loops
- Mitigation Mode

Pre-Merger TCPL

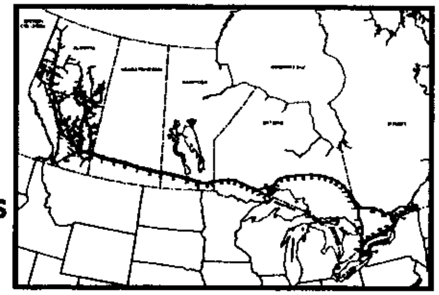
- TRAPRAM: TransCanada Pipelines Risk Assessment Model
- Susceptibility & consequence models applied along mainline.
- Applied to Prioritize Mitigative Actions (e.g. Hydro, Proximity, digs,etc.)

Pre-Merger NGTL

- Failure risk reduction
  - Failure frequency & consequences
- Integrity management program considered:
  - SCC, Corrosion, Geotech
- Considered consequence for SCC and Corrosion prioritization.
- Considered hazards individually

Merged TCPL Pipeline System

- 38,000 km of natural gas transmission pipelines
  - NPS 2 to 48
- Geographic diversity:
  - Population densities
  - Terrain differences
  - Regional System Complexities
  - Regulatory differences
  - 5 provinces



Merged Integrity Program

- Consistent Philosophy
- Risk-Based Approach System Wide
- Reflects Geographic Diversity
- Address All Known Hazards
- Data Reusability
- Integrity Program Optimization

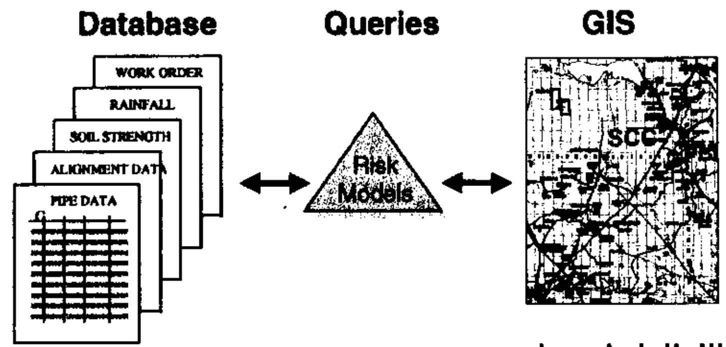
Consistent Philosophy

- Integrity Targets:
  - Zero Rupture
    - >NPS XX
    - Class > X
  - Business Consequence
    - <$xxx,xxx
  - Emissions Targets

Risk Management - A Common Approach

- Public Safety
- Reliability
- Competition
- System Scale
- Geographic Diversity
- Time-Dependent Failure Causes

Pipeline Risk Information Management - Concept



Levels I, II, III

Program Development Challenges

- Consistent Data Models
- Consistent Hazard Models
- PIRAMID
- Integration:
  - Mixed mechanisms
  - Annual program optimization
- Macro versus Micro Assessment
- Regional Business Consequence Model
- Communication & Consultation

Hazard Initiation and Growth Models

- External Corrosion
- Environmentally-Assisted Cracking: SCC, HIC
- External interference
- Geotechnical
- Mixed Mechanisms:
  - Cracks in Corrosion
  - Geotechnical with Corrosion or Cracks

PIRAMID

- Off-the-Shelf Modules:
  - External Interference
  - Corrosion
- Customization of Hazard Models
- Customization of Consequence Models
- Integration with Integrity Data

Program Optimization Concepts

- Obtain Greatest Risk Reduction for Resources Expended:
  - Selecting Appropriate hazard to mitigate
  - Prioritizing segments
  - Mitigation against Multiple Hazards
- Cost Effectiveness
- Enhanced Reliability

Macro Versus Micro Risk Assessment

- Data Scale Dependency
- Hazard Model Dependency
- Analytical "Horsepower"
- Spatial versus Relational
- GIS Interface

Regional Issues

- Upstream Customer Impacts
- Downstream Delivery Impacts
- Competition
- Linear versus Highly Networked System
- Populated versus Remote
- Gathering versus Mainline Operation

Current State

- Developing PRIM & PRIME
  - Populating databases
  - Refining models
  - GIS Customisation
- Implementation in 2000-01
- Stay Tuned

APR 14/99

SIGN IN
WG 4 C 1.15:3.45

Wednesday 1pm
WG 4C

NAME	ORGANIZATION
Brian Griffin	Golder Associates
TIM BALDWIN	BG TECHNOLOGY
John Hendershot	NEB
Mark Ottem.	Trans Mountain Pipe Line
Bob Elber	Consultant
DOUG CLARK	Gulf Midstream Services Limited
Clive Ward	BG Technology
Joshua Johnson	CC Technologies
Max Buck	Conoco Pipeline Co.
Marie-Chantal Labrie	NEB.
TED HAMRE	CANSPEC
Paul Trudel	NEB
MIKE GLOVER	BTS - A CORRPRO COMPANY
Don Powell	Amoco Canada Petroleum
BRUCE DUPUIS	Integrated Integrity Inc.
CARLO SPINELLI	SNAM SpA
Mark Yeomans	TCPL
DARREN HILL	HILLTECH CONSULTING LTD.
WILLIAM JARVIS	WILLIAMSON INDUSTRIES
NOEL BILLETTE	Natural Resources Canada
DICK GRAHAM	TRANSGAS
PAUL GRECO	UNION GAS
DON MC NABB	APACHE PIPELINE PRODUCTS
DENIS TRUDEAU	CORRPRO

CYRIL KARVONEN	TRANSCANADA MIDSTREAM
ERROL BATCHELOR	WESTCOAST ENERGY INC.
Guy Hervieux	Atco Pipelines
Wes Macleod	KOMEX INTERNATIONAL LTD.
FRED BAINES	BC GAS
NORM TRUSLER	BC GAS
FRANK GAREAU	NATIONAL ENERGY BOARD
GARRY SOMMER	CORRPRO CANADA, INC.
Rob Bruce	Risk Management Research Ltd
Kevin Cicansky	TCPL
Glenn Yuen	Dynamic Risk Assessment
SEAN BLACK	WILLIAMS
RICK WATTENS	AEC PIPELINES
~~[illegible]~~	
ANDREW FRANCIS	BG Technology
PAUL MEANWELL	UNION GAS LIMITED
Joanna Makomaski	Enbridge Consumers gas.
MARC SPENZER	M&C INTEGRITY ENG.
GORDON DAW	N.E.B.
~~HA~~ H. PAREKH	INDIAN OIL CORPORATION LTD.
BRIAN NIESBITT	NATIONAL ENERGY BOARD
LEO JANSEN	NEB.
Stephen Gosse	Westcoast Energy.
Jane DAWSON.	PII
GORD WENGRENIUK	BASELINE TECHNOLOGIES INC.
Minh Ho	NEB
Carl JASKE	CC Technologies
Terris Chorney	Enbridge Pipelines

4C BANFF PIPELINE INTEGRITY WORKSHOP 3:30-5:00 PM

~~2:45 PM.~~

990414 SESSION 4C RISK ASSESSMENT

NAME	COMPANY/ORGANIZATION
A Francis	BG Technology
Brian Griffin	Golder Associates
Bob Eiber	Consultant
Mark Ottem.	Trans Mountain Pipe Line
PAUL MEANWELL	UNION GAS LIMITED
John Hendershot	NEB
GORDON DAW	NEB.
Clive Ward	BG Technology
MARC SPENCER	H&C INTEGRITY ENG.
Joanna Makomaski	Enbridge Consumers Gas.
Brian NESBITT	NATIONAL ENERGY BOARD
Max Buck	Conoco Pipeline Co
Neal Thomassen	Thomassen Energy Consultants Ltd
Joshua Johnson	CC Technologies
Paul Trudel	NEB
LEO JANSEN	NEB/ONE
Marie-Chantal Labrie	NEB.
TED HAMRE	CANSPEC
WILLIAM JARVIS	WILLIAMSON INDUSTRIES
Minh Ho	NEB
Don Powell	Amoco Canada Petroleum Co.
CARLO SPINELLI	SNAM
Jane Dawson.	PII.
PATRICK VIETH	PII
DARREN HILL	HILLTECH CONSULTING LTD.
Stephen Gosse	WestCoast Energy
LARRY HUNT	WESTCOAST ENERGY

DOEL BILLETTE	Natural Resources Canada
Carl Jaske	CC Technologies
Dick Graham	TransGas
Terris Chorney	Enbridge Pipelines
Aaron Dinovitzer	Fleet Technology Ltd.
RICK WATTENS.	AEC PIPELINES
CYRIL KARVONEN	TRANSCANADA MIDSTREAM
BRAD WATSON	TRANSCANADA PIPELINE
ERROL BATCHELOR	WESTCOAST ENERGY INC.
Guy Henvieux	Atco Pipelines.
BERT JOHNSON	GULF CANADA RESOURCES
DENIS TRUDEAU	CORRPRO
GARRY SOMMER	CORRPRO CANADA, INC.
Wenyue Zheng	CANMET
Ian Scott	CAPP
FRANK GAREAU	NATIONAL ENERGY BOARD
GORD WENGRENIUK	BASELINE TECHNOLOGIES INC
SEAN BLACK	WILLIAMS
PAUL GRECO	UNION GAS
MIKE GLOVER	BTS - CORRPRO

Risk Assessment and Risk Management - Communications and Public Consultation

Facilitator: Mr. Anton Walker, Suncor Energy Oil Sands, Calgary, Alberta
Co-chairs: Mr. David De Gagne, Alberta Energy and Utilities Board, Calgary, Alberta
Mr. Terry Gibson, Gecko Management Consultants, Calgary, Alberta (not available)

Objectives

The objectives of this program was broken down into four steps

1. The first was how risk communication fits into risk management framework and its importance within the overall success of the project in becoming a reality. This was presented by Mr. James Wright of Risk Management Associates.
2. The second step was to highlight as an example the CAPP public involvement guidelines for which operators could use in developing their own specific communication programs. This was presented by Ms. Bev Denis of Gulf Canada.
3. The third step demonstrated a specific case study using the Caroline interrogatory process as an example of how an effective communications and public involvement program can re-establish trust and credibility levels within a community.
4. The last step was to use the principles of fundamentals learned in the first three steps and apply those to an extreme situation (e.g., eco-terrorism) and identify the direction the industry and regulators need to take in order to reduce the likelihood of extreme situations.

Background

A video that had been put together by CBC newsmagazine and W5 portrays the deep unrest with a few isolated individuals near a Northern Alberta community. As expected the newscast was not well balanced and certainly was geared towards sensationalising the situation. Notwithstanding this, for the individuals involved the risk are real in their perception.

Because of the media involvement, the seriousness of the allegations and the environment in which the community must exist, some response from the government and industry seems necessary and inevitable.

Regardless of how well the regulators and industry are able to respond, they will not be able to completely repair the damage that has been afflicted on their reputations. The object then is to ensure that a similar situation does not recur. As such, the industry through various associations, such as CEPA, CAPP, CGA, and regulators, such as NEB, EUB, TSB, etc., must develop mechanisms that ensure that the principles of risk communication are adopted and used accordingly.

Observations and Challenges

After the presentations, the floor was opened for discussion during which several observations were made that pose challenges to the industry and regulators in addressing risk communication effectively.

Regulators

It was observed that regulators should establish their credibility independent of the industry in order to be objective and provide effective mediation. The challenge for the regulators is to ensure that there is a level playing field with regard to public involvement and community relations programs by establishing clear expectations so that there is no doubt about the level of commitment required by the industry.

Media

It was observed that the media has a critical role in shaping reactions among the public and interest groups. Media often does not portray the complete information and may be biased towards issues that are controversial. It is found that the industry is generally reactive rather than proactive. It is, therefore, a challenge for the industry to ensure that a balanced picture about its activities is presented-all the time.

Industry

Part of the problem that the industry faces with the public is its piece-meal approach to development. In addition, part of the public animosity faced by the industry is due to an increase in new projects, media hype and the numerous players involved. Another significant problem is the increased pace of the industry. Many decisions are made to meet approvals in the short term. The challenge for the industry is to include the public in the overall industry development plans for a particular area. It is also important to build trust through effective relationships, admit to a mistake when it occurs and make a commitment to ensure effective public involvement.

Information and Training

While there is a comprehensive manual on public involvement prepared by CAPP, there is inadequate information on risk communication and its process. It is, therefore, necessary to develop a risk communication handbook that should be a companion to the CAPP public involvement manual. For this purpose, a committee should be established under PRASC to develop the handbook, promote risk communication and train personnel in the industry.

CAPP Public Consultation Guidelines

Presented by
Bev Dennis, Community Relations Coordinator
Gulf Canada Resources

CAPP

This Presentation Will Provide:

- an historical overview of consultation processes
- a review of public involvement principles and practices
- a description of how these principles can be effectively applied to work with the public in the oil and gas industry
- available resources
- issues

CAPP 2

A History of Public Consultation

- **Canadian oil and gas industry produced public consultation guidelines in 1989.**
- **A formal review of these guidelines took place in 1992.**
  - **Multi-stakeholder, multi-sector committee.**
  - **Resource collection housed at Mount Royal College**
  - **One day training course.**

CAPP 3

The Canadian oil and gas industry commits significant resources to developing positive relationships with the public as a means of improving the overall business environment. However, public cynicism an changing regulatory requirements are causing our industry members to address a broad range of public interests more consistently and proactively than in the past.

For the Canadian oil and gas industry, formal development of processes to assist public involvement began in 1986 with the Canadian Petroleum Association's *Environmental Code of Practice.* It was followed in 1989 by the CPA's *Public Consultation Guidelines*.

In 1992, the CPA and the Independent Petroleum Association of Canada merged to form CAPP. In that year, a multi-stakeholder and multi-sectoral process was initiated to improve and expand the guidelines. The result was a comprehensive guide for public involvement and a collection of resource materials available to CAPP member companies which is housed at Mount Royal College's city centre location.

Why Consult the Public?

- **It's the LAW...**
- **More Informed Public**
- **Less Tolerant Public**

CAPP 4

Public consultation has taken on a new significance in the last couple of years. The reasons are many and the benefits even greater. One of the most important reasons, however -- it's the LAW. Consultation is legislated and minimum requirements have been mandated.

Secondly, the public is more informed, better educated, and therefore more concerned about what is happening in their community. And if there's going to be development, there had better be some direct benefit back to that community.

And lastly, the community is far less tolerant and more demanding that companies be accountable for their activities, their impacts and their errors, as well as the actions of their employees and contractors.

What do We Call IT?

Public Consultation

Public Involvement

PEOPLE - COMMUNICATION

Public Engagement

Stakeholder Participation

CAPP

5

What is Public Involvement?

- **Public involvement goes beyond informing people to involving them in decisions that may affect their lives.**

CAPP 6

•Process through which relationship building occurs.

•Needs to be integrated into your project planning and decision making processes (early and throughout).

•Must address both the specific nature of the company and the unique characteristics of the interested and affected stakeholders.

•"Fit for purpose" - not a cookie cutter approach.

Why Consult?

- **It's the "right way" to do business**
- **It's the "smart way" to do business**

CAPP 7

Involving the public is the "right way" to do business:

Effective public involvement can help build cooperative working relationships with local communities, interest groups and governments at all levels in areas where your company operates or hopes to operate. It can achieve balanced decisions and results that are effective, fair and enduring, and that respect the knowledge, values and rights of all affected parties.

Involving the public is also the "smart way" to do business:

•Establish good relations with residents, representatives and stakeholders

•develop positive attitudes toward your company's activities

•provide accurate information to the public about your activities.

Benefits of Public Involvement

- **Local partnership rather than a "critical eye"**
- **Minimize regulatory intervention**
- **Identifies and resolves issues/conflicts**
- **Provides early warnings about issues before they escalate**
- **Foundation for resolution of problems & incidents**
- **Industry makes better decisions**
- **Competitive advantage**
  - prevents delays
  - intervener support
- **Saves Money**
  - reduces liabilities
  - hearing, staff, intervener costs

CAPP 8

Costs of <u>NOT</u> Involving the Public

- **Do not under estimate the power of the public.**
  - Increased difficulty gaining approvals and licenses from regulators.
  - Escalation of issues, requiring more costly mitigation, enhancement and compensation measures.
  - Delays, lengthy and costly public hearings, project cancellations, and long term opposition to your company.
  - Bad publicity, damaged reputation and time required for the associated damage control.
  - Formation of polarized groups that fight any kind of development
  - Devalued standing with shareholders and customers.

CAPP 9

You may have one of the greatest engineered projects in the world, but if the public doesn't understand it, or want it, it likely won't get off the drawing board.

Examples:
The EUB recently pulled a company's approved application for an \$11 million pipeline, with surveying and construction underway, in the Rimbey area because a local farmer felt he had been excluded from intervening in the project because he didn't have information.

Mission Statement:

To achieve balanced decisions and results that respect the knowledge, values and rights of all affected interests.

CAPP 10

Public Involvement Guidelines

▮ Shared Process

Develop together a readily understood process among participants by negotiating.

CAPP 11

Shared Process:

•scope and terms of reference that identify decisions that ARE and ARE NOT open to input

•expectations and objectives

•benefits and losses

•constraints and boundaries

•roles, responsibilities and protocols

•timeliness

•control and enforcement

•ways and means to share resources

•monitoring and evaluation

•ways of handling disagreements

Public Involvement Guidelines

- **Respect**

Demonstrate respect for the participants and the process.

CAPP 12

Respect:

- honoring diverse cultures, perspectives, values, approaches and interests
- declaring one's own interests, values and perspectives to other participants
- recognizing the legitimate rights of stakeholders participate in decisions affecting them
- interacting honestly, openly and ethically
- bridging differences with integrity and courtesy
- acknowledging participants' professional codes of practice
- adhering to objectives, expectations, commitments and protocols agreed upon for the process.

Public Involvement Guidelines

- **Commitment**

  Demonstrate commitment to the process and results.

CAPP 13

Commitment:

•engaging affected interests in defining problems, expectations and objectives

•building trust and relationships from the outset, with a long-term orientation

•following through on commitments made during the process

•incorporating input from all participants

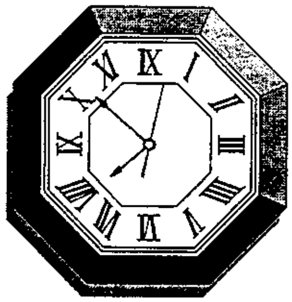
•fostering collaborative and voluntary agreements

•maintaining a constructive, problem-solving focus.

Public Involvement Guidelines

- **Timeliness**

  Demonstrate that time is an important resource



CAPP 14

Timeliness:

•sharing information early and often to assist all interests to prepare and to act knowledgeably

•providing early and adequate notice of opportunities for involvement

•negotiating timelines among participants

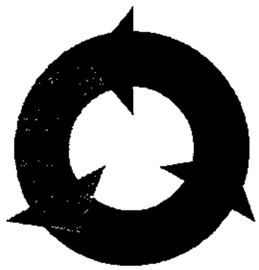
•establishing and adhering to realistic deadlines

•responding in a timely manner to questions and requests.

Public Involvement Guidelines

- **Relationships**

  Establish, maintain and enhance relationships.



CAPP 15

Relationships:

•fostering trust and respect through performance

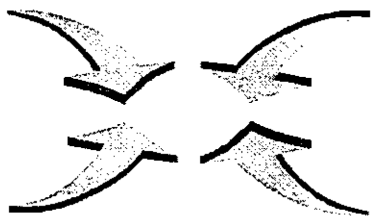
•facilitating the voluntary building of ongoing, constructive relationships

•improving the quality of existing relationships among participants

Public Involvement Guidelines

- **Communication**

Communicate effectively to develop mutual understanding.



CAPP 16

Communication

•listening carefully

•being honest and open

•using plain language

•providing opportunities for information exchange and mutual education regarding interests, objectives and values

Public Involvement Guidelines

- **Responsiveness**

Demonstrate flexibility and responsiveness.

CAPP 17

Responsiveness

- recognizing that public involvement is a dynamic,ongoing process
- building flexibility into the process
- balancing participants' and process needs
- moving towards objectives and using resources effectively
- including and using feedback mechanisms
- continually evaluating and modifying the process in an ongoing manner

Public Involvement Guidelines

- **Accountability**

Demonstrate accountability to affected interests and process participants.

CAPP 18

Accountability

•encouraging participants to solicit input form their constituents and to maintain communications with them

•expecting participants to commit to and follow through on the negotiated process and its results

•becoming familiar with the rules and regulations affecting the issues under discussion

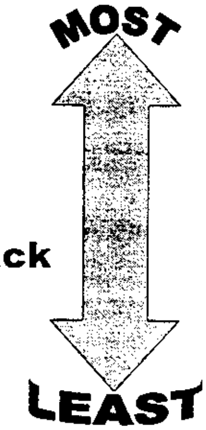
Unless you are willing to consider the answer -- don't ask the question.

CAPP

A company needs to be clear about how much influence (and over what aspects of decision making) it is prepared to share.

Levels of Public Involvement

- **Self - Determinism**
- **Delegated Authority**
- **Joint Planning**
- **Consultation**
- **Information - Feedback**
- **Education**
- **Persuasion**



CAPP 20

Costs of Public Involvement

"Why can't we find the time and resources to do it right the first time, when we find the time and resources to do it over?"

▮ Anonymous

CAPP 21

Public involvement is an investment, with benefits, risks and costs. But like contingency planning in a safety program where it can be difficult to assess the cost savings attributable to accident prevention, it is not always possible to comprehensively estimate the benefits, or quantify costs and savings of an effective public involvement program.

One easily identifiable cost is personnel. Some companies hire community relations or public affairs staff who can act as internal consultants on public involvement for a broad range of company plans, projects and operations. Others contract external public involvement consultants to assist with a particular project of problem. Still other companies train existing staff in conflict resolution, public involvement and communications.

Hiring staff and training or engaging experienced consultants may appear to be costly in the short term. However, these costs for public involvement can be relatively small compared to the potential costs of failed communication. A poorly conceived, inappropriate public involvement process for a development or operation can result in concern and conflict related to both the development and the communication process.

Five Steps of Public Involvement

"If you don't have a plan for where you're going, you may end up somewhere else."

1. Establish a preliminary plan.
2. Make initial community contacts.
3. Prepare a detailed plan.
4. Implement public involvement plan
5. Monitor, evaluate, and follow through.

GAPP 22

Step 1
Establish a Preliminary Plan

Objectives

- To identify issues that might be raised by a particular project proposal or activity.
- To determine the public groups that will probably be interested in reviewing or influencing your company's preliminary plans.

CAPP 23

✓ *What publics (e.g., residents, landowners, aboriginal organizations, community associations and others) should be contacted about the project?*

✓ *Which formal or informal leaders and organizations should be consulted?*

✓ *Which government and regulatory authorities (e.g., local, regional, provincial, national or First Nations, as appropriate) should be contacted and in what order?*

✓ *What types of issues or concerns do you expect these publics to raise about the proposed activity?*

✓ *What information will these various publics need (e.g., maps, project descriptions or reports) and how can this information be prepared in a form that is understandable and useful to them?*

✓ *What groups or departments within the company should be aware of plans to initiate a public involvement program?*

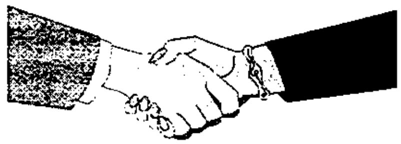
✓ *How and when will the public involvement program be integrated with the company's project planning and decision making processes?*

✓ *What budget and other resources might you need?*

Step 2
Make Initial Community Contacts

Objectives

- To start the public involvement process
- To obtain information from initial contacts to prepare a more detailed public involvement plan



24

✓*List government agencies, formal groups, informal groups, individuals, and formal and informal community leaders likely to be interested in company plans*

✓*Describe the major issues likely to emerge during the involvement process*

✓*Estimate the level of public interest in and significance of these issues.*

Step 3
Prepare a Detailed Plan

Objectives

- **To allow your company to think its way clearly through the entire public involvement process.**
- **To integrate public involvement activities with decision-making processes.**

CAPP 25

Your public involvement plan should be appropriate to the type of project or activity your company is involved in. The level of detail will vary depending on the scale and sensitivity of the project and the nature of public interests. The plan should include

✓*The objectives of the plan*

✓*A description of the major issues*

✓*A list of key publics*

✓*An estimate of the level of concern these publics will have for each of the major issues*

✓*A description of the decision making process*

✓*A list and schedule of activities including assigned responsibility for their completion*

✓*Identification of intervals at which the plan will be reviewed*

✓*Methods that can be used to evaluate the success of the plan after it is completed*

Step 4
Implement Public Involvement Plan

Objectives

- To assess information about issues you have received from the public
- To generate options or project modifications to resolve public issues
- To reach mutually agreeable solutions through negotiations and co-operative problem solving

CAPP 26

Use a variety of approaches and adjust your program as you go to reflect the needs of your publics and the feedback received. Developing and implementing a detailed public involvement plan will help you to:

✓*Develop relationships based on trust and credibility*

✓*Document, analyze, assess and categorize the information you obtain*

✓*Clarify issues, and identify options for resolution*

✓*Build consensus and implement mutually acceptable resolutions*

✓*Improve planning and decision making*

Step 5
Monitor, Evaluate & Follow Through

Objectives

- To ensure you have built a public involvement program that's right for your company and your publics
- To evaluate your program to make sure it's working
- To find opportunities to improve your program
- To create lasting positive relationships with your publics

CAPP 27

Monitoring, Evaluating and Following through are essential in public involvement. They close the management loop. Reviewing and evaluating your company's activities, following through and following up on the public's concerns will:

✓*Enhance your company's ability to operate in a particular area*

✓*Help your company in developing a sound management approach to public involvement throughout its areas of operation*

✓*Improve your ongoing public involvement programs*

In the Guide:

- **Toolbox:**
  - Glossary of terms and techniques.

Advisory Committees

Displays

Newsletters

Questionnaires

Public Hearings

Surveys

Mediation

GAPP 28

Tool Box

- **How to:**
  - **Set up advisory committee or task force**
  - **Run an effective "public meeting"**
  - **Host a successful "open house"**

CAPP 29

In the Guide

- **Backgrounders to help you better understand the benefits, challenges and processes of public involvement.**
  - Trust and Credibility
  - Common Problems
  - Communication
  - Communities and Culture
  - Conflict and Consensus
  - Planning
  - Financial & People Resources
  - Regulatory Requirements
  - Strategic Consideration

CAPP 30

Trust and Credibility
•building positive relationships
•building personal trust
•building corporate trust
•building an open and credible process

Common Problems
•conflicting company messages
•different companies working at cross purposes
•false expectations by participants
•puzzling recommendations from the public
•losing contact with the wider public
•participants who seem determined to cause trouble
•public rejection of your public involvement program
•problems caused by corporate deadlines

Communication
•listening and talking effectively
•feedback- getting and giving
•nonverbal communication
•probing and being a good listener
•risk communication

Communities and Culture
•differences in types of communities
•differences in density, history and culture
•identifying formal and informal community leaders
•public involvement with aboriginal communities and First Nations
•legal and regulatory background to aboriginal communities
•petroleum industry relations with First Nations

Conflict and Consensus
•levels of conflict
•degrees of resolution
•developing a shared evaluation of options

Planning
•planning matrices to help you develop and record your plans
•guidelines for documentation to ensure you keep accurate and useful records of your public involvement plans and activities
•guidelines for ensuring your emergency response planning includes meaningful public involvement

Financial and People Resources
•estimating a realistic budget
•picking the right people - clarifying your needs
•developing your corporate training program

Regulatory Requirements

Strategic Considerations
•demystifying decision making
•determining the scale, sensitivity and nature of publics
•extending public involvement from cradle to grave
•timing - start early
•addressing management responsibilities

In the Guide

- **Examples and Exercises**
  - to learn or teach others about effective public involvement
- **Resources**
  - description of other reference material
  - bibliography of documents and other guidelines

GAPP 31

"The need to build trust and communicate does not go away when an event is over, a crises has passed or the financial results are out. It's an integral part of the day-to-day management and leadership of a company. And that is the same regardless of its size."

Rick George
President and CEO, Suncor

CAPP

WORKING GROUP 5 COMPANY UNIFICATION
Wednesday April 13, 1999, 8:15 a.m.
Co Chairs – Bruce Dupuis, (Integrated Integrity Inc.) / Keith Leewis (GRI)

Name of Speaker – Wanda Alison, TransCanada Pipeline, IT Department
Topic – Pipeline Integrity's Common Data Management Approach
Summary: Discussion of the decision process to move to a unified data model after the merger and a highlight of the hurdles faced. Benefits of integration were identified as:

- Increased efficiency in data collection and management
- Increase efficiency for management of TCPL's assets
- Improved business and customer service through the use of integrated, consistent and timely data
- Improved understanding and capability of data sharing by integrating maintenance activities.

Key elements of a successful integration are:

- Program sponsorship
- Multi-disciplined team – build partnership
- Communication
- Organization Structure that supports Decision Making
- Documented benefits & cost savings
- Balance Integration & Implementation Decisions

Speaker Name: Sean Black, Williams Northwest Pipeline
TOPIC: 5 into 1
Summary: Discussion of the issues addressed and the problems faced in moving the five companies in the Williams family to a unified risk assessment and management process.

Overall:
The discussion focussed on the applications used to facilitate a unified data structure (i.e. GIS). Although this technology was identified as not necessarily required, it was seen as a common platform to share to data within an organization. It was suggested that a protocol for evolving from the spreadsheet to database to GIS would be of benefit for companies facing this issue. Sean with Williams emphasized the value of an enterprise data management tool in maintaining knowledge within a company given the mobility of people.

The cost associated with unifying data within a company was difficult to capture when all aspects are considered. The importance of a corporate champion and a multi-discipline coordination group was emphasized, with communication in general bring the key to success.

The potential value of open structure vs. third party owned GIS systems was introduced.

WORKING GROUP 5 INDUSTRY UNIFICATION
Wednesday April 13, 1999, 10:15 a.m. Session

Speaker: Mel Hutzi/ Mary Kai Manson
Topic: Pipeline Industry Unification: Data Management Standards, Leveraging The PPDM Experience
Summary: Presentation of the evolution and scope of the Public Petroleum Data Model. Model managed by a self funded independent governing organization. Since it's formation in 1991 it has grown to a world standard for the upstream industry.

Speaker: Wayne Feil, Imperial Oil,
Topic: PRASC
Summary: Emphasized the necessity of the industry providing input into the direction of the PRASC incident database and it harmonization with other databases. It was suggested that a common data dictionary would be a prudent place to start, rather than going directly into data consolidation.

Speaker: Glenn Yuen, (Dynamic Risk)
Topic: ISAT 2.0 Pipeline Open Database Standard (PODS)
Summary: PODS is a proposed unified data model for the pipeline industry to facilitate sharing and analysis of data, and reduce costs associated with application customization . The scope of PODS includes all assets associated with the pipeline including compression facilities. Unlike the original ISAT, PODS is designed to support GIS technology with its structure. PODS has evolved with significant input and support from software and application vendors.

Discussion:
PODS was clarified as a data model (it facilitates functionality, but does not directly provide any).
There was broad support for industry harmonization in terms of data dictionaries and data models. The "go forward" for industry harmonization requires a structured process and direct participation from the owner/operators with broad representation. However, a process to continue was not agreed upon.

Key Points of the Information Management
- Compatibility
- Benefits: Quantify
- Incremental –Cross Fertilization / Use
- Small Successes – "KISS"
- Scaling Protocols – Small /Middle /Large enterprises
- Simple to Multiple Coordinates Systems
- Structured Data Across Industry
- Tie Common Data Together
- Standardization
- Feed Regulatory Compliance
- Buy In – Formal Structure

Working Group 5

HA GIC

Banff/99 Pipeline Workshop

Pipeline Industry Unification:
Data Management Standards
Leveraging the PPDM Experience

Mel Huszti / Mary Kai Manson

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HA GIC

Are you interested in ...?

Adding Value and Enhancing Productivity through:

- Enabling quick deployment of solutions
- Benefiting from new technology
- Supporting process re-engineering
- Reducing dependence on any single vendor
- Increasing your data value; managing data as an asset
- Attaining "plug" & "play" interoperability

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If so ...

then

Industry Data Management Standards are an essential component of your company's business strategy.

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Overview

- Data Management Standards
- The PPDM Experience
- Options for Achieving Pipeline Standards
- Standards Organization Checklist
- Discussion

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Data Management Standards

- Impact
  - how data is described & stored
  - what data is stored
- Require Consensus and Scalability across:
  - Projects
  - Functional Groups
  - Intra-company
  - Inter-company

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Elements of Data Management Standards

- Data Definitions
  - data dictionary
- Data Model
  - describes relationships between data
  - logical description
  - physical implementation
- Reference Data
  - standardized data content eg. fluid names, units of measure, facility codes, etc.

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M. Huszti + M.K. Manson

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The PPDM Experience

- Public Petroleum Data Model Association
- www.ppdm.org
- (403) 660-7817

HA GIC

Mission Statement

"PPDM Association is a non-profit organization through which members world-wide cooperate to develop an open standard data model as the foundation for managing data as an essential asset in the global business of oil and gas exploration and production."

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PPDM Association - Startup Triggers

- Business problem - reduce data management costs
- Required multi-company solution & perspective
- New technology available: client server
- Perceived exponential increase in value realization through broad industry adoption
- Neutral forum required to support industry co-operation
- PPDM - a non-profit organization was formed in 1991

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PPDM Profile

- Neutral, open environment
- One member, one vote
- Business driven sustained growth in
  - deliverables, membership, funding
- Governance - International Board, CEO
- Current Funding - membership fees, project funding
- Resources - contract staff, member volunteers

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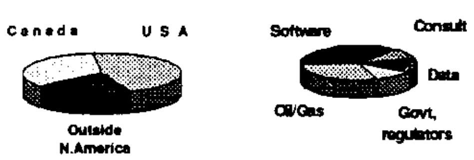
Membership Distribution

Approx. 100 members



Based on membership fee revenue

Based on number of members

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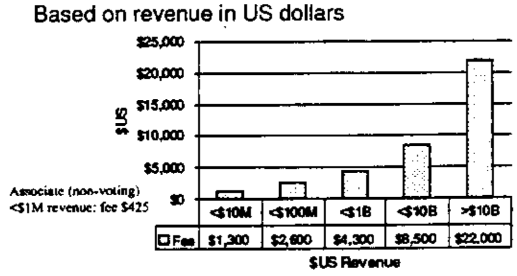
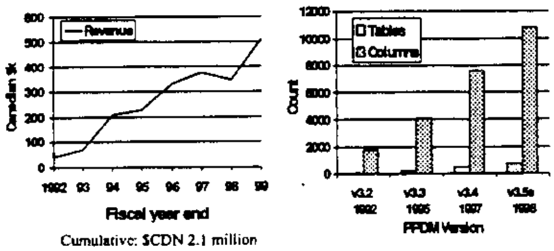
Membership fees '98-'99

Based on revenue in US dollars



WorkingGroups

Growth of the PPDM Association



Cumulative: $CDN 2.1 million

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Model growth: business areas
Life cycle of a property asset

	Land	Seismic	Wells	Reserves	Facilities	Prod'n	Financial
Discover	✓	✓	✓	✓			✓
Produce	✓		✓	✓	✓	✓	✓
Process					✓	✓	✓
Market					✓	✓	✓
Abandon	✓		✓	✓	✓	✓	
Completed in v3.4	50%	60%	60%	<5%	20%	60%	<5%

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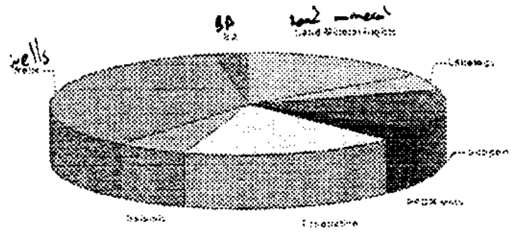
Subject Distribution in PPDM 3.4



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PPDM - the *Invisible* Defacto Standard

- PPDM - in use worldwide
- PPDM - defacto standard in Canada
- PPDM - is or is becoming a defacto standard in many other regions of the world
- PPDM - most users unaware they rely on it
- PPDM - demand for further model expansion

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PPDM Evolution - Key Events

- 1991 PPDM Association initiated
- PPDM / POSC merger initiatives
- Project Discovery collaborative effort
- PPDM v3.4 comprehensive integrated release - December '97
- PPDM v3.5 alpha testing in progress
  - Stratigraphy, Land Surface Rights, Business Associates, Facilities, Named Areas
- New initiatives - Compliance, Spatial, Populated reference tables, Sample implementation

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PPDM Deliverables

- Data Model - DDLs in Oracle
  - Tables, columns, keys, constraints, indexes
- Documentation
  - Entity-relationship diagrams
  - Business requirements
  - Architectural Principles
- Future
  - Populated reference tables
  - User guides

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M. Huszti & M.K. Manson

HA GIC

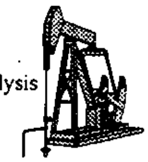
Architectural Principles

- A set of guidelines for model design
  - Table and column names
  - Field types and lengths
  - Constraints
  - Units of measure
  - Geographic references
  - Extending or sub-setting PPDM
- Consistency and ease of use
- Facilitate new module development

HA GIC

Wells

- Covers well reporting requirements
  - General, scouting, licenses and permits
  - Positional, directional survey
  - Drilling & completion events
  - Cores, pressure tests, logs, fluid analysis
  - Tops, interpretations, velocities



HA GIC

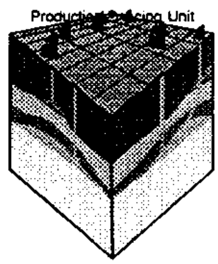
Production Information

- Production data supported for
  - Well
  - Production string
  - Production at formation
  - Commingled production
  - Facility
  - Field / pool / county
  - Lease unit (Land right)
  - Business unit

HA GIC

Production Information

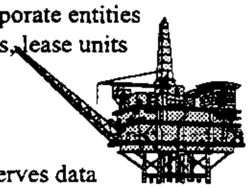
- Allocation
- Forecasts
- Volumetric data
  - Allocated / Measured
  - By substance
  - Monthly / daily
- Fluid / gas analysis
- Allowable production



HA GIC

Production Information

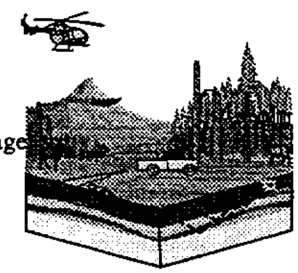
- Cross reference to corporate entities such as wells, facilities, lease units etc.
  - Track multiple versions of the data
- Future support for reserves data



HA GIC

Seismic

- Field acquisition
- Processing
- Time picks
- Restricted coverage
  - marine, 3-D,
  - interpreted features



Working Group 5

Seismic Geodetic

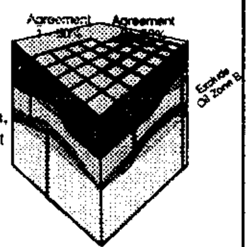
- Geodetic transformations
  - Geodetic datums
  - Map projection
- World-wide applicability
- Seismic survey point reference to
  - monuments
  - facility
  - well node

Information Management

- Manage data not actually stored in the database
  - paper files and boxes of data
  - maps, sections, paper logs ...
  - digital data (disk, tape, optical disk, flat files...)
- Physical products linked to seismic line etc.
- Indexing, circulation, maintenance

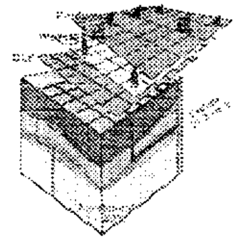
Land Mineral Right & Contracts

- Mineral Rights
  - Surface & sub-surface description
  - Analysis & maintenance
    - pre-acquisition, acquisition, obligations, relinquishment
- In Progress
  - Contracts, surface rights



Integration in PPDM 3.4

- Model integration (Wells, Land Mineral Rights, Production)
- Preliminary
  - Explicit connections
  - Spatial



PPDM Release Strategy

- Not more than every 2 years
- Major release (v3.x , v4.x ...)
  - New Architectural Principles
- Subject release (v3.4, v3.5 ...)
  - Increase depth and breadth of model
- Correction release (v3.41, v3.42 ...)
  - Critical corrections to subject release
- Test versions
  - Alpha (v3.4a), Beta (v3.4b), Pre-production

Options for Pipeline Standards

- Go it alone:
  - Create a new Pipeline Data Management Standards Association
- Partner with other industry data management standards initiatives (eg. PPDM)
  - a formal or informal arrangement
- Wait for integrated commercial solution or partnership alliances
  - may not become a standard

M. Huszti + M.K. Manson

HAGIC

Standards Organization Checklist

- Clear business drivers - Value realization, alternatives
- Broad industry support & involvement
- Funding base - adequate, stable, desired type
- Development process & skills
- Governance - Managing diverse stakeholders
- Marketing & Communication infrastructure
- Technology curve positioning
- Scope of standards - Integration

HAGIC

Standards Organization Checklist cont'd

- Standards Clarity
  - Architectural Principles
  - Sample Implementation
  - Populated Reference Tables
  - Compliance Measurement

HAGIC

PPDM Strengths

- Neutrality - balanced input & removal of biases
- Necessary core competencies - proven processes
- Model foundation: primed for take-up, based on proven relational technology
- Measurable success - international track record
- Demonstrated industry support
- Solid organization - worldwide membership

HAGIC

Perspective

- History has shown that data management standards are difficult and expensive to develop. They require a sustained broad base of industry support.
- Ultimately only good standards will be adopted. They don't need to be perfect.
- Standards add extensive business value. Your commitment can make it happen.

HAGIC

Thankyou

- **Husztl Associates Ltd**
- **Mel Husztl**
- **(403) 239-0912**
- **husztim@cadvision.com**
- Extensive PPDM experience: founding member '90, member Board of Directors '90-'95; Executive Director '95-'99.

- **Great Ideas Consulting Ltd**
- **Mary Kai Manson**
- **(403) 870-8140**
- **glc@nucleus.com**
- Extensive PPDM experience: current member; member Board of Directors '93-'97; Co-Executive Director '97-'99.

HAGIC

Discussion

- Leveraging from the PPDM Experience

ISAT 2.0 (PODS)

Pipeline Open Database Standard

Presenter: Glenn Yuen, P.Eng.
Dynamic Risk Assessment Systems

PODS Pipeline Open Database Standard

- Overview & New Features
- Benefits
- Compatibility
- Who's Using ISAT
- PODS for Total Data Management
- PODS in Integrity Management
- Example

Overview

- Extensive Upgrade of GRI ISAT (1995)
- Standard definition for data storage
- Enterprise database
- Not vendor dependent
- Starting point which can be customized for each operator

Overview

- All pipelines (Producer, Transmission, and Distribution)
- All pipeline assets and integrity related data
- Directly supports trending, failure models, risk assessments

New Features

- Optimized for modern GIS software and databases
- Optional implementation of certain features
- Historical tracking
- Improved network model
- Pipeline coordinate warehouse
- Multiple pipeline geometries including schematics
- Multiple linear coordinate systems

New Features - Integrity

- Inline Inspections
- Excavation Data
- Surface Measurements
- Corrosion Facilities
- Repairs
- Risk Assessment

PODS Benefits

- Reduce Costs
  - Most of the Work is Done
  - One Source For All Data
  - Eliminate Duplication of Effort
  - Standard Formats For Data Vendors
  - Encourage Applications Developers
- Corporate Wide Data Sharing
- Enables Industry Collaboration

Compatibility

- ESRI, Intergraph, and Smallworld GIS
- Oracle, Sybase and MS SQL Server
- CEPA SCC Database
- National Pipeline Mapping Standard
- PPDM (Public Petroleum Data Model)
- ILI Specs from Pipeline Operator Forum
- MFL Data Formats
- Excavation Data Collection and Corrosion Mapping Techniques

Who's Using ISAT?

Operating Companies

- Williams Companies
- Duke Energy
- TransCanada/Nova
- KN Energy
- Dynegy
- Enron
- Marathon
- CMS Energy (Panhandle)
- Conoco
- Southern Natural
- Mobil
- Shell
- Chevron
- Sante Fe PipeLine
- El Paso Gas
- Colonial Pipeline
- Buckeye Pipeline
- Air Liquide

Who's Using ISAT?

Application Developers

- Bass-Trigon
- Dynamic Risk Assessment Systems
- Eagle Information Mapping
- ESRI
- Geofields
- Intergraph
- MJ Harden
- New Century Software
- Smallworld

Available Third Party Applications

- GIS
- Facilities and Database Manager
- As-built Generators
- Risk Assessment & Integrity Assessment
- Inline Inspection Data Analysis
- Query & Correlation Tools

PODS for Total Data Management

- All Physical Pipeline Facilities
- Interface with SCADA, Data Collectors
- Coordinate Data From All Sources
- Network Hierarchy, Stationing and Equations
- Operating Information
- Regulatory Compliance and Information
- Crossings
- Population

PODS In Integrity Management

- Inline Inspections
- Hydrostatic Tests
- Excavations and Defect Measurements
- Soil, Corrosion Deposits, Electrolyte Samples
- Repair History, Pipe and Coating Condition
- Surface Measurements
- Soil and Environment
- Risk Assessment Results

Possible Applications/Analyses

- Unlimited Ways to Correlate Datasets
- Advanced Trending Studies
- Data Mining
- Pit Matching
- Corrosion Growth Models
- Soils Models
- Excavation - ILI defect correlation
- Excavation Planning

Possible Applications/Analyses

- Advanced Failure Models
- Risk Assessment
- Simulations
- Maintenance Planning
- Code Compliance Audits
- Effective Visualization of Problems
- Emergency Response
- Insurance/Financial Loss

More Information

- Sponsor ______________________
- Design Team ______________________

Foothills Pipe Lines Ltd.

ENGINEERING CALCULATIONS

File	Page of
Date	

Subject	
Prepared By	Checked By

ATTENDANCE LIST 8:15 AM WEDNESDAY APRIL ~~8~~ 1999 WORKING GROUP 5

NAME	AFFILIATION	SIGNATURE
KRIS MAJURY	ENSIGHT INFO.	
Minh Ho	NEB	
Mark Ottem.	Trans Mountain Pipe Line.	
ANTON KACICNIK	ENBRIDGE CONSUMERS GAS	
Kyle Keith	Foothills Pipe Lines Ltd	
Stephen Jacobson (Reporter)	Foothills	
ANDREW WOZNIEWSKI	IMPERIAL OIL RESOURCES	
FRANK M. Christensen	FMCMCI	
BRYAN SCOTT	ENBRIDGE PIPELINES INC.	
Joshua Johnson	CC Technologies	
MARTIN FLEMING	PYXIS GEOMATICS	
PAUL GRECO	Union Gas	
MIKE GLOVER	BTS - CORRPRO	
RON MAURIER	CORRPRO CANADA	
GARRY SOMMER	CORRPRO CANADA, INC.	
GREG TOTH	Trans Mountain Pipeline	
Charles Savoie	Norwest Labs	
Mark Yeomans	TransCanada Pipelines	Mark Yeomans
Tim McMullen	Gibson Petroleum	
Jim Burke	J.E. Mann Associates	James Burke
Bernie Frost	AEUB	Bernie Frost
Wayne Feit	Imperial Oil.	

Name	Affiliation	Signature
Stan Weng	M+C Integrity Engineering Ltd.	
Bob Shapka	Talisman Energy	
VALENTINO PISTONE	SNAM	
DARIUS BOUCHER	COLT ENG'G	
Kevin Cicansky	TCPL	
KEITH LEEWIS	GAS RESEARCH	
SEAN BLACK	WILLIAMS	
Glenn Yuen	Dynamic Risk Assessment	
BRUCE DUPUIS	Integrated Integrity Inc	

WG. 5 — Information Management, Data Case Development & Use — 10:30

Name	Affiliation
LARRY HUNT	WESTCOAST ENERGY
Minh Ho	NEB
ANDREW WOZNIEWSKI	IMPERIAL OIL RESOURCES
MARTIN FLEMING	PYXIS GEOMATICS
GORDON DAW	N.E.B.
Joshua Johnson	CC Technology
RON MAURIER	CORRPRO CANADA
MIKE GLOVER	DTS - CORRPRO
DAVE GRECO	UNION GAS
Mark Yeomans	TCPL
GORD WENGRENIUK	BASELINE TECHNOLOGIES INC
Chuck Savoie	Norwest Labs
BRIAN CUMMING	NORWEST LABS.
DICK GRAHAM	TRANSGAS.
IAN FRASER	IMPERIAL OIL
Scott Beaugrand	PPDM Association
TRUDY CURTIS	PPDM Association
Tim McMullen	Gibson Petroleum
Bob Shapka	Talisman Energy
Wayne Feil	Imperial Oil
Jim MARR	MARR ASSOCIATES
VALENTINO PISTONE	Pistone
Kevin Cicansky	TCPL
GARY KAI MANSON	Great Ideas Consulting
KEITH LEWIS	GAS RESEARCH
Wanda Allison	TRANSCanada
SEAN BLANK	WILLIAMS

Glenn Yuen	Dynamic Risk Assessment
BRUCE DUPUIS	Integrated Integrity Inc
Kyle Keith	Foothills Pipe Lines Ltd.
Stephen Jacobson	Foothills Pipe Lines Ltd.

In-Line Inspection Working Group

Co Chairs: Bruce Lawson: WestCoast Energy, Arti Bhatia: Enbridge Pipelines
Rapporteur: Bryan Scott: Enbridge Pipelines

Summary Of Presentations

Segment #1
ILI Tools for Corrosion, Mechanical Damage and Other Inspection.

Presentations:

David Hektner/Jeff Sutherland
BJ Pipeline Inspection Services

Topic: Vectra MFL Tool

Summary: The Presentation will cover the operation of the Vectra MFL tool and the related software technology. The following describes the areas to be covered:

Vectra System Applications

- Speed Control for High Velocity Gas Pipelines,
- Inertial Measurement System for :
  GPS Location of Features and Anomalies,
  and Pipeline Mapping for GIS Integration,
- Tri-Axial Sensor Technology for High
  Resolution Defect Sizing,
- 'Near Virtual Reality' VECTRA VIEW
  data analysis software.

Benefits

- High Capacity Gas By-Pass Speed Control,
- Tri-Axial, High Resolution Sensor Technology,
- Inertial Mapping;
-'Near Virtual Reality' VECTRA VIEW Software;
- Pre-Packaged Inspection Database for GIS.

Keith Grimes, Pipe Integrity International

Topic: ILI Tools for Corrosion

Summary: Handling large data volumes, LAPA, Corrosion Growth, Girth Weld Inspection, Hard Spots, Blisters, Dual Diameters, Variable Bypass, Spatial Analysis.

Tim Marston, Pipetronix Limited

In-line Inspection Data Management

Integrating ILI results together with other inspection survey results, combined with all available pipeline system related information as the basis of pipeline data management.

Bryce Brown , Rosen Pipeline Inspection

Topic: Latest Developments – In-Line Inspection

Summary:
This presentation is meant to give the audience a general impression of the technologies available to date and into the near future. This includes the following topics:

1. Maintenance/Pre-Inspection Pigging,
2. Geometry Inspection,
3. Metal Loss Inspection,
4. Speed Control,
5. XYZ Mapping,
6. and Reporting

The representatives from the ILI companies will describe the latest technologies in corrosion inspection, mechanical damage, high-resolution caliper and inertial tools.

Discussion:

Risk Analysis using MFL.

A question was raised as to the accuracy of defining pitting corrosion. Is the old data valid given the fact that the technology has improved?

Vendor's Response:

The same tool technology is used but the software component has changed so that their data can be updated and a valid comparison can be made. All vendors agree with this philosophy. If corrosion growth analysis is to be done, it may be better to utilize the same vendor however not always necessary. By accessing the raw data, as computer systems have become "more friendly" we are in a better situation to perform this analysis. Raw data from the past can be reprocessed and configured to better be compared with more recent inspection data

Reliability and Confidence in the Tools

Vendor Statement: Even the best tools cannot achieve 100 percent reliability because you have to make allowances for defect differences, normalizing data sets based on girth weld signal matching.

In order to improve reliability there also has to be feedback from the operating companies regarding the effectiveness of the inspections and validation in the field with respect to tool performance.

Definitions

Operator Input:

Discussion of the term "high resolution" was initiated. Most operator's felt that the words are used to better advertise the tool and may not necessarily related to tool performance.

Vendor's Response: The vendor's were in agreement that the tool performance was the defining factor not the tool title.

Automation of Data Analysis

Operator Question: The operator's requested an explanation of the degree to which automat6ion ("non-human factors" – computer based analysis).

Vendor's response: The vendor's responded that with MFL analysis a combination of manual and automated procedures is used. The manual checks are used to evaluate the more significant or serious defects. Less serious defects are run through computer based algorithms to be sized. The amount of automated analysis is a function of the number of defects detected by the ILI tool.

ILI contracts:

The operator's were questioned about their views on a two tiered/staged contract execution and payment schedule. The first stage would outline the requirements for performance in the field and attach a certain cost to this work. The second stage would outline the requirements for reporting and data validation and attach a value to this work. Most operators felt this was a good approach to ensure some integrity and performance from the tools

Confidence Levels:

The vendor's were asked about the level of confidence with their tools. The vendor's state that the level of confidence is related to how much information they have about the nature of defects on the line being inspected. The contracts are usually reported to an eighty- percent Confidence Interval Performance Specification. If more information is given to the vendor's prior to the inspection, and post inspection with validation, this confidence will be bettered.

Accuracy - Improving tool capabilities.

It was emphasized by the vendors as a result of the last statement better confidence can be achieved by better information on the line however improved accuracy has a higher cost component. The vendors did caution the operators that the limitations of accuracy limits are a direct function of the physics of the MFL technology and that improvements over the commercially stated +/- 10 percent is unlikely.

Summary Of Presentations

Segment #2
ILI tools for Crack Detection

Presentations:

Keith Grimes , Pipeline Integrity International

Topic: ILI for Cracking – TFI

Summary:
The shortcomings of "standard" MFL, TFI Methodology, Data Comparison, Result, Future Plans.

Neb Uzelac, Pipetronix Limited

Topic: Sensitivity and repeatability of detection.

The UltraScan CD tool was discussed and it's capabilities for detection of SCC. The results of a recent inspection were demonstrated and reinforced the high level of issue of reliability and repeatability of the tool.

Patrick Porter, Tuboscope Vetco Pipeline Services

Topic: Electromagnetic Acoustic Transducer (EMAT)

Summary:

Tuboscope Vetco Pipeline Services (TVPS) is testing EMAT technology for the detection of Stress Corrosion Cracking (SCC) using an In-Line Inspection tool. Gas Research Institute (GRI) and T. D. Williamson (TDW) developed this technology over the last 12 years. It was originally developed to detect and quantify corrosion defects in operating pipelines and was recently modified to the SCC detection application. TVPS is working with GRI to commercialize the system developed. A prototype tool has been built and tested. The first tests were conducted in the Pipeline Simulation Facility using crack defects designed by GRI. The tool has also been tested in several operating pipelines. This paper will review the novel aspects of the technology; the results of the field trials and speculate on the commercial potential and schedule for the inspection service.

Martin Phillips, Pipeline Integrity International

Topic: PII Elastic Wave Crack Technology

Summary:

INSPECTION MISSION

- -STRESS CORROSION CRACKING - FULL PIPE
- -LONG SEAM FATIGUE CRACKING - LONG SEAM
- -LACK OF FUSION - LONG SEAM
- -HOOK CRACKS - LONG SEAM
- -SHRINKAGE CRACKS - LONG SEAM

OPERATING PERFORMANCE

- -GAS AND LIQUIDS
- -UP TO 1000 PSIG
- -UP TO 50 ° C
- -UP TO 4 M/S IN LIQUID
- -UP TO 9 M/S IN GAS WITH BYPASS

-UP TO 150 KM RANGE IN ONE PASS

INSPECTION PERFORMANCE

- -DETECTION OF CRACKS > 50MM
- -DETECTION OF CRACKS > 20%
- -PIPEBODY OR SEAMWELD
- -LENGTH ± 10MM
- -DEPTH ± 25%
- -LOCATION ACCURACY AS PER MFL
- -DENTS ARE DETECTED

ACHIEVEMENTS

- -OPERATIONAL SINCE 1992
- -3000 KM OF INSPECTION
- -OVER 140 CRACKS & WELD DEFECTS
- -418KM SUCCESSFULLY HYDROTESTED
- -HYDROTEST WAIVERS FOR TWO USA OPERATORS
- -$5.3M GRI, CEPA, PII DEVELOPMENT

FUTURE DEVELOPMENTS

- -INCREASE NUMBER OF TOOL SIZES
- -COATING CONDITION
- -DISCRIMINATION
- -REDUCE OPERATIONAL COSTS

The representatives from the ILI companies will describe recent successes and future advancements in crack detection tool technologies.

Discussion:

Tool Development Strategies

A question was raised about potential incentives that would be offered by vendor's if operator's supported development of ILI crack tools. The vendor's responded that they would welcome support and entertain profit sharing proposals although the payback may be over an extended period of time.

Definition of "False Call"

The vendors were asked about their definition of a "false call". The operator's as to the ability to differentiate between inclusions and cracks further clarified the statement.

With respect to the Pipetronix CD tool: Inclusions and cracks are confused only on small scaled defects. Any significant defects would not be confused

Elastic Wave Tool Response: Although it is recognized as an issue, it is seen as a concern for defects that would fail 100 percent SMYS.

The consensus in the workshop was that the issue of false call sets up an unrealistic expectation of the vendors. The vendors felt that the operator had to better define their need as to what they require from a crack tool and thereby the operator could set a better definition for "false call".

The vendor's requested that the operator define a range of what they viewed acceptable. The operator's felt that the minimum standard from a crack tool was discrimination of defects that would fail a hydrotest at 100% SMYS. Ideally the higher standard would result in 100 percent detection, discrimination and sizing of all crack features greater than 10 percent wall thickness.

Feedback

It was restated that feedback from the operator's is still required to increase the level of confidence in the tools by the vendors.

Level of analysis

The onus is on the operators to better define their needs with respect to reportable crack sizes i.e. Where You Set Your Cut Off Levels. The operators have to be prepared that with more detailed analysis comes a higher cost for inspection.

Other Technologies

A question was asked about how to relate ILI data collected to assist in the assessment of unpiggable pipelines. Research from other organizations is underway and may assist in addressing these issues.

Circumferential MFL Inspection Technology

Research issues are still being addressed as to the capabilities and limitations of circumferential MFL technology. One of the key advantages of this technology is its ability to be miniaturized.

User's Groups

It was suggested that the ILI Crack Tool vendors develop a "User's Group" with their historical and current clients. This was suggested to be expanded to incorporate all technologies.

FORWARD ACTIONS:

- Initiating "User's Groups" to assist in the advancement of all ILI tool technologies
- Feedback of field data to the ILI Vendors to improve confidence and proper technology selection.
- Industry standards are required for reporting tool specifications, accuracy, confidence levels and terminology.

Working Group 6.

Banff 99
In-line Inspection Session

Latest Developments - Inline Inspection

ROSEN

BANFF/99 PIPELINE WORKSHOP

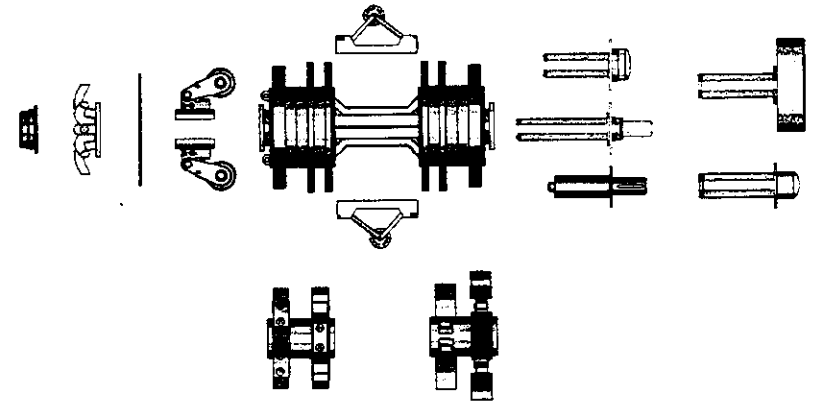
Latest Developments - Inline Inspection

PIPELINE INSPECTION

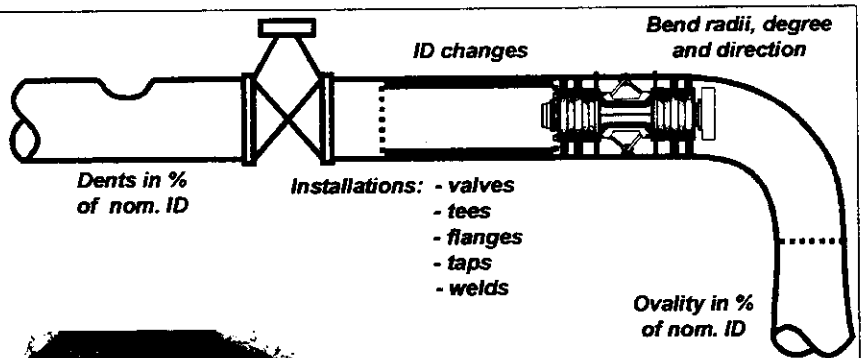
BANFF/99 PIPELINE WORKSHOP

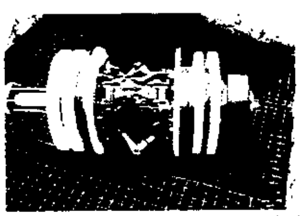
R. Stelmachuk & B. Brown.

Maintenance/Pre-Inspection Pigging



Geometry Inspection





PURPOSE:
- VERIFY PIPELINE CONSTRUCTION SPECS.
- DETECT ANY HIDDEN THIRD PARTY DAMAGE.
- ENSURE SAFE PASSAGE OF INSPECTION PIGS.

Topics

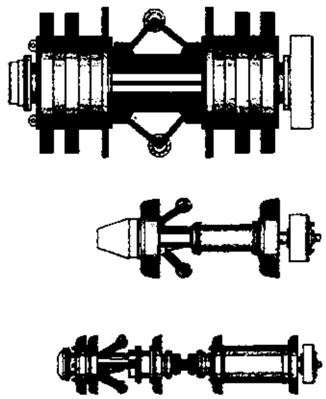
- MAINTENANCE/PRE-INSPECTION PIGGING
- GEOMETRY INSPECTION
- METAL LOSS INSPECTION
- SPEED CONTROL
- XYZ MAPPING
- REPORTING

Maintenance/Pre-Inspection Pigging

- FULL RANGE OF HIGHLY EFFICIENT CLEANING PIGS
- HIGH WEAR RESISTANT POLYURETHANE DISKS PROVIDING UNSURPASSED PERFORMANCE
- EXCELLENT BATCHING CAPABILITY
- COST EFFECTIVE
- EASY HANDLING
- ALL SIZES CAN BE EQUIPPED WITH PIG LOCATORS, BRUSHES, MAGNETS, ETC.
- ALL CLEANING PIGS AND ASSECORIES ARE MANUFACTURED BY ROSEN

Geometry Inspection

ELECTRONIC GEOMETRY PIG (6" - 56")

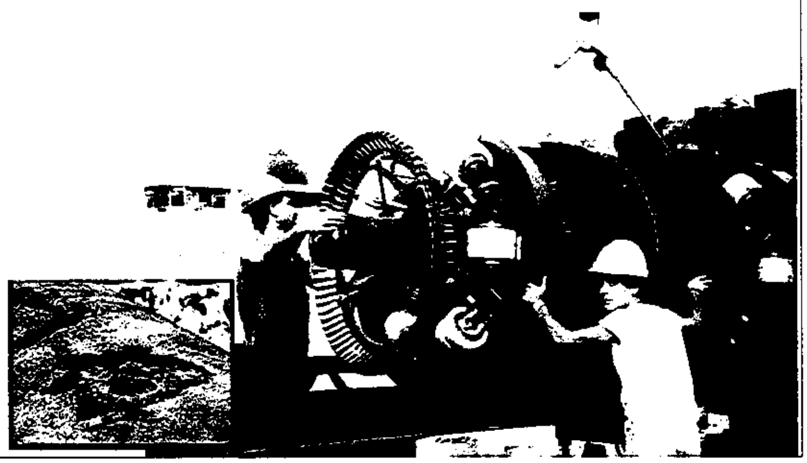


SYSTEM DESCRIPTION:

- EDDY CURRENT BASED TECHNOLOGY
- UP TO 32 CHANNELS (SENSORS)
- BEND DETECTION AND MEASUREMENT
- TEMPERATURE AND PRESSURE RECORDING

Metal Loss Inspection

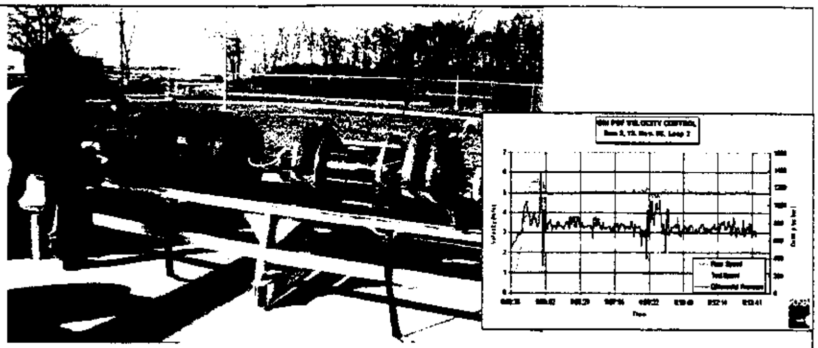
CORROSION DETECTION PIG (4" - 56")



Metal Loss Inspection

- SOPHISTICATED ELECTRONICS
- SENSOR TYPE AND DESIGN
- REFINEMENT OF SIZING ALGORITHMS
- NUERAL NETWORKS

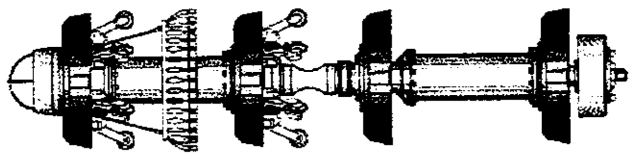
Speed Control



- Recently Tested Successfully.
- First Tool Available in Summer of 1999.
- Initial Range of Service: 24" - 36".

XYZ Mapping (GPS)

- Recently Tested in Client Pipeline.
- Available in 16" and up.



Reporting

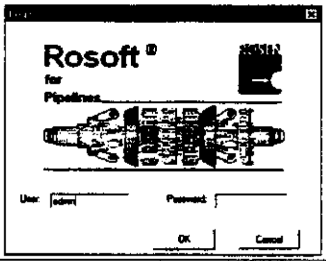
The Inspection Survey Report
Includes the following:

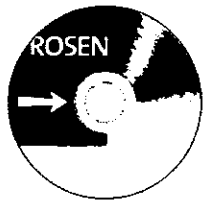
- written report detailing all activities, parameters and results,
- feature, installation and marker lists,
- graphical output,
- pipe tally,
- survey logs,
- client software (Y2K compliant).

Reporting

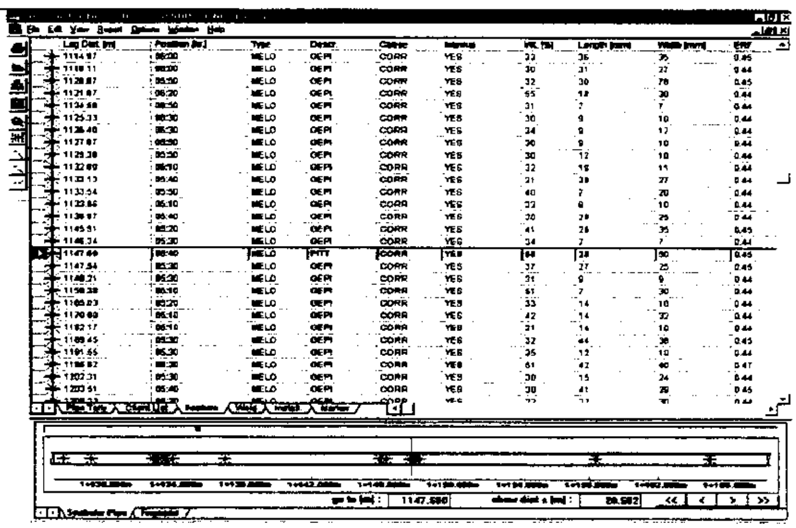
ROSOFT - Client Software Package

- Windows Based (WIN95, 98 and NT4)
- Database Format (*.dbf)
- View and Access all 'Raw' Survey Data
- Feature, Installation and Marker Management
- Generate Client Specific Lists (set filters)
- Various Graphical Output (Distributions, Pressure Based)

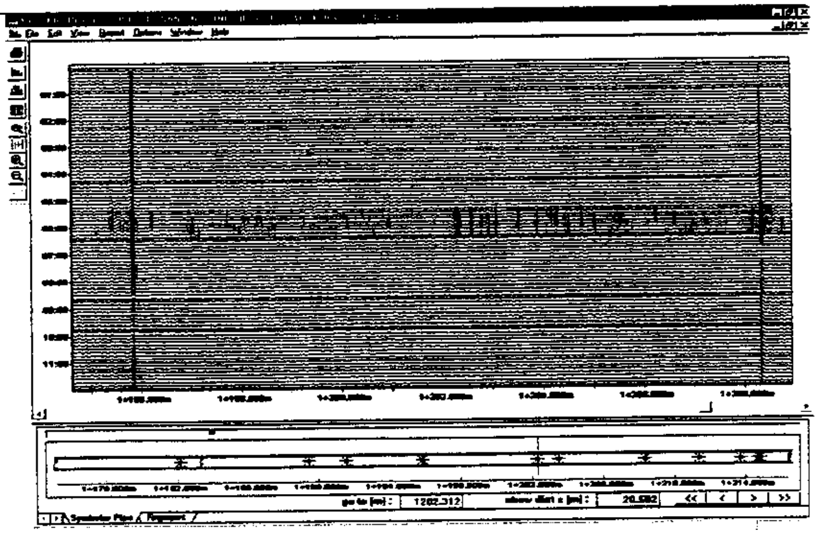




Reporting

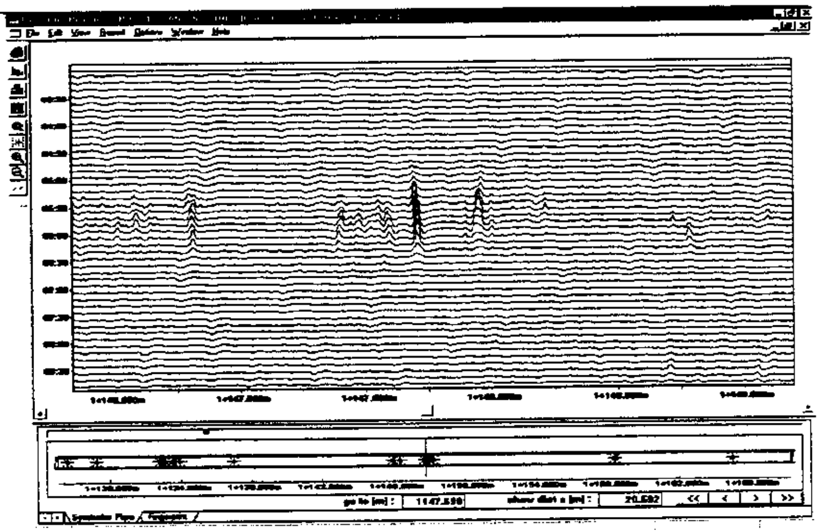


Reporting



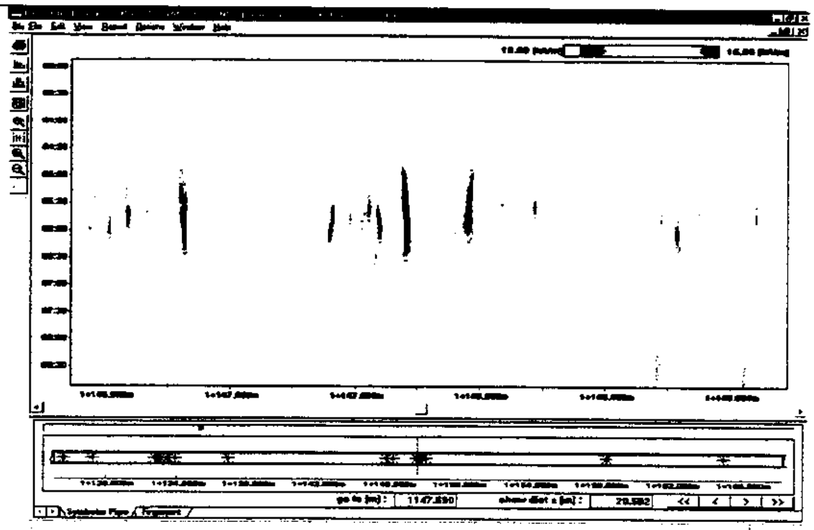
Managing Pipeline Integrity - Technologies for the New Millennium

Reporting



Managing Pipeline Integrity - Technologies for the New Millennium

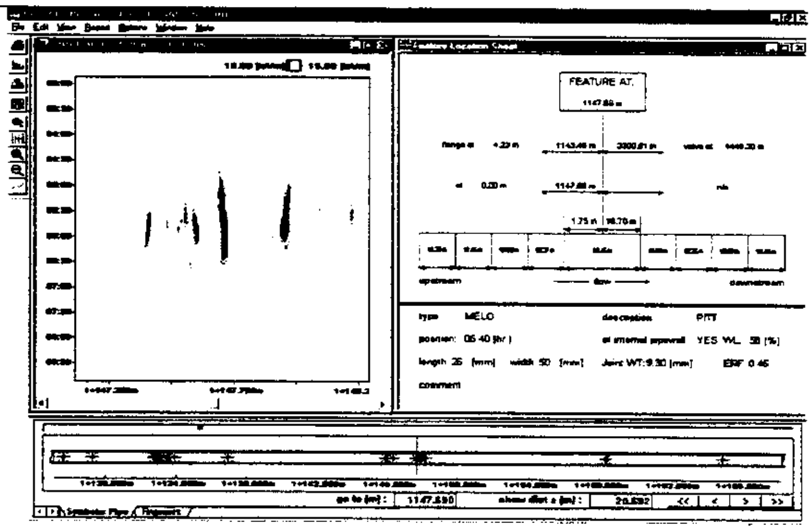
Reporting



Managing Pipeline Integrity - Technologies for the New Millennium

BANFF/99 PIPELINE WORKSHOP

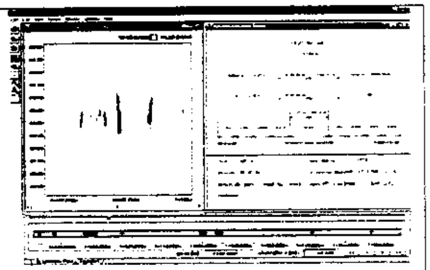
Reporting



Managing Pipeline Integrity - Technologies for the New Millennium

BANFF/99 PIPELINE WORKSHOP

Reporting



- REPORTING FORMAT TAILORED TO THE FIELD APPLICATION.
- DIRECT ACCESS TO DATA DURING FIELD EXCAVATION.
- ON-CALL SUPPORT PROVIDED.

Questions?

PROTECTION OF YOUR INVESTMENT PROTECTS THE ENVIRONMENT.

YOUR PARTNER IN PIPELINE INTEGRITY ASSESSMENT.

Working Group 6

Banff 99

In-line Inspection Session

Crack Detection

UltraScan CD

Sensitivity and repeatability of detection

Neb Uzelac

Pipetronix

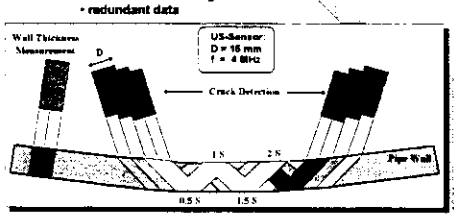
Pipetronix

BANFF/99 PIPELINE WORKSHOP

UltraScan CD

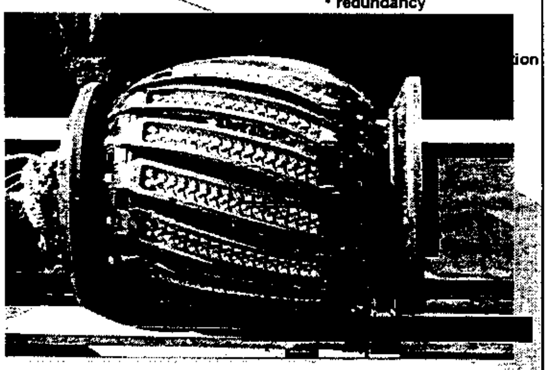
DEPLOYMENT OF SENSORS

- 480 - 840 crack detection sensors
- circumferential spacing - 10 mm (a couple)
- uniform wall coverage
- redundant data

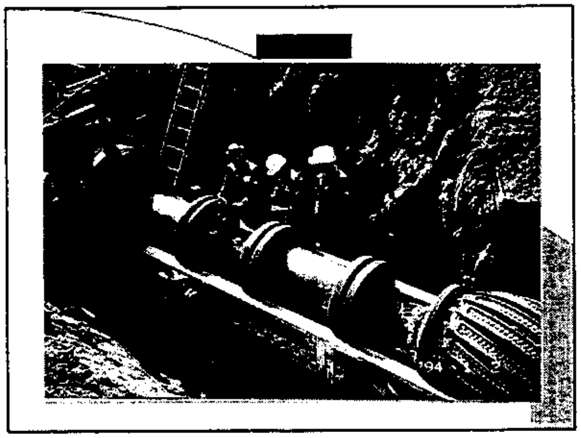


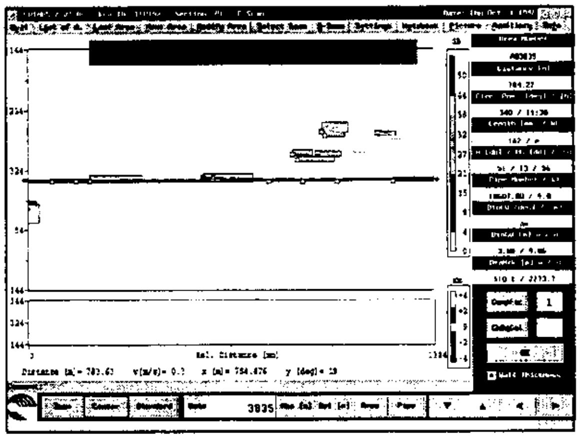
- sensitivity
- accuracy
- reliability

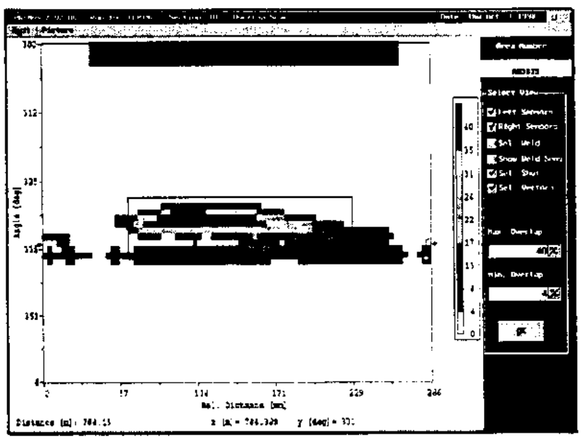
- redundancy

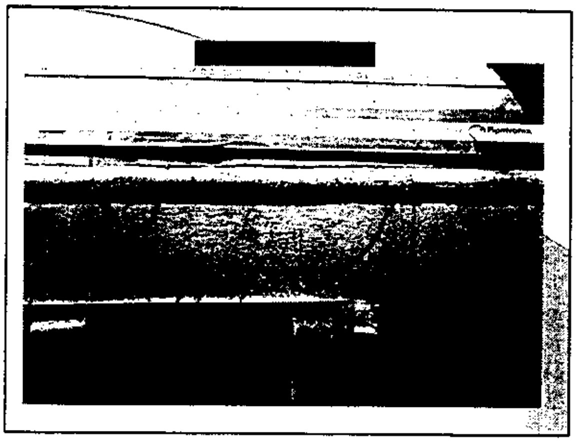


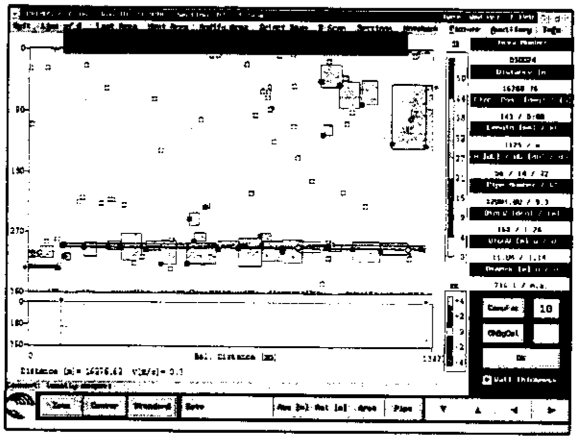
N. Uzelac

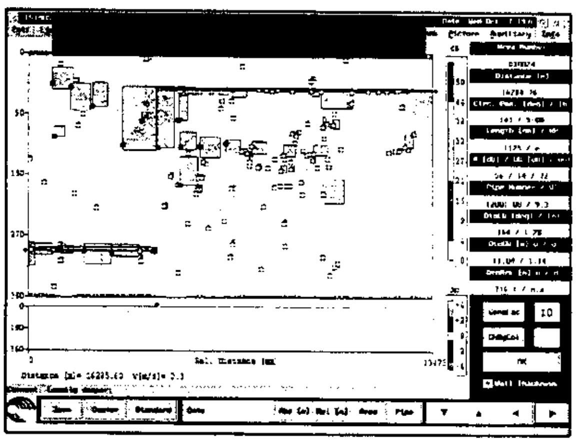


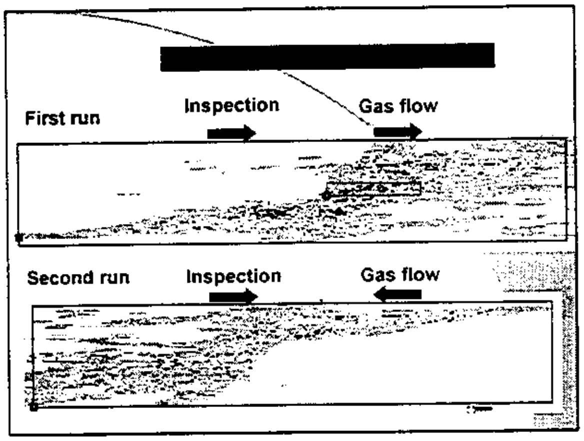








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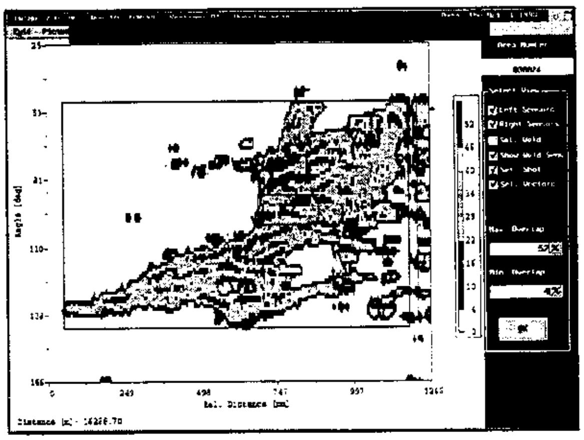
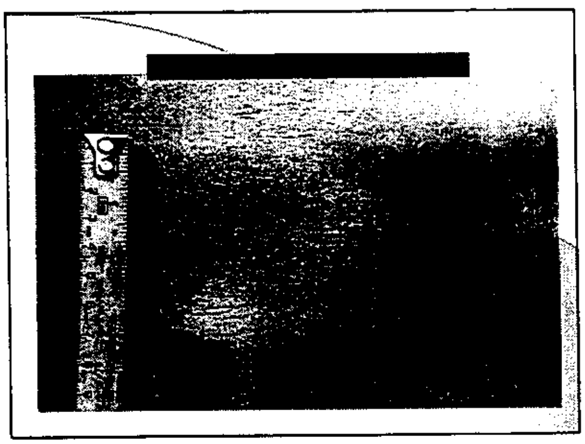
First run
Inspection
Gas flow
Second run
Inspection
Gas flow

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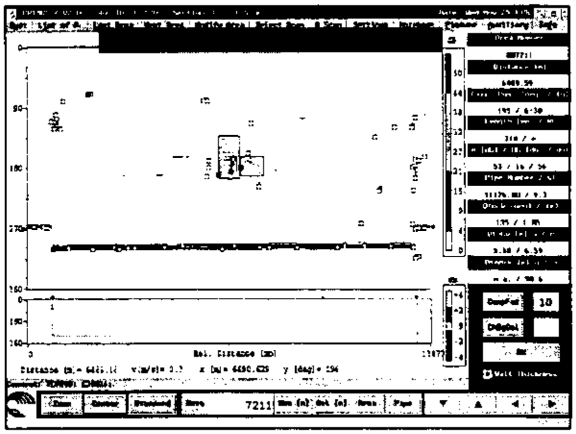

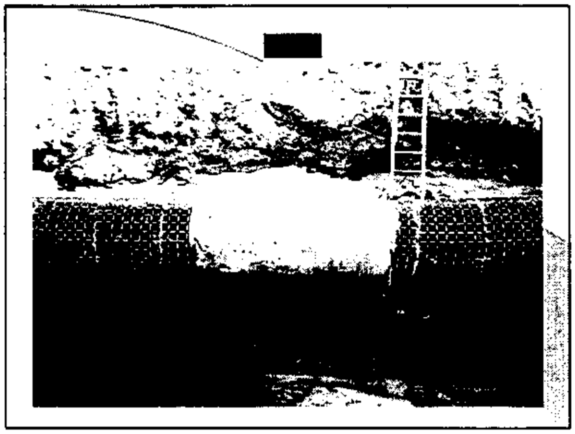

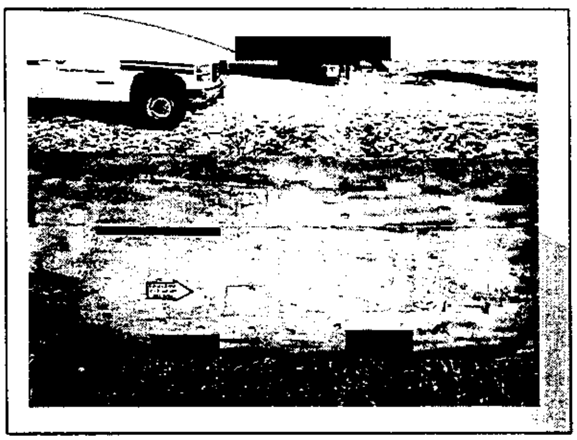

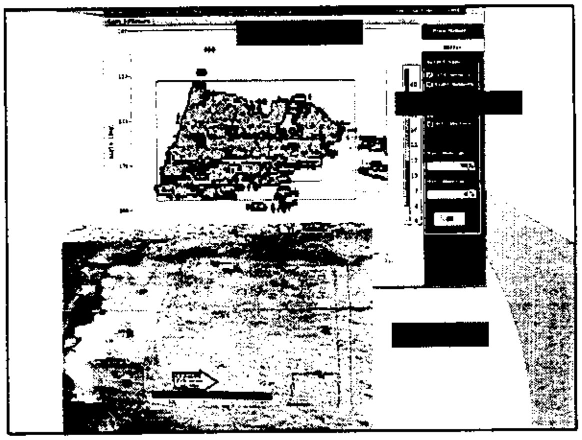

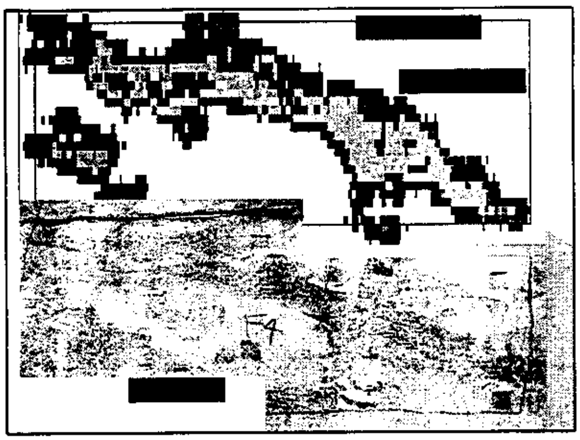
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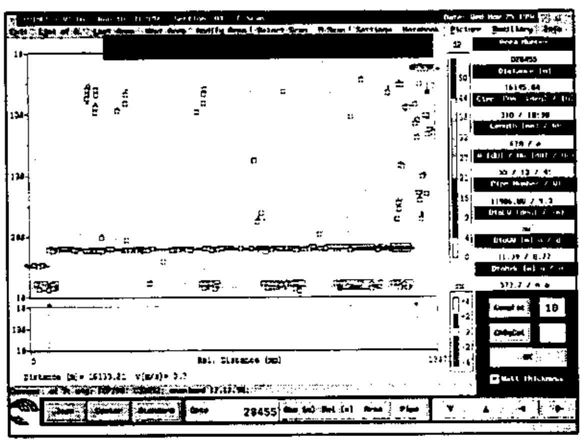
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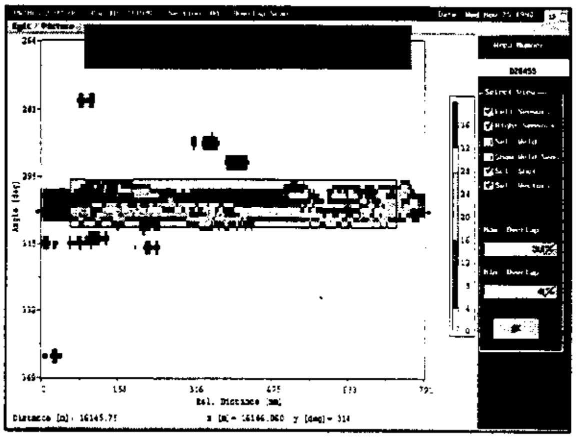
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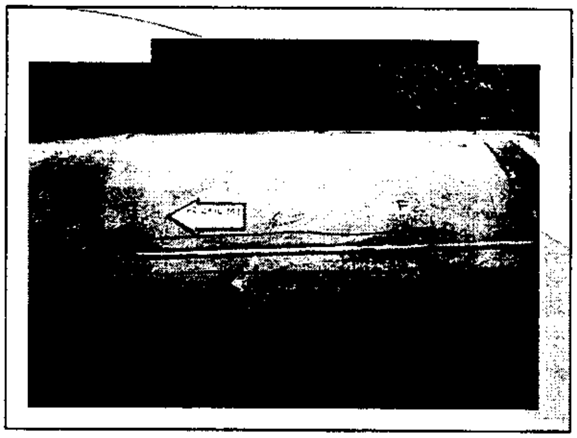
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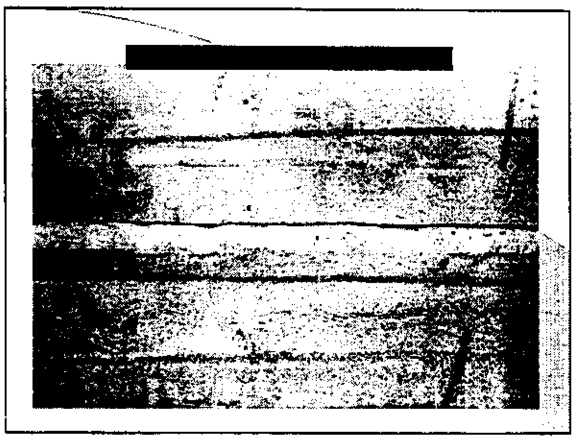
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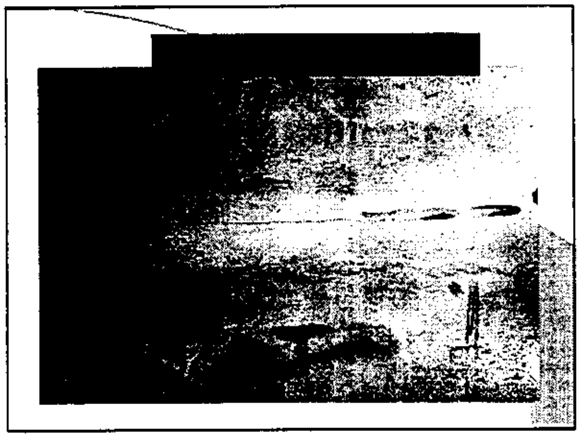
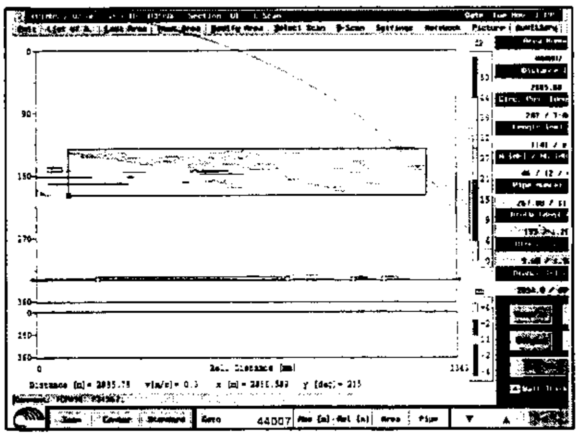
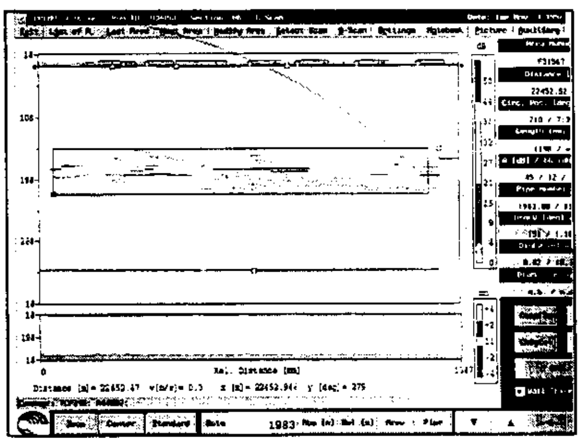






Wednesday 3:30 Working Group 6F: In-Line Inspection

	Company	Name	Position	Phone No.
53.	Suncor Energy	Bob Enjeneski		
54.	Talisman Energy	Bob Shapka	Corrosion Engineer	403 237-1953
55.	TransCanada Midstream	Cyril Karvonen		
56.	TransCanada PipeLines	Blaine Ashworth		
57.	TransCanada PipeLines	Reena Sahney	Project Leader Inline Inspection & Excavation	(403) 290-6037
58.	Trans Mountain Pipe Line Co. Ltd.	Rob Hadden		
59.	Trans Mountain Pipe Line Co. Ltd.	Dave Harper		
60.	Transportation Safety Board	Lawrence H. Gales		
61.	Tuboscope Vetco Pipeline Services	Jim M. Cone	Sales Calgary Jim Cone	
62.	Tuboscope Vetco Pipeline Services	Stefan Papenfuss	Director Sales & MKTG	713-799-5433
63.	UCISCO Canada Inc.	Jim Foley		
64.	UCISCO Canada Inc.	Douglas Gall		
65.	UCISCO Canada Inc.	Chris Mitskopoulos		
66.	Welland Pipe	Bob Lessard		
67.	Westcoast Energy	Mike Bell	Team Leader P/L Ops.	604-869-5550
68.	Westcoast Energy Inc.	Colin Gagne		
69.	Westcoast Energy	Bill Huska		
70.	Westcoast Energy Inc.	Ed McClarty		
71.	Westcoast Energy	Don Sinclair		
72.	Western Facilities Management Ltd.	Ron Cooper		
73.	Williamson Industries Inc.	William Jarvis		
74.	Enbridge Pipelines Inc.	Blair Carroll	Pipeline Integrity Engineer	(780) 420-5237
75.	ROSEN PIPELINE INSPECTION	RICK STELMACHUK	MANAGER TECH. SERVICE	403-269-1191
76.	ROSEN PIPELINE INSPECTION	BRYCE BROWN	SEN. ENGR.	281-925-0280
77.	TRAPIL	Patrick Villart		33 1 55 76 80 00
78.	TRAPIL	François Jacquiot		

a t t e n d a n c e s h e e t

Wednesday 3:30 Working Group 6F: In-Line Inspection

	Company	Name	Position	Phone No.
79.	ENBRIDGE Pipelines	Susan Miller	Manager, Pipeline Integrity	(780) 420-8182.
80.	INDIAN OIL CORPORATION	HARSUKH PAREKH	Deputy General Manager	91-281-456112
81.	CHEVRON CANADA RESOURCES (INDIA LTD)	SCOTT OLIPHANT	CORROSION REP.	403-234-5014,
82.	Nova Chemicals	Robert Wade	Sr. Inspector	403-314-7473
83.	Pipetronix Ltd.	Detlef Dirksen	VP	905 738 7559
84.	PIPETRONIX GmbH	TIM MARSTON	MANAGER PIPELINE INTEGRITY	
85.	Mobil Oil Canada	Reg MacDonald	Corrosion Specialist	403-260 7827
86.	The Cook Group	Tom Cook		905-541-9818
87.	NOVA Research	FRASER KING	Corrosion Scientist	403-250-4714
88.	Hunter McDonnell	Mike Webb	consultant	780 499-1480
89.	Enbridge Pipelines	Juan Nejic	Engineer, Pipeline Integrity	780 420-8523
90.	Trans Gas Ltd.	Mike Cameron	Engineer, Pipeline Integrity	306. 777. 9562
91.	MARR ASSOCIATES	JIM MARR	PRESIDENT	403 258 22..
92.	PIPETRONIX LTD.	NED UZELAC	TECHNOLOGY MGR.	(905) 738-7559
93.	Enbridge Pipelines Inc. ~~ARTI BHATIA~~			
94.				
95.				
97.				
98.				
99.				

Wednesday 3:30 Working Group 6F: In-Line Inspection

	Company	Name	Position	Phone No.
1.	AEC Pipelines	Wendy Stewart		
2.	AEUB	Bernie Frost		
3.	AEUB	Dave Hill		297-5839
4.	Alaska North Slope LNG Project	Terry Klatt		
5.	Alliance Pipeline Ltd.	Lorne Carlson		
6.	Alliance Pipeline Ltd.	Thea Van Hardeveld		
7.	Battelle	J. Bruce Nestleroth	Research Scientist	614-424-3181
8.	BC Gas	Fred Baines		
9.	BC Gas Utility Ltd.	Chris Billinton		
10	BC Gas Utility	Ferenc Pataki		
11.	Biztek Consulting, Inc.	Raymond R. Fessler		
12.	BJ Pipeline Inspection Services	Dave Hektner		
13	BJ Pipeline Inspection Services	Jeff Sutherland		
14.	Canadian 88 Energy Corp.	Brandt Sanregret		
15.	CANMET Materials Technology Laboratory	Winston Revie		
16.	Canspec Group Inc.	Steve Cooper		
17.	CC Technologies	Carl E. Jaske		
18.	Colt Engineering Corp	Darius M. Boucher		
19.	Corrpro Canada, Inc.	Garry Sommer		
20.	Corrpro Canada, Inc.	Denis Trudeau		
21.	Robert J. Eiber Consultant	Bob Eiber		
22.	Enbridge Pipelines Inc.	Roger Argument		
23.	Enbridge Consumers Gas	Anton Kacicnik		
24.	Foothills Pipelines Ltd.	Kyle Keith		
25.	Gecko Management	Terry Gibson		
26.	Greenpipe Industries Ltd.	Jim Zakowski	Manager, Integrity Projects	403-260-6703

Wednesday 3:30 Working Group 6F: In-Line Inspection

	Company	Name	Position	Phone No.
27.	Gulf Midstream Services	Rod Trefanenko		
28.	Hunter McDonnell Pipeline Services Inc.	Shamus McDonnell		(780) 944-0539
29.	Husky Oil Pipeline	Jeremy Nielsen		
30.	Imperial Oil Resources	Darryl Shylan		
31.	IPSCO Inc.	Richard Kruger		
32.	MC Integrity Management Ltd.	Marc Spencer		
33.	Cimarron ~~MC~~ Integrity ~~Management~~ Ltd.	Audrey Van Aelst	Intermediate Integrity & Design Engineer	403-258-720
34.	M+C ~~MC~~ Integrity ~~Management~~ Engineering Ltd.	Stanley Wong	Senior Integrity Engg.	403-295-6080
35.	Morrison Scientific Inc.	Guy Desjardins		
36.	National Energy Board	John Hendershot		
37.	National Energy Board	Marie-Chantal Labrie		
38.	National Energy Board	Paul Trudel		
39.	Morrison Scientific Inc.	Tom Morrison	Senior Partner	403-262-8161
40.	National Energy Board	Brian Nesbitt		
41.	NB Dept. of Natural Resources & Energy	Donald R. Persaud		
42.	Pembina Pipeline Corporation	Dave P. Kwas		
43.	Pengrowth	Len Danyluk		
44.	Petro Line	Robert Smyth		
45.	Pipeline Integrity International	Keith Grimes		
46.	Pipeline Integrity International	Martin Phillips		
47.	Pipeline Integrity International	N. Daryl Ronsky		
48.	Pipeline Integrity International	Patrick H. Vieth		
49.	Pipeline Remediation Inc.	Kevin Thiessen		
50.	Pipetronix GmbH	Herbert Willems		
51.	SNAM S.p.A.	Valentino Pistone		+39 02 520 5132
52.	Suncor Energy Inc. (Pipelines)	Dexter Dakin		

a t t e n d a n c e s h e e t

Wednesday 3:30 Working Group 6F: In-Line Inspection

	Company	Name	Position	Phone No.
53.	Suncor Energy	Bob Enjeneski		
54.	Talisman Energy	Bob Shapka		
55.	TransCanada Midstream	Cyril Karvonen		
56.	TransCanada PipeLines	Blaine Ashworth	Specialist	290 7394
57.	TransCanada PipeLines	Reena Sahney		
58.	Trans Mountain Pipe Line Co. Ltd.	Rob Hadden		
59.	Trans Mountain Pipe Line Co. Ltd.	Dave Harper		
60.	Transportation Safety Board	Lawrence H. Gales		
61.	Tuboscope Vetco Pipeline Services	Jim M. Cone		
62.	Tuboscope Vetco Pipeline Services	Stefan Papenfuss		
63.	UCISCO Canada Inc.	Jim Foley		
64.	UCISCO Canada Inc.	Douglas Gall		
65.	UCISCO Canada Inc.	Chris Mitskopoulos		
66.	Welland Pipe	Bob Lessard		
67.	Westcoast Energy	Mike Bell		
68.	Westcoast Energy Inc.	Colin Gagne		
69.	Westcoast Energy	Bill Huska		
70.	Westcoast Energy Inc.	Ed McClarty		
71.	Westcoast Energy	Don Sinclair		
72.	Western Facilities Management Ltd.	Ron Cooper		
73.	Williamson Industries Inc.	William Jarvis		
74.	~~Mo Mohitpour~~	7.		
75.	TransCanada Int	Mo Mohitpour	Specialist	261 5280
76.	J.R. Marr Associates	Jim Burke		258-2233
77.	~~BR~~ CANMET	BILL TYSON		(613)992-9573
78.	~~[illegible]~~ BG Technology	Bin Fu	Manager, Structural Integrity.	44-1509-283233

a t t e n d a n c e s h e e t

Wednesday 3:30 Working Group 6F: In-Line Inspection

	Company	Name	Position	Phone No.
79.	PETROLINE	Bob Smyth		
80.	IMPERIAL OIL RESOURCES	ANDREW WOZNIEWSKI		
81.	RAINBOW PIPE LINE CO. LTD.	PETER MARRECK	CHIEF ENGINEER	(403) 260-7795
82.	WESTCOAST ENERGY INC	WALTER SODERQUIST	TECH.	(250) 262-3480
83.	TQM Pipeline	Gaston Leclerc	Eng.	514 874-8884
84.	PEMBINA PIPELINE	GEORGE CHERRINGTON	MAINT SUPERVISOR	542-5341
85.	FOOTHILLS PIPE LINES LTD.	STEPHEN JACOBSON	CO-OP STUDENT	(403) 294-4455
86.	CORRPRO CANADA	RON MAURIER	V.P./LSer.	780 447-4565
87.	Morrison Scientific Inc. ~~Guy Desjardins~~	Guy Desjardins	President	403 262-8160
88.	TransCanada P/L	Bob Worthingham	Senior Engineer	403 2907860
89.	Associated Corrosion	Brian Holtsbaum	President	403 2509041
90.	TCPL	Mark Yeomans	Engineer	403 290-6170
91.	TransGas Ltd.	Mike Cameron	Engineer	306.777.9[illegible]
92.	AEC PIPELINES LTD.	PHIL MICHAILIDES	ENGINEER	780-417-4423
93.	AEC PIPELINES LTD.	MICHELLE SORENSEN	ENGINEER	780 439 2229
94.	Ludwig & Associates Eng Ltd	Rory Belger	Engineer	(780) 468-303
95.	University of Alberta	David W Murray	Prof. Emeritus	780-492-511
97.	MARR ASSOCIATES	JIM MARR	PRESIDENT	403-2582253
98.				
99.				

a t t e n d a n c e s h e e t

Wednesday 3:30 Working Group 6F: In-Line Inspection

	Company	Name	Position	Phone No.
1.	AEC Pipelines	~~Wendy Stewart~~		
2.	AEUB	Bernie Frost		
3.	AEUB	Dave Grzyb		
4.	Alaska North Slope LNG Project	Terry Klatt	Manager, Pipeline	(907) 265-6859
5.	Alliance Pipeline Ltd.	Lorne Carlson		
6.	Alliance Pipeline Ltd.	Thea Van Hardeveld		
7.	Battelle	J. Bruce Nestleroth		
8.	BC Gas	Fred Baines		
9.	BC Gas Utility Ltd.	Chris Billinton		
10	BC Gas Utility	Ferenc Pataki		
11.	Biztek Consulting, Inc.	Raymond R. Fessler		
12.	BJ Pipeline Inspection Services	Dave Hektner	Tech Sales	403/531-7580.
13	BJ Pipeline Inspection Services	Jeff Sutherland	Team Leader	531-5335
14.	Canadian 88 Energy Corp.	Brandt Sanregret		
15.	CANMET Materials Technology Laboratory	Winston Revie		
16.	Canspec Group Inc.	Steve Cooper		
17.	CC Technologies	Carl E. Jaske		
18.	Colt Engineering Corp	Darius M. Boucher		
19.	Corrpro Canada, Inc.	Garry Sommer		
20.	Corrpro Canada, Inc.	Denis Trudeau		
21.	Robert J. Eiber Consultant	Bob Eiber		
22.	Enbridge Pipelines Inc.	Roger Argument		
23.	Enbridge Consumers Gas	Anton Kacicnik		
24.	Foothills Pipelines Ltd.	Kyle Keith	Pipeline Engineer	(403) 294 4446
25.	Gecko Management	Terry Gibson		
26.	Greenpipe Industries Ltd.	Jim Zakowski		

a t t e n d a n c e s h e e t

Wednesday 3:30 Working Group 6F: In-Line Inspection

	Company	Name	Position	Phone No.
27.	Gulf Midstream Services	Rod Trefanenko		
28.	Hunter McDonnell Pipeline Services Inc.	Shamus McDonnell		
29.	Husky Oil Pipeline	Jeremy Nielsen		
30.	Imperial Oil Resources	Darryl Shylan		
31.	IPSCO Inc.	Richard Kruger		
32.	MC Integrity Management Ltd.	Marc Spencer		
33.	MC Integrity Management Ltd.	Audrey Van Aelst		
34.	MC Integrity Management Ltd.	Stanley Wong		
35.	Morrison Scientific Inc.	Guy Desjardins		
36.	National Energy Board	John Hendershot		
37.	National Energy Board	Marie-Chantal Labrie		
38.	National Energy Board	Paul Trudel		
39.	Morrison Scientific Inc.	Tom Morrison		
40.	National Energy Board	Brian Nesbitt		
41.	NB Dept. of Natural Resources & Energy	Donald R. Persaud		
42.	Pembina Pipeline Corporation	Dave P. Kwas		
43.	Pengrowth	Len Danyluk		
44.	Petro Line	Robert Smyth		
45.	Pipeline Integrity International	Keith Grimes		
46.	Pipeline Integrity International	Martin Phillips		
47.	Pipeline Integrity International	N. Daryl Ronsky	GENERAL MANAGER	403 262 7447
48.	Pipeline Integrity International	Patrick H. Vieth		
49.	Pipeline Remediation Inc.	Kevin Thiessen		
50.	Pipetronix GmbH	Herbert Willems		
51.	SNAM S.p.A.	Valentino Pistone		
52.	Suncor Energy Inc. (Pipelines)	Dexter Dakin		

	Company	Name	Position	Phone No.
55.	TransGas Limited	Jules Chorney		
56.	Trans Mountain Pipe Line Co. Ltd.	Dave Harper		
57.	Tuboscope Vetco Pipeline Services	Jim M. Cone	Mgr. Cdn. Sales.	(403)2765300
58.	Tuboscope Vetco Pipeline Services	Stefan Papenfuss	Director Sales & Mtg.	(713)799-5433
59.	UCISCO Canada Inc.	Jim Foley		
60.	UCISCO Canada Inc.	Douglas Gall		
61.	UCISCO Canada Inc.	Chris Mitskopoulos		
62.	Welland Pipe	Bob Lessard		
63.	Westcoast Energy	Mike Bell	Team Leader P/L Operations	(604)869-5550
64.	Westcoast Energy Inc.	Colin Gagne		
65.	Westcoast Energy	Bill Huska		
66.	Westcoast Energy Inc.	Ed McClarty		
67.	Williamson Industries Inc.	Al Forster		
68.	Williamson Industries Inc.	William Jarvis		
69.	Enbridge Pipelines Inc.	Blair Carroll	Pipeline Integrity Engineer	(780)420-5237
70.	TRAPIL	Patrick Villart		33 1 55 76 80 00
71.	TRAPIL	JACQUIOT Francois		33 1 55 76 80 00
72.	CHEVRON CANADA RESOURCES	SCOTT OLIPHANT		403-257-3427
73.	BG Technology.	Bin Fu	Manager (Structural Integrity)	44-1509-283233
74.	Pipetronix	Detlef Dirksen	VP	905 738 7559
75.	TUBOSCOPE VETCO	PATRICK PORTER	MNGR TECH.	713 799 5508
76.	WARREN	WALDEGGER	ENBRIDGE (SASK)	
77.	Ludwig & Associates Eng Ltd			(780) 468-3030
78.	NOVA Research	FRASER KING	CORROSION SCIENTIST	(403) 250-4714
79.	Shamus McDonnell		HUNTER McDONNELL	(780)944-0539
80.	PIPETRONIX LTD	NEB UZELAC	Technology Mgr.	(905) 738-7559
81.	ALDO DIFLUMERI	FEDERATED PIPE LINES LTD.	PIPELINE/TANK INTEGRITY	(403) 232-728[illegible]
82.	Enbride Pipe Lines	Juan Mejia	Integrity Engineer	(780) 420-8523

a t t e n d a n c e s h e e t

	Company	Name	Position	Phone No.
83.	Associated Corrosion	Brian Holtsbaum	President	403/250-9041
84.	PII	Martin Phelips	Product Manager	011 44 191 247 -06
85.	Corrpro Canada	Ron Maurier	V.P. P/L Services	780 447-4565
86.	Rainbow Pipe Line	Barry Martens	ATL/TM	780-449-5856
87.	Greenpipe	Steve Lemon	Field Rep	403-260-6727
88.	Husky Oil Operations Limited	Bob Kliciak	Sr. Staff Eng.	403 298-7078
89.	Westcoast Energy	Walter Soderquist	Tech	250 262-3450
90.	PII	Daryl Rowsky		403 262 744-
91.	Aaron Dinovitzer	Fleet Technology	Senior Eng.	(613)592-28
92.	Enbridge CG	Anton Kacicnik	Project Supervisor	(416) 496-7130
93.	AEC Pipelines Ltd	Michelle Sorensen	Operations Eng	780449 22
94.	CANMET	Wenyue Zheng	SCC specialist	613 992-7904
95.	Enbridge.	Sue Miller.	Manager.	(780)420-818
96.	Marr Assoc.	Jim Marr	President	403-258-2
97.	Rosen	Rick Stewchuk.	Manager.	403-269-1191
98.	Rosen	Bryce Brown	Snr. Engr.	281-925-0280
99.				
100				

Time Wednesday 1:15 Working Group 6E: In-Line Inspection

	Company	Name	Position	Phone No.
1.	AEC Pipelines	Phil Michailides	P/L INTEGRITY GROUP	417-4423 (780) [redacted]
2.	AEUB	Bernie Frost		
3.	AEUB	Dave [redacted] Hill	Prod Ops Section Lead	247-5839
4.	Alaska North Slope LNG Project	Terry Klatt		
5.	Alliance Pipeline Ltd.	Lorne Carlson		
6.	Alliance Pipeline Ltd.	Thea Van Hardeveld		
7.	Battelle	J. Bruce Nestleroth	Research Scientist	614-424-3481
8.	BC Gas	Glen Scott		
9.	BC Gas Utility	Barry Anderson		
10	BC Gas Utility	Ferenc Pataki		
11.	Biztek Consulting, Inc.	Raymond R. Fessler	Tech. Sales.	403/531-7580.
12.	BJ Pipeline Inspection Services	Dave Hektner		
13	BJ Pipeline Inspection Services	Jeff Sutherland	Team Leader	
14.	Canadian 88 Energy Corp.	Brandt Sanregret		
15.	Canspec Group Inc.	Steve Cooper		
16.	CC Technologies	Carl E. Jaske		
17.	The Cook Group	Thomas J. Cook		
18.	Robert J. Eiber Consultant	Bob Eiber		
19.	Enbridge Pipelines Inc.	Roger Argument		
20.	Enbridge Pipelines (Sask.) Inc.	Warren Waldegger		
21.	Foothills Pipelines Ltd.	Kyle Keith		
22.	jameszakowski@greenpipe.com Greenpipe Industries Ltd.	Jim Zakowski	Manager, Integrity Projects	403-260-6703
23.	Hunter McDonnell Pipeline Services Inc.	Michael Webb	Integrity Consultant [illegible]	780-499-1480
24.	Imperial Oil Resources	Darryl Shylan		
25.	IPSCO Inc.	Richard Kruger		
26.	MC Integrity Management Ltd.	Marc Spencer		

a t t e n d a n c e s h e e t

	Company	Name	Position	Phone No
27.	Granom ~~MG~~ Integrity ~~Management~~ Ltd.	Audrey Van Aelst	Pipeline Design Integrity	403-258-72
28.	Minerals Management Service	Robert W. Smith BS	Pipeline Research Team Leader	1 703 787 1
29.	Morrison Scientific Inc.	Guy Desjardins		
30.	Morrison Scientific Inc.	Tom Morrison	Senior Partner	403-262-8160
31.	National Energy Board	John Hendershot		
32.	National Energy Board	Brian Nesbitt		
33.	National Energy Board	Paul Trudel		
34.	NB Dept. of Natural Resources & Energy	Donald Persuad		
35.	Nova Chemicals	Robert Wade		
36.	Pembina Pipeline	George Cherrington		
37.	Pembina Pipeline Corporation	Dave P. Kwas		
38.	Petro Line	Robert Smyth		
39.	Pipeline Integrity International	Keith Grimes		
40.	Pipeline Integrity International	Martin Phillips		
41.	Pipeline Integrity International	Patrick H. Vieth		
42.	Pipeline Remediation Inc.	Kevin Thiessen		
43.	Pipetronix GmbH	Herbert Willems		(+49) 7244 732 167
44.	RTD Quality Services Inc.	Richard Kania		
45.	RTD Quality Services Inc.	Bob Simmons		
46.	SNAM S.p.A.	Valentino Pistone		
47.	Talisman Energy	Bob Shapka		
48.	TQM Pipeline	Gaston Leclerc	Engineer	514 874 8884
49.	TransCanada Midstream	Cyril Karvonen		
50.	TransCanada PipeLines	Blaine Ashworth		
51.	TransCanada PipeLines	Greg Nordquist		
52.	TransCanada PipeLines	Reena Sahney	Project Leader Inline Inspection & Excavations	(403)
53.	TransCanada PipeLines	Brad Watson		
54.	TransCanada PipeLines	Mark Yeomans		

Working Group 7 External Corrosion

Co-Chair: Susan Miller (Enbridge Pipelines)
Co Chair: Robert Worthingham (TransCanada Pipelines Ltd.)

Banff 1997 External Corrosion Summary

This working group focused on monitoring, assessing and predicting external corrosion. The participants agreed on the great value of determining corrosion rates, specifically the growth rates of pits and any correlation with environments and operating conditions. It would be helpful to agree on a methodology and on common data to be collected, for comparison purposes, and to include the data in a database, such as the CEPA database. Updates on activities to evaluate corrosion rates and state-of-the-art developments should be included in future Workshops.

Producers Group to develop an internal corrosion model based on failure mechanisms. The model must be cost-effective for upstream pipelines, be reasonably accurate, properly assess three phase flow, be user friendly, be readily accessible by field operators, and should have an output that can be used with a risk matrix.

There is a need for improved inhibitor batch pig technology. In addition, any changes in an inhibited system must be monitored so that, for example, there is a record of when the becomes water-wet.

Presentation

Working Group 7C - Remaining Strength Assessment

Objectives

1. Determine if more comprehensive language should be included in CSA
2. Review criteria for use of RSTRENG
3. Determine if more training is required in industry on conducting assessments

CSA – Jake Abes (Pipeline Safety Inc.)

Summary: *attached*

Questions and Discussion

1. Carl Jaske (CC Technologies) – better to have regulations more general than too specific so future development can be implemented
2. Jake Abes (Pipeline Safety Inc.) - people are using programs, such as RSTRENG, with little or no experience
3. Mike Reed (Trans Mountain Pipeline Company) – Is this going to become a design standard as oppose to a guideline?
4. Jake Abes (Pipeline Safety Inc.) - we have a responsibility as an industry to set the minimum standard but ultimately it will a responsibility of the design engineer

5. Marc Spencer (M&C Integrity) – Commentaries may apply to these clauses to give more depth to the clauses. The specifics would be better as commentaries as oppose to embedding them into the code.
6. Jake Abes (Pipeline Safety Inc.) - CSA is inconsistent between being prescriptive and flexible
7. Bob Eiber (Consultant) – If you become too prescriptive, the document becomes difficult to maintain. Do not rule out future development by making the code too prescriptive. Specifics may be address through CSA training programs.
8. Don Marr (Corrpro Canada Inc.) – Have there been a number of cases of failures due to inadequate training? The professional engineering practices need to play a role.
9. Jake Abes (Pipeline Safety Inc.) - Need to decide if we want to stay with B31G or modified B31G
10. Susan Miller (Enbridge Pipelines Inc.) – Who is using B31G? ~17 Who is using modified B31G? ~ 30 Other? ~6
11. Aaron Dinovitzer (Fleet Technology Ltd.) – uses in-house document
12. Marc Spencer (M&C Integrity) – uses plastic collapse
13. Bin Fu (BG Technology) – uses a British standard that is currently being used throughout the UK
14. Bob Worthingham (TransCanada Pipelines) – uses RSTRENG and B31G. How many are using RSTRENG? ~34
15. Barry Martens (Rainbow Pipelines) – What do people use for acceptable burst pressure? RSTENG does not include a safety factor.
16. Pat Vieth (Pipeline Integrity International) - there is no safety tolerance in the code. Currently, CSA allows the company to do an engineering assessment which this could be a part of. B31G and RSTRENG are explicit in using a safety factor.
17. Susan Miller (Enbridge Pipelines Inc.) – Nothing in CSA mandates a factor for safety for acceptable burst pressure.
18. Pat Vieth (Pipeline Integrity International) – safety factor needs to be addressed in an assessment. If your design factor is 0.72, that implicitly means that you should maintain this factor for the life of the pipeline.
19. Tom Morrison (Morrison Scientific) – There are errors in everything. Include and consider error levels in engineering assessments of defects. This may include field measurements, ILI measurements and RSTRENG.
20. Arti Bhatia (Enbridge Pipelines Inc.) - this would also apply to field measurement – use best tools to obtain the most accurate measurements.
21. Aaron Dinovitzer (Fleet Technology Ltd.) – From the history of the line, need to know how much you may fluctuate from the MOP.

R-Streng – Pat Vieth (Pipeline Integrity International)

Summary: *attached*

Questions and Discussion

1. Susan Miller (Enbridge Pipelines Inc.) – Who has training in RSTRENG? ~5 If there was a 1-day course, how many would be interested in attending? ~80%
2. Keith Grimes (Pipeline Integrity International) - There should be some kind of research or consensus on interaction of corrosion. What to use for interaction rules?
3. Pat Vieth (Pipeline Integrity International) – interaction is defined as how far apart (axially or radial) do areas of corrosion have to be before they are considered separate defects? There are different rules of thumb.
4. Bob Worthingham (TransCanada Pipelines) – Need to understand the limits
5. Carl Jaske (CC Technologies) – used the average – RSTENG or effective area method for interaction corrosion is a useful tool but should be validated
6. Application of RSTENG and B31G can also apply to cracks
7. Jake Abes (Pipeline Safety Inc.) – Is training necessary? What sort of problems come out of the training sessions?
8. Pat Vieth (Pipeline Integrity International) – A good example of this is burst pressure vs. MOP. If you have some understanding then the results have more meaning.
9. Corrosion data must be used in conjunction with statistical frequency analysis methods.
10. More data is required to apply RSTRENG to high strength steel (above X65)
11. Bin Fu (BG Technology) – B31G is conservative around flow stress and shape. From experience, finds many people ignore the flow stress.
12. Pat Vieth (Pipeline Integrity International) – compared to flow stress and geometry, the Folias factor plays a big role in causing a problem for pipeline operators
13. B31G was based on 37 data points; RSTRENG based on a lot more
14. Marc Spencer (M&C Integrity) – The design factor applies to infinite length of pipeline but if you apply this factor to a single joint, the result is very conservative. Does not think it is a safe assumption to apply a single design factor. Other items need to be taken into consideration
15. Pat Vieth (Pipeline Integrity International) – by applying statistics, you can overcome
16. Bruce Lawson (Westcoast Energy Inc.) – there are many points outside the band – how come?
17. Pat Vieth (Pipeline Integrity International) – many points go back to the 1960s that add to the variability to the data. Instead of using flow stress, Pat will use the UTS. By applying a safety factor, will eliminate the effects of scattered data.
18. Bruce Lawson (Westcoast Energy Inc.) – Do you feel the ILI data is accurate in determining accurate features?
19. Pat Vieth (Pipeline Integrity International) – Validate the data by doing excavations
20. John Beavers (CC Technologies) – What are the effects of end caps on the burst pressure?

21. Pat Vieth (Pipeline Integrity International) – very little end effects (~10%) due to the loading
22. Failure criteria, based on predicted failure stress, is less than SYMS. Predicted failure stress from RSTRENG is greater than SMYS.
23. Barry Martens (Rainbow Pipelines) – Can the defect be ground out?
24. Pat Vieth (Pipeline Integrity International) – yes, but then you have a blunt notch defect – B31G would then apply
25. Jake Abes (Pipeline Safety Inc.) – CSA has special provisions for determining how to assess a ground out area.

Conclusions and Recommendations for 7C
1. There are different methodologies being developed.
2. There are errors in measurement no matter how careful the measurement is taken. The goal is to reduce the error as much as possible.
3. Allow latitude to take advantage of new findings.
4. Engineering critical assessment training should be made available.

Working Group 7D – Corrosion Growth Estimation

Objectives
1. Explore advances indirect and direct monitoring methods
2. Use of represented ILI data
3. Use of soil coupons
4. Identify other methods used and their success in application to pipeline integrity programs

Modelling Corrosion Growth – Guy Desjardins (Morrison Scientific)

Summary: *attached*

Questions and Discussion
1. Bob Eiber (Consultant) – How variable is the corrosion rate along the pipeline from year to year?
2. Guy Desjardins (Morrison Scientific) – Tends to vary when something changes such as, no CP or with seasons.
3. Bob Eiber (Consultant) - Have you been able to tie the corrosion rate to the inspection method? Will you get various corrosion rates from two vendors or will the rate be the same?
4. Guy Desjardins (Morrison Scientific) – It may vary a bit especially in length due to the different tools. This averages out over time.
5. Bob Worthingham (TransCanada Pipelines) – double logarithmic graph vs. mm/yr. (depth) Gumble graphs like this are used to predict the inspection frequency and shows distribution of corrosion rates. Rates vary from zero to 0.85 mm/ yr.
6. Carl Jaske (CC Technologies) – Does the step reflect a +/- 1 variability in the distribution?

7. Bob Worthingham (TransCanada Pipelines) – This may be an artefact First inspection data points are grown to predict future inspections
8. Bob Worthingham (TransCanada Pipelines) – currently were are working on asphalt lines but plan to expand
9. Scott Oliphant (Chevron Canada Resources) – What success have people had with inspection of coatings other than ILI?
10. Susan Miller (Enbridge Pipelines Inc.) – ILI can be a limitation, if for example, pigging of tape coated lines is not feasible. For some lines have found a correlation to drainage points. Where there was a drainage point the severity and frequency of corrosion was higher.
11. Jane Dawson (Pipeline Integrity International) – in addition to the inspections, one needs to continue to complete CP surveys, coating surveys, etc.
12. Bob Worthingham (TransCanada Pipelines) – agrees; however, this assists with finding the problems and assist with the priority
13. Tom Cook (The Cook Group) – What is the confidence level?
14. Tom Morrison (Morrison Scientific) – upper limits 50% of the wall, 80% of the time – more seriously, have examined the errors on the ILI tools. The confidence limit on the prediction is slightly higher than the tool.
15. Bob Worthingham (TransCanada Pipelines) – takes into account the variability of the tool to aid in a better confidence of the prediction
16. Guy Desjardins (Morrison Scientific) – accuracy of the data plays a large part in the accuracy of the prediction
17. George Cherrington (Pembina Pipeline) – the internal corrosion needs to be considered
18. Bob Worthingham (TransCanada Pipelines) – internal corrosion is not of concern with the sweet gas lines
19. Don Marr (Corrpro Canada Inc.) – has had success in finding corrosion with over the line surveys. If you are confident why complete future ILI; why not complete periodic digs?
20. Bob Worthingham (TransCanada Pipelines) – new features could show up – the frequency of ILI has been reduced
21. John Beavers (CC Technologies) – Could you identify if the rates were as high as the graph showed? Do you have models that show high rates on other parts of the system?
22. Bob Worthingham (TransCanada Pipelines) – we are working on this. Field observations have confirmed these rates.
23. Arti Bhatia (Enbridge Pipelines Inc.) – there is some cross correlation with geographical data. Also the data from ILI may transfer to other lines if the geographic characteristics are similar.
24. Bob Simmons (RTD Quality Services Inc.) – Is the excavation data consistent? Or does it vary from company to company? 1" grid vs. ½ " grid?
25. Growth rate is not a single number but a reflection of a probability.

Use of CP Coupons – Greg VanBoven (NOVA Research and Technology Corporation)
Summary: *attached*

Questions and Discussion
1. Grant Firth (Corrpro Canada Inc.) – In October there was a step-up with some probes and a step-down with other probes. What was the cause?
2. Greg VanBoven (NOVA Research and Technology Corporation) – not sure but will assume there was an interference problem
3. Bob Worthingham (TransCanada Pipelines) – there are about 100 coupons throughout the system.
4. Bob Worthingham (TransCanada Pipelines) – some correlation work in progress to understand various soil parameters. This will help understand the risk to the pipeline.
5. Carl Jaske (CC Technologies) – is the coupon maintained at the same temperature as the pipe?
6. Greg VanBoven (NOVA Research and Technology Corporation) – temperatures are similar therefore both the pipe and the coupon will need to be measured
7. Barry Martens (Rainbow Pipelines) – found quite a few problems with the MFL tool so Rainbow is now using the UT tool
8. Susan Miller (Enbridge Pipelines Inc.) – similar experience to Rainbow. With tape lines, tenting occurs around the weld yielding narrow axial external corrosion (NAEC). Other techniques may also include circumferencial examination. With any method, you need to take into account the errors.
9. John Baron (Shell Canada Limited) – Shell runs ILI tools to look for anomalies. They have tried to correlate soil data to external corrosion. They have seen rates as high as 1.5 mm/yr. – this lead to a failure. Are you looking for anything else such as pH in soil analysis?
10. Tom Jack (NOVA Research and Technology Corporation) – NRTC is researching redox potentials, at depth soil parameters, deposition of the soil, surface parameters and soil texture.
11. Marc Spencer (M&C Integrity) – Why do these parameters trigger some locations but not others?
12. Bruce Lawson (Westcoast Energy Inc.) – the CEPA database has space for additional information. Has anyone considered building a database for external corrosion.
13. A working database should be considered for the next workshop.
14. Bob Worthingham (TransCanada Pipelines) – Review of objectives: Continuing to use ILI data; coupons are used to obtain estimations on the pipe; other method are being used

Conclusions and Recommendations 7D
1. The industry should develop a standard approach to measuring corrosion in the field
2. Identify guidance for soil analysis.
3. A shared database of soil conditions and corrosion rates should be devleoped, perhaps CEPA.

Managing Pipeline Integrity:
Technologies for the New Millenium

Working Group 7c : External Corrosion
Remaining Strength Assessments

Working Group 7c: External Corrosion Remaining Strength Assessments

OBJECTIVES

1) Determine if more comprehensive language should be included in CSA
2) Review the criteria for use of RSTRENG
3) Determine if more training is required in industry on conducting assessments

Working Group 7c: External Corrosion Remaining Strength Assessments

SPEAKERS

Jake Abes - CSA

Pat Vieth - RSTRENG

CSA Z662-99 Oil and Gas Pipeline Systems

CLAUSE 10.8.1.6

Where piping is not suitable for continued service at the established operating pressure due to the presence of defects, either the piping shall be operated at pressures that are determined by engineering assessment to be acceptable, or the affected piping shall be repaired in accordance with the applicable requirements of Clauses 10.8.2 to 10.8.6 inclusive.

CSA Z662-99 Oil and Gas Pipeline Systems

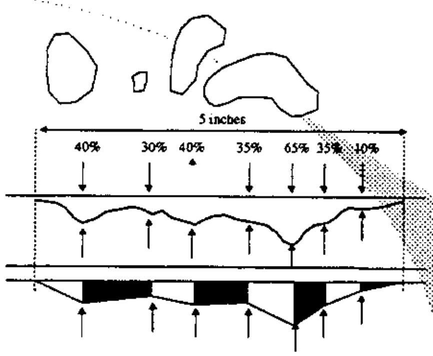
CLAUSE 10.8.2.2.5

Corroded areas that exceed the depth or length limits specified in Clauses 10.8.2.2.3 and 10.8.2.2.4 shall be considered to be defects, unless determined by an engineering assessment to be acceptable. The engineering assessment shall include consideration of service history and loading, anticipated service conditions, the mechanism of imperfection formation, imperfection dimension, failure modes, and material properties (including fracture toughness properties).

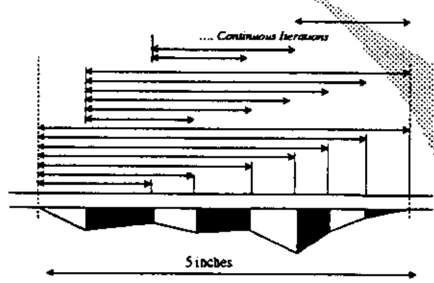
RSTRENG

- **Re**maining **Streng**th of Corroded Pipe
- Tool for predicting the remaining strength of corroded pipe
- PRC *International* sponsored research (1989)
  - addressed inherent conservatism in B31G
  - developed analysis methods
  - validated against database of corroded pipe
  - continued validation against expanded database

RSTRENG



RSTRENG Effective Area Iterative Calculation



RSTRENG

- RSTRENG provides accurate assessment and analysis of the corrosion
- Addresses difficult in the definition of length via the iterative calculation
- Software provides the means for conducting the calculation
- Training and understanding of corrosion measurement and assessment is encouraged

Managing Pipeline Integrity: Technologies for the New Millenium

Robert Worthingham
TransCanada PipeLines
Calgary, AB

Working Group 7: External Corrosion
Corrosion Growth Estimation

OBJECTIVES

1) Explore advances in direct and indirect monitoring methods
2) Use of repeated ILI Data
3) Use of soil coupons
4) Identify other methods used and their success in application to pipeline integrity programs

2

Corrosion Rate and Severity Prediction from Multiple ILI Runs

R. Worthingham
TransCanada Pipe Lines

T. Morrison and G. Desjardins
Morrison Scientific

The Problem ... When do we inspect next?

- How do we optimize the reinspection frequency?
- When will the remaining flaws have deteriorated sufficiently to be in danger of rupture?
- How do we spend the ILI resources wisely to inspect as many lines as possible, and then only when needed?

4

The Dream ...

- High resolution ILI data could be used to identify *where* corrosion pits were growing and *how fast* they were growing!
- Allow for *just in time* inspection and repair
- Allow for coating repair of sites that are growing *before* they need reinforcement or removal

5

Site Specific Approach

- Match *individual* corrosion pits reliably by correcting for ILI tool variability with PHOENIX
- Determine *individual* corrosion pitting rates and project the expected size of each pit into the future

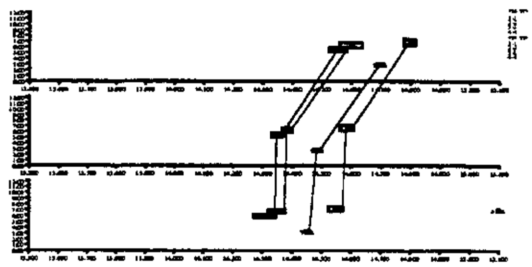
6

PHOENIX

- Monte Carlo analysis of each feature used to determine probability of failure in a given year. Takes into account tool repeatability and variability.
- Critical sub-feature analysis used on all ILI data collected since 1994 (Rstreng, Lapa)
- Validate ILI vendor analysis

7

Matches from Phoenix



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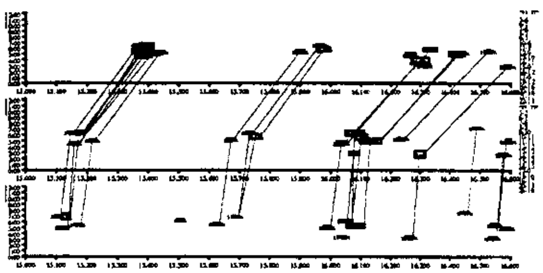

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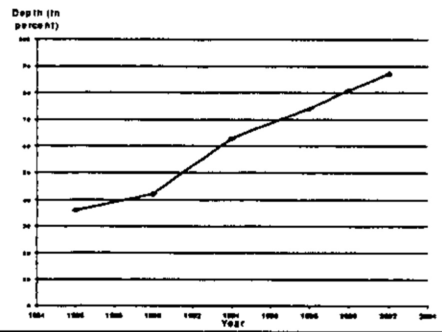
Increasing Depth with Time



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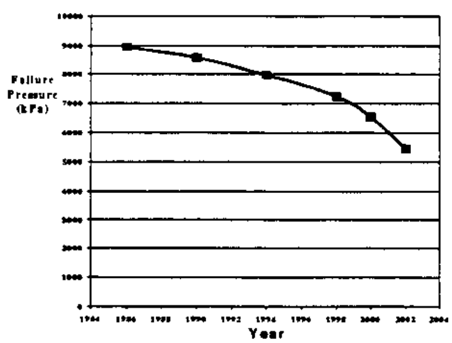
Failure Pressure Decline



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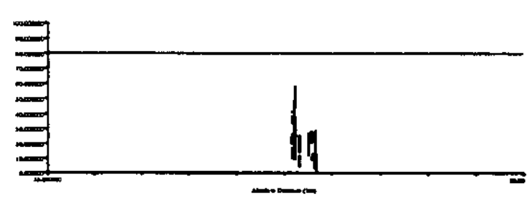
Growth in Penetration Through Wall—Example 1



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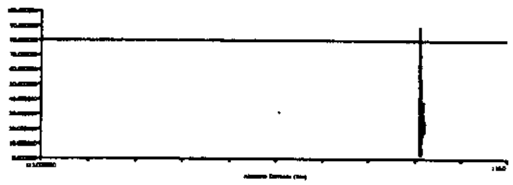
Growth in Penetration Through Wall—Example 2



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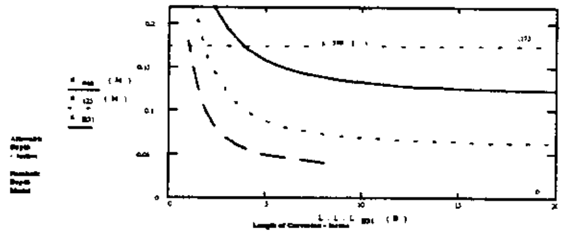
Critical Feature Sizes



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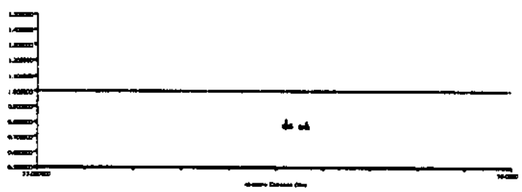
Growth in FPR (Failure Pressure Ratio)—Example 1



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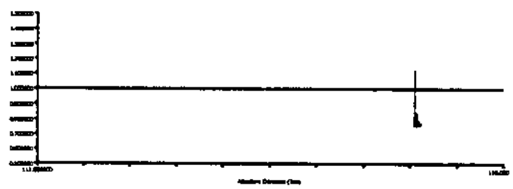
Growth in FPR (Failure Pressure Ratio)—Example 2



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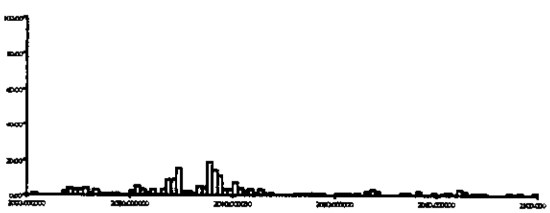
Frequency of Failure Dates

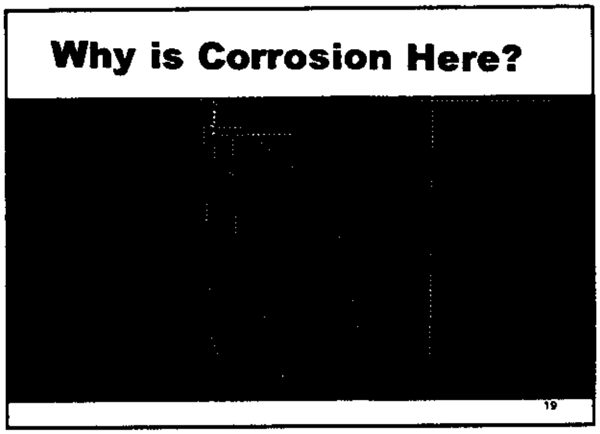


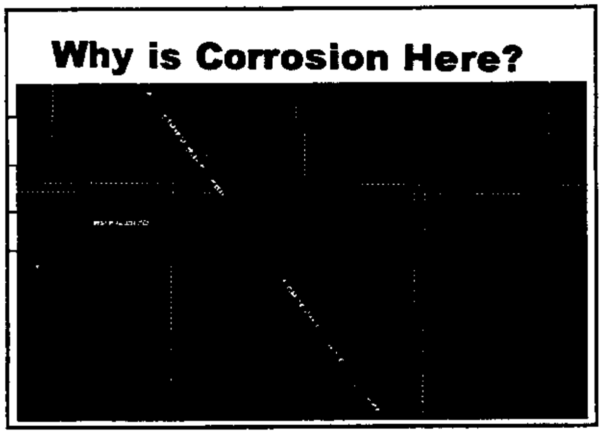
17

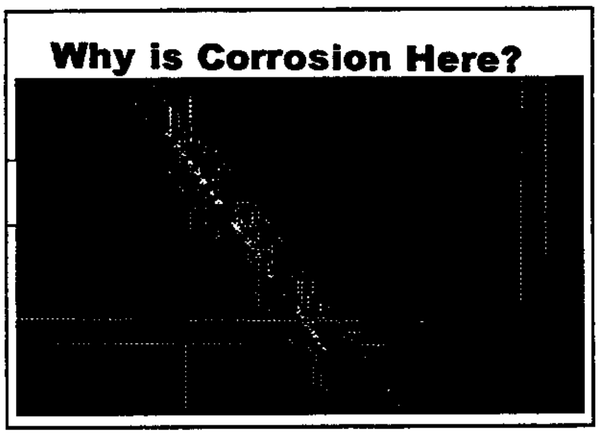
Where is Corrosion Occurring?

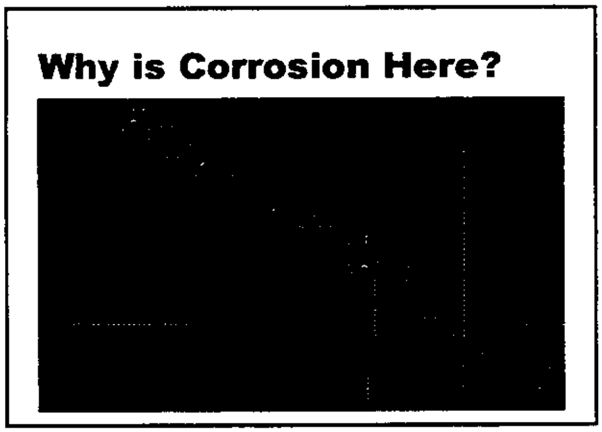
- By viewing the growth data in a GIS, it is possible to help answer WHY? and WHERE?
- Correlations with environmental, geographic and construction related factors can be made.
- Where will the first failures occur?
- Where are the fast growing pits?

18


Why is Corrosion Here?


Why is Corrosion Here?


Why is Corrosion Here?


Why is Corrosion Here?

Corrosion Modeling with Coupons

1999 Banff Pipeline Workshop
Working Group 7D

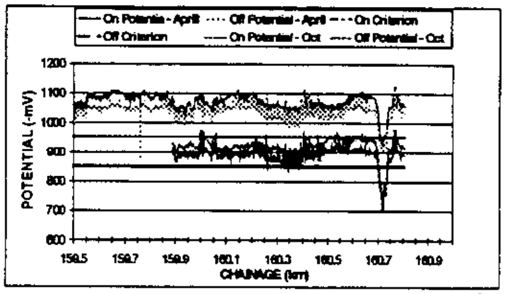
G. Van Boven
NOVA Research & Technology Corp.

OBJECTIVE

To understand the corrosion state of a 40 year old asphalt coated pipeline in seasonally dry soils where an apparent seasonal lack of protective CP as measured against conventional guidelines is observed.

2

Close Interval Survey



3

How Can the CP Issues of This Line Be Dealt With?

- Add anode beds to increase line polarization
- Perform close interval surveys only in the winter or early spring
- Initiate a research program aimed at understanding and demonstrating pipe protection.

4

Research!

A seasonal study using buried coupons, environmental probes and electrochemical corrosion rate measurements aimed at :

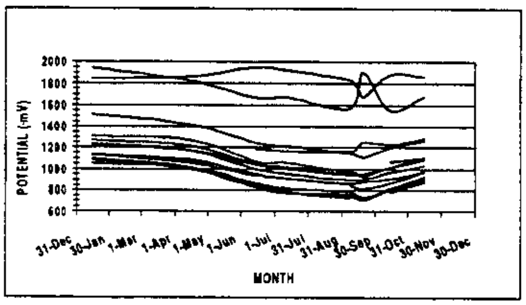
Understanding the Relation of CP to Environmental Changes

Evaluating the Impact of the Environment on Corrosion

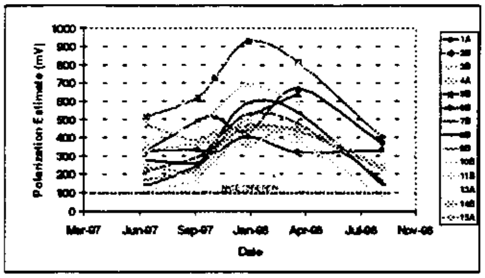
Demonstrating Pipeline Protection with Alternate CP Criteria

5

Seasonal "On" Potentials

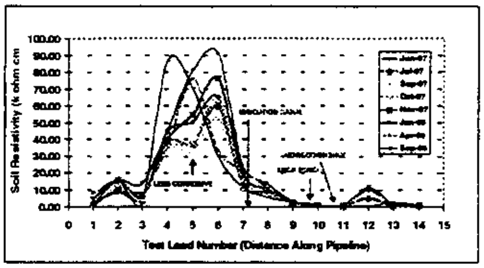


NACE 100 mV of Polarization



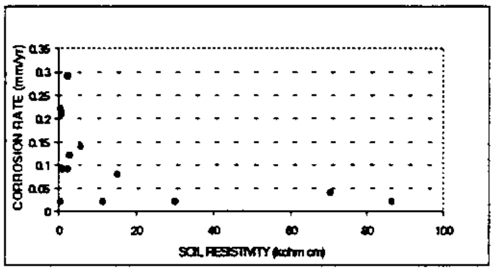
7

Seasonal Soil Resistivity



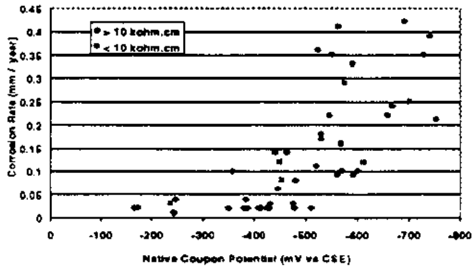
8

Soil Corrosivity & Soil Resistance



9

Soil Corrosivity & Native Coupon Potential



10

Two Mechanisms

1] MOISTURE DEPENDENCE: Unprotected coupon corrosion rates less than 0.05 mm / year

- Soil resistance is greater than 10 Kohm.cm
- Native coupon potentials are more positive than -500 mV $_{CSE}$
- Oxidation - reduction potentials more positive than -250mV)(Au Vs CSE)

11

2] O_2 Dependence

- Soil moisture is not limiting corrosion & O_2 dependant corrosion may be present.
- These areas can be a concern if inadequate CP and/or defective coating is present.

12

Finally

- General CP guidelines are often difficult too meet and in some cases may be misleading as to the degree of polarization on the pipe.
- Adequate polarization may have to be demonstrated with alternate criteria.

13

1st SESSION

L. G. 7 EXTERNAL CORROSION 8:15

Name	Affiliation
Bob Vilyus	PII
Keith Grimes	PII.
MO MOHITPOUR	TRANSCANADA INTERNATIONAL
DELTON GRAY	ATCO PIPELINES
GRANT FIRTH	CORRPRO CANADA, INC (EDM)
Sin Tsai	TransCanada PipeLines
Richard Kania	RTD Quality
Leonard Leskiw	Can-Ag Enterprises
Aaron Dinovitzer	Fleet Technology Ltd.
IBRAHIM KONUK	Geological Survey of Canada
Jane Dawson	PII
Arti Bhatta	Enbridge
SANKARA PAPAVINASAM	CANMET
LINDA GRAY	ALBERTA RESEARCH COUNCIL
ROB HADDEN	TRANS MOUNTAIN PIPE LINE
MIKE REED	TRANS MOUNTAIN PIPE LINE
GLEN SCOTT	B. C. GAS
FERENC PATAKI	BC GAS UTILITY
Richard Kruger	IPSCO Inc
NATHAN TOWNLEY	IPSCO Inc
Robert Smith	Minerals Management Service
CLIVE WARD	BG Technology
Jim Steeves	Proactive Technologies Int'l.
[illegible]ORGE CHERRINGTON	PEMBINA PIPELINE
BARRY MARTENS	RAINBOW PIPE LINE
MICHELLE SORENSEN	AEC PIPELINES
PHIL MICHAILIDES	AEC PIPELINES
WALTER SOMERQUIST	WESTCOAST ENERGY INC.

3RD SESSION

Name	Affiliation
ALEBACHEW DEMOZ	CANMET / Devon
Guy Desjardins	Morrison Scientific Inc
LAWRENCE GALES	TRANSPORTATION SAFETY BOARD
BOB KLICIAK	HUSKY OIL OPERATIONS LIMITED
Rudy Steiner	HUSKY OIL OPERATIONS LIMITED
ROY W SCHUBERT	SHELL CANADA LIMITED
Dave Hertner	BJ Pipeline Inspection Ser.
Bruce Nestleroth	BATTELLE
Lorne Carlson	Alliance Pipeline
Jeff Sutherland	BJ Pipeline Inspection Services
Don Powell	Amoco Canada Petroleum
Darren Hill	HILLTECH CONSULTING LTD
STEVE COOPER	CANSPEC GROUP INC.
Mike Cameron	Trans Gas
Bill Tyson	MTL / CANMET
Audrey Van Aelst	Cimarron Integrity Ltd
JIM MARR	MARR ASSOCIATES.
John Beavers	CC Technologies
Fraser King	NOVA Research
Jim Zakowski	Greenpipe Industries
DARRYL SHYIAN	IMPERIAL OIL RESOURCES
William Jarvis	WILLIAMSON INDUSTRIES
Bob Simmons	RTD QUALITY SERVICES.
Max Buck	Conoco Pipeline Co.
Wenyue Zheng	CANMET
Bob Wade	Nova Chemicals
Jim Bronson	Canusa
Ed BAGG	WESTCOAST ENERGY
Mike Bell	Westcoast Energy

1st Session.

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Tom Morrison	(403) 262-8160	Morrison Scientific
Carl E. Jaske	614/761-1214	CC Technologies
Ram Wu		3M Canada
Ted Hamre	780 490 2432	Canspec
Scott Oliphant	403/~~23~~234-5049	Chevron
Guowu Shen	613/996-4367	MTL/CANMET
Su Xu	(613) 992-1960	MTL/CANMET
Greg Van Boven	403 250 0601	Nova R&D
Weixing Chen	780 492 7706	University of Alberta
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Bert Johnson	(403) 233-3217	Gulf Canada Resources Ltd.
Don Marr	(780) 447-4565	Corrpro Canada
Daryl Rohsky	403 262 7447	PII Canada
Shamus McDonnell	(780) 944-0539	Hunter McDonnell Pipeline Serv.
Mike Webb	(780) 499-1480	Hunter McDonnell Pipeline Serv.
P. K. Deb	91-11-8558076	IOCL, India
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Guy Hervieux	(780) 420-5473	Atco Pipelines
BnFu	+44-1509-283233	BG Technology (England)
Tom Jack	403 2504781	NOVA Research & Technology Corp.
Loral Lukaniuk	403-290-7069	TransCanada Pipelines.
Tom Driedger	403.263.7448	Pyxis Geomatics
Bruce Lawson	604 691 5662	Westcoast Energy Inc
Brian Holtsbaum	403 250 9041	Associated Corrosion Consultants

3RD SESSION.

VILTART	Patrick	33 1 55 76 80 00	TRAPIL
JACQUIOT	François	"	TRAPIL
ROD TREFANENKO		(780) 464-9112	GULF MIDSTREAM SERVICES
JAKE ABES		403 517 6441	Pipeline Safety Consulting Inc
Reg MacDonald		403 260 7827	Mobil Oil Canada

ATTENDANCE SHEET

2ND SESSION.
WED. 14.

W.G. 7 — EXTERNAL CORROSION — 16:30

Name	Affiliation
Tom Morrison	Morrison Scientific
Guy Desjardins	Morrison Scientific
Carl Laske	AVANTI TE[illegible] Technologies
TED HAMRE	CANSPEC
SCOTT OLIPHANT	CHEVRON CANADA RESOURCES
GREG VAN BOVEN	NOVA RED
Weixing Chen	University of Alberta
Tom Cook	The Cook Group.
DON MARR	CORRPRO CANADA
DARYL RONSKY	PII
Shamus McDonnell	HUNTER McDONNELL PIPELINE SERV.
Mike Webb	Hunter McDonnell Pipeline Serv.
P. K. Deb	IOCL, India
WARREN WALDEGGER	ENBRIDGE (SASK)
MARC SPENCER	M&C Integrity Eng.
Stan Wong	M+C Integrity Eng Ltd
DENIS TRUDEAU	CORRPRO
Barry Martens	Rainbow Pipe Line
PETER MARRECK	RAINBOW PIPE LINE COMPANY LTD.
ALDO DIFLUMERI	FEDERATED PIPE LINES LTD.
Bin Fu	BG Technology.
Clive Ward	" "
Tom JACK	NOVA Research.
GLENN MACINTOSH	DENSO NORTH AMERICA INC.
CORAL LUKANIUK	TRANSCANADA PIPELINES.
TOM DRIEDGER	PYXIS [illegible]

Bruce Lawson	Westcoast Energy Inc
Brian Holtsbaum	Associated Corrosion Consultants Ltd
Darren Hill	Hilltech Consulting Ltd.
Don Powell	Amoco Canada Petroleum Co
Jeff Sutherland	BJ Pipeline Inspection Services
Lorne Carlson	Alliance Pipeline
Bruce Nestleroth	BATTELLE
Dave Heftner	BJ Pipeline Inspection Service
Mimoun Elboujdaïni	CANMET/OTTAWA
SANKARA PAPAVINASAM	CANMET/OTTAWA
MARTY WELDEN	KOCH PIPELINES CANADA - CALGARY
ED BAGG	WESTCOAST ENERGY INC
Bob Lessard	WELLAND PIPE LTD.
Aida Lopez	TRANSCANADA Pipelines
KEVIN GARRITY	CC TECHNOLOGIES CANADA, LTD.
Jim Mitchell	Camrose Pipe [illegible]
Alex Afageris	" "

2ND SESSION
WED. 14
10:36

- W.G. 7

EXTERNAL CORROSION

Name	Affiliation
ARTI BHATIA	Enbridge Pipelines Inc
Jane Dawson	P.I.I.
DON PERSAUD	Dept. of Nat. Res. & Energy - N.B.
ANTON KACICNIK	ENBRIDGE CONSUMERS GAS
GRANT FIRTH	CORRPRO CANADA, Inc.
Siu TSAI	TCPL
GARRY SOMMER	CORRPRO CANADA, INC.
SAJ Shapiro	Morrison Scientific Inc.
Jingli Luo	University of Alberta
VILTART Patrick	TRAPIL
ACQUIOT François	TRAPIL
ROD TREFANENKO	GULF MIDSTREAM SERVICES
Jim Zakowski	Greenpipe Industries
DARRYL SHYIAN	IMPERIAL OIL RESOURCES
Bob Simmons	RTD QUALITY SERVICES
Max Buck	Conoco Pipeline Co.
Robert Wade	Nova Chemicals
NATHAN TOWNLEY	IPSCO INC
Richard Kruger	IPSCO Inc.
NORM TRUSLER	BCGAS
MIKE REED	TRANS MOUNTAIN PIPE LINE
Blaine Ashworth	Trans Canada PipeLines
Greg Toth	Trans Mountain Pipe Line
LINDA GRAY	ALBERTA RESEARCH COUNCIL
Reg MacDonald	Mobil Oil Canada
A. Demoz	CANMET / Devon
GASTON LECLERC	TQM Pipeline
PHIL MICHAILIDES	AEC PIPELINES

Name	Affiliation
MICHELLE SORENSEN	AEC PIPELINES LTD.
CYRIL KARVONEN	TRANSCANADA MIDSTREAM
GEORGE CHERRINGTON	PEMBINA PIPELINE
Jim Burke	J.E. Marr Associates
Robert Smith	Minerals Management Service
STEVE COOPER	CANSPEC GROUP INC.
Mike Cameron	TransGas Ltd.
BOB EIBER	CONSULTANT
Audrey Van Aelst	Cimarron Integrity Ltd.
John Beavers	CC Technologies
Fraser King	NOVA Research
PATRICK VIETH	PIPELINE INTEGRITY INTERNA
MO MOHITPOUR	TRANSCANADA INTERNATIONAL
Guy Hervieux	Atco Pipelines

BANFF/99 PIPELINE WORKSHOP

Managing Pipeline Integrity - Technologies for the New Millennium

April 12 - 15, 1999

14-Apr-99
10:45 p.m.

FUNCTION	NAME	SURNAME	CORPORATION	CITY	PROV./ STATE	PHONE	FAX	E-MAIL
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	Terry	Klatt	Alaska North Slope Lng Project	Anchorage	AK	907 265-6859	907 265-6638	tklatt@mail.arco.com
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Sponsor	Shu	Lee	Alberta Energy & Utilities Board	Calgary	AB	403 297-3200	403 297-3520	david.degagne@eub.gov.ab.ca.
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	Don	Powell	Amoco Canada Petroleum	Calgary	AB	403-233-6331	403-233-1195	donald_a_powell@amoco.com
WG3 - co-chair	Matt	Celiner	Anteris Corrosion Inc.	Calgary	AB	403 221-8212	403 232-8211	anteris@nucleus.com
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	Tim	Edward	Baseline Technolgies Inc.	Edmonton	AB	780 423-1717	780 423-1112	time@baselinetech.com
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	Raymond	Fessler	Biztek Consulting Inc.	Evanston	IL	847 733-7410	847 733-9541	biztekrrf@aol.com
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	Brendt	Sanregret	Canadian 88 Energy Corporation	Pincher Creek	AB	403 627-7456	403 627-3213	brandts@telusplanet.net
Co-chair	Ian	Scott	Canadian Association of Petroleum Producers	Calgary	AB	403 267 1132	403 266 3261	scott@capp.ca
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BANFF/99 PIPELINE WORKSHOP

Managing Pipeline Integrity - Technologies for the New Millennium

April 12 - 15, 1999

14-Apr-99
10:45 p.m.

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	Joshua	Johnson	CC Technologies Laboratories, Inc.	Dublin	OH	614 761-1214	614 761-1633	johnsoj@cct.labs.com
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	Don	Marr	Corrpro Canada Inc.	Edmonton	AB	780 447-4565	780 447-3215	
	Ron	Maurier	Corrpro Canada Inc.	Edmonton	AB	780 447-4565	780 447-1643	ron.maurier@corrpro.ca
	Garry	Sommer	Corrpro Canada Inc.	Edmonton	AB	780 447-4565	780 447-1643	corrpro1@planet.eon.net
	Denis	Trudeau	Corrpro Canada Inc.	Edmonton	AB	780 447-4565	780 447-1643	corrpro1@planet.eon.net
Exhibit	Ken	Bales	CSA International	Etobicoke	ON	416 747-2647	416 401-6804	balesk@csa.ca
	Glenn	MacIntosh	Denso North American Inc.	Sherwood Park	AB	780 449-4060	780 449-5300	gmarintosh@densona.com
	Donald	Persaud	Dept. of Natural Resources & Energy	Fredericton	NB	506 453-7166	506 453-3671	dpersaud@gov.rib.ca
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	Saeed	Kangarloo	Enbridge International Inc.	Calgary	AB	403 231-3937	403 231-3954	saeed.kangarloo@cnpl.enbridge.com
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	Roger	Argument	Enbridge Pipelines Inc.	Edmonton	AB	780 420-8521	780 420-5389	roger.argument@cnpl.enbridge.com
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	Les	Sargeant	Westcoast Energy Inc.	Prince George	BC	250 960-2000	250 960-2002	
	Don	Sinclair	Westcoast Energy Inc.	Fort St. John	BC	250 262-3511	250 262-3529	
	Walter	Soderquist	Westcoast Energy Inc.	Fort St. John	BC	250 262-3480	250 262-3529	
	Darren	Wait	Westcoast Energy Inc.	Fort Nelson	BC	250 774-7600	250 774-7843	
	Keith	Carr	Western Facilities Management	Calgary	AB	403 705-7010	403 705-7020	
	Ron	Cooper	Western Facilities Management	Fort St. John	BC	250 785-6791	250 785-4003	
	Al	Forster	Williamson Industries Inc.	Edmonton	AB	780 440-6637	780 440-1903	al_forester@wii.ca
	William	Jarvis	Williamson Industries Inc.	Georgetown	ON	905 873-2272	905 877-0369	william.jarvis@wii.ca
	Bill	Kantors						
	Jim	Wright						
	Michael J.	Zelensky		Calgary	AB	403 274-7904	403 274-7904	mzelensky@shaw-wave.ca

Issues

- need for a "cooperative" industry approach to public involvement
- greater respect for people's time
- more lead time required - resident's understanding of the "system"
- residents wanting larger set backs from pipelines
- residents wanting larger emergency response planning zones
- residents demanding better compensation for disturbance (neighbours too)
- community relations audits as important as environmental audits
- bad attitudes

CAPP 33

Presented by:

David DeGagne, EUB

Terry Gibson, Gecko Management

- ew our experience related to public lvement and consultation related to Sundre-Caroline area
- kground to the Caroline Interrogatory ess
- uss the current situation

[redacted]

[redacted]mmunity/Industry
[redacted]hnical Committee
[redacted]Noise 1994-present

[redacted]oline Interrogatory
[redacted]cess Coordinator
[redacted]6-1999

[redacted]oline B Pool
[redacted]visory 1998 -

- Terry
  - Emergency planning - drilling 1986-1991
  - Community Affairs Coordinator - construction and start-up 1991-1994
  - Consultant 1994-1999
  - Caroline B Pool Advisory1998/9

[redacted]

[redacted]d gas exploration from the 1950's
[redacted]more than 25 operating oil and gas companies
[redacted]4000 oil and gas wells, and related facilities
[redacted] System - major transmission point
[redacted] Caroline - Beaverhill Lake - deep, sour gas
[redacted]g commenced 1985 (3 years after the
[redacted]epole Blowout)

[redacted]

- [redacted] l Caroline Field - east of the Town of [redacted]dre - stretches to the Village of [redacted]line
- [redacted]dre - population - 2,000
- [redacted]line - population 400
- [redacted]y farms and ranches; many cottages [redacted] camping areas

[redacted]

- [redacted]Public is nervous about sour gas
- [redacted] - Lodgepole blowout #1
- [redacted] - Lodgepole blowout #2
- [redacted] Major EUB Public Inquiry
- [redacted]ic continued to be worried about sour [redacted] - and very distrustful of industry

[redacted]

- [redacted]t find in Alberta in 20 years
- [redacted]illion capital - 15 producing wells - reservoir [redacted]ng 50 square miles (over 30 wells drilled to define [redacted]ld)
- [redacted]r compressor stations (50,000 hp)
- [redacted]lant
- [redacted]ur Forming and load-out facility
- [redacted]construction jobs
- [redacted]erating jobs
- [redacted]billion cash flow over 20 years

[redacted]

- [redacted] 1985 - first contact of community
- [redacted]mber 1987 - first public meetings
- [redacted]ary 1988 - Caroline Gas Field [redacted]sory Board established
- [redacted]-1989 - Community Offices [redacted]lished
- [redacted]y/Shell competition to develop the [redacted]

[redacted]

[redacted] 1989 - Sundre Parade

[redacted] - May 1990 - ERCB Hearing

[redacted] ber 1990 - construction commencement

[redacted] 1992 - construction work force peaks at [redacted]

[redacted] - Oct. 1992 - Community Offices closed

[redacted] mber 1992 - February 1993 - start up

[redacted]

[redacted]

[redacted] l Opportunities

[redacted] ty (e.g. emergency planning)

[redacted] ic Health (emissions)

[redacted] er - pollution - volumes used

[redacted] road

[redacted] ory of mistrust; lack of openness

[redacted] t

[redacted]

[redacted]

- [redacted]s from service rig - small release of sour gas - [redacted]st 1987
- [redacted]d the neighbourhood - they were angry
- [redacted] meeting - company told them "you were not at [redacted]there really was not a problem!"
- [redacted]mpany didn't listen!
- [redacted]mpany was close minded
- [redacted]mpany didn't admit it when they didn't know the [redacted]ers
- [redacted]mpany didn't apologize

[redacted]

[redacted]

- [redacted]sten and to keep an open mind
- [redacted]pologize
- [redacted]ave empathy and sensitivity
- [redacted] prepared to deal with anger and [redacted]rust - and do not take things [redacted]onally
- [redacted]ok for solutions jointly with [redacted]eholders - e.g. work together on ERP

[redacted]

[redacted]

[redacted] Expectations

[redacted]mmunity Consultation Program

[redacted]l Opportunities

[redacted]ds and Traffic

[redacted]rmation and Education Vehicles

[redacted]nco

[redacted]ury

[redacted]

[redacted]

[redacted]mmunity Advisory Board

[redacted]rgency Planning Committee

[redacted]o-Economic

[redacted]ronmental Monitoring and Studies

[redacted], Water and Soils

[redacted]estock

[redacted]ildlife

[redacted]

[redacted]

[redacted]spaper articles

[redacted]sletters

[redacted]rs

[redacted]ic Consultation Committees

[redacted]kly e-mail - Shell and key
[redacted]eholders

[redacted]

[redacted]

[redacted]blished in 1992

[redacted]l, Amoco, Mobil

[redacted]ally a low profile

[redacted]ally focused on emergency response
[redacted]community information

[redacted]

- [redacted] r issue
- [redacted] idual coordinators - Shell, Dilcon, [redacted] tech-Lavalin
- [redacted] tory
- [redacted] racts broken into smaller pieces
- [redacted] mation/educational meetings
- [redacted] ns and contractors
- [redacted] tored progress

[redacted]

- [redacted] ificant impact on the community
- [redacted] ctively monitored roads
- [redacted] truction traffic schedules
- [redacted] ng for workers
- [redacted] s used to transport workers to [redacted] re and Caroline at night

[redacted]

[redacted]jor outside company was hired to supply [redacted]y-mix concrete

[redacted]ONS LEARNED:

[redacted]e team must be supportive

[redacted]king the talk"

[redacted] your receive approvals, you are [redacted]untable

[redacted]mistake erodes support - admit your [redacted]akes - and you can recover!

[redacted]

[redacted]

[redacted]ury potentially detected in the Caroline gas [redacted]m

[redacted]ceived health risk

[redacted]prior to start-up - Company - nervous

[redacted]sion to be open

[redacted]ed employees

[redacted]acted stakeholders

[redacted]Company had few answers

[redacted]ng eventually confirmed Mercury was not a [redacted]em

[redacted]

[redacted]

[redacted]eholders appreciated openness

[redacted]l credibility increased

[redacted]hbourhood trust of Shell increased

[redacted]

[redacted]ng early paid off

[redacted]to face resident contacts most effective (but
[redacted]nsive)

[redacted]gness to make changes - a key element of
[redacted]ess

[redacted]lo not always need to have all of the answers

[redacted]ommunity helped

[redacted] first to understand and then to be
[redacted]rstood"

[redacted]thy

[redacted]

- [redacted] istent messengers
- [redacted] nunication - quality Vs. quantity
- [redacted] d types of public forums - know the [redacted] nce
- [redacted] ocal media - a key audience
- [redacted] ll of the public will support the company
- [redacted] egy development and planning for [redacted] nunication events
- [redacted] kay to say no

[redacted]

- [redacted] of community affairs personnel went from 11 [redacted]) to 1 (1994)
- [redacted] any significantly reduced/stopped providing [redacted] nation to the community
- [redacted] urces related to community affairs dropped [redacted] ically (analogous to moving from dating to [redacted] age - lots of resources to keeping operating [redacted] ses low)
- [redacted] lacency in the post-approval/post [redacted] ruction stage

[redacted]

[redacted]ine leak - January 1994

[redacted] start-up problems

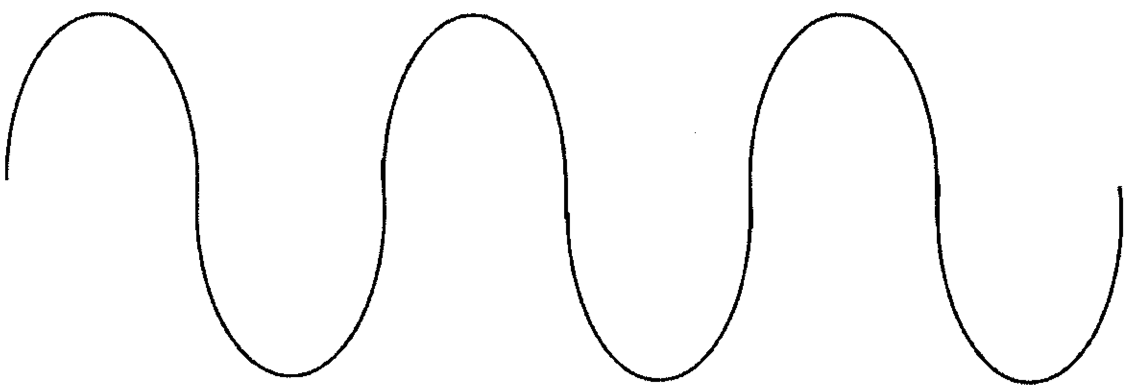
[redacted]ived start-up problems and rumors

[redacted]ta Cattle Commission Report

[redacted] application for expansion

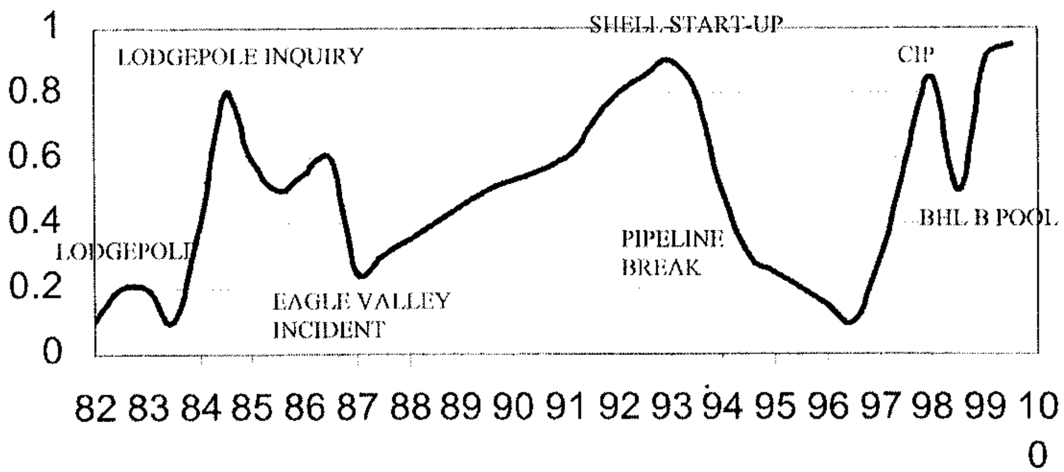
[redacted]

Over sensitive to community needs



[redacted]omplacency - under sensitive to community needs

[redacted]



[redacted]

[redacted]erns raised by the community

- [redacted]blic Health
- [redacted]imal Health (Cattle Commission Report)
- [redacted]issions
- [redacted]cline in Public Trust & Credibility

[redacted] Hearing (October 1996)

- [redacted]-hearing Meeting (June 1996)
  - [redacted]imit scope, no human/animal health evidence
  - [redacted]promise to initiate separate process
- [redacted]plication Approved, Appeal Denied (deep anger)

[redacted]

[redacted]id Technique Combining

[redacted]nsensus Based Dispute Resolution,

[redacted]lity Industry Pre-hearing Information Requests,

[redacted]gotiated Settlements,

[redacted]orised of 4 Stages

[redacted]ge 1 - Process Review and Public Input

[redacted]ge 2 - Identification and Clarification of Issues

[redacted]ge 3 - Response by Industry & Government

[redacted]ge 4 - Public Forum and Follow-up Action

[redacted]

[redacted]n Credible Facilitator (Dr. George Kupfer)

[redacted]ify Most Affected Parties

[redacted]view Affected Parties (issues , concerns & [redacted]onal experiences)

[redacted]ment in a Formal Report

[redacted]

- [redacted]gorize Issues & Concerns
  - [redacted] Operator or Government Agency
  - [redacted] Region
  - [redacted]vincially
- [redacted]firm & Validate with Community
- [redacted]ding Possible Approaches to Issue
  [redacted]lution
- [redacted]ard List to Shell, SPOG, CAPP, AEP
  [redacted]B.

[redacted]

- [redacted]l, SPOG, AEP, & EUB Prepared
  [redacted]ten Response to Identified Issues and
  [redacted]cerns Including:
  - [redacted]knowledgement of the issue
  - [redacted]soning why the issue existed
  - [redacted]ps taken to address issue in past
  - [redacted]ure action to resolve issue appropriately
- [redacted] Written Responses to CIP
  [redacted]icipants

[redacted]

- [redacted]nal Presentation of Responses by [redacted]l. SPOG, AEP & EUB to the [redacted]mmunity and Answer Questions
- [redacted]blishment of SPOG as the Focal Point [redacted]ssue Resolution
  - [redacted]deal with issues regionally
  - [redacted]include Public members in Committees and [redacted]cision making processes

[redacted]

[redacted]

- [redacted]roducers in area strongly encouraged [redacted]tively participate.
- [redacted]ed Workshops on:
  - [redacted]veloping working relationship with the [redacted]mmunity
  - [redacted]mmunicating effectively (7 Habits, Impact [redacted]wsletter, Open House, BBQ)
- [redacted]ructured to accommodate public [redacted]cipation.

[redacted]

[redacted]

[redacted]ted concerns for residents & EUB

[redacted]l for coordinated, consistent
[redacted]oach by operators for new E & P.

[redacted]sory sub-committee formed including

[redacted]OG representative

[redacted]mmunity members (responsible to
[redacted]nstituents)

[redacted]L “B” Pool mineral holders

[redacted]B (Head & Field Office Reps)

[redacted]

[redacted]on: “A long term relationship
[redacted]ed on mutual trust, honesty and
[redacted]ect, by way of sharing pertinent
[redacted]rmation & resolving issues to
[redacted]efit all stakeholders.”

[redacted]

[redacted]blishment of Community performance
[redacted]sures and development expectations

- [redacted]ergency response planning [redacted]mmunications/egress routes)
- [redacted]pact minimization (W/PL/ ProdFac/ProcPlt)
- [redacted]ission reduction (flaring/testing/producing)
- [redacted]erator Development Plan reflected contract [redacted]h the Public

[redacted]

[redacted]ept & involve the public early as a [redacted]imate partner (better solutions & [redacted]in).

[redacted]en carefully to public concerns and [redacted]ond to them in an open, honest & [redacted] manner.

[redacted]

[redacted]tinuously evaluate your efforts an
[redacted]e improvements when needed.

[redacted]k collaboratively (eg. SPOG),
[redacted]ators are often painted with the same
[redacted]h.

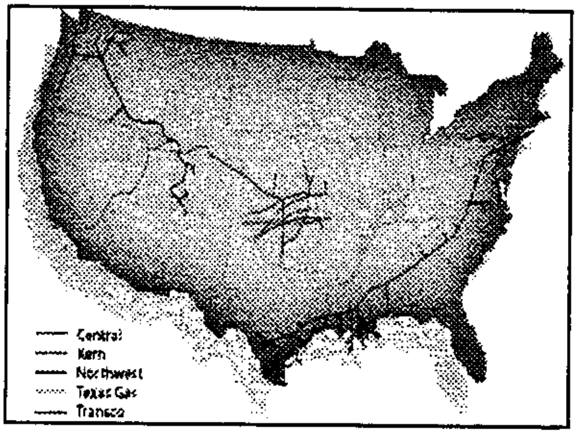
[redacted]

J. Sean Black

Working Group 4C

Northwest-Risk Management Program

Banff/99 Pipeline Workshop
Risk Management Presentation



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Why Are We Developing a RM Program?

- Potential to use RM in Everyday Operations
- Miss-Match between Where We *Are* Spending Dollars and Where We *Need* to Spend Dollars
- US DOT is offering a risk based approach to regulations
- Makes common sense

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Project Goals

- Address and Understand the Needs of System
- Demonstrate RM is Superior to "One Size Fits All" regulation
- Increase Reliability and Safety of the System
- Make Regulation Work Through Partnership

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Overall Description of the Program

Williams

Overall Description

Phased Approach

- Phase I - Development and Test RM Principles on Specific Segments
- Phase II - Implement Program System Wide 2000-2002
- Implement Risk Program on all Williams Gas Pipeline Systems.

Phase I - Lessons Learned

- Existing risk control programs created excellent starts
- Company missing comprehensive approach focused on alternatives
- RM is a culture change
- Initial fear of having a formal quantification of risks available to outside sources
- Upper management support and understanding is essential

Realized Benefits

Realized Regulatory Benefits

- Project in Western Washington
- Regulations would have mandated 6 miles of replacement and 3 miles of strength test to maintain MAOP
- Risk assessment model and process gave background and documentation to demonstrate that this money spent on 9 miles was not addressing our highest risks

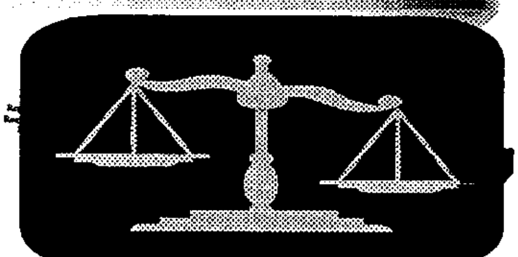
Realized Regulatory Benefits

- Alternatives were tested in RA models to show activities such as:
  - Internal Inspection of 73 miles
  - Additional SCC testing
  - Additional geologic hazard mitigation
  - Increased public awareness in populated areas
  - Installation of remotely operated valves
- Provided superior safety to the public

Realized Regulatory Benefits

- Completing alternative projects rather than prescriptive projects provided approximately 3.5 Million additional dollars which we then able to apply to other areas on the system
- Many operational benefits such as:
  - Removal of liquids
  - The ability to internally inspect in future at low cost
  - Increase knowledge of segment for future considerations

Weighing the Alternatives



Risk ... vs. ...
Compliance with Current Regulations
by Proposed Alternatives

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Realized Operational Benefits

- 2 mile segment, CIS, Depolorization testing, annual pipe to soil reads, and bellholing indicated a corrosion problem
- Project was submitted to replace 2 miles of pipeline

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Realized Operational Benefits

- Comprehensive RA performed on this segment
- RA results
  - 2 mile area was high risk due to corrosion as well as other areas outside of the 2 mile area.
  - Within much larger C/S to C/S segment numerous geologic hazards exist
  - Potential for Internal Corrosion exist
  - Potential exist for liquids within segment

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Realized Operational Benefits

- Risk assessment results and comparison of the alternative competing projects indicated the internally inspecting the much larger area addressed the highest risks to 80 miles of pipeline
- Project cost equal to the original plan to replace 2 miles of pipeline.

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Long Term Benefits

- Experience and Knowledge walks out the door everyday.
- RM focuses on capturing knowledge for future utilization.
- Formal RM gives decision makers better information to make decisions
- RM helps to reduce subjectivity and emotional decisions

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Risk Management Program Development

- Get upper management support.
- Start out slow, don't try to instituted formal RM all at once.
- Determine what your risk profile before you go after data.
- Communicate RM as nothing more than putting common sense into a process.
- Involve field throughout the process.

Williams

Questions?

ATTENDANCE LIST 8^{15}

4D - Risk Assessment/Risk Management - Communications/Public Consultation/Planning

Name	Affiliation	email
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ATTENDANCE LIST 8/15

4D - Risk Assessment/Risk Management - Communications, Public Consultation Planning

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PAUL MEANWELL	UNION GAS LIMITED.
IAN DOWSETT	CONOR PACIFIC ENVIRONMENTAL
[illegible]	NEB
FRANK GAREAU	National Energy Board
FRED BAINES	B C GAS
Terris Chorney	Enbridge Pipelines
TIM BALDWIN	BG TECHNOLOGY
GORDON DAW	N.E.B.